FREE GAMSAT PRACTICE MOCK

GAMSAT Practice Test PDF: Mock 22 with Answers

Mock 22 in full: Section 1 (62 questions) and Section 3 (75 questions), then an answer key and a worked explanation for every question.

Last reviewed 10 November 2026. Sit it online, timed and marked: gamsatpracticetest.com/?test=m22-full

What this is. These are original practice questions written for gamsatpracticetest.com. This is not an ACER past paper and it is not official GAMSAT material. ACER has never released a sat GAMSAT paper. For what officially exists, see gamsatpracticetest.com/gamsat-past-papers. Passages taken from public domain works are credited under each one.

What's inside

- Section 1, Reasoning in Humanities and Social Sciences: 62 questions on 21 passages (pages 4 to 31).
- Section 3, Reasoning in Biological and Physical Sciences: 75 questions on 20 stimulus units (pages 32 to 51).
- Answer sheets for both sections (pages 2 to 3).
- Answer key and worked explanations (pages 52 to 66).

How to sit it

1. Sit Section 1 in 100 minutes and Section 3 in 150 minutes, the real exam's times for 62 and 75 questions.
2. Work without a calculator, a formula sheet or a periodic table, as in the real exam. Any value a question needs is in its own passage.
3. Every question has four options and the same value, and a wrong answer costs nothing, so answer every question.
4. Mark your answers on the answer sheet, then check them against the key and read the explanation for every question you missed or guessed.
5. Section 2 (Written Communication) is a writing task, so it is not in this PDF. Mock 22's two writing tasks are on the site.

Answer sheet: Section 1

Fill in one bubble per question. Time allowed: 100 minutes for 62 questions.

Name _____ Date _____ Start time _____ Finish time _____

1	A	B	C	D	22	A	B	C	D	43	A	B	C	D
2	A	B	C	D	23	A	B	C	D	44	A	B	C	D
3	A	B	C	D	24	A	B	C	D	45	A	B	C	D
4	A	B	C	D	25	A	B	C	D	46	A	B	C	D
5	A	B	C	D	26	A	B	C	D	47	A	B	C	D
6	A	B	C	D	27	A	B	C	D	48	A	B	C	D
7	A	B	C	D	28	A	B	C	D	49	A	B	C	D
8	A	B	C	D	29	A	B	C	D	50	A	B	C	D
9	A	B	C	D	30	A	B	C	D	51	A	B	C	D
10	A	B	C	D	31	A	B	C	D	52	A	B	C	D
11	A	B	C	D	32	A	B	C	D	53	A	B	C	D
12	A	B	C	D	33	A	B	C	D	54	A	B	C	D
13	A	B	C	D	34	A	B	C	D	55	A	B	C	D
14	A	B	C	D	35	A	B	C	D	56	A	B	C	D
15	A	B	C	D	36	A	B	C	D	57	A	B	C	D
16	A	B	C	D	37	A	B	C	D	58	A	B	C	D
17	A	B	C	D	38	A	B	C	D	59	A	B	C	D
18	A	B	C	D	39	A	B	C	D	60	A	B	C	D
19	A	B	C	D	40	A	B	C	D	61	A	B	C	D
20	A	B	C	D	41	A	B	C	D	62	A	B	C	D
21	A	B	C	D	42	A	B	C	D					

Score: _____ / 62

Answer key on page 52

Answer sheet: Section 3

Fill in one bubble per question. Time allowed: 150 minutes for 75 questions.

Name _____ Date _____ Start time _____ Finish time _____

1 (A) (B) (C) (D)	26 (A) (B) (C) (D)	51 (A) (B) (C) (D)
2 (A) (B) (C) (D)	27 (A) (B) (C) (D)	52 (A) (B) (C) (D)
3 (A) (B) (C) (D)	28 (A) (B) (C) (D)	53 (A) (B) (C) (D)
4 (A) (B) (C) (D)	29 (A) (B) (C) (D)	54 (A) (B) (C) (D)
5 (A) (B) (C) (D)	30 (A) (B) (C) (D)	55 (A) (B) (C) (D)
6 (A) (B) (C) (D)	31 (A) (B) (C) (D)	56 (A) (B) (C) (D)
7 (A) (B) (C) (D)	32 (A) (B) (C) (D)	57 (A) (B) (C) (D)
8 (A) (B) (C) (D)	33 (A) (B) (C) (D)	58 (A) (B) (C) (D)
9 (A) (B) (C) (D)	34 (A) (B) (C) (D)	59 (A) (B) (C) (D)
10 (A) (B) (C) (D)	35 (A) (B) (C) (D)	60 (A) (B) (C) (D)
11 (A) (B) (C) (D)	36 (A) (B) (C) (D)	61 (A) (B) (C) (D)
12 (A) (B) (C) (D)	37 (A) (B) (C) (D)	62 (A) (B) (C) (D)
13 (A) (B) (C) (D)	38 (A) (B) (C) (D)	63 (A) (B) (C) (D)
14 (A) (B) (C) (D)	39 (A) (B) (C) (D)	64 (A) (B) (C) (D)
15 (A) (B) (C) (D)	40 (A) (B) (C) (D)	65 (A) (B) (C) (D)
16 (A) (B) (C) (D)	41 (A) (B) (C) (D)	66 (A) (B) (C) (D)
17 (A) (B) (C) (D)	42 (A) (B) (C) (D)	67 (A) (B) (C) (D)
18 (A) (B) (C) (D)	43 (A) (B) (C) (D)	68 (A) (B) (C) (D)
19 (A) (B) (C) (D)	44 (A) (B) (C) (D)	69 (A) (B) (C) (D)
20 (A) (B) (C) (D)	45 (A) (B) (C) (D)	70 (A) (B) (C) (D)
21 (A) (B) (C) (D)	46 (A) (B) (C) (D)	71 (A) (B) (C) (D)
22 (A) (B) (C) (D)	47 (A) (B) (C) (D)	72 (A) (B) (C) (D)
23 (A) (B) (C) (D)	48 (A) (B) (C) (D)	73 (A) (B) (C) (D)
24 (A) (B) (C) (D)	49 (A) (B) (C) (D)	74 (A) (B) (C) (D)
25 (A) (B) (C) (D)	50 (A) (B) (C) (D)	75 (A) (B) (C) (D)

Score: _____ / 75

Answer key on page 52

Section 1: Reasoning in Humanities and Social Sciences

62 questions. Time allowed: 100 minutes. Questions come in units that share one passage or set of data.

Unit 1: Human life and its conditions

Questions 1 to 3

Since we have learned to study the development of human life as we study the evolution of species throughout the animal kingdom, some peculiar phenomena which have puzzled the philosopher and moralist for so long, begin to show themselves in a new light. We begin to see that, so far from being inscrutable problems, requiring another life to explain, these sorrows and perplexities of our lives are but the natural results of natural causes, and that, as soon as we ascertain the causes, we can do much to remove them. In spite of the power of the individual will to struggle against conditions, to resist them for a while, and sometimes to overcome them, it remains true that the human creature is affected by his environment, as is every other living thing. The power of the individual will to resist natural law is well proven by the life and death of the ascetic. In any one of those suicidal martyrs may be seen the will, misdirected by the ill-informed intelligence, forcing the body to defy every natural impulse, even to the door of death, and through it. But, while these exceptions show what the human will can do, the general course of life shows the inexorable effect of conditions upon humanity. Of these conditions we share with other living things the environment of the material universe. We are affected by climate and locality, by physical, chemical, electrical forces, as are all animals and plants. With the animals, we farther share the effect of our own activity, the reactionary force of exercise. What we do, as well as what is done to us, makes us what we are. But, beyond these forces, we come under the effect of a third set of conditions peculiar to our human status; namely, social conditions. In the organic interchanges which constitute social life, we are affected by each other to a degree beyond what is found even among the most gregarious of animals. This third factor, the social environment, is of enormous force as a modifier of human life. Throughout all these environing conditions, those which affect us through our economic necessities are most marked in their influence.

Source: Charlotte Perkins Gilman, Women and Economics, Chapter I, 1900 edition. Project Gutenberg eBook #57913. Public domain.

1 **The passage mainly argues that:** A B C D

- **A.** the sorrows of human life are puzzles that only another life could explain
- **B.** human life is shaped by natural and social conditions, so its troubles have causes that can be found
- **C.** the individual will is never able to resist natural law
- **D.** human beings are less affected by their surroundings than other living things are

2 **Why does the writer mention the ascetic?** A B C D

- **A.** To suggest that giving up comfort is the best way to escape social conditions
- **B.** To prove that the human will cannot be misdirected by poor information
- **C.** To argue that self-denial is a natural result of economic necessity
- **D.** To show the will acting against nature, as an exception to the general rule

3 **The writer speaks of the "inexorable effect of conditions upon humanity". In this passage, "inexorable" most nearly means:**

A B C D

A. not to be turned aside
B. slow and gentle in its working
C. harmful in nearly every case
D. noticed only by careful study

Unit 2: A night crossing and a morning departure

Questions 4 to 6

Poem 1

The gray sea and the long black land;
And the yellow half-moon large and low;
And the startled little waves that leap
In fiery ringlets from their sleep,
As I gain the cove with pushing prow,
And quench its speed i' the slushy sand.

Then a mile of warm sea-scented beach;
Three fields to cross till a farm appears;
A tap at the pane, the quick sharp scratch
And blue spurt of a lighted match,
And a voice less loud, through its joys and fears,
Than the two hearts beating each to each!

Poem 2

Round the cape of a sudden came the sea,
And the sun looked over the mountain's rim:
And straight was a path of gold for him,
And the need of a world of men for me.

Glossary (ours): prow, the front of a boat.

Source: Robert Browning, "Meeting at Night" and "Parting at Morning", Complete Poetic and Dramatic Works (Cambridge Edition). Project Gutenberg eBook #50954. Public domain.

4 **In Poem 1, what does the speaker do after the boat reaches the cove?**

A B C D

A. Crosses a beach and three fields to a farm
B. Waits in the boat until the little waves have settled
C. Lights a match to signal to someone waiting inside
D. Rows on for another mile along the coast

5 **Which statement best compares the endings of the two poems?** A B C D

- **A.** Poem 1 ends on fear of the dark and the unknown, while Poem 2 ends on joy at the sunrise
- **B.** Poem 1 ends on a quarrel with the household, while Poem 2 ends on a quiet reconciliation
- **C.** Poem 1 ends on a closeness reached, while Poem 2 ends on a pull towards a wider world
- **D.** Both poems end on the speaker choosing the freedom of the sea over the land

6 **Poem 1 ends with the line "Than the two hearts beating each to each!", after a series of images of sea, moon and land. The effect of ending this way is to:** A B C D

- **A.** show that the speaker regrets the journey and wishes to turn back
- **B.** suggest that the voice inside the farm is angry and the speaker afraid of it
- **C.** confirm that the household is asleep and the farm is deserted
- **D.** move from large outdoor scenes to a small private sound, so that feeling outweighs setting

Unit 3: A mole leaves his spring-cleaning

Questions 7 to 9

The Mole had been working very hard all the morning, spring-cleaning his little home. First with brooms, then with dusters; then on ladders and steps and chairs, with a brush and a pail of whitewash; till he had dust in his throat and eyes, and splashes of whitewash all over his black fur, and an aching back and weary arms. Spring was moving in the air above and in the earth below and around him, penetrating even his dark and lowly little house with its spirit of divine discontent and longing. It was small wonder, then, that he suddenly flung down his brush on the floor, said “Bother!” and “O blow!” and also “Hang spring-cleaning!” and bolted out of the house without even waiting to put on his coat. Something up above was calling him imperiously, and he made for the steep little tunnel which answered in his case to the gravelled carriage-drive owned by animals whose residences are nearer to the sun and air. So he scraped and scratched and scrabbled and scrooged and then he scrooged again and scrabbled and scratched and scraped, working busily with his little paws and muttering to himself, “Up we go! Up we go!” till at last, pop! his snout came out into the sunlight, and he found himself rolling in the warm grass of a great meadow.

“This is fine!” he said to himself. “This is better than whitewashing!” The sunshine struck hot on his fur, soft breezes caressed his heated brow, and after the seclusion of the cellarage he had lived in so long the carol of happy birds fell on his dulled hearing almost like a shout. Jumping off all his four legs at once, in the joy of living and the delight of spring without its cleaning, he pursued his way across the meadow till he reached the hedge on the further side.

"Hold up!" said an elderly rabbit at the gap. "Sixpence for the privilege of passing by the private road!" He was bowled over in an instant by the impatient and contemptuous Mole, who trotted along the side of the hedge chaffing the other rabbits as they peeped hurriedly from their holes to see what the row was about. "Onion-sauce! Onion-sauce!" he remarked jeeringly, and was gone before they could think of a thoroughly satisfactory reply. Then they all started grumbling at each other. "How stupid you are! Why didn't you tell him..." "Well, why didn't you say..." "You might have reminded him..." and so on, in the usual way; but, of course, it was then much too late, as is always the case.

Source: Kenneth Grahame, The Wind in the Willows, Chapter I (The River Bank). Project Gutenberg eBook #289. Public domain. Italics not shown.

7 **What first makes the Mole leave his house?** A B C D

- **A.** A rabbit at the gap in the hedge demands sixpence for using the private road
- **B.** The spring brings a restless longing that makes him drop his work
- **C.** He has run out of whitewash and cannot finish the walls
- **D.** His back aches so badly that he cannot climb the steps again

8 **The narrator says the Mole's tunnel "answered in his case to the gravelled carriage-drive owned by animals whose residences are nearer to the sun and air". The effect of this comparison is mainly to:** A B C D

- **A.** criticise the Mole for being ashamed of his low and dark home
- **B.** treat the Mole's tunnel with mock grandeur, as if it were part of an estate
- **C.** show that the animals above ground are far richer and more powerful than he is
- **D.** warn that the tunnel is unsafe and likely to fall in on him

9 **The excerpt ends with the rabbits' quarrel: "but, of course, it was then much too late, as is always the case." The narrator presents the quarrel as:** A B C D

- **A.** a serious dispute that will divide the rabbits from one another for good
- **B.** a plot among the rabbits to catch the Mole on his way back
- **C.** a familiar habit of thinking of a good reply too late
- **D.** the reason the Mole decides to go back to his house at once

Unit 4: Youth and total unemployment in Germany and Spain

Questions 10 to 12

Unemployment rate, annual data, as a percentage of the labour force. The table gives the rate for people aged 15 to 24 and for people aged 15 to 74 in each country.

Year	Germany, age 15 to 24	Germany, age 15 to 74	Spain, age 15 to 24	Spain, age 15 to 74
2010	10.5 b	6.6 b	41.5	19.9
2011	9.1 b	5.5 b	46.2	21.4
2012	8.6	5.1	52.9	24.8
2013	8.3	4.9	55.5	26.1

Year	Germany, age 15 to 24	Germany, age 15 to 74	Spain, age 15 to 24	Spain, age 15 to 74
2014	8.2	4.7	53.2	24.5
2015	7.7	4.4	48.3	22.1
2016	7.5	3.9	44.4	19.6
2017	7.2	3.5	38.6	17.2
2018	6.6	3.2	34.3	15.3
2019	6.1	2.9	32.5	14.1
2020	7.9 b	3.6 b	38.3	15.5
2021	7.0	3.6	35.0 d	14.9 d
2022	6.0	3.1	29.7 d	13.0 d
2023	5.9	3.1	28.7 d	12.2 d
2024	6.6	3.5	26.5 d	11.4 d
2025	7.1	3.8	24.9 d	10.5 d

A letter after a value is the publisher's flag for that value: b = break in time series; d = definition differs (see metadata).

Source: Data: Eurostat, Unemployment by sex and age, annual data (dataset une_rt_a), re-use authorised with the source acknowledged (Commission Decision of 12 December 2011). Values and flags as published; selection and layout ours.

10 **In how many of the years shown is the rate for Spanish people aged 15 to 24 above 40 per cent?** (A) (B) (C) (D)

A. 7
B. 6
C. 8
D. 5

11 **Which statement is supported by the table?** (A) (B) (C) (D)

A. The German youth rate is lower in 2025 than in 2010, so fewer young Germans are unemployed
B. In some years the German youth rate is higher than the Spanish youth rate
C. The total rate for Spain falls in every year from 2010 to 2025
D. Spain's 2025 youth rate is above every German total rate in the table

12 **The German youth rate rises from 6.1 in 2019 to 7.9 in 2020, and the 2020 value carries the flag b. What does the flag imply for this comparison?** (A) (B) (C) (D)

A. The 2020 value is provisional and is expected to be revised
B. The rise is certain to be larger than the table shows
C. Part of the rise may reflect a change in how the series is measured, so the change is less reliable
D. The 2020 value applies to a different age group from the other years

Unit 5: A quarrel over omens at a birth

Questions 13 to 16

HOTSPUR.
Lord Mortimer and cousin Glendower,
Will you sit down? And uncle Worcester,
A plague upon it! I have forgot the map.

GLENDOWER.
No, here it is.
Sit, cousin Percy, sit, good cousin Hotspur;
For by that name as oft as Lancaster doth speak of you
His cheek looks pale, and with a rising sigh
He wisheth you in heaven.

HOTSPUR.
And you in hell,
As oft as he hears Owen Glendower spoke of.

GLENDOWER.
I cannot blame him. At my nativity
The front of heaven was full of fiery shapes,
Of burning cressets, and at my birth
The frame and huge foundation of the Earth
Shaked like a coward.

HOTSPUR.
Why, so it would have done
At the same season, if your mother's cat
Had but kitten'd, though yourself had never been born.

GLENDOWER.
I say the Earth did shake when I was born.

HOTSPUR.
And I say the Earth was not of my mind,
If you suppose as fearing you it shook.

GLENDOWER.
The heavens were all on fire, the Earth did tremble.

HOTSPUR.
O, then th' Earth shook to see the heavens on fire,
And not in fear of your nativity.
Diseased nature oftentimes breaks forth
In strange eruptions; oft the teeming Earth
Is with a kind of colic pinch'd and vex'd
By the imprisoning of unruly wind
Within her womb, which for enlargement striving,
Shakes the old beldam Earth, and topples down
Steeples and moss-grown towers. At your birth

Our grandam Earth, having this distemp'rature,
In passion shook.

GLENDOWER.
Cousin, of many men
I do not bear these crossings. Give me leave
To tell you once again that at my birth
The front of heaven was full of fiery shapes,
The goats ran from the mountains, and the herds
Were strangely clamorous to the frighted fields.
These signs have mark'd me extraordinary,
And all the courses of my life do show
I am not in the roll of common men.
Where is he living, clipp'd in with the sea
That chides the banks of England, Scotland, Wales,
Which calls me pupil or hath read to me?
And bring him out that is but woman's son
Can trace me in the tedious ways of art,
And hold me pace in deep experiments.

HOTSPUR.
I think there is no man speaks better Welsh.
I'll to dinner.

MORTIMER.
Peace, cousin Percy, you will make him mad.

GLENDOWER.
I can call spirits from the vasty deep.

HOTSPUR.
Why, so can I, or so can any man,
But will they come when you do call for them?

GLENDOWER.
Why, I can teach you, cousin, to command the devil.

HOTSPUR.
And I can teach thee, coz, to shame the devil
By telling truth; tell truth, and shame the devil.
If thou have power to raise him, bring him hither,
And I'll be sworn I have power to shame him hence.
O, while you live, tell truth, and shame the devil!

MORTIMER.
Come, come, no more of this unprofitable chat.

GLENDOWER.
Three times hath Henry Bolingbroke made head
Against my power; thrice from the banks of Wye
And sandy-bottom'd Severn have I sent him

Bootless home and weather-beaten back.

HOTSPUR.
Home without boots, and in foul weather too!
How 'scapes he agues, in the devil's name!

Glossary (ours): cressets, torches; beldam, old woman; clipp'd in, enclosed; agues, fevers.

Source: William Shakespeare, Henry IV, Part 1, Act III, Scene I (Hotspur, Glendower, Mortimer). Project Gutenberg eBook #1516. Public domain.

13 **What does Glendower say happened when he was born?** A B C D

A. A great storm destroyed the castle where he was born
B. A comet appeared that foretold victory over Henry Bolingbroke
C. His mother's cat had kittens while the Earth shook
D. The heavens burned with fiery shapes and the Earth trembled

14 **Hotspur says the Earth may be "with a kind of colic pinch'd and vex'd / By the imprisoning of unruly wind". His purpose is to:** A B C D

A. give a natural cause for the shaking, so the birth is no special sign
B. support Glendower by showing that the Earth trembled at his coming
C. display his medical learning to Mortimer, who is listening
D. suggest that Glendower's mother was unwell on the day that he was born

15 **Which description best fits the way Glendower speaks of himself?** A B C D

A. modest, and unsure that the signs at his birth meant anything
B. sure that he is set apart from ordinary men
C. uneasy about what Mortimer thinks of him
D. amused by his own boasting and glad to be laughed at

16 **Glendower says he has sent Henry Bolingbroke "Bootless home and weather-beaten back". Hotspur answers: "Home without boots, and in foul weather too!" Hotspur's reply:** A B C D

A. plays on a word to turn a boast into a joke
B. repeats Glendower's words to show that he admires them
C. expresses sympathy for a king who has been driven from the field
D. shows that Hotspur has not understood the word and is puzzled by it

Unit 6: On travelling hopefully

Questions 17 to 18

Little do ye know your own blessedness; for to travel hopefully is a better thing than to arrive, and the true success is to labour.

Source: Robert Louis Stevenson, "El Dorado", in Virginibus Puerisque, and Other Papers. Project Gutenberg eBook #386. Public domain. Line breaks reflowed.

17 **The writer's main point is that:** A B C D

- **A.** journeys are more comfortable than staying where one is
- **B.** success can be claimed only by those who reach their goal
- **C.** effort spent on a goal matters more than reaching it
- **D.** those who travel hopefully are certain to arrive in the end

18 **The opening clause, "Little do ye know your own blessedness", suggests that the writer thinks the readers are:** A B C D

- **A.** failures, because they have never reached any of their goals
- **B.** foolish, and ought to be ashamed of how little they have learned
- **C.** better off than they realise, being still on the way
- **D.** proud, and unwilling to admit the mistakes they have made

Unit 7: A lawyer introduces himself

Questions 19 to 21

I am a rather elderly man. The nature of my avocations for the last thirty years has brought me into more than ordinary contact with what would seem an interesting and somewhat singular set of men, of whom as yet nothing that I know of has ever been written: I mean the law-copyists or scriveners. I have known very many of them, professionally and privately, and if I pleased, could relate divers histories, at which good-natured gentlemen might smile, and sentimental souls might weep. But I waive the biographies of all other scriveners for a few passages in the life of Bartleby, who was a scrivener of the strangest I ever saw or heard of. While of other law-copyists I might write the complete life, of Bartleby nothing of that sort can be done. I believe that no materials exist for a full and satisfactory biography of this man. It is an irreparable loss to literature. Bartleby was one of those beings of whom nothing is ascertainable, except from the original sources, and in his case those are very small. What my own astonished eyes saw of Bartleby, that is all I know of him, except, indeed, one vague report which will appear in the sequel.

Ere introducing the scrivener, as he first appeared to me, it is fit I make some mention of myself, my employés, my business, my chambers, and general surroundings; because some such description is indispensable to an adequate understanding of the chief character about to be presented.

Imprimis: I am a man who, from his youth upwards, has been filled with a profound conviction that the easiest way of life is the best. Hence, though I belong to a profession proverbially energetic and nervous, even to turbulence, at times, yet nothing of that sort have I ever suffered to invade my peace. I am one of those unambitious lawyers who never addresses a jury, or in any way draws down public applause; but in the cool tranquility of a snug retreat, do a snug business among rich men's bonds and mortgages and title-deeds. All who know me, consider me an eminently safe man. The late John Jacob Astor, a personage little given to poetic enthusiasm, had no hesitation in pronouncing my first grand point to be prudence; my next, method. I do not speak it in vanity, but simply record the fact, that I was not unemployed in my profession by the late John Jacob Astor; a name which, I admit, I love to repeat, for it hath a rounded and orbicular sound to it, and rings like unto bullion. I will freely add, that I was not insensible to the late John Jacob Astor's good opinion.

Glossary (ours): scrivener, copyist; imprimis, first; employés, employees.

Source: Herman Melville, "Bartleby, the Scrivener", opening. Project Gutenberg eBook #11231. Public domain. Italics not shown.

19 **What does the narrator say about the available information on Bartleby?** (A) (B) (C) (D)

- **A.** His life has already been written up by several other scriveners
- **B.** Little can be learned apart from what the narrator saw himself
- **C.** He was the narrator's own employer for thirty years before this
- **D.** He wrote a full account of his own life, which the narrator has read

20 **The narrator calls the lack of a biography of Bartleby "an irreparable loss to literature". This phrase is best understood as:** (A) (B) (C) (D)

- **A.** a sincere statement that literature has been seriously and permanently harmed
- **B.** an attack on law-copyists, who should have been writers instead
- **C.** an admission that he has read very little literature
- **D.** a mock-solemn exaggeration that shows how highly he rates his subject

21 **Why does the narrator keep repeating the name of John Jacob Astor?** (A) (B) (C) (D)

- **A.** It shows how much he values the good opinion of a wealthy man
- **B.** It shows that Astor was the only client he had in thirty years
- **C.** It prepares the reader for the part Astor will play later in the story
- **D.** It shows that he secretly resents the praise Astor gave him

Unit 8: System alert levels

Questions 22 to 25

A company grades the alerts raised by its online system into levels. The ladder below shows the levels from the most severe to the least severe. Level 0 means that there is no alert.

Severity	Level
Most severe	Level 1
	Level 2
Least severe	Level 3

Side box: Maintenance window.

Definitions:

- Level 3 applies if the error rate is at least 1 per cent for at least 5 minutes.
- Level 2 applies if the error rate is at least 5 per cent for at least 5 minutes, or if the Level 3 condition has lasted at least 60 minutes.
- Level 1 applies if Level 2 applies and payments are affected.
- During a declared maintenance window, Level 2 and Level 3 are both reported as Level 3. Level 1 is not changed.
- If none of the conditions applies, there is no alert (Level 0).

Minutes are counted while the stated error rate has been continuously present. If more than one level applies, the most severe is used.

Source: Original, written for this project.

22 **The error rate is 1.0 per cent and has lasted 4 minutes. No payments are affected and there is no maintenance window. What is reported?**

A B C D

A. Level 3
B. Level 2
C. Level 1
D. Level 0

23 **The error rate is 1.0 per cent and has lasted 60 minutes. No payments are affected and there is no maintenance window. What is reported?**

A B C D

A. Level 3
B. Level 2
C. Level 1
D. Level 0

24 **During a declared maintenance window, the error rate is 5.0 per cent and has lasted 30 minutes. No payments are affected. What is reported?**

A B C D

A. Level 0
B. Level 2
C. Level 3
D. Level 1

25 **Which of the following statements are true?**

A B C D

I. During a maintenance window, an alert that would otherwise be Level 1 is reported as Level 3.
II. An error rate of 0.5 per cent that has lasted 200 minutes, with payments affected, gives Level 0.
III. An error rate of 5.0 per cent that has lasted 5 minutes, with payments affected, is reported as Level 1 whether or not there is a maintenance window.

A. II and III only
B. I and II only
C. I and III only
D. I, II and III

Unit 9: A sonnet about evening

Questions 26 to 28

Down by the shore at even, when the waves
  Lap lightly on the reedy rims, and soft,
  One trembling star, a blossom, flames aloft,
Where the sunk sun the western heaven laves
With lowest tides of day; the tired world craves
  For the great night that cometh brooding in,
  With draught of healing over earth's far din,
And blessed rest that recreates and saves.

Far in the breathing woods the whip-poor-will
  Reiterates his plaintive note; and hark!
  A dusky night-hawk whirrs athwart the dark,
Haunting the shadows, till in silvern swoon,
Hunted by her own spirit, strange and still,

Over the waters comes the wan, white moon.

Glossary (ours): laves, washes; athwart, across.

Source: Wilfred Campbell, "Dusk", in Beyond the Hills of Dream, 1899. Project Gutenberg eBook #54453. Public domain.

26 **The poem mainly presents dusk as:** A B C D

- **A.** a quiet time of healing rest after the day's noise
- **B.** a threatening time in which dangers gather in the dark
- **C.** a time of regret for pleasures that are now lost
- **D.** a short pause with little in it between two busier parts of a day

27 **In the second part of the poem, beginning "Far in the breathing woods", the poet mainly:** A B C D

- **A.** moves inland to a memory of an earlier, happier evening by the shore
- **B.** describes a noisy storm that disturbs the calm of the first part
- **C.** explains why the whip-poor-will sings its plaintive note
- **D.** adds night creatures to the scene and ends with the moon over the water

28 **The poem pictures the night as one that "cometh brooding in" and the moon as coming "in silvern swoon". Taken together, these phrases suggest that night is imagined as:** A B C D

- **A.** a hostile force that attacks and overpowers the tired world
- **B.** a gentle presence that settles slowly over the world
- **C.** a sudden event that ends the day in alarm and confusion
- **D.** a lively celebration that the tired world joins with relief

Unit 10: A letter sent with a new book

Questions 29 to 31

CHARLES DARWIN TO A.R. WALLACE. Ilkley, November 13th, 1859.

My dear Sir,

I have told Murray to send you by post (if possible) a copy of my book, and I hope that you will receive it at nearly the same time with this note. (N.B. I have got a bad finger, which makes me write extra badly.) If you are so inclined, I should very much like to hear your general impression of the book, as you have thought so profoundly on the subject, and in so nearly the same channel with myself. I hope there will be some little new to you, but I fear not much. Remember it is only an abstract, and very much condensed. God knows what the public will think. No one has read it, except Lyell, with whom I have had much correspondence. Hooker thinks him a complete convert, but he does not seem so in his letters to me; but is evidently deeply interested in the subject. I do not think your share in the theory will be overlooked by the real judges, as Hooker, Lyell, Asa Gray, etc. I have heard from Mr. Slater that your paper on the Malay Archipelago has been read at the Linnean Society, and that he was EXTREMELY much interested by it.

I have not seen one naturalist for six or nine months, owing to the state of my health, and therefore I really have no news to tell you. I am writing this at Ilkley Wells, where I have been with my family for the last six weeks, and shall stay for some few weeks longer. As yet I have profited very little. God knows when I shall have strength for my bigger book.

I sincerely hope that you keep your health; I suppose that you will be thinking of returning (Mr. Wallace was in the Malay Archipelago.) soon with your magnificent collections, and still grander mental materials. You will be puzzled how to publish. The Royal Society fund will be worth your consideration. With every good wish, pray believe me,

Yours very sincerely, CHARLES DARWIN.

P.S. I think that I told you before that Hooker is a complete convert. If I can convert Huxley I shall be content.

Source: Charles Darwin, letter to A. R. Wallace, Ilkley, 13 November 1859, in Life and Letters of Charles Darwin, Volume 2, edited by Francis Darwin. Project Gutenberg eBook #2088. Public domain. The parenthesis about the Malay Archipelago is the editor's. Line breaks reflowed.

29 **Why does Darwin say that he has no news to tell Wallace?** A B C D

- **A.** He has spent the months working hard on his larger book
- **B.** He has not had a letter from Hooker or Lyell for some time
- **C.** He has seen no naturalist for months because of his health
- **D.** He has just returned from a long journey abroad

30 **Darwin hopes that Wallace will find "some little new" in the book, "but I fear not much". The most likely reason for this remark is that Darwin:** A B C D

- **A.** believes that the book is of very little value and is not worth reading
- **B.** is asking Wallace to keep the book private until reviewers have seen it
- **C.** is trying to discourage Wallace from reading the whole book
- **D.** recognises that Wallace has already thought along the same lines

31 **The postscript says that Hooker is "a complete convert" and adds: "If I can convert Huxley I shall be content." What does this suggest about Darwin's aim at this point?** A B C D

- **A.** He expects every scientist to accept the book without argument
- **B.** He is most concerned about the money the book will earn
- **C.** He wants Wallace to write the reviews for the Linnean Society
- **D.** He wants the support of respected scientists, one by one

Unit 11: A preface about writing a colonial history

Questions 32 to 34

I believe that there is amongst the people of the Mother Country a minority, now ceasing to be small, which takes a quickening interest in the Colonies. It no longer consists merely of would-be investors, or emigrants who want to inquire into the resources, industries, and finances of one or other of the self-governing parts of the Empire. Many of its members never expect to see a colony. But they have come to recognise that those new-comers into the circle of civilized communities, the daughter nations of Britain, are not unworthy of English study and English pride. They have begun to suspect that the story of their struggles into existence and prosperity may be stirring, romantic, and interesting, and that some of their political institutions and experiments may be instructive, though others may seem less safe than curious. Some of those who think thus complain that it is not always easy to find an account of a colony which shall be neither an official advertisement, the sketch of a globe-trotting impressionist, nor yet an article manufactured to order by some honest but untravelled maker of books. They ask, or at least some of them, to my knowledge, ask, for a history in which the picturesque side of the story shall not be ignored, written simply and concisely by a writer who has made a special study of his subject, or who has lived and moved amongst the places, persons, and incidents he describes. I have lived in New Zealand, have seen it and studied it from end to end, and have had to do with its affairs: it is my country. But I should not have presumed to endeavour to supply in its case the want above indicated had any short descriptive history of the colony from its discovery to the present year been available. Among the many scores of books about the Islands, some of which are good, more of which are bad, I know of none which does what is aimed at in this volume. I have, therefore, taken in hand a short sketch-history of mine, published some six months ago, have cut out some of it and have revised the rest, and blended it with the material of the following chapters, of which it forms nearly one-third. The result is something not quite so meagre in quantity or staccato in style, though even now less full than I should have liked to make it, had it been other than the work of an unknown writer telling the story of a small archipelago which is at once the most distant and well-nigh the youngest of English states. I have done my best in the later chapters to describe certain men and experiments without letting personal likes and dislikes run away with my pen; have taken pains to avoid loading my pages with the names of places and persons of no particular interest to British readers; and at the same time have tried not to forget the value of local colour and atmosphere in a book of this kind.

Source: William Pember Reeves, The Long White Cloud (Ao Tea Roa), Preface, 1899 edition. Project Gutenberg eBook #12411. Public domain.

32 **According to the writer, why was this book written?**

A B C D

A. No existing short history gave readers what they were asking for
B. The colonial government asked for a book to attract emigrants
C. Travellers asked for a guide that would lead them through the Islands
D. An earlier sketch had been withdrawn because of errors

33 **The writer lists three existing kinds of account: "an official advertisement, the sketch of a globe-trotting impressionist, nor yet an article manufactured to order". The purpose of this list is to:**

A B C D

A. admit that the writer has already produced each of the three kinds
B. show the faults of existing accounts, which this book aims to avoid
C. praise each kind for the different reader that it serves best
D. prove that readers in Britain have no interest at all in the Colonies

34 **Which description best fits the writer's stance towards the subject and towards the readers?**

A B C D

A. as a well-read scholar who has never seen the Islands for himself
B. as a seller of land who is anxious to attract new settlers
C. as someone with first-hand knowledge who is modest about the result
D. as a stern critic who wishes to correct the errors of British readers

Unit 12: Two poems about birds in flight

Questions 35 to 37

Poem 1

Whither, midst falling dew,
While glow the heavens with the last steps of day,
Far, through their rosy depths, dost thou pursue
Thy solitary way?

Vainly the fowler's eye
Might mark thy distant flight to do thee wrong,
As, darkly painted on the crimson sky,
Thy figure floats along.

Seek'st thou the plashy brink
Of weedy lake, or marge of river wide,
Or where the rocking billows rise and sink
On the chafed ocean side?

There is a Power whose care
Teaches thy way along that pathless coast,
The desert and illimitable air,
Lone wandering, but not lost.

All day thy wings have fanned,
At that far height, the cold, thin atmosphere,
Yet stoop not, weary, to the welcome land,
Though the dark night is near.

And soon that toil shall end;
Soon shalt thou find a summer home, and rest,
And scream among thy fellows; reeds shall bend,

Soon, o'er thy sheltered nest.

Thou'rt gone, the abyss of heaven
Hath swallowed up thy form; yet, on my heart
Deeply hath sunk the lesson thou hast given,
And shall not soon depart.

He who, from zone to zone,
Guides through the boundless sky thy certain flight,
In the long way that I must tread alone,
Will lead my steps aright.

Poem 2

Along the narrow sandy height
I watch them swiftly come and go,
Or round the leafless wood,
Like flurries of wind-driven snow,
Revolving in perpetual flight,
A changing multitude.

Nearer and nearer still they sway,
And, scattering in a circled sweep,
Rush down without a sound;
And now I see them peer and peep,
Across yon level bleak and gray,
Searching the frozen ground,

Until a little wind upheaves,
And makes a sudden rustling there,
And then they drop their play,
Flash up into the sunless air,
And like a flight of silver leaves
Swirl round and sweep away.

Glossary (ours): plashy, splashy; marge, edge; fowler, hunter of birds; illimitable, without limit; yon, that over there.

Source: Poem 1: William Cullen Bryant, "To a Waterfowl", in Poems by William Cullen Bryant. Project Gutenberg eBook #16341. Poem 2: Archibald Lampman, "Snowbirds", in Lyrics of Earth, 1895. Project Gutenberg eBook #12664. Public domain.

35 **One difference between the poems is that the speaker of Poem 1:** (A) (B) (C) (D)

A. speaks to one bird and draws a lesson for the speaker's own life, while the speaker of Poem 2 only describes a flock

B. describes a flock from a distance, while the speaker of Poem 2 speaks to one bird and draws a lesson

C. is afraid of the bird, while the speaker of Poem 2 feels at ease with the flock being watched

D. hopes to catch the bird, while the speaker of Poem 2 wants the flock to leave the field

36 **In Poem 1, the lines "There is a Power whose care / Teaches thy way along that pathless coast" mean that the speaker believes:**

A B C D

A. the bird has simply learned the route by flying it many times
B. a caring power guides the bird where there is no track
C. the coast has been marked out by hunters for the bird to follow
D. the bird is lost and will not find its way before nightfall

37 **How does the ending of Poem 2 differ from the ending of Poem 1?**

A B C D

A. Poem 2 ends on a prayer for the safety of the birds, while Poem 1 ends on a plain description of them
B. Poem 2 ends on a warning to the flock about the weather, while Poem 1 ends on a question to the bird
C. Poem 2 ends on a thought about the speaker's future, while Poem 1 ends on the flight of the bird
D. Poem 2 ends on the flock sweeping away, while Poem 1 ends on the speaker's hope for guidance

Unit 13: Average hourly earnings in the United States

Questions 38 to 40

Average hourly earnings of employees in total private employment, seasonally adjusted, for December of each year. Values are in dollars per hour, in the money of each year (current dollars). The first column covers all employees; the second covers production and nonsupervisory employees only.

December of	All employees (dollars per hour)	Production and nonsupervisory employees (dollars per hour)
2015	25.25	21.23
2016	25.93	21.76
2017	26.63	22.29
2018	27.56	23.11
2019	28.38	23.85
2020	29.91	25.16
2021	31.39	26.76
2022	32.94	28.22
2023	34.29	29.47
2024	35.69	30.66
2025	37.02	31.83

Source: Data: US Bureau of Labor Statistics, average hourly earnings of employees, total private, seasonally adjusted (series CES0500000003 and CES0500000008), public domain. Values as published; selection and layout ours.

38 **In how many of the Decembers shown is the all employees figure at least 30 dollars?**

A B C D

A. 4
B. 6
C. 5
D. 3

39 **From December 2015 to December 2025, which statement is correct?**

A B C D

A. The all employees figure rose by more dollars and also by a larger percentage
B. The two figures rose by the same number of dollars
C. The production and nonsupervisory figure rose by fewer dollars but by a larger percentage
D. The production and nonsupervisory figure rose by more dollars

40 **Which conclusion cannot be drawn from the table alone?**

A B C D

A. An hour of work buys more in 2025 than in 2015
B. The all employees figure is above the other figure in every year shown
C. Both figures are higher in each December than in the one before it
D. The all employees figure is over 37 dollars in the last December shown

Unit 14: A husband asks after his household

Questions 41 to 43

ORGON
Ah! Good morning, brother.

CLEANTE
I was just going, but am glad to greet you.
Things are not far advanced yet, in the country?

ORGON
Dorine ...

(To Cleante)
Just wait a bit, please, brother-in-law.
Let me allay my first anxiety
By asking news about the family.

(To Dorine)
Has everything gone well these last two days?
What's happening? And how is everybody?

DORINE
Madam had fever, and a splitting headache
Day before yesterday, all day and evening.

ORGON
And how about Tartuffe?

DORINE
Tartuffe? He's well;
He's mighty well; stout, fat, fair, rosy-lipped.

ORGON
Poor man!

DORINE
At evening she had nausea
And couldn't touch a single thing for supper,
Her headache still was so severe.

ORGON
And how
About Tartuffe?

DORINE
He supped alone, before her,
And unctuously ate up two partridges,
As well as half a leg o' mutton, deviled.

ORGON
Poor man!

DORINE
All night she couldn't get a wink
Of sleep, the fever racked her so; and we
Had to sit up with her till daylight.

ORGON
How
About Tartuffe?

DORINE
Gently inclined to slumber,
He left the table, went into his room,
Got himself straight into a good warm bed,
And slept quite undisturbed until next morning.

ORGON
Poor man!

DORINE
At last she let us all persuade her,
And got up courage to be bled; and then
She was relieved at once.

ORGON
And how about
Tartuffe?

DORINE
He plucked up courage properly,

Bravely entrenched his soul against all evils,
And to replace the blood that she had lost,
He drank at breakfast four huge draughts of wine.

ORGON
Poor man!

DORINE
So now they both are doing well;
And I'll go straightway and inform my mistress
How pleased you are at her recovery.

Glossary (ours): bled, treated by having blood let; deviled, cooked with hot spices.

Source: Molière, Tartuffe, Act I, Scene V (verse translation by Curtis Hidden Page). Project Gutenberg eBook #2027. Public domain. Indentation removed.

41 **Each time Dorine reports on Madam's condition, Orgon:** A B C D

- **A.** asks how the fever began and how long it has lasted
- **B.** asks how Tartuffe is, and pities him when told
- **C.** sends Dorine to fetch a doctor for his wife without delay
- **D.** tells Dorine to go and sit with his wife through the night

42 **The contrast between Dorine's reports on Madam and on Tartuffe mainly shows that Orgon:** A B C D

- **A.** is too tired after his journey to follow what Dorine is telling him
- **B.** believes that Tartuffe has caught the same fever as his wife
- **C.** is hiding his deep worry about his wife behind a show of calm
- **D.** pities Tartuffe, who is well, and barely notices his sick wife

43 **What is the main effect of the repeated exchange ("And how about Tartuffe?" ... "Poor man!")?** A B C D

- **A.** It builds comedy from the pattern and shows how blind Orgon is to what Dorine reports
- **B.** It shows that Dorine cannot understand what Orgon is asking
- **C.** It delays the action until Madam has recovered from her fever
- **D.** It prepares the audience for the sudden death of Tartuffe

Unit 15: On lost time

Questions 44 to 45

"Lost time is never found again; and what we call time enough, always proves little enough."

Source: Benjamin Franklin, Poor Richard's sayings as quoted in "The Way to Wealth", in Franklin's Way to Wealth; or, "Poor Richard Improved". Project Gutenberg eBook #43855. Public domain. Line breaks reflowed.

44 **According to the saying, what is wrong with believing there is "time enough"?**

A B C D

- **A.** Time seems to pass more slowly when work is being put off
- **B.** The time people think they have usually proves too short
- **C.** Time that has been lost can be recovered by working hard
- **D.** Those who delay tend to finish their work without trouble

45 **Which situation best illustrates the saying?**

A B C D

- **A.** A student revises a little each night and finishes with days to spare
- **B.** A traveller reaches the station an hour before the train leaves
- **C.** A writer waits until the week before a deadline and then runs out of time
- **D.** A shopkeeper finds a purse that a customer lost the day before

Unit 16: A man describes his own spite

Questions 46 to 49

I am a sick man.... I am a spiteful man. I am an unattractive man. I believe my liver is diseased. However, I know nothing at all about my disease, and do not know for certain what ails me. I don't consult a doctor for it, and never have, though I have a respect for medicine and doctors. Besides, I am extremely superstitious, sufficiently so to respect medicine, anyway (I am well-educated enough not to be superstitious, but I am superstitious). No, I refuse to consult a doctor from spite. That you probably will not understand. Well, I understand it, though. Of course, I can't explain who it is precisely that I am mortifying in this case by my spite: I am perfectly well aware that I cannot "pay out" the doctors by not consulting them; I know better than anyone that by all this I am only injuring myself and no one else. But still, if I don't consult a doctor it is from spite. My liver is bad, well, let it get worse!

I have been going on like that for a long time, twenty years. Now I am forty. I used to be in the government service, but am no longer. I was a spiteful official. I was rude and took pleasure in being so. I did not take bribes, you see, so I was bound to find a recompense in that, at least. (A poor jest, but I will not scratch it out. I wrote it thinking it would sound very witty; but now that I have seen myself that I only wanted to show off in a despicable way, I will not scratch it out on purpose!)

When petitioners used to come for information to the table at which I sat, I used to grind my teeth at them, and felt intense enjoyment when I succeeded in making anybody unhappy. I almost did succeed. For the most part they were all timid people, of course, they were petitioners. But of the uppish ones there was one officer in particular I could not endure. He simply would not be humble, and clanked his sword in a disgusting way. I carried on a feud with him for eighteen months over that sword. At last I got the better of him. He left off clanking it. That happened in my youth, though.

But do you know, gentlemen, what was the chief point about my spite? Why, the whole point, the real sting of it lay in the fact that continually, even in the moment of the acutest spleen, I was inwardly conscious with shame that I was not only not a spiteful but not even an embittered man, that I was simply scaring sparrows at random and amusing myself by it. I might foam at the mouth, but bring me a doll to play with, give me a cup of tea with sugar in it, and maybe I should be appeased. I might even be genuinely touched, though probably I should grind my teeth at myself afterwards and lie awake at night with shame for months after. That was my way.

Source: Fyodor Dostoyevsky, Notes from Underground, Part I, section I, translated by Constance Garnett. Project Gutenberg eBook #600. Public domain.

46 **Why does the narrator say he does not consult a doctor?** A B C D

- **A.** He cannot afford the fees and so does without
- **B.** He thinks that medicine is nonsense and doctors are frauds
- **C.** He is certain that his liver is perfectly sound
- **D.** Out of spite, though he knows it injures only himself

47 **The narrator calls one remark "a poor jest" but says that he "will not scratch it out". This shows that he:** A B C D

- **A.** wrote the line carelessly and intends to improve it later
- **B.** is aware of his own vanity but chooses to keep the line
- **C.** is confident that the reader will find the joke very witty
- **D.** is trying to hide an earlier mistake from the reader

48 **The narrator says he was "simply scaring sparrows at random". This image suggests that his spite was:** A B C D

- **A.** more bluster than a real wish to harm anyone
- **B.** aimed at people who could do him real harm
- **C.** a carefully planned campaign against his enemies
- **D.** a result of his years in government service

49 **The narrator begins "I am a spiteful man", yet later says he was "not even an embittered man". How does the later statement relate to the opening claim?** A B C D

- **A.** The later statement is a lie meant to hide the true extent of his spite
- **B.** The later statement shows that he has recovered from his spite
- **C.** The later admission undercuts the claim: his spite was largely show
- **D.** The later statement describes other officials, not the narrator

Unit 17: A sonnet about envy and consolation

Questions 50 to 52

When in disgrace with fortune and men's eyes
I all alone beweep my outcast state,
And trouble deaf heaven with my bootless cries,
And look upon myself, and curse my fate,
Wishing me like to one more rich in hope,
Featur'd like him, like him with friends possess'd,
Desiring this man's art, and that man's scope,
With what I most enjoy contented least;
Yet in these thoughts my self almost despising,
Haply I think on thee, and then my state,
Like to the lark at break of day arising

From sullen earth, sings hymns at heaven's gate;
For thy sweet love remember'd such wealth brings
That then I scorn to change my state with kings.

Glossary (ours): bootless, useless; haply, by chance.

Source: William Shakespeare, Sonnet 29 (When in disgrace with fortune and men's eyes), Shakespeare's Sonnets. Project Gutenberg eBook #1041. Public domain.

50 **Which description best fits the change in the speaker's feelings over the poem?** A B C D

A. from pride in success to shame at losing it
B. from calm acceptance to anger at friends who have failed the speaker
C. from joy in company to envy of the rich and famous
D. from despair at the speaker's own lot to joy in remembered love

51 **The speaker's state is compared to "the lark at break of day arising / From sullen earth, sings hymns at heaven's gate". This image mainly shows:** A B C D

A. that the speaker has spent the night singing and now feels tired
B. that the speaker plans to leave the town at first light
C. that the speaker is as free and as carefree as a wild bird
D. a lift from low spirits to joy when love comes to mind

52 **The last two lines say that remembered love "such wealth brings / That then I scorn to change my state with kings". What does "wealth" refer to here?** A B C D

A. money that the speaker has inherited
B. the worth the speaker finds in being loved
C. the success that the speaker once enjoyed and has since lost
D. the praise of men who admire the speaker's art

Unit 18: A report on an election campaign

Questions 53 to 54

THE state of things in regard to my candidature, in which I know that you are supremely interested, is this, as far as can be as yet conjectured. The only person actually canvassing is P. Sulpicius Galba. He meets with a good old-fashioned refusal without reserve or disguise. In the general opinion this premature canvass of his is not unfavourable to my interests; for the voters generally give as a reason for their refusal that they are under obligations to me. So I hope my prospects are to a certain degree improved by the report getting about that my friends are found to be numerous. My intention was to begin my own canvass just at the very time that Cincius tells me that your servant starts with this letter, namely, in the campus at the time of the tribunician elections on the 17th of July. My fellow candidates, to mention only those who seem certain, are Galba and Antonius and Q. Cornificius. At this I imagine you smiling or sighing. Well, to make you positively smite your forehead, there are people who actually think that Caesonius will stand. I don't think Aquilius will, for he openly disclaims it and has alleged as an excuse his health and his leading position at the bar. Catiline will certainly be a candidate, if you can imagine a jury finding that the sun does not shine at noon. As for Aufidius and Palicanus, I don't think you will expect to hear from me about them.

Source: Marcus Tullius Cicero, Letter I to Atticus, in Letters of Marcus Tullius Cicero, translated by Evelyn S. Shuckburgh. Project Gutenberg eBook #2812. Public domain. Line breaks reflowed.

53 **Why does the writer say that Galba's early canvassing "is not unfavourable to my interests"?** A B C D

- **A.** Voters turn Galba away by saying they already owe the writer a favour
- **B.** Galba has promised to withdraw in the writer's favour
- **C.** Galba's early start gives the writer more time to prepare a campaign
- **D.** Galba's canvass has shown that voters dislike every candidate

54 **The writer says: "Catiline will certainly be a candidate, if you can imagine a jury finding that the sun does not shine at noon." This remark is best understood as:** A B C D

- **A.** a report from a reliable source that Catiline has already decided to stand
- **B.** a forecast that Catiline will stand because he is so popular
- **C.** a joke that he can stand only if a jury reaches an absurd verdict, so the writer expects him not to stand
- **D.** a prediction that the sun will fail to shine at noon on election day

Unit 19: On praising the dead

Questions 55 to 56

That praises are without reason lavished on the dead, and that the honours due only to excellence are paid to antiquity, is a complaint likely to be always continued by those, who, being able to add nothing to truth, hope for eminence from the heresies of paradox; or those, who, being forced by disappointment upon consolatory expedients, are willing to hope from posterity what the present age refuses, and flatter themselves that the regard which is yet denied by envy, will be at last bestowed by time. Antiquity, like every other quality that attracts the notice of mankind, has undoubtedly votaries that reverence it, not from reason, but from prejudice. Some seem to admire indiscriminately whatever has been long preserved, without considering that time has sometimes co-operated with chance; all perhaps are more willing to honour past than present excellence; and the mind contemplates genius through the shades of age, as the eye surveys the sun through artificial opacity. The great contention of criticism is to find

the faults of the moderns, and the beauties of the ancients. While an authour is yet living we estimate his powers by his worst performance, and when he is dead we rate them by his best. To works, however, of which the excellence is not absolute and definite, but gradual and comparative; to works not raised upon principles demonstrative and scientifick, but appealing wholly to observation and experience, no other test can be applied than length of duration and continuance of esteem. What mankind have long possessed they have often examined and compared, and if they persist to value the possession, it is because frequent comparisons have confirmed opinion in its favour. As among the works of nature no man can properly call a river deep or a mountain high, without the knowledge of many mountains and many rivers; so in the productions of genius, nothing can be stiled excellent till it has been compared with other works of the same kind. Demonstration immediately displays its power, and has nothing to hope or fear from the flux of years; but works tentative and experimental must be estimated by their proportion to the general and collective ability of man, as it is discovered in a long succession of endeavours. Of the first building that was raised, it might be with certainty determined that it was round or square, but whether it was spacious or lofty must have been referred to time. The Pythagorean scale of numbers was at once discovered to be perfect; but the poems of Homer we yet know not to transcend the common limits of human intelligence, but by remarking, that nation after nation, and century after century, has been able to do little more than transpose his incidents, new name his characters, and paraphrase his sentiments.

Source: Samuel Johnson, Preface to Shakespeare, 1765 (as dated in the file). Project Gutenberg eBook #5429. Public domain. Spelling as printed.

55 **According to Johnson, why must works resting on "observation and experience" be judged by length of duration?** A B C D

- **A.** Writers of the past were wiser than writers of today
- **B.** Their worth shows itself only after long comparison
- **C.** Critics are never willing to praise a living writer
- **D.** Mathematical proof has shown that the old works are correct

56 **Johnson contrasts the "Pythagorean scale of numbers" with the poems of Homer. The contrast serves to show that:** A B C D

- **A.** a numerical truth is seen at once, while the worth of a poem needs time to show
- **B.** Homer was a better poet than any writer who came after him
- **C.** poetry should be treated as a branch of mathematics
- **D.** the scale of numbers was discovered long before any poem was written

Unit 20: The UK households saving ratio

Questions 57 to 58

Households' and NPISH saving ratio, in per cent, by year. NPISH are non-profit institutions serving households, so the sector covers them as well as households. Each value is a percentage, not an amount of money.

Year	Saving ratio (per cent)
2010	12.2

Year	Saving ratio (per cent)
2011	10.2
2012	9.4
2013	9.1
2014	8.3
2015	10.4
2016	7.2
2017	5.6
2018	5.6
2019	5.8
2020	16.6
2021	12.7
2022	5.1
2023	6.7
2024	9.6
2025	9.7

Source: Data: Office for National Statistics, Households' and NPISH saving ratio (series NRJS). Contains public sector information licensed under the Open Government Licence v3.0. Values as published; selection and layout ours.

57 **In how many of the years shown is the ratio below 6 per cent?**

A B C D

A. 3
B. 5
C. 6
D. 4

58 **A reader says: "The ratio is highest in 2020, so households saved more money in 2020 than in any other year shown." Which comment is most accurate?**

A B C D

A. The conclusion is safe, because the ratio is highest in 2020
B. The conclusion is unsafe, because the table covers only some of the years
C. The conclusion is unsafe, because a ratio is a share, so a higher share need not mean more money saved
D. The conclusion is unsafe, because the ratio fell between 2019 and 2020

Unit 21: Should people be paid when companies use their

Questions 59 to 62

Eight people respond to the question: should people be paid when companies use their personal data?

1. Companies earn money from what people search for, buy and click on. The people who create that information help to produce the profit, and they should receive a share of it.

2. If data carried a price, many people would sell it without thinking about the risks. Some information, once sold, can never be taken back.

3. A single person's data is worth little on its own and a great deal in a large collection. Nobody has found a way to say what one person's share should be.

4. A payment of a few dollars matters more to someone on a low income than to someone who is well off. The people who need money most would be the most likely to give up their privacy.

5. Limits on what a company may collect in the first place protect everyone equally. Payment treats privacy as something to be bought, when it might be better guarded.

6. Anonymous health records can help researchers to find the causes of disease. Asking for a payment for each use would make that work slow and expensive.

7. Data passes from one company to another, often through several steps. Few people could say who holds their data now, so few could check whether they had been paid.

8. Individuals have little bargaining power against a large company. A body that acts for a whole group of people could set terms that no single person could win.

Source: Original, written for this project. The comments are invented and are not attributed to any real person.

59 **Which comment argues that a payment scheme could treat people unequally according to their income?**

A B C D

A. Comment 2
B. Comment 4
C. Comment 5
D. Comment 3

60 **Comments 3 and 7 both point to practical difficulties. How do the difficulties differ?**

A B C D

A. Comment 3 concerns setting a value on one person's data, while Comment 7 concerns knowing where the data has gone
B. Comment 3 concerns the cost of research, while Comment 7 concerns the pressure on poorer people
C. Comment 3 concerns who holds the data, while Comment 7 concerns the price of one person's share
D. Comment 3 concerns bargaining power, while Comment 7 concerns the limits on collection

61 **Which comment most directly offers a way round the difficulty described in Comment 3?**

A B C D

A. Comment 1
B. Comment 5
C. Comment 8
D. Comment 2

62 **A speaker argues: "Pay people for their data, and they will take better care over how it is used." Which comment most directly weakens this argument?**

A B C D

A. Comment 1
B. Comment 6
C. Comment 8
D. Comment 2

Section 3: Reasoning in Biological and Physical Sciences

75 questions. Time allowed: 150 minutes. Questions come in units that share one passage or set of data.

Unit 1: Ranking five ionic solids by lattice energy

Questions 1 to 4

Lattice energy is the energy needed to separate one mole of an ionic solid into its gaseous ions. As a rough guide, for solids of similar structure it rises as the product of the two ion charges rises, and falls as the distance between the ion centres grows. That distance is the cation radius plus the anion radius. The values below are rounded teaching values.

Solid	Cation	Anion	Cation radius (pm)	Anion radius (pm)	Lattice energy (kJ mol^{-1})
MgO	Mg^{2+}	O^{2-}	70	140	3800
CaO	Ca^{2+}	O^{2-}	100	140	3400
NaF	Na^{+}	F^{-}	100	130	920
NaCl	Na^{+}	Cl^{-}	100	180	790
KCl	K^{+}	Cl^{-}	140	180	720

All five solids form colourless crystals. Melting points are not given.

1 **Which solid has the shortest distance between its ion centres?** (A) (B) (C) (D)

A. MgO, at 210 pm
B. CaO, at 240 pm
C. NaF, at 230 pm
D. NaCl, at 280 pm

2 **Which statement best explains why KCl has a lower lattice energy than NaCl?** (A) (B) (C) (D)

A. K^{+} carries a smaller charge than Na^{+}, so each ion pair attracts less strongly
B. Cl^{-} is larger in KCl than in NaCl, so the ion centres are further apart
C. The larger K^{+} ion has a higher charge density, which weakens the attraction to Cl^{-}
D. K^{+} is larger than Na^{+}, so the ion centres are further apart and the attraction is weaker

3 **Take (product of ion charges) ÷ (distance between ion centres) as the rough guide. For MgO this quantity is about how many times the value for NaF?** (A) (B) (C) (D)

A. About 1
B. About 2
C. About 4
D. About 16

4 **A student predicts that CaO melts at a higher temperature than NaCl. What does the table support?** (A) (B) (C) (D)

- **A.** The prediction is proved, because lattice energy is the energy needed to melt the solid
- **B.** The prediction fails, because Ca^{2+} and Na^{+} both have a radius of 100 pm, so the two solids must melt at the same temperature
- **C.** The prediction is wrong, because CaO has the shorter ion separation and therefore the weaker attraction
- **D.** The prediction is reasonable, because CaO has the larger lattice energy, but the table gives no melting points to confirm it

Unit 2: Counting RNA primers in one replication bubble

Questions 5 to 8

A replication origin opens into a bubble, and a replication fork moves away from the origin in each direction. Each fork copies 6,000 base pairs.

DNA polymerase can only add nucleotides to an existing 3′ end that carries a free hydroxyl group, and it builds new DNA only in the 5′ to 3′ direction. Primase is the enzyme that makes a short RNA primer, which supplies that 3′ end.

At each fork the leading strand is built continuously from a single primer. The lagging strand is built in separate Okazaki fragments, each 1,000 nucleotides long, and each fragment needs its own primer. Count exactly one primer per fragment. The whole genome of the organism is much larger than the region described here.

5 **Why can DNA polymerase not start a new strand on a bare template?** (A) (B) (C) (D)

- **A.** It can only copy RNA templates, so it needs an RNA strand to begin on
- **B.** It can only work in the 3′ to 5′ direction, so a primer is needed to turn it round
- **C.** It must first unwind the helix, and unwinding needs a primer to hold the strands apart
- **D.** It can only extend an existing strand that supplies a free 3′ hydroxyl group

6 **How many primers are needed to build the lagging strand at one fork?** (A) (B) (C) (D)

- **A.** 1
- **B.** 6
- **C.** 7
- **D.** 12

7 **How many primers are needed in total to copy the region between the two forks of the bubble?** (A) (B) (C) (D)

- **A.** 7
- **B.** 12
- **C.** 14
- **D.** 28

8 **A mutant cell makes no primase. What is the most likely result at the origin?** (A) (B) (C) (D)

- **A.** Leading strands are made but lagging strands are not
- **B.** Replication begins as normal but stops after the first Okazaki fragment on each fork
- **C.** No new DNA is made, because the polymerase has no 3′ end to extend
- **D.** DNA polymerase makes its own primers more slowly, so replication only slows down

Unit 3: Which collision outcomes are possible?

Questions 9 to 12

Two carts move on a frictionless horizontal track. Cart 1 (mass 2.0 kg) moves at 3.0 m s^{-1} towards cart 2 (mass 1.0 kg), which is at rest. The carts collide. A student proposes three possible outcomes P, Q and R, giving each cart's final speed in the original direction of motion.

Momentum is $p = mv$ and kinetic energy is $KE = \frac{1}{2}mv^2$. Total momentum is conserved in every collision here. Kinetic energy is conserved only in an elastic collision. In a perfectly inelastic collision the carts move off together. No energy source acts on the carts, so their total kinetic energy cannot increase. The carts carry numbered flags.

Outcome	Cart 1 final speed (m s^{-1})	Cart 2 final speed (m s^{-1})
P	1.0	4.0
Q	2.0	2.0
R	0	6.0

9 **What is the total momentum of the two carts before the collision?** (A) (B) (C) (D)

- **A.** 3.0 kg m s^{-1}
- **B.** 6.0 kg m s^{-1}
- **C.** 9.0 kg m s^{-1}
- **D.** 18 kg m s^{-1}

10 **Which outcome is an elastic collision, and why?** (A) (B) (C) (D)

- **A.** Q, because the carts finish together at the same speed, so no kinetic energy is lost
- **B.** R, because cart 1 passes all of its momentum to cart 2 and so comes to rest
- **C.** P and Q, because both of them conserve the total momentum of 6.0 kg m s^{-1}
- **D.** P, because both momentum and kinetic energy are unchanged (6.0 kg m s^{-1} and 9.0 J)

11 **Which outcome cannot occur, and why?** A B C D

- **A.** R, because cart 1 finishes at rest, and a cart cannot stop in a collision
- **B.** Q, because the carts finish with the same speed, which breaks conservation of momentum
- **C.** P, because cart 2 finishes faster than cart 1 started
- **D.** R, because its final kinetic energy of 18 J is more than the 9.0 J available

12 **What fraction of the initial kinetic energy is lost in outcome Q?** A B C D

- **A.** None
- **B.** One third
- **C.** One half
- **D.** Two thirds

Unit 4: When a Grignard reagent destroys itself

Questions 13 to 15

Alkyl and aryl bromides react with magnesium metal in dry ether to give organomagnesium reagents, written R-MgBr, in which R behaves like a carbanion, R^-. Such a reagent adds to formaldehyde ($H_2C{=}O$) and, after aqueous acid is added, gives an alcohol with one more carbon than R-Br, written R-CH_2OH.

R^- is a very strong base. It removes any proton that is more acidic than the C-H bond of the matching alkane R-H. A lower pKa means a stronger acid. Approximate pKa values: carboxylic acid O-H 4.7; alcohol O-H 16 (water behaves similarly); alkane C-H 50.

Four bromides were each treated with magnesium in dry ether, then with formaldehyde, then with aqueous acid. Only two gave the expected alcohol.

Bromide	Condensed structure
1-bromopropane	$CH_3CH_2CH_2Br$
2-bromoethanol	$HOCH_2CH_2Br$
4-bromobenzoic acid	$HO_2C\text{-}C_6H_4\text{-}Br$
4-bromoanisole	$CH_3O\text{-}C_6H_4\text{-}Br$ (an ether)

The magnesium was added as turnings (24.3 g mol^{-1}).

13 **Which two bromides gave the expected alcohol?** A B C D

- **A.** 1-bromopropane and 4-bromoanisole
- **B.** 2-bromoethanol and 4-bromobenzoic acid
- **C.** 1-bromopropane and 2-bromoethanol
- **D.** 4-bromobenzoic acid and 4-bromoanisole

14 **Which statement best explains why 2-bromoethanol does not give the expected alcohol?**

A B C D

A. A bromine atom on a carbon next to an OH group cannot react with magnesium, so no reagent forms at all

B. The O-H proton is less acidic than a C-H proton, so the reagent removes a proton from the carbon chain instead

C. The OH group reacts with formaldehyde first, so none is left for the Grignard reagent to attack

D. The reagent forms but removes the O-H proton of another molecule, so it is destroyed before reaching formaldehyde

15 **Propylmagnesium bromide is accidentally exposed to water. What is the main organic product?**

A B C D

A. Propan-1-ol

B. Butan-1-ol

C. Propane

D. Hexane

Unit 5: Mice missing parts of antigen presentation

Questions 16 to 19

Cytotoxic (CD8) T cells recognise viral peptides displayed on MHC class I molecules and kill the infected cells. Helper (CD4) T cells recognise peptides displayed on MHC class II molecules and are needed for B cells to make antibody against a viral protein. Assume these are the only roles.

Mice of six strains were infected with the same virus. The table records whether the virus was cleared by day 10 and the level of antibody to a viral protein. The TAP-deficient strain cannot load peptides onto MHC class I. Its result is not given. Mice were housed in the same room and were of the same age.

Strain	Virus cleared by day 10	Antibody to viral protein
Normal	Yes	High
Lacks MHC class I	No	High
Lacks MHC class II	Yes	None
Lacks CD8 T cells	No	High
Lacks CD4 T cells	Yes	None
TAP-deficient	Not given	Not given

16 **Which strains failed to clear the virus by day 10?**

A B C D

A. Lacks MHC class II, and lacks CD4 T cells

B. Lacks MHC class I, and lacks CD4 T cells

C. Lacks MHC class I, and lacks CD8 T cells

D. Lacks MHC class II, and lacks CD8 T cells

17 **Which strains made no antibody to the viral protein?** A B C D

- **A.** Lacks MHC class I, and lacks CD8 T cells
- **B.** Lacks MHC class II, and lacks CD4 T cells
- **C.** Lacks MHC class I, and lacks CD4 T cells
- **D.** Lacks CD4 T cells and lacks CD8 T cells

18 **What outcome is predicted for the TAP-deficient strain?** A B C D

- **A.** The virus is not cleared, but antibody to the viral protein is high
- **B.** The virus is cleared, but no antibody is made against the viral protein
- **C.** The virus is not cleared and no antibody is made against the viral protein
- **D.** The virus is cleared and antibody is high, as in normal mice

19 **A student concludes that the MHC class I molecules themselves, rather than CD8 T cells, kill the infected cells. How should this conclusion be judged?** A B C D

- **A.** Not supported: the MHC class I and CD8 strains both fail to clear the virus, so the table cannot say which part does the killing
- **B.** Supported: the strain lacking MHC class I fails to clear the virus, so the molecule itself must be doing the killing
- **C.** Supported: the CD8-deficient strain also fails, so the effect must come from MHC class I alone and not from T cells
- **D.** Not supported: the strain lacking MHC class II still clears the virus, which shows MHC molecules play no part

Unit 6: Four runs of marble chips in acid

Questions 20 to 23

Four runs of the same reaction were compared. Each run used 100 mL of hydrochloric acid and 5.0 g of calcium carbonate ($CaCO_3$, molar mass 100 g mol^{-1}, which is 0.050 mol).

$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$

The carbon dioxide was collected in a gas syringe. Take the molar volume of CO_2 as 24 L mol^{-1} in every run. A 250 mL conical flask was used each time.

Run	Form of $CaCO_3$	HCl concentration (mol L^{-1})	Temperature (°C)	Initial rate of CO_2 release (mL min^{-1})
A	Lumps	1.0	20	10
B	Powder	1.0	20	40
C	Lumps	2.0	20	20
D	Lumps	1.0	40	20

20 **Which pair of runs isolates the effect of surface area on the initial rate?** (A) (B) (C) (D)

A. A and C
B. A and D
C. C and D
D. A and B

21 **What total volume of carbon dioxide is released when run A is complete?** (A) (B) (C) (D)

A. 600 mL
B. 1200 mL
C. 2400 mL
D. 4800 mL

22 **Run C uses acid twice as concentrated as run A. How does its total CO_2 volume compare with run A?** (A) (B) (C) (D)

A. It is twice as large, because the acid concentration is twice as high
B. It is the same, because the $CaCO_3$ is used up in both runs
C. It is smaller, because the faster reaction loses more gas before the syringe can collect it
D. It is larger, but less than twice as large, because the extra acid reacts only partly

23 **A student notes that runs C and D have the same initial rate and concludes that doubling the concentration and warming by 20 °C affect the reaction in the same way. How should this be judged?** (A) (B) (C) (D)

A. Supported: any two changes that produce equal rates must be acting on the reaction in the same way
B. Not supported: equal rates show equal size of effect here, not that the two changes act in the same way
C. Not supported: doubling the concentration cannot double the rate, so run C must be slower than run D
D. Supported: both changes work by exposing more of the solid surface to acid, the one thing that sets rates

Unit 7: Blood groups in two populations

Questions 24 to 27

The ABO blood group is controlled by one gene with three alleles: I^A, I^B and i. I^A and I^B are codominant, and i is recessive to both.

Genotype	Blood group
I^AI^A or I^Ai	A
I^BI^B or I^Bi	B
I^AI^B	AB
ii	O

Let p, q and r be the frequencies of I^A, I^B and i, with p + q + r = 1. A population in Hardy-Weinberg equilibrium has genotype frequencies p^2, q^2, r^2, 2pq, 2pr and 2qr. This holds only for a very large population with random mating and with no mutation, migration or selection acting on the gene.

Population 1. p = 0.2, q = 0.1, r = 0.7.

Population 2. A blood bank recorded the observed blood-group frequencies of donors sampled in a single year.

Blood group	O	A	B	AB
Observed frequency	0.64	0.17	0.17	0.02

24 **What frequency of blood group O is expected in population 1?** A B C D

A. 0.21
B. 0.35
C. 0.49
D. 0.70

25 **What frequency of blood group A is expected in population 1?** A B C D

A. 0.04
B. 0.20
C. 0.28
D. 0.32

26 **What frequency of blood group AB is expected in population 1?** A B C D

A. 0.01
B. 0.02
C. 0.04
D. 0.30

27 **Is the observed frequency of group AB in population 2 consistent with Hardy-Weinberg equilibrium?** A B C D

A. No: AB should be 0.04 as in population 1, so the observed value of 0.02 is too low for equilibrium
B. Yes: the other groups imply I^A 0.1 and I^B 0.1, so AB = 2pq = 0.02, which matches
C. No: with O at 0.64, AB should be 0.36, the remainder of the population, so 0.02 is far too low
D. It cannot be tested, because Hardy-Weinberg applies only to genes with two alleles and ABO has three

Unit 8: How much does the eye change its power? Questions 28 to 31

In a simple model of the eye, the lens forms a real image on the retina, which stays 0.020 m behind the lens. The power of the lens, in dioptres (D, where 1 D = 1 m^{-1}), is

$P = 1/d_o + 1/d_i$

where d_o is the distance from the object to the lens and d_i is the distance from the lens to the image. The focal length is f = 1/P. The eye changes the power of its lens to focus objects at different distances. This is called accommodation. For a very distant object, take $1/d_o$ as zero.

The reading text used in the experiments was printed in italics.

28 **What power must the lens have to focus a very distant object on the retina?** A B C D

A. 0 D
B. 0.020 D
C. 50 D
D. 54 D

29 **By how much must the lens increase its power to change from a distant object to a page held at 0.25 m?** A B C D

A. 0.25 D
B. 2.0 D
C. 4.0 D
D. 54 D

30 **When the eye changes from a distant object to one at 0.50 m, what happens to the focal length of the lens?** A B C D

A. It lengthens slightly, from 20.0 mm to about 20.8 mm
B. It stays at 20.0 mm, because the image distance is fixed at the retina
C. It changes from infinity to 0.50 m, matching the object distance
D. It shortens slightly, from 20.0 mm to about 19.2 mm

31 **An older person can add at most 2.0 D to the power of the lens. What is the nearest object that can be brought into focus?** A B C D

A. 0.25 m
B. 0.50 m
C. 1.0 m
D. 2.0 m

Unit 9: Making and breaking an ester, with an oxygen label

Questions 32 to 35

Ethyl ethanoate forms from ethanoic acid and ethanol in an acid-catalysed equilibrium. At the working temperature the equilibrium constant is 4.

$CH_3COOH + C_2H_5OH \rightleftharpoons CH_3COOC_2H_5 + H_2O \quad K = 4$

Three runs were carried out.

- **Run A.** 1.0 mol of ethanoic acid and 1.0 mol of ethanol, with 5 drops of concentrated sulfuric acid, were left to reach equilibrium.
- **Run B.** Ethyl ethanoate labelled in the alkoxy oxygen, $CH_3C(=O)\text{-}^{18}O\text{-}CH_2CH_3$, was heated with excess aqueous sodium hydroxide until the ester had gone.
- **Run C.** Unlabelled ethyl ethanoate was heated with sodium hydroxide dissolved in water enriched in ^{18}O, so that the hydroxide oxygen was ^{18}O.

In base, hydroxide attacks the carbonyl carbon, and it is the bond between the carbonyl carbon and the alkoxy oxygen that breaks. The O-CH_2 bond is left intact. The ethanoic acid produced reacts with excess hydroxide to give ethanoate.

32 How much ethyl ethanoate is present at equilibrium in run A?

A B C D

A. 0.33 mol
B. 0.50 mol
C. 0.67 mol
D. 0.80 mol

33 In run B, where is the ^{18}O found at the end?

A B C D

A. In the ethanol only
B. In the ethanoate ion only
C. Shared equally between ethanol and ethanoate
D. In the water only

34 In run C, the label is found in:

A B C D

A. the ethanol, and not in the ethanoate ion
B. both the ethanol and the ethanoate ion, one atom each
C. neither product, because the label stays in the water
D. the ethanoate ion, and not in the ethanol

35 Why does run B go essentially to completion although run A stops with ester still present?

A B C D

A. Sodium hydroxide is a stronger catalyst than sulfuric acid, so the equilibrium constant is larger in run B
B. Excess water in run B pushes the equilibrium to the right until the constant reaches infinity, whatever the temperature
C. The oxygen label in run B slows the reverse reaction through an isotope effect, which stops it completely
D. The ethanoic acid formed is converted to ethanoate, which cannot react with ethanol, so the reverse step is removed

Unit 10: Enlarged ventricles in three patients

Questions 36 to 38

Cerebrospinal fluid (CSF) is made by the choroid plexus in the ventricles. It flows from the lateral ventricles to the third ventricle, through the cerebral aqueduct to the fourth ventricle, and out to the space around the brain, where it is reabsorbed into the blood through the arachnoid granulations.

Scans and daily CSF figures were recorded for a normal adult and for three patients. Reabsorption is not impaired in patient 1. The scans were taken on the same machine.

Person	Lateral ventricles	Third ventricle	Fourth ventricle	CSF made (mL per day)	CSF reabsorbed (mL per day)
Normal	Normal	Normal	Normal	500	500
Patient 1	Enlarged	Enlarged	Normal	500	500
Patient 2	Enlarged	Enlarged	Enlarged	500	250
Patient 3	Enlarged	Enlarged	Enlarged	1000	500

36 **Where is the most likely site of obstruction in patient 1?** (A) (B) (C) (D)

- **A.** Between the lateral ventricles and the third ventricle
- **B.** The arachnoid granulations, where CSF returns to the blood
- **C.** The cerebral aqueduct, between the third and fourth ventricles
- **D.** The choroid plexus, where the CSF is first made in the ventricles

37 **Which statement correctly separates the likely causes in patients 2 and 3?** (A) (B) (C) (D)

- **A.** Patient 2 makes more CSF than normal, and patient 3 reabsorbs less than normal
- **B.** Both patients reabsorb less than normal, but patient 3 does so by a larger amount
- **C.** Neither can be separated, because the ventricles look the same on scans
- **D.** Patient 2 reabsorbs less than the normal amount of CSF, and patient 3 makes more than normal

38 **By how much does the CSF volume increase each day in patients 3 and 2?** (A) (B) (C) (D)

- **A.** Patient 3 gains 1000 mL and patient 2 gains 250 mL
- **B.** Both patients gain 500 mL
- **C.** Patient 3 gains 500 mL and patient 2 gains 750 mL
- **D.** Patient 3 gains 500 mL and patient 2 gains 250 mL

Unit 11: Identifying a metal from the hydrogen it releases

Questions 39 to 42

A 0.23 g sample of a metal M, known to be one of the five metals in the table, reacts completely with cold water in a 500 mL beaker. The hydrogen given off measures 112 mL, at a temperature and pressure where the molar volume of a gas is 22.4 L mol^{-1}. The hydroxide solution formed is made up to 1.00 L at 25 °C.

Group 1 metals react as $2M + 2H_2O \rightarrow 2MOH + H_2$. Group 2 metals react as $M + 2H_2O \rightarrow M(OH)_2 + H_2$. At 25 °C, $[H^+][OH^-] = 1.0 \times 10^{-14}$ $mol^2\ L^{-2}$ and $pH = 14 + \log_{10}[OH^-]$.

Metal	Group	Molar mass (g mol^{-1})
Lithium	1	7
Sodium	1	23
Potassium	1	39
Magnesium	2	24
Calcium	2	40

39 **How many moles of hydrogen were released?** (A) (B) (C) (D)

- **A.** 5.0×10^{-4} mol
- **B.** 5.0×10^{-3} mol
- **C.** 5.0×10^{-2} mol
- **D.** 5.0 mol

40 **Which metal is M?** (A) (B) (C) (D)

A. Lithium
B. Sodium
C. Potassium
D. Calcium

41 **What is the pH of the solution at 25 °C?** (A) (B) (C) (D)

A. 2.0
B. 11.7
C. 12.0
D. 12.3

42 **A student assumes M is a group 2 metal. Which conclusion is correct?** (A) (B) (C) (D)

A. The assumption is confirmed, because it gives about 23 g mol^{-1}, which is close to magnesium at 24 g mol^{-1}
B. The assumption is ruled out, because it gives a molar mass of 46 g mol^{-1}, which no listed metal has
C. The assumption is ruled out, because group 2 metals cannot release hydrogen from cold water
D. The assumption cannot be tested, because both group 1 and group 2 metals release the same volume of hydrogen

Unit 12: Growth rates of four soil isolates

Questions 43 to 46

Four bacterial isolates, I1 to I4, were grown in a laboratory. Growth is given as doublings per hour, where 0 means no growth. The temperature trials were run at pH 7 and the pH trials at 37 °C. Not every isolate was tested in every trial. The isolates came from different soil samples.

Temperature trials (pH 7)

Isolate	4 °C	20 °C	37 °C	60 °C
I1	0.1	0.5	1.0	0
I2	0.4	0.5	0	0
I3	0	0	0.2	1.2

pH trials (37 °C)

Isolate	pH 3	pH 5	pH 7	pH 9
I1	0	0.2	1.0	0.3
I4	1.0	0.8	0.1	0

43 **Which isolate grew fastest at 4 °C, among those tested at that temperature?** (A) (B) (C) (D)

A. I2
B. I1
C. I3
D. I1 and I2, which grew at the same rate

44 **At which tested temperature did I1 and I2 both grow, and at the same rate?** (A) (B) (C) (D)

A. 4 °C
B. 20 °C
C. 37 °C
D. 60 °C

45 **A single I2 cell is placed in suitable medium at 4 °C and pH 7. Assuming steady growth with no lag, about how many cells are present after 10 h?** (A) (B) (C) (D)

A. 4
B. 5
C. 16
D. 1024

46 **A scientist needs an isolate for a hot spring at 60 °C and pH 3. What do the tables support?** (A) (B) (C) (D)

A. None of the isolates can be chosen with confidence, because none was tested at both 60 °C and pH 3
B. I3 should be chosen, because it grows fastest of all the isolates at 60 °C
C. I4 should be chosen, because it grows fastest at the lowest pH that was tested
D. I2 should be chosen, because it is the only isolate that grows well in the cold

Unit 13: A heater with series and parallel parts

Questions 47 to 50

A heater circuit is connected to an 18 V supply of negligible internal resistance. A 4.0 Ω resistor is connected in series with a parallel pair made of a 6.0 Ω resistor and a 3.0 Ω resistor. The supply current passes through the 4.0 Ω resistor first, then divides between the two parallel resistors, which rejoin before returning to the supply.

For resistors in series, $R = R_1 + R_2 + \ldots$ For resistors in parallel, $1/R = 1/R_1 + 1/R_2 + \ldots$ Ohm's law is $V = IR$. The resistors are colour coded.

47 **What is the total resistance connected to the supply?** (A) (B) (C) (D)

A. 2.0 Ω
B. 6.0 Ω
C. 9.0 Ω
D. 13 Ω

48 **What is the potential difference across the parallel pair?** (A) (B) (C) (D)

A. 6.0 V
B. 9.0 V
C. 12 V
D. 18 V

49 **What current flows through the 3.0 Ω resistor?** (A) (B) (C) (D)

A. 1.0 A
B. 2.0 A
C. 3.0 A
D. 6.0 A

50 **The 3.0 Ω resistor fails and no longer conducts. What is the supply current now?** (A) (B) (C) (D)

A. 1.0 A
B. 1.8 A
C. 2.0 A
D. 3.0 A

Unit 14: Retention times in reversed-phase chromatography

Questions 51 to 54

In reversed-phase liquid chromatography the column packing is nonpolar (C18 chains) and the mobile phase is a polar mixture of water and acetonitrile. A solute is held on the column longer when it is more hydrophobic, so retention time rises with logP, a measure of hydrophobicity. A higher fraction of acetonitrile makes the mobile phase less polar and lowers every retention time.

Three solutes were run at two mobile-phase compositions. The flow rate was 1.0 mL min^{-1} and the column was 150 mm long.

Solute	logP	Retention time at 40% acetonitrile (min)	Retention time at 60% acetonitrile (min)
A	0.5	2.0	1.5
B	2.0	6.0	3.0
C	3.5	18.0	6.0

51 **In what order do the solutes leave the column?** (A) (B) (C) (D)

A. C, then B, then A
B. B, then A, then C
C. C, then A, then B
D. A, then B, then C

52 **Which statement about the separation of B and C is supported by the table?** (A) (B) (C) (D)

A. Raising acetonitrile from 40% to 60% narrows the ratio of their retention times from 3.0 to 2.0
B. Raising acetonitrile from 40% to 60% leaves the gap between their retention times unchanged
C. At 60% acetonitrile solute C elutes before solute B
D. At 60% acetonitrile the gap between B and C is larger in minutes than at 40%

53 **The same mixture is passed down a normal-phase silica column, in which the stationary phase is polar and more polar solutes are held longer. Which elution order is expected?** (A) (B) (C) (D)

A. C, then B, then A
B. A, then B, then C
C. B, then C, then A
D. A and C together, then B

54 **At 40% acetonitrile each rise of 1.5 in logP multiplies the retention time by the same factor. A solute D with logP 5.0 would be expected to elute at about:**

A B C D

A. 30 min
B. 36 min
C. 54 min
D. 162 min

Unit 15: The kidney limit for glucose

Questions 55 to 58

Glucose is filtered at the glomerulus and reabsorbed in the proximal tubule by transporters that can handle only a limited amount per minute. This limit is the transport maximum, Tm.

- Filtered load = plasma glucose concentration × glomerular filtration rate (GFR).
- If the filtered load is below Tm, all of it is reabsorbed and none is excreted.
- If the filtered load is above Tm, the excretion rate = filtered load - Tm.

For one patient, GFR is 100 mL min^{-1} (which is 1.00 dL min^{-1}) and Tm is 375 mg min^{-1}. The patient's blood is sampled at four times.

Plasma glucose (mg dL^{-1})	**200**	**300**	**450**	**600**
Filtered load (mg min^{-1})	200	300	450	600

The samples were taken in the morning.

55 **At what plasma glucose concentration does glucose first appear in the urine?**

A B C D

A. 37.5 mg dL^{-1}
B. 375 mg dL^{-1}
C. 450 mg dL^{-1}
D. 600 mg dL^{-1}

56 **What is the rate of glucose excretion when plasma glucose is 450 mg dL^{-1}?**

A B C D

A. 75 mg min^{-1}
B. 375 mg min^{-1}
C. 450 mg min^{-1}
D. 825 mg min^{-1}

57 **GFR doubles to 200 mL min^{-1} while Tm stays at 375 mg min^{-1}. What is the excretion rate at a plasma glucose of 300 mg dL^{-1}?**

A B C D

A. 0 mg min^{-1}
B. 225 mg min^{-1}
C. 300 mg min^{-1}
D. 600 mg min^{-1}

58 **Why does urine volume rise when glucose is excreted?** (A) (B) (C) (D)

- **A.** Glucose left in the tubule holds water by osmosis, so less water is reabsorbed and more is lost
- **B.** Glucose in the filtrate opens more water channels in the collecting duct, so water leaves faster
- **C.** Glucose raises GFR above normal, so far more filtrate forms than the tubule can handle
- **D.** Excess glucose is converted to water in the tubule cells and added to the urine

Unit 16: Ions left in solution after a precipitation

Questions 59 to 62

A 100 mL sample of 0.10 mol L^{-1} sodium sulfate solution is mixed with 100 mL of 0.20 mol L^{-1} barium chloride solution at room temperature.

$Na_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$

Barium sulfate is insoluble, and the amount that stays dissolved is negligible. The reaction goes to completion and the two volumes may be added.

59 **How many moles of barium sulfate precipitate?** (A) (B) (C) (D)

- **A.** 0.0050 mol
- **B.** 0.010 mol
- **C.** 0.020 mol
- **D.** 0.030 mol

60 **What is the chloride concentration in the final mixture?** (A) (B) (C) (D)

- **A.** 0.050 mol L^{-1}
- **B.** 0.10 mol L^{-1}
- **C.** 0.20 mol L^{-1}
- **D.** 0.40 mol L^{-1}

61 **What is the concentration of barium ions left in the final mixture?** (A) (B) (C) (D)

- **A.** 0.010 mol L^{-1}
- **B.** 0.050 mol L^{-1}
- **C.** 0.10 mol L^{-1}
- **D.** 0.20 mol L^{-1}

62 **Which relationship between the ion concentrations holds in the final mixture?** (A) (B) (C) (D)

- **A.** $[Ba^{2+}] + [Na^+] = [Cl^-]$
- **B.** $[Ba^{2+}] + [Na^+] = 2[Cl^-]$
- **C.** $2[Ba^{2+}] = [Na^+] + [Cl^-]$
- **D.** $2[Ba^{2+}] + [Na^+] = [Cl^-]$

Unit 17: Choosing a steriliser setting for a spore-former

Questions 63 to 65

A laboratory sterilises equipment in a steam steriliser. Species G forms heat-resistant spores. The table gives the time needed to kill all 10^6 spores of G at each of three temperatures. Growing (vegetative) cells of G die within 2 min at 100 °C.

Temperature (°C)	Time to kill all 10^6 spores (min)
100	1200
110	120
121	15

Every load also carries a biological indicator, a strip bearing 10^6 spores of G. After the cycle the strip is placed in broth and incubated. Growth in the broth means spores survived. The steriliser is a bench-top model.

63 **A tool is boiled at 100 °C for 20 min. Which outcome is best supported?**

A B C D

A. All vegetative cells and all spores of G are killed, because 20 min is far longer than 2 min

B. The spores of G are killed but the vegetative cells survive

C. All vegetative cells of G are killed, but spores of G survive

D. Only some vegetative cells of G are killed, because 100 °C is too low to act on cells

64 **A load is held at 110 °C for 60 min. What should the indicator show?**

A B C D

A. Growth, because 60 min is only half of the 120 min needed at 110 °C

B. No growth, because 60 min is much longer than the 15 min needed at 121 °C

C. No growth, because 110 °C is above the boiling point of water

D. No growth, because vegetative cells die in 2 min and the spores have no cells left to grow from

65 **A load is run at 121 °C for 15 min, but the indicator grows. Which interpretation is best?**

A B C D

A. Spores of G are not killed in 15 min at 121 °C, so the times in the table must be wrong

B. The indicator can be ignored, because the machine reached 121 °C and the load is sterile

C. Only vegetative cells survived, so the load is sterile apart from the indicator strip itself

D. The conditions at the indicator did not match the set values, so the load cannot be treated as sterile

Unit 18: An enzyme that needs two groups in the right state

Questions 66 to 68

An enzyme is active only when two side groups are both in their active form: a carboxylate group (conjugate acid pKa 4.0) must be deprotonated, and an imidazole group (conjugate acid pKa 6.0) must be protonated. Activity is proportional to the fraction of molecules that have both groups in the active form.

For a group with a given pKa, at a given pH:

- fraction deprotonated = 1 ÷ (1 + 10^(pKa − pH))
- fraction protonated = 1 ÷ (1 + 10^(pH − pKa))

Relative activity (percentage of the maximum, which is found at pH 5) was measured with substrate in saturating amounts in every assay.

pH	3	4	5	6	7
Relative activity (%)	11	60	100	60	11

66 **What is the main reason activity falls between pH 5 and pH 3?** (A) (B) (C) (D)

A. The imidazole group loses its proton and is no longer in its active form
B. The substrate concentration falls as the solution becomes more acidic
C. Both groups become deprotonated at the same time
D. The carboxylate group becomes protonated and is no longer in its active form

67 **A variant enzyme has its carboxylate pKa at 3.0 and its imidazole pKa at 7.0, with the same rule for activity. What is the best prediction?** (A) (B) (C) (D)

A. The optimum stays at about pH 5, with a broader region of high activity
B. The optimum stays at about pH 5, with a narrower region of high activity
C. The optimum moves to about pH 7, where the imidazole is half protonated
D. The optimum moves to about pH 3, where the carboxylate is half deprotonated

68 **At pH 5, about what fraction of enzyme molecules have both groups in the active form?** (A) (B) (C) (D)

A. 50%
B. 83%
C. 91%
D. 100%

Unit 19: Longer survival and more people with the disease

Questions 69 to 72

A town of 100,000 people has a chronic disease. **Incidence** is the number of new cases arising per 100,000 people per year. **Prevalence** is the number of people per 100,000 who have the disease at one point in time, counting both new and existing cases. When incidence and duration are both steady, prevalence is approximately incidence × average duration of disease in years.

A new drug does not cure the disease but extends survival. It is taken as a daily tablet.

	Before the drug	After the drug
New cases per 100,000 per year	50	50
Average duration of the disease (years)	4	10

69 **After the drug, about how many people per 100,000 have the disease at one time?**

A B C D

A. 50
B. 60
C. 200
D. 500

70 **Which statement best explains why prevalence rises although incidence is unchanged?**

A B C D

A. People live with the disease longer, so more are alive with it at any time though the same number fall ill each year
B. The drug causes extra new cases, so the true incidence has gone up even though the table shows no change
C. Prevalence counts only the newly arising cases, and the drug increases the number of those each year
D. Incidence is given per 100,000 and prevalence per person, so the two figures cannot be compared with each other

71 **A health planner wants to know (i) how many people need ongoing care and (ii) how quickly people are newly falling ill. Which measures answer these?**

A B C D

A. Prevalence for (i) and incidence for (ii)
B. Incidence for (i) and prevalence for (ii)
C. Prevalence for both (i) and (ii)
D. Incidence for both (i) and (ii)

72 **Town Y has 20 new cases per 100,000 per year and an average duration of 25 years. Compared with the town after the drug, Town Y has:**

A B C D

A. a higher prevalence and a lower incidence
B. a lower prevalence and a lower incidence
C. the same prevalence but a lower incidence
D. the same prevalence and the same incidence

Unit 20: Density and repeated readings

Questions 73 to 75

A student finds the density of a steel cylinder from its mass, 25.4 g (three significant figures), and its volume, 3.2 mL (two significant figures). In a product or quotient, the result has as many significant figures as the least precise value used.

A second student tests two length-measuring instruments, X and Y, on a rod whose true length is 10.00 cm. Accuracy is how close a reading is to the true value. Precision is how close repeated readings are to one another.

Instrument	Readings (cm)
X	9.1, 9.2, 9.1
Y	9.9, 10.2, 9.8, 10.1

73 **What is the density of the cylinder, reported correctly?**

A B C D

A. 7.9 g mL^{-1}
B. 7.938 g mL^{-1}
C. 7.94 g mL^{-1}
D. 8 g mL^{-1}

74 **Which description of the two instruments is correct?**

A B C D

A. X is accurate but not precise; Y is precise but not accurate
B. Both are accurate, because every reading lies within 1 cm of the true length
C. X is precise but not accurate; Y is accurate but less precise
D. Y is both accurate and more precise than X, because its mean is exactly 10.00 cm

75 **The maker of X supplies a correction that adds 0.9 cm to every reading. What is the effect on instrument X?**

A B C D

A. Its accuracy improves and its precision is unchanged
B. Both its accuracy and its precision improve
C. Its accuracy is unchanged and its precision improves
D. Its precision worsens, because the readings now differ more from the original values

Answer key: Section 1

Click a number to jump to its explanation.

1. B	12. C	23. B	34. C	45. C	56. A
2. D	13. D	24. C	35. A	46. D	57. D
3. A	14. A	25. A	36. B	47. B	58. C
4. A	15. B	26. A	37. D	48. A	59. B
5. C	16. A	27. D	38. C	49. C	60. A
6. D	17. C	28. B	39. C	50. D	61. C
7. B	18. C	29. C	40. A	51. D	62. D
8. B	19. B	30. D	41. B	52. B	
9. C	20. D	31. D	42. D	53. A	
10. A	21. A	32. A	43. A	54. C	
11. D	22. D	33. B	44. B	55. B	

Answer key: Section 3

Click a number to jump to its explanation.

1. A	14. D	27. B	40. B	53. A	66. D
2. D	15. C	28. C	41. C	54. C	67. A
3. C	16. C	29. C	42. B	55. B	68. B
4. D	17. B	30. D	43. A	56. A	69. D
5. D	18. A	31. B	44. B	57. B	70. A
6. B	19. A	32. C	45. C	58. A	71. A
7. C	20. D	33. A	46. A	59. B	72. C
8. C	21. B	34. D	47. B	60. C	73. A
9. B	22. B	35. D	48. A	61. B	74. C
10. D	23. B	36. C	49. B	62. D	75. A
11. D	24. C	37. D	50. B	63. C	
12. B	25. D	38. D	51. D	64. A	
13. A	26. C	39. B	52. A	65. D	

Explanations: Section 1

Click a number to jump back to its question.

Unit 1: Human life and its conditions

1. B: The writer says our sorrows are "the natural results of natural causes" that can be removed once the causes are found, and then sets out three kinds of condition that shape us. Option A is the view the passage rejects ("so far from being inscrutable problems"). Option C overreads the claim about the ascetic: the will can "resist them for a while, and sometimes overcome them". Option D reverses the final claim that the social environment acts on us more strongly than it does on even the most gregarious animals.

2. D: The ascetic is offered as proof of "the power of the individual will to resist natural law", but the writer then calls such cases "exceptions" that stand against "the general course of life". Option B contradicts the text, which says the will is "misdirected by the ill-informed intelligence" in such a case. Options A and C give the ascetic a purpose, escape or economic cause, that the passage never states.

3. A: The word is set against "exceptions": the will can resist conditions only for a while and in rare cases, so the general effect is one that cannot be turned aside. Option C adds harm, but the writer says that once the causes are known "we can do much to remove" our sorrows. Option B contradicts the sense of force that the contrast with the will requires. Option D confuses how hard an effect is to see with how hard it is to resist.

Unit 2: A night crossing and a morning departure

4. A: After landing the speaker passes "a mile of warm sea-scented beach" and "three fields to cross till a farm appears". Option B has the order wrong: the waves "leap in fiery ringlets from their sleep" as the prow arrives and do not settle. Option C misplaces the match: its scratch and spurt are heard after the speaker taps at the pane, so it is struck inside. Option D keeps the speaker at sea after the boat has already gained the cove.

5. C: Poem 1 closes on "the two hearts beating each to each", an image of closeness reached after the journey. Poem 2 closes on "the need of a world of men for me", a claim from outside the personal that draws the speaker on. Option A attributes fear to Poem 1 and pure joy to Poem 2, although neither poem names those feelings. Option B invents a quarrel and a reconciliation. Option D ignores that Poem 1 ends on land, at a farm.

6. D: The closing comparison sets a quiet voice against two heartbeats. After wide images of sea, moon and shore, the last image is small and close, so what the speaker feels counts for more than where the speaker is. Option A misreads "joys and fears": the line says the voice speaks through those feelings, not that the speaker wants to turn back. Option B imports anger that no word in the poem supports. Option C contradicts the voice, which is heard.

Unit 3: A mole leaves his spring-cleaning

7. B: Spring penetrates even his little house "with its spirit of divine discontent and longing", and the narrator adds "It was small wonder, then, that he suddenly flung down his brush". Option A takes a later event, the rabbit at the hedge, as the cause of something that happens before it. Option D mistakes a result of the cleaning for the reason he stops. Option C invents a shortage that the passage never mentions.

8. B: A "carriage-drive" for a mole is a humorous overstatement: the narrator dresses a steep little tunnel in the language of a country house. Option C reads "nearer to the sun and air" as a measure of wealth, but the rabbits who appear later are shown as foolish, not grand. Option A reads shame into "lowly", which describes the house, whereas the Mole is delighted to leave it. Option D finds a danger that the passage does not mention.

9. C: Each rabbit blames another for not having thought of a reply, "in the usual way", and the narrator generalises: it is "always the case" that the reply comes too late. The tone is gently teasing. Option A treats a passing squabble as a lasting split. Option B invents a plan against the Mole, who has already gone. Option D contradicts the text, in which the Mole is "gone before they could think of a thoroughly satisfactory reply".

Unit 4: Youth and total unemployment in Germany and Spain

10. A: The rate exceeds 40 per cent from 2010 (41.5) to 2016 (44.4), which is seven years, and falls to 38.6 in 2017. Option B drops one of the opening years, for example by starting the count at 2011. Option C counts 2017, whose value of 38.6 is below 40. Option D counts only the years above 45.

11. D: Spain's 2025 youth rate is 24.9, while the highest German total rate shown is 6.6 (2010), so the statement holds. Option A confuses a rate with a count: a rate is a share of the labour force, and the table gives no numbers of people. Option B is false, since the German youth rate never exceeds 10.5 and the Spanish rate never falls below 24.9. Option C is false: the Spanish total rises in 2011 (19.9 to 21.4) and in 2020 (14.1 to 15.5).

12. C: The key defines b as a break in time series, meaning the values on either side of the break may not be measured in the same way, so the size of the rise from 2019 to 2020 cannot be taken at face value. Option A confuses the flag with a provisional flag, which the table does not use. Option B guesses a direction for the error, which a break does not give. Option D contradicts the column heading, which fixes the age group for every year.

Unit 5: A quarrel over omens at a birth

13. D: Glendower says "The front of heaven was full of fiery shapes" and that the Earth "Shaked like a coward". Option C comes from Hotspur's mockery, who says the Earth would have shaken the same way "if your mother's cat had but kitten'd". Option B invents a comet and a prophecy. Option A names a storm and a ruined castle, neither of which appears in the speech.

14. A: Hotspur says nature "oftentimes breaks forth / In strange eruptions", so the shaking at the birth had an ordinary cause and marks nobody out. Option B takes his sarcasm at face value: "the Earth shook to see the heavens on fire, / And not in fear of your nativity" is a rejection of Glendower's claim. Option D mixes up the Earth's colic with the mother. Option C finds a show of learning that the speech does not aim at, since Mortimer later tells Hotspur to stop.

15. B: Glendower says the signs "have mark'd me extraordinary" and that he is "not in the roll of common men", and he claims he can "call spirits from the vasty deep". Option D is contradicted by his anger: "I do not bear these crossings". Option A reverses his insistence on the signs. Option C turns his reply to Hotspur into worry about Mortimer, who speaks only to calm Hotspur.

16. A: Hotspur takes "Bootless" to mean "without boots" and pictures the king trudging home in the rain, which makes the victory sound foolish. Option D calls the pun a misunderstanding, but the scene shows him mocking Glendower throughout ("tell truth, and shame the devil"). Option B reads the echo as praise. Option C finds sympathy for the king that the comic picture does not express.

Unit 6: On travelling hopefully

17. C: The sentence sets "to travel hopefully" above "to arrive" and says "the true success is to labour", so the effort is valued above the arrival. Option B states the opposite view. Option D promises an arrival that the sentence never guarantees. Option A takes "travel" literally and adds a claim about comfort that the sentence does not make.

18. C: Blessedness means good fortune, and the "for" that follows gives the reason: those still travelling and labouring hold what the writer calls the better state. Option A reads the opposite into the clause, treating the unfinished journey as a failure. Options B and D supply faults, ignorance or pride, when the clause is a gentle reminder of something valuable that the readers already have.

Unit 7: A lawyer introduces himself

19. B: The narrator says "no materials exist for a full and satisfactory biography" and that what he knows is "What my own astonished eyes saw of Bartleby", apart from one vague report. Option A reverses this, since the narrator says "nothing... has ever been written" about scriveners. Option C confuses Bartleby with the narrator's thirty years of work among copyists. Option D invents an autobiography.

20. D: The grand wording is out of proportion to the subject, a copyist about whom little is known, and so it shows the narrator's self-importance and a touch of humour. Option A takes the claim at face value. Option B finds a quarrel with copyists, whom the narrator treats as an "interesting" set of men. Option C invents an admission about his reading.

21. A: He admits that he loves to repeat the name because it "rings like unto bullion", and says he "was not insensible" to Astor's good opinion, which reveals how much he prizes the approval of a rich man. Option B turns a source of pride into a limit on his work. Option C depends on events outside the excerpt, which cannot be judged from it. Option D reverses the tone: he is pleased, not resentful.

Unit 8: System alert levels

22. D: Level 3 needs the rate to last at least 5 minutes, and 4 minutes is short of that, so no condition applies. Option A would be right at 5 minutes. Option B needs a rate of 5 per cent or a Level 3 condition lasting 60 minutes. Option C needs Level 2 and payments affected.

23. B: The Level 3 condition has lasted 60 minutes, and the Level 2 rule counts a Level 3 condition that has lasted "at least 60 minutes", so the alert rises to Level 2. Option A stops at the Level 3 condition and ignores the time rule. Option C needs payments to be affected. Option D ignores that 1.0 per cent for 5 minutes is already enough for Level 3.

24. C: A rate of 5 per cent for at least 5 minutes gives Level 2, and during a maintenance window Level 2 is reported as Level 3. Option B ignores the window. Option D needs payments to be affected. Option A treats the window as hiding the alert altogether, whereas it only lowers the reported level.

25. A: Statement I is false because the window changes Level 2 and Level 3 only, and Level 1 is not changed. Statement II is true: 0.5 per cent is under the 1 per cent needed for Level 3, so neither the time rule nor the payments rule can apply. Statement III is true: Level 2 applies and payments are affected, so Level 1 holds with or without the window. Options B, C and D each accept statement I.

Unit 9: A sonnet about evening

26. A: The tired world "craves / For the great night", which comes "With draught of healing" and "blessed rest that recreates and saves". Option B picks up "haunting the shadows" and "hunted", but the moon is "strange and still", the bird's note is "plaintive", and nothing in the poem is a danger. Option C supplies regret, which no line expresses. Option D treats dusk as an empty gap, whereas the poem fills it with sound and light.

27. D: The second part adds the whip-poor-will's "plaintive note" and the night-hawk that "whirrs athwart the dark", then closes on the moon coming "Over the waters". Option A reads "Far" as a journey in memory, but the scene stays in the present. Option B contradicts the mood, since the moon is "strange and still". Option C asks for a reason the poem never gives; it only reports the bird's cry.

28. B: Night "cometh brooding in" like a slow, covering presence, and the same sentence gives it a "draught of healing" and "blessed rest". "Swoon" adds a dreamy hush to the moon. Option A takes "brooding" in its gloomy sense and ignores the healing. Option C ignores the slow movement of "cometh" and "comes". Option D adds noise and festivity where the poem has "still" and a plaintive cry.

Unit 10: A letter sent with a new book

29. C: Darwin writes: "I have not seen one naturalist for six or nine months, owing to the state of my health, and therefore I really have no news to tell you." Option A is contradicted by his remark "God knows when I shall have strength for my bigger book". Option B conflicts with the letter, which reports what he has heard from Hooker and from Slater. Option D reverses the travellers: it is Wallace who is abroad.

30. D: Darwin has just said that Wallace has "thought so profoundly on the subject, and in so nearly the same channel with myself", so he expects little to be new to Wallace. Option A turns modest courtesy into a low opinion of his own work, which the letter contradicts by asking Wallace for his "general impression of the book". Option C is contradicted by his request to "hear your general impression". Option B invents a request for secrecy.

31. D: Naming one convert and wishing for another shows that he counts support person by person, among men he respects ("the real judges, as Hooker, Lyell, Asa Gray"). Option A is contradicted by "God knows what the public will think" and by his doubts about Lyell. Option B finds a money motive that the letter never mentions. Option C confuses Wallace's paper, which was read at the Linnean Society, with reviews of the book.

Unit 11: A preface about writing a colonial history

32. A: The writer says that of the many books about the Islands he knows "of none which does what is aimed at in this volume", and that he would not have attempted it "had any short descriptive history of the colony... been available". Option B conflicts with the complaint against books that are "an official advertisement". Option C turns the readers' wish for a history into a wish for a guide. Option D invents a withdrawal; the earlier sketch was revised and built into the book.

33. B: The three kinds are introduced as what readers "complain" that they find, set against the history they ask for, "written simply and concisely by a writer who has made a special study of his subject". Option C reverses the tone from complaint to praise. Option D contradicts the opening claim that a growing minority takes "a quickening interest" in the Colonies. Option A is not supported: the writer says only that he revised a short sketch of his own.

34. C: The writer says "I have lived in New Zealand... it is my country", yet calls the book "less full than I should have liked" and himself "an unknown writer". Option A contradicts the first claim. Option B is ruled out by the complaint against the "official advertisement". Option D ignores the goodwill shown to the readers, whose "quickening interest" the writer welcomes.

Unit 12: Two poems about birds in flight

35. A: Poem 1 addresses "thou" and ends with the lesson that the Power who guides the bird "Will lead my steps aright". Poem 2 speaks of the birds as "them", watches their movements and draws no moral. Option B swaps the two poems. Option C invents fear in Poem 1, where the speaker is moved and reassured. Option D confuses the "fowler", who is named as a danger to the bird, with the speaker.

36. B: The Power's "care" teaches the bird its way on a "pathless" coast, and the next line calls the bird "Lone wandering, but not lost". Option D contradicts that line directly. Option A removes the Power, which the stanza puts first. Option C turns the fowler of the previous stanza into a guide, although he is only a threat that "Might mark thy distant flight to do thee wrong".

37. D: Poem 2 closes with the birds that "Swirl round and sweep away", an image with no conclusion drawn. Poem 1 closes with the speaker's hope that the guiding hand "Will lead my steps aright". Option C swaps the two endings. Option A reverses them in a different way: it puts a prayer in Poem 2 and a description in Poem 1. Option B has Poem 2 warn the birds, but the speaker does not speak to them at all, and Poem 1 asks its questions at the start, not the end.

Unit 13: Average hourly earnings in the United States

38. C: The all employees figure is 30 dollars or more from December 2021 (31.39) to December 2025 (37.02), which is five Decembers. Option B counts December 2020, whose figure of 29.91 is just below 30. Option A leaves out one of the five years. Option D counts only the Decembers above 33 dollars.

39. C: The all employees figure rose by 37.02 minus 25.25, which is 11.77 dollars, and the other figure by 31.83 minus 21.23, which is 10.60 dollars. Since 21.23 × 1.5 is about 31.85, the second figure rose by just under 50 per cent, whereas 25.25 × 1.5 is about 37.9, well above 37.02, so the first rose by clearly less. Option A is right about dollars and wrong about percentages. Options B and D are wrong about dollars.

40. A: The table is in current dollars and gives no prices, so it cannot show what an hour of pay buys. Options B, C and D can each be checked against the columns: the first column is higher in every row, both columns rise in every row, and the last value is 37.02.

Unit 14: A husband asks after his household

41. B: After every report Orgon asks "And how about Tartuffe?" and answers each reply with "Poor man!". He never asks about the fever, never calls a doctor and gives no order about his wife, which rules out Options A, C and D.

42. D: Madam has a fever, nausea and a sleepless night, while Tartuffe is "stout, fat, fair, rosy-lipped", eats two partridges and sleeps soundly, yet Orgon cries "Poor man!" each time. His pity goes to the one who is well. Option B ignores that Tartuffe is described as thriving. Option C supposes a hidden worry for which the scene gives no sign: he never refers to his wife. Option A invents a journey and a tiredness.

43. A: Each round sets a worsening account of Madam against a cheerful account of Tartuffe, and Orgon's unchanging reply makes the gap funnier and his blindness plainer. Option B reverses the roles: Dorine answers fully each time. Option C confuses stage delay with a change in Madam, who has already recovered ("both are doing well"). Option D finds a threat to Tartuffe that the text contradicts, since he is in robust health.

Unit 15: On lost time

44. B: The saying ends "what we call time enough, always proves little enough": the time people believe they have turns out to be too little. Option C contradicts the first clause, "Lost time is never found again". Option D reverses the point that delay leads to shortage. Option A describes how time feels, which the saying does not discuss.

45. C: The writer treats the days remaining as "time enough" and then finds them too few, which matches "what we call time enough, always proves little enough". Option A is the opposite case, where time is used early. Option B shows time in surplus, not shortage. Option D is about a lost object, not lost time.

Unit 16: A man describes his own spite

46. D: He says "I refuse to consult a doctor from spite" and admits that "by all this I am only injuring myself and no one else". Option B is contradicted by his statement that he has "a respect for medicine and doctors". Option C conflicts with his belief that his liver is diseased. Option A introduces a money problem that the passage never mentions.

47. B: He explains that he wrote the line "thinking it would sound very witty", has since seen that he "only wanted to show off in a despicable way", and keeps it "on purpose". He sees his vanity and displays it anyway. Option C reverses his judgment of the joke. Option A treats the line as a draft to be mended, though he refuses to change it. Option D has him concealing, when he is confessing.

48. A: Scaring sparrows is noisy and harmless, and he places the image beside his admission that he was "not even an embittered man", so his spite was show rather than real malice. Option C contradicts "at random". Option B reverses the image, since sparrows are small and weak. Option D takes the office as the cause, but the narrator explains his spite as part of his own character, not the job.

49. C: He admits that he was "inwardly conscious with shame" that even at the height of his spleen he was "simply scaring sparrows", so the spite he announces was more display than feeling. Option A makes the later statement a cover-up, when it is a confession. Option B ignores that he writes in the present tense "I am a spiteful man". Option D misreads the passage: the sentence is about himself.

Unit 17: A sonnet about envy and consolation

50. D: The speaker begins "in disgrace", weeping over an "outcast state" and cursing fate, then thinks of the loved one and ends scorning to "change my state with kings". Option A reverses the direction of the feeling. Option C gets the envy right but treats it as the end point, when the envy ("Wishing me like to one more rich in hope") comes early and is overcome. Option B invents anger at friends.

51. D: The lark rises from "sullen earth" to sing at "heaven's gate", and the comparison follows directly on "Haply I think on thee", so it pictures the speaker's mood rising from gloom to joy. Option C takes only the freedom of a bird and misses the contrast between earth and heaven. Option B reads the dawn as a journey. Option A treats the lark as singing at night, when it rises at "break of day".

52. B: The "wealth" is brought by "thy sweet love remember'd", so it is the value of being loved, which the speaker rates above a king's position. Option D picks up "this man's art" from the sixth line, but there the speaker is envying other people's skill, not receiving praise. Option C reverses the sense, since the poem opens on failure. Option A takes "wealth" as money, which the final line sets aside.

Unit 18: A report on an election campaign

53. A: The writer reports that "the voters generally give as a reason for their refusal that they are under obligations to me", so the refusals advertise his own support. Option B and Option D report events that the letter does not mention. Option C is a plausible benefit of an early start, but the writer says that he means to begin his own canvass on a fixed day and gives the voters' answers as the reason.

54. C: The "if" clause names a verdict as absurd as saying that the sun does not shine at noon, so "certainly" is ironic: only an absurd jury would let Catiline stand. Option B takes "certainly" at face value and invents his popularity. Option A makes the sentence a plain report. Option D reads the comparison as a literal forecast about the weather.

Unit 19: On praising the dead

55. B: Johnson argues that "nothing can be stiled excellent till it has been compared with other works of the same kind", and comparison over many years is the only test left for works that cannot be demonstrated. Option C overstates his remark that a living author is judged by his worst performance, which he gives as a habit of critics and not as his reason. Option A repeats an attitude he criticises, that some people admire "whatever has been long preserved". Option D confuses the contrast he draws, since works that can be demonstrated do not need time.

56. A: The scale "was at once discovered to be perfect", whereas Homer's standing is known only because "nation after nation, and century after century" has failed to rise above it. The pair sets instant proof against slow judgment. Option B overreads the claim: Johnson says only that later writers have done "little more than transpose his incidents". Option C reverses the point, which is that poetry does not admit demonstration. Option D asserts a date that the passage does not give.

Unit 20: The UK households saving ratio

57. D: The ratio is below 6 in 2017 (5.6), 2018 (5.6), 2019 (5.8) and 2022 (5.1), which makes four years. Option A leaves out 2019, whose 5.8 is only just under 6. Option B adds a year such as 2023, whose 6.7 is above 6. Option C counts two years more than the table allows.

58. C: The table gives a percentage and no amounts, so a higher share could go with a smaller amount if the income it is a share of had changed. Option A treats a ratio as an amount. Option D is false, since the ratio rose from 5.8 to 16.6. Option B objects to coverage, but the claim is about "any other year shown", and the problem is the kind of measure.

Unit 21: Should people be paid when companies use their personal data?

59. B: Comment 4 says that a small payment matters more to someone on a low income, so the people who need money most would be most willing to give up their privacy. Option A (Comment 2) warns about risk to everyone who sells. Option C (Comment 5) argues for limits on collection. Option D (Comment 3) concerns how hard it is to set a price.

60. A: Comment 3 says that no one has found a fair price for a single person's data, and Comment 7 says that people cannot follow their data from company to company. Option C swaps the two difficulties. Option B gives Comment 3 the argument of Comment 6 and Comment 7 the argument of Comment 4. Option D gives Comment 3 the point of Comment 8 and Comment 7 the point of Comment 5.

61. C: Comment 3 says that one person's data is worth little alone and a great deal in a large collection, and Comment 8 proposes a body that acts for a whole group, so the terms would be set for the collection and not for each person. Option A (Comment 1) supports payment without saying how to price it. Option B (Comment 5) replaces payment with limits. Option D (Comment 2) is a further objection to payment.

62. D: Comment 2 says that a price would lead people to sell data without thinking about the risks, which is the reverse of taking better care. Option A (Comment 1) supports payment on grounds of fairness. Option B (Comment 6) is about the cost of paying for each use in research. Option C (Comment 8) suggests a way to organise payment and does not address care.

Explanations: Section 3

Click a number to jump back to its question.

Unit 1: Ranking five ionic solids by lattice energy

1. A: The distance between ion centres is the sum of the two radii, so MgO gives 70 + 140 = 210 pm, the smallest of the four. Option C is tempting because F^- has the smallest anion radius (130 pm), but Na^+ is much larger than Mg^{2+} and the sum for NaF is 230 pm. Option D is the longest distance in the group, not the shortest.

2. D: Both solids have a 1+ cation and a 1- anion and share the same anion, so only the cation radius differs: 140 pm for K^+ against 100 pm for Na^+. The larger separation (320 pm against 280 pm) gives the weaker attraction and the lower lattice energy. Option A changes a charge that is the same in both. Option B changes the anion, which is Cl^- in both. Option C reverses the effect of size on charge density.

3. C: MgO gives (2 × 2) ÷ 210 and NaF gives (1 × 1) ÷ 230, so the ratio is 4 × 230 ÷ 210, a little over 4. The table agrees: 3800 ÷ 920 is about 4. Option A compares only the distances and ignores charge. Option B counts only the cation charge (2 against 1) and forgets that O^{2-} is also double the charge of F^-. Option D applies the charge ratio of 4 twice.

4. D: CaO has a much larger lattice energy than NaCl (3400 against 790 kJ mol^{-1}), so a higher melting point is a sensible inference, but it remains an inference because no melting points are listed. Option A confuses lattice energy, which is the energy to reach gaseous ions, with the energy to melt. Option B ignores the different anions and the charge on Ca^{2+}; the separations are 240 pm and 280 pm. Option C reverses the link between separation and attraction.

Unit 2: Counting RNA primers in one replication bubble

5. D: The stem states that polymerase adds nucleotides only to a 3′ hydroxyl that already exists, which is why primase supplies a primer. Option A claims RNA templates are required, but the strand being copied here is DNA. Option B reverses the direction of synthesis given in the stem. Option C gives unwinding to the polymerase, a job done by other enzymes at the fork.

6. B: Each fork copies 6,000 base pairs in fragments of 1,000 nucleotides, so 6,000 ÷ 1,000 = 6 fragments, one primer each. Option A is the leading strand primer alone. Option C adds the leading primer to the lagging ones, which gives the total for the fork but not for the lagging strand. Option D doubles the count to cover both forks.

7. C: Each fork needs 6 primers for the lagging strand and 1 for the leading strand, which is 7. Two forks give 14. Option A stops at one fork. Option B counts only the lagging primers at two forks (6 × 2) and drops both leading primers. Option D counts the leading primer and each lagging fragment twice.

8. C: Every new strand, leading or lagging, needs a primer to give polymerase a free 3′ hydroxyl, so without primase no synthesis can begin. Option A wrongly treats the leading strand as primer-free, but the stem says it starts from a single primer. Option B lets the first fragment form, which also needs a primer. Option D gives polymerase a property that the stem rules out.

Unit 3: Which collision outcomes are possible?

9. B: Cart 2 is at rest, so the total is the momentum of cart 1: 2.0 × 3.0 = 6.0 kg m s^{-1}. Option C is the initial kinetic energy in joules (½ × 2.0 × 3.0^2), not a momentum. Option A is the speed of cart 1. Option D uses mv^2 instead of mv.

10. D: In P the momentum is 2.0 × 1.0 + 1.0 × 4.0 = 6.0 kg m s^{-1} and the kinetic energy is 1.0 + 8.0 = 9.0 J, both equal to their initial values. Option A describes a perfectly inelastic collision, where kinetic energy is lost (6.0 J remains). Option B gives cart 2 too much kinetic energy. Option C uses a test, conserved momentum, that every outcome passes.

11. D: In R the momentum is 6.0 kg m s^{-1}, as required, but the kinetic energy is ½ × 1.0 × 6.0^2 = 18 J, twice the 9.0 J the carts started with, and nothing supplies the extra energy. Option A is a claim the stem does not support; a cart can stop in a collision. Option B is wrong because Q conserves momentum (2.0 × 2.0 + 1.0 × 2.0 = 6.0). Option C compares speeds, not energies, and the elastic outcome P does give cart 2 a higher speed.

12. B: In Q the final kinetic energy is ½ × 2.0 × 2.0^2 + ½ × 1.0 × 2.0^2 = 4.0 + 2.0 = 6.0 J, so 3.0 J of the 9.0 J is lost, which is one third. Option A describes an elastic collision, which is outcome P. Option C would leave 4.5 J, but the carts retain 6.0 J. Option D gives the fraction that remains, not the fraction lost.

Unit 4: When a Grignard reagent destroys itself

13. A: The two that work carry no proton more acidic than an alkane C-H: 1-bromopropane has only C-H bonds, and 4-bromoanisole has an ether oxygen with no O-H. The O-H of 2-bromoethanol and the CO_2H of 4-bromobenzoic acid are both far more acidic than pKa 50. Option B is the two that fail. Option C pairs a working bromide with the alcohol. Option D pairs the acid with the ether.

14. D: With an O-H of pKa 16 and the carbanion equivalent of a pKa 50 conjugate acid, the strong base takes the proton at once and the reagent is lost as an alkane-type product. Option A is an unsupported claim; nothing in the stem says magnesium cannot insert. Option B reverses the acidity order given in the stem. Option C invents a competing reaction with formaldehyde that the stem does not describe.

15. C: Water is a far stronger acid than propane, so the carbanion-like propyl group takes a proton and becomes propane. Option A would need the oxygen of water to bond to carbon, which is not what a strong base does. Option B is the product of adding formaldehyde and acid, not of water. Option D would need two propyl groups to join, which is not a step in the stem.

Unit 5: Mice missing parts of antigen presentation

16. C: The table shows "No" for the strain lacking MHC class I and for the one lacking CD8 T cells, both parts of the cytotoxic pathway. Option A lists the two strains that cleared the virus. Options B and D each pair one strain that failed with one that succeeded.

17. B: Antibody production needs helper T cells acting through MHC class II, and the table gives "None" for exactly those two strains. Option A lists the strains that made high antibody. Option C pairs a defect that makes no antibody with one that leaves antibody high. Option D does the same with the CD8 strain.

18. A: Without TAP, peptides cannot be loaded onto MHC class I, so CD8 T cells cannot recognise infected cells and clearance fails, as in the MHC class I and CD8 strains. MHC class II presentation is untouched, so helper T cells still work and antibody is high. Option B gives the outcome of a defect in the class II route. Option C loses both functions. Option D predicts normal mice.

19. A: Both defects give the same result, so the table cannot say which part of the pathway does the killing. Option B is true of the data but does not show that MHC I kills. Option C treats a second matching result as ruling out the cells. Option D wrongly generalises from class II to class I, which the stem assigns to a different role.

Unit 6: Four runs of marble chips in acid

20. D: Runs A and B differ only in the form of the solid (lumps against powder), so any change in rate is due to surface area. Option A changes the acid concentration alone and so tests concentration. Option B changes temperature alone. Option C changes both concentration and temperature at once, so it cannot isolate either.

21. B: $CaCO_3$ is 0.050 mol and needs 0.10 mol HCl, which is exactly the 0.10 mol in 100 mL of 1.0 mol L^{-1} acid. Both are used up and 0.050 mol of CO_2 forms: 0.050 × 24 = 1.2 L, or 1200 mL. Option A halves that amount. Option C counts one CO_2 for every HCl (0.10 mol). Option D doubles that again.

22. B: Run C holds 0.20 mol HCl against 0.050 mol $CaCO_3$, so the carbonate limits and 0.050 mol of CO_2 forms, the same as in run A where the acid was exactly enough. Option A treats a doubled concentration as a doubled yield. Option C invents a loss of gas that the set-up does not describe. Option D treats the excess acid as if it partly reacted, but no more $CaCO_3$ is left to react.

23. B: Equal rates tell us only that the two changes produced the same size of effect in this experiment. One change raises the number of acid particles per volume and the other raises the energy of collisions, so the cause differs. Option A treats equal outcomes as proof of an equal cause. Option C contradicts the table, where run C (20 mL min^{-1}) is twice run A (10 mL min^{-1}). Option D invents a surface-area mechanism, and surface area is the same in runs C and D.

Unit 7: Blood groups in two populations

24. C: Group O is the genotype ii, so its expected frequency is $r^2 = 0.7 \times 0.7 = 0.49$. Option D reports the allele frequency r without squaring it. Option A uses r(1 - r), which is not a genotype frequency. Option B halves the allele frequency.

25. D: Group A includes both I^AI^A and I^Ai, so the frequency is $p^2 + 2pr = 0.04 + 0.28 = 0.32$. Option A counts only I^AI^A and option C only I^Ai, each leaving out a genotype. Option B reports the allele frequency of I^A, which is not the frequency of the phenotype.

26. C: AB is the heterozygote I^AI^B, so its frequency is $2pq = 2 \times 0.2 \times 0.1 = 0.04$. Option B leaves out the factor of 2, which counts the two ways to receive the alleles. Option A is q^2, the frequency of I^BI^B. Option D adds the two allele frequencies.

27. B: O is $r^2 = 0.64$, so r = 0.8. Groups A and O together are $(p + r)^2 = 0.81$, so p + r = 0.9 and p = 0.1. Groups B and O together give q = 0.1. Then $2pq = 2 \times 0.1 \times 0.1 = 0.02$, which equals the observed AB. Option A borrows the expected value from the other population. Option C treats the remainder as AB, but A and B also take shares. Option D is wrong because the genotype frequencies in the stem already cover three alleles.

Unit 8: How much does the eye change its power?

28. C: For a distant object $1/d_o$ is zero, so P = 1/0.020 = 50 D. Option A leaves out the image term, as if distant objects needed no focusing. Option B uses the image distance itself instead of its reciprocal. Option D is the power needed for an object at 0.25 m.

29. C: The extra power is the new object term, 1/0.25 = 4.0 D, because the image term stays at 50 D. Option D is the total power, not the increase. Option A treats the distance in metres as if it were a power. Option B is the increase for an object at 0.50 m.

30. D: The power rises from 50 D to 52 D, so f = 1/P falls from 1/50 = 20.0 mm to 1/52, about 19.2 mm. Option A reverses the direction; 20.8 mm would be 1/48 D, a lower power. Option B confuses a fixed image distance with a fixed lens. The lens changes shape, and its power changes with it. Option C mistakes the object distance for the focal length.

31. B: The extra power equals $1/d_o$ for the nearest object, so $d_o = 1/2.0 = 0.50$ m. Option A uses the 4.0 D of a young reader. Option C doubles the answer instead of taking the reciprocal. Option D reads 2.0 D as 2.0 m.

Unit 9: Making and breaking an ester, with an oxygen label

32. C: All species share one volume, so the volume cancels. With x mol of ester and water, $K = x^2 \div (1 - x)^2 = 4$, so $x \div (1 - x) = 2$ and x = 2/3, about 0.67 mol. Option B corresponds to K = 1. Option D solves $x \div (1 - x) = 4$, forgetting to take the square root. Option A reports the amount of acid left, not the ester.

33. A: The ^{18}O sits in the alkoxy oxygen. The bond that breaks is carbonyl carbon to alkoxy oxygen, so the labelled oxygen leaves still attached to the ethyl group and becomes the O-H of ethanol. Option B would need the acyl C-O bond to be the one retained. Option C assumes the label moves between the fragments. Option D treats the oxygen as exchanging with solvent, which the stem does not describe.

34. D: The hydroxide oxygen attacks the carbonyl carbon and stays on the acyl side when the C-O bond to the alkoxy group breaks. It ends up in the ethanoate, while the ethanol keeps its original oxygen. Option A is run B turned round. Option B spreads the label with no step to do so. Option C ignores that the hydroxide ends up bonded to carbon.

35. D: In base the acid product is deprotonated to ethanoate, which is no longer an acid able to esterify, so nothing remains to feed the reverse reaction. Option A treats a catalyst as changing K, but a catalyst changes the rate, not the equilibrium constant. Option B suggests a limit that no amount of water can reach. Option C brings in an isotope effect that is far too small to account for a complete reaction.

Unit 10: Enlarged ventricles in three patients

36. C: Fluid backs up in the lateral and third ventricles, but the fourth stays normal, so the block lies between the third and fourth ventricles. Option A would leave the third ventricle normal. Option B would enlarge all three ventricles, as in patient 2. Option D would be a production defect, which fits patient 3 and would not spare the fourth ventricle.

37. D: Patient 2 makes the normal 500 mL per day but reabsorbs only 250, a reabsorption fault. Patient 3 makes 1000 mL, double the normal amount, while reabsorbing the normal 500, a production fault. Option A swaps the two patients. Option B fails on patient 3, whose reabsorption is normal. Option C ignores the CSF figures, which are the difference between them.

38. D: The daily gain is the amount made minus the amount reabsorbed: 1000 - 500 = 500 mL for patient 3 and 500 - 250 = 250 mL for patient 2. Option A uses the amount made for patient 3 without subtracting reabsorption. Option B gives both patients the same gain, which is the amount made in patient 2. Option C adds the amount made and the amount reabsorbed for patient 2 instead of subtracting.

Unit 11: Identifying a metal from the hydrogen it releases

39. B: Convert the volume to litres first: 112 mL is 0.112 L, and $0.112 \div 22.4 = 0.0050$ mol. Option D gives 5.0 mol, which divides 112 by 22.4 without converting millilitres to litres. Option C is ten times too large and option A ten times too small.

40. B: If M is in group 1, 0.0050 mol of H_2 comes from 0.0100 mol of M, so the molar mass is $0.23 \div 0.0100 = 23$ g mol^{-1}, which is sodium. A group 2 metal would give 0.0050 mol of M and a molar mass of 46 g mol^{-1}, which matches no metal in the table. Option D (calcium) is the nearest group 2 value but 46 is not 40. Options A and C would need only 0.070 g and 0.39 g for the same hydrogen.

41. C: Each mole of H_2 comes with 2 mol of OH^-, so 0.0050 mol of H_2 means 0.0100 mol of OH^- in 1.00 L. Then $[OH^-] = 1.0 \times 10^{-2}$ mol L^{-1} and $pH = 14 + \log(10^{-2}) = 12.0$. Option A reports the pOH as if it were the pH. Option B sets $[OH^-]$ equal to the 0.0050 mol of H_2, missing the second hydroxide. Option D doubles the hydroxide a second time.

42. B: For a group 2 metal, 0.0050 mol of H_2 comes from 0.0050 mol of M, giving $0.23 \div 0.0050 = 46$ g mol^{-1}, and none of the five metals has that molar mass. Option A gets 23 by using the group 1 mole ratio, not the group 2 one. Option C contradicts the stem, where group 2 metals react as $M + 2H_2O \rightarrow M(OH)_2 + H_2$. Option D is wrong because the same hydrogen volume gives a different amount of metal under each assumption, so the 0.23 g mass does separate them.

Unit 12: Growth rates of four soil isolates

43. A: At 4 °C, I2 managed 0.4 doublings per hour, against 0.1 for I1 and 0 for I3. Option B is the isolate with the second-highest rate. Option C is the one that did not grow at all. Option D reads the 20 °C column, where I1 and I2 are equal, by mistake.

44. B: Both isolates give 0.5 doublings per hour at 20 °C. Option A compares 0.1 with 0.4, which differ. Option C compares 1.0 with 0, so only I1 grows. Option D gives 0 for both, so neither grows and there is no growth rate to match.

45. C: At 0.4 doublings per hour, 10 h gives 4 doublings, so $2^4 = 16$ cells. Option A reports the number of doublings, not the number of cells. Option B adds one cell per doubling (1 + 4), as if growth were linear. Option D is 2^{10}, which assumes a doubling every hour.

46. A: I3 was tested at 60 °C only at pH 7, and I4 at pH 3 only at 37 °C, so neither result predicts growth when both conditions apply together. Option B uses the temperature result and ignores pH. Option C uses the pH result and ignores temperature. Option D picks I2, which shows no growth (0) at 60 °C.

Unit 13: A heater with series and parallel parts

47. B: The parallel pair gives 1/R = 1/6.0 + 1/3.0 = 1/2.0, so R = 2.0 Ω, and adding the 4.0 Ω resistor in series gives 6.0 Ω. Option D adds all three resistors as if they were in series. Option A stops at the parallel pair and leaves out the 4.0 Ω resistor. Option C adds the two parallel resistors in series and leaves out the 4.0 Ω resistor.

48. A: The supply current is 18 ÷ 6.0 = 3.0 A. The 4.0 Ω resistor takes 3.0 × 4.0 = 12 V, leaving 18 - 12 = 6.0 V across the pair (equivalently 3.0 A × 2.0 Ω). Option B assumes the supply voltage is shared equally. Option C is the voltage across the 4.0 Ω resistor. Option D applies the full supply voltage to the pair.

49. B: With 6.0 V across the pair, the current in the 3.0 Ω resistor is 6.0 ÷ 3.0 = 2.0 A. Option A is the current in the 6.0 Ω resistor. Option C is the supply current, which divides between the branches. Option D is the voltage across the pair, not a current.

50. B: Only the 4.0 Ω and 6.0 Ω resistors remain in series, giving 10 Ω, so the current is 18 ÷ 10 = 1.8 A. Option A subtracts the old current in the failed branch (3.0 - 2.0) and forgets that the voltage across the 6.0 Ω resistor changes. Option C is the old current in the failed branch. Option D assumes the supply current does not change.

Unit 14: Retention times in reversed-phase chromatography

51. D: The least hydrophobic solute (A, logP 0.5) is held least and elutes first, and the most hydrophobic (C, logP 3.5) is held longest, so the order is A, B, C at both compositions. Option A is the order for a column that holds polar solutes longest, not this one. Options B and C fit neither the logP values nor the retention times, which both rank the solutes A, B, C.

52. A: At 40% the ratio is 18.0 ÷ 6.0 = 3.0 and at 60% it is 6.0 ÷ 3.0 = 2.0, so the peaks are relatively closer. The gap in minutes also shrinks, from 12.0 to 3.0. Option B is false because 12.0 min becomes 3.0 min. Option C reverses the order, which the table shows does not happen. Option D claims the opposite of the observed fall from 12.0 to 3.0 min.

53. A: On a polar column the least polar solute is held least, so C (logP 3.5) comes off first and A (logP 0.5) last. Option B is the reversed-phase order. Option C has no basis in the logP values, which rank A, B, C in a single scale. Option D cannot occur because A and C differ greatly in logP.

54. C: From A to B and from B to C the time rises threefold (2.0, 6.0, 18.0) for each 1.5 of logP, so one more step to logP 5.0 gives 18 × 3 = 54 min. Option A extends the last rise of 12 min as if it were constant. Option B doubles the time instead of applying the threefold factor. Option D applies the factor of 3 twice, a step of 3.0 in logP.

Unit 15: The kidney limit for glucose

55. B: Glucose appears when the filtered load exceeds Tm. With 1.00 dL min^{-1} filtered, the load equals the concentration in mg dL^{-1}, so the threshold is 375 mg dL^{-1}. Option A divides by 10 where no conversion is needed. Option C is the first row of the table with glucose in urine, not the threshold itself. Option D is the highest row in the table.

56. A: The filtered load is 450 mg min^{-1} and 375 mg min^{-1} is reabsorbed, so 450 - 375 = 75 mg min^{-1} is excreted. Option B is the amount reabsorbed. Option C is the amount filtered. Option D adds the two figures instead of subtracting.

57. B: With GFR of 2.00 dL min^{-1} the filtered load is 300 × 2 = 600 mg min^{-1}, which exceeds Tm, so 600 - 375 = 225 mg min^{-1} is excreted. Option A keeps the original GFR, giving a load below Tm and no excretion. Option C reports the old filtered load. Option D reports the new filtered load without subtracting the reabsorbed part.

58. A: Unreabsorbed glucose adds to the solute concentration of the tubular fluid, so water follows it by osmosis and stays in the urine. Option B reverses the effect on water channels; open channels would help water leave the urine. Option C makes a claim about GFR that the stem does not support. Option D invents a conversion that does not occur.

Unit 16: Ions left in solution after a precipitation

59. B: Sodium sulfate supplies 0.100 L × 0.10 = 0.010 mol of sulfate and barium chloride supplies 0.100 L × 0.20 = 0.020 mol of barium. Sulfate is limiting, so 0.010 mol of $BaSO_4$ forms. Option C reports the barium, which is in excess. Option D adds the two amounts. Option A halves the sulfate for no reason.

60. C: Chloride does not react. $BaCl_2$ at 0.20 mol L^{-1} gives 0.040 mol of Cl^- in 0.100 L, and that amount now sits in 0.200 L, so $[Cl^-]$ = 0.20 mol L^{-1}. Option D uses the chloride concentration in the barium chloride bottle (0.40 mol L^{-1}) without allowing for the doubled volume. Options B and A correspond to the sodium and barium amounts, not the chloride.

61. B: Barium starts at 0.020 mol and 0.010 mol is removed in the precipitate, leaving 0.010 mol in 0.200 L, which is 0.050 mol L^{-1}. Option C divides the 0.010 mol by 0.100 L and ignores the mixing. Option D is the original barium chloride concentration, which ignores both the reaction and the dilution. Option A gives the 0.010 mol itself without dividing by the volume.

62. D: The solution is electrically neutral, so positive charge equals negative charge. Ba^{2+} counts twice, giving 2(0.050) + 0.10 = 0.20 mol L^{-1}, which equals $[Cl^-]$. Option A counts Ba^{2+} once and gives 0.15 against 0.20. Option B also counts chloride twice and gives 0.15 against 0.40. Option C puts Cl^- on the wrong side and gives 0.10 against 0.30.

Unit 17: Choosing a steriliser setting for a spore-former

63. C: Vegetative cells die within 2 min at 100 °C, so 20 min is plenty, but killing all the spores at 100 °C takes 1200 min. Option A applies the time for cells to spores. Option B reverses the two forms. Option D contradicts the 2 min given for vegetative cells.

64. A: At 110 °C it takes 120 min to kill all 10^6 spores, so after 60 min some survive and will grow in the broth. Option B borrows the time for a different temperature. Option C mistakes a high temperature for sterilising conditions on its own. Option D counts cells killed at 100 °C, but the indicator contains spores.

65. D: The table says 15 min at 121 °C kills all the spores, so growth means that the indicator was not held at 121 °C for 15 min, for example because steam did not reach it. That puts the rest of the load in doubt too. Option A rejects the data on the strength of one result. Option B trusts the machine setting over the control. Option C claims vegetative cells, which the indicator does not contain.

Unit 18: An enzyme that needs two groups in the right state

66. D: As pH drops towards and below 4.0, the carboxylate picks up a proton and turns into its inactive acid form, so fewer molecules have both groups active. Option A describes the fall at higher pH, not lower. Option B contradicts the stem, which says substrate is saturating in every assay. Option C reverses the direction of protonation in acid.

67. A: The optimum lies midway between the two pKa values, (3.0 + 7.0) ÷ 2 = 5.0. With the pKa values further apart, a wider range of pH keeps both groups in the right state, so the curve is broader. Option B reverses the effect of moving the values apart. Option C and option D each treat one group alone as setting the optimum, which ignores the second group.

68. B: At pH 5, $1 \div (1 + 10^{-1}) = 0.91$ of the carboxylate groups are deprotonated and $1 \div (1 + 10^{-1}) = 0.91$ of the imidazole groups are protonated. The groups act together, so the fraction is 0.91 × 0.91 = 0.83. Option A is the fraction for one group at its own pKa. Option C counts one group alone and forgets the other. Option D treats the optimum as meaning every molecule is active.

Unit 19: Longer survival and more people with the disease

69. D: Prevalence is approximately incidence × duration, which is 50 × 10 = 500 per 100,000. Option A is the incidence, unchanged by the drug. Option B adds the two figures instead of multiplying. Option C is the prevalence before the drug (50 × 4).

70. A: With the same number of new cases each year and each case lasting longer, cases accumulate, so more people have the disease at one moment. Option B contradicts the table, where incidence stays at 50. Option C misdefines prevalence, which counts new and existing cases. Option D invents a difference in units that the stem does not describe.

71. A: The number of people who have the disease at a given time sets the need for ongoing care, and that is prevalence. The rate of newly arising cases shows how quickly people fall ill, and that is incidence. Option B swaps the two. Option C uses prevalence for the rate of new cases, which it does not measure. Option D uses incidence for the burden of existing cases.

72. C: Town Y has a prevalence of about 20 × 25 = 500 per 100,000, equal to the 500 in the town after the drug, but its incidence of 20 is below 50. Option A takes the lower incidence as a sign of a higher prevalence. Option B takes the lower incidence as a sign of lower prevalence, ignoring the long duration. Option D claims equal incidence, but 20 is not 50.

Unit 20: Density and repeated readings

73. A: The quotient 25.4 ÷ 3.2 is 7.9375, and with two significant figures in the volume the result is 7.9 g mL^{-1}. Option B and option C keep three or four figures that the volume does not justify. Option D rounds to one figure, which discards information the volume does carry.

74. C: X readings agree closely (spread 0.1 cm) but their mean, about 9.13 cm, is well below 10.00 cm. Y readings scatter more (spread 0.4 cm) but average 10.00 cm. Option A swaps the two descriptions. Option B accepts a 0.9 cm error as accurate. Option D confuses a correct mean with a small spread, and Y has the larger spread.

75. A: Adding the same amount to every reading shifts the mean from about 9.13 cm to about 10.03 cm, so accuracy improves. The readings stay 0.1 cm apart, so precision is unchanged. Option B credits the shift with narrowing the spread. Option C reverses the two effects. Option D measures spread against the old readings, not against one another.

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