Cambridge Assessment
Admissions Testing

BioMedical Admissions Test

Specimen Section 2 answers

1 The correct answer is option **H**.

The removal of nitrogen gas from the air, process 1, into the soil is nitrogen fixation. The release of nitrogen back into the air, process 2, is denitrification. In addition, the breakdown of nitrogen-rich dead plant material, such as plant protein, is decomposition (decay).

2 The correct answer is option **E**.

Addition polymerisation takes place between unsaturated molecules, such as those containing the C = C double bond (alkenes), which can join with another C = C bond to form new C – C linkages in a polymer. Fully saturated molecules, such as alkanes, cannot undergo addition polymerisation.

Alkenes have the general formula C_nH_{2n} and alkanes have the general formula C_nH_{2n+2}. Both formulae can have other atoms in them by replacing one or more H atoms by a halogen, e.g. Cl, Br, I.

In this question, compound 1 is fully saturated; there are no double (or triple) bonds present. Compound 2 is an alkene, as is compound 4 (with 2 Cl atoms). Compound 3 has the general formula of an alkane (with 1 Br atom) and therefore is fully saturated. Compound 5 matches the general formula of an alkene (with 4 Cl atoms). Therefore, only compounds 2, 4, and 5 can undergo addition polymerisation.

3 The correct answer is option **F**.

Statement 1: Aluminium, being a good conductor of heat, would increase, not decrease, the rate of heat loss by conduction. Statement 1 is not correct.

Statement 2: The aluminium sheet does trap air (that is one of its purposes) and the fact that air is trapped reduces heat loss by convection. Statement 2 is correct.

Statement 3: Aluminium is shiny and therefore a poor emitter of thermal radiation. It does reduce heat loss by radiation (that being its other purpose). Statement 3 is correct.

Therefore, only statements 2 and 3 are correct.

4 The correct answer is option **C**.

A right-angled triangle is given.

The area of a triangle $= \frac{1}{2} \times$ base $\times$ height

The height is the vertical height which is given as $2-\sqrt{2}$
In this case, the area is $\dfrac{\left(2-\sqrt{2}\right)\left(4+\sqrt{2}\right)}{2} = \dfrac{8-4\sqrt{2}+2\sqrt{2}-\sqrt{2}\sqrt{2}}{2}$

Because $\sqrt{2}\sqrt{2}=2$, this expression simplifies to $\dfrac{6-2\sqrt{2}}{2}=3-\sqrt{2}$

5 The correct answer is option **F**.

The SAN pacemaker is found within the wall of the right atrium, which eliminate all options apart from **B** and **F**. Whilst the left side of the heart pumps oxygenated blood to the body, the right pumps deoxygenated blood to the lungs.

6 The correct answer is option **D**.

This question relies on studying the equation and the numbers of atoms on both sides. The Na atoms provide the starting point here as on the right-hand side there are 5 and on the left-hand side are a 1 and a 2.

The first effort would be would be to make **c** $=$ 1, **a** $=$ 1 and **b** $=$ 2 in order to balance the Na atoms, and then use them to find the value of **d**. Using the original values (**c**, **a** and **b**), the P atoms also balance so it is then a matter of adding up the O and H atoms on the left-hand side. This gives **d** $=$ 2 as a value to balance them.

7 The correct answer is option **C**.

The mass of the two cars is the same which means that the kinetic energy is proportional to speed squared. Therefore, as car Q has twice the speed of car P, it will have four times the kinetic energy. Gravitational potential energy is proportional to the change in height, and so the car which rises 50 m will have twice the gravitational potential energy of the car that has only risen 25 m.

8 The correct answer is option **B**.

In the expression, every term inside the bracket has to be squared. The easiest way to simplify it is to consider each term separately.

$2^2 = 4$ $\left(x^{\frac{3}{2}}\right)^2 = x^3$ $\left(\sqrt{z}\right)^2 = z$ $\left(y^3\right)^2 = y^6$

When combined, the expression becomes $\dfrac{4x^3y^6}{z}$

None of the other expressions is equal to this.

9 The correct answer is option **C**.

As the genotypes of P and Q are given, the genotype of S will be a combination of one allele from each of P and Q, which makes S heterozygous. There is a 50% chance that U will inherit the recessive allele from S. If T is homozygous recessive, then individual U will have a 100% chance of inheriting a recessive allele from T. So the probability that individual U will inherit both recessive alleles is 50% (options **A** and **C**).

However, if T is heterozygous, then individual U will have a 50% chance of inheriting the recessive allele from T. Therefore the chance of individual U inheriting both recessive alleles from 2 heterozygous parents will be 25%. Therefore only option **C** is correct.

10 The correct answer is option **D**.

Bond breaking is an endothermic process, whilst bond making is an exothermic process.

The equation is exothermic overall, which means that more energy is released when bonds are made than is needed for bonds being broken.

The bonds to be broken are on the left-hand side ($N\equiv N$ and $3 \times$ $H-H$) and made on the right-hand side ($2 \times 3 \times$ $N-H$) of the equation. This means that the $6 \times$ $N-H$ bond energies must be greater than the $N\equiv N$ and $3 \times$ $H-H$ bond energies in total. Looking at the number of bonds from the mole ratios in the equation (1 **:** 2 **:** 3), the answer must be option **D**: $6z > x + 3y$

11 The correct answer is option **A**.

When travelling at terminal velocity, the force of air resistance (drag) on the parachutist will be equal and opposite to his weight. This is true when travelling at a high terminal velocity before opening the parachute and when travelling at a lower terminal velocity after opening the parachute. Terminal velocity means zero acceleration which means there is zero resultant force acting.

During the act of opening the parachute, there is a rapid deceleration which means that momentarily there must be a resultant upwards force acting on the parachutist. During that instant, there must therefore be air resistance which is much greater than the weight.

The correct graph is therefore one that shows the same air resistance force, in the same direction, throughout apart from during the moment of opening the parachute. And during that moment there must be a much larger air resistance force, again all in the same direction. The only graph that shows all this is graph **A**.

B and **D** are incorrect because they show the air resistance force changing direction, which is not possible as it will always be upwards. **C** and **D** are incorrect because they show different air resistance forces at terminal velocity before and after opening the parachute.

12 The correct answer is option **E**.

The probability of an event is equal to the number of ways for something to happen divided by the total number of possible results.

The probability that the first ball taken out was red is $\frac{x}{x+y+z}$

The chosen ball is now replaced, irrespective of colour, so there are still $x+y+z$ balls in the bag.

The probability that the second ball taken out was blue is $\frac{y}{x+y+z}$

The probability that both events occur is the product of the individual probabilities to give the expression: $\frac{xy}{(x+y+z)^2}$

13 The correct answer is option **E**.

The transfer between one neuron and the next is *via* a transmitter substance that diffuses across the synaptic gap, hence statement 4 is correct. The arrival of the signal at the end of the neuron next to the synapse stimulates the release of the transmitter, hence statement 3 is also correct.

14 The correct answer is option **B**.

From the information provided, it is clear that the compound is ionically bonded.

None of the compounds A-F have an overall charge, so the total sum of the charges of the individual ions must equal zero.

It is possible to work out, for each compound, the total number of positive charges (coming from Mg^{2+} and H^+) and the total number of negative charges (coming from PO_4^{3-}). Only $Mg(H_2PO_4)_2$ correctly balances the charges.

15 The correct answer is option **D**.

Source X: 24 hours is 5 half-lives. So in that time the activity of source X will halve 5 times: 320 to 160 to 80 to 40 to 20 to 10. After 24 hours, the activity of X will have fallen to 10 counts per minute.

Source Y: 8 hours is 3 half-lives. So in that time the activity of Y will halve 3 times: 480 to 240 to 120 to 60. After 24 hours, the activity of Y will have fallen to 60 counts per minute.
The combined count rate after 24 hours is therefore $10 + 60 = 70$ counts per minute.

16 The correct answer is option **E**.

In the formula $r = 1 - \frac{6\sum d^2}{n(n^2-1)}$, the $\sum d^2$ term has to be isolated.

In the first instance, add $\frac{6\sum d^2}{n(n^2-1)}$ to both sides of the equation to give $r + \frac{6\sum d^2}{n(n^2-1)} = 1$

Then subtract r from both sides of the equation to give $\frac{6\sum d^2}{n(n^2-1)} = 1 - r$

Divide both sides of the equation by 6 to give $\frac{\sum d^2}{n(n^2-1)} = \frac{1-r}{6}$

Finally multiply both sides of the equation by $n(n^2-1)$ to give $\sum d^2 = \frac{1-r}{6}(n)(n^2-1)$

This is not exactly the same as any of the given answers but $n(n^2-1) = n^3 - n$ and so the rearranged formula is equivalent to $\sum d^2 = \frac{(1-r)(n^3-n)}{6}$

17 The correct answer is option **E**.

During breathing out, the diaphragm muscles relax, so statement 2 is incorrect. The ribcage moves down and in during breathing out, so statement 1 is correct. This causes a decrease in the volume of the thorax leading to an increase in pressure within the lungs, so statement 3is correct as well.

18 The correct answer is option **D**.

Several methods can be used to calculate the answer, one of which is shown below:

Mass of PbS from the ore $= 480 \times \frac{75}{100} = 360\,\text{kg}$

1 mole PbS is $207 + 32 = 239\,\text{g}$, which is approximately 240 g.

Number of moles of PbS $= \frac{360 \times 10^3}{240} = \frac{3}{2} \times 10^3 =$ Number of moles of Pb

Mass of Pb $= \left(\frac{3}{2} \times 10^3\right) \times 207 = \left(3 \times 10^3\right) \times 103.5 = 310.5\,\text{kg}$

The only option close to this estimate is 311.8 kg

19 The correct answer is option **A**.

The trough to peak height is $16 - 10 = 6$ m. The amplitude is defined as the maximum displacement from the equilibrium position, i.e. from the middle to the trough or peak, and is therefore 3 m.

The period of the wave is 12 hours, reading directly from the graph.

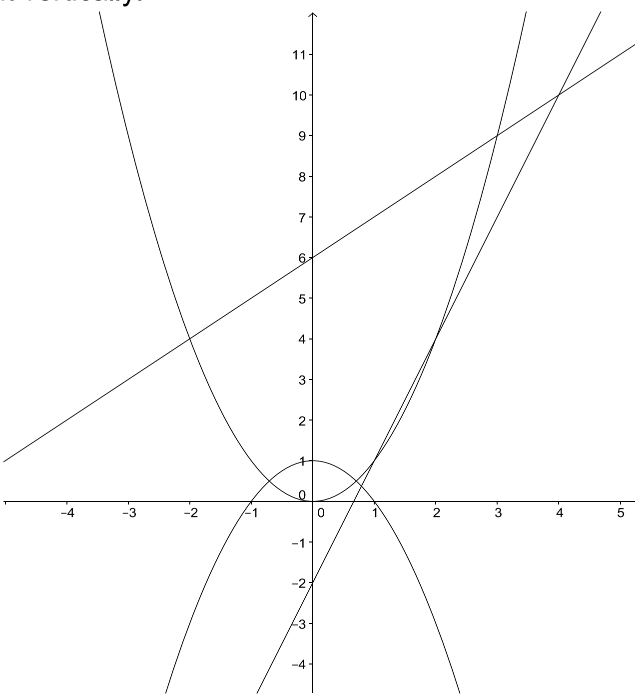
12 hours $=$ 12×60 minutes $=$ 12×3600 seconds

$$\text{Frequency} = \frac{1}{\text{period}} = \frac{1}{12 \times 3600}\text{ Hz}$$

20 The correct answer is option **E**.

One way to approach this question is to sketch the graphs of the four equations.

The graph of $y = 3x - 2$ is a straight line which intersects the y -axis at (0, – 2). The gradient of the line is 3.
The graph of $y = x + 6$ is also a straight line. This line intersects the y-axis at (0,6) and has a gradient of 1.
The graph of $y = x^2$ is a parabola which touches the x-axis at (0,0).
The graph of $y = 1 - x^2$ is exactly the same shape as $y = x^2$ but it has been inverted and translated by 1 unit vertically.



It is clear from the diagram that $y = x + 6$ and $y = 1 - x^2$ do not intersect.

An alternative approach is to solve each pair of equations.

21 The correct answer is option **C**.

Oxygen is required for aerobic respiration which releases energy. The energy released is used for active transport which moves substances up the concentration gradient. The only answer that shows movement against the concentration gradient is option **C**.

22 The correct answer is option **C**.

The Periodic Table is structured so that:

the number of the group shows the number of electrons in the outer shell of the atom;

the number of the period shows the total number of shells of the atom.

In this example, Y has gained a -3 charge, i.e. 3 electrons have been added to the atom to make the configuration that of a noble gas (2,8,8). The atom Y must therefore have the electron configuration 2,8,5. This means Y is in Group 15 and Period 3.

23 The correct answer is option **B**.

Output power $= 0.50\,\text{kW} = 500\,\text{W}$

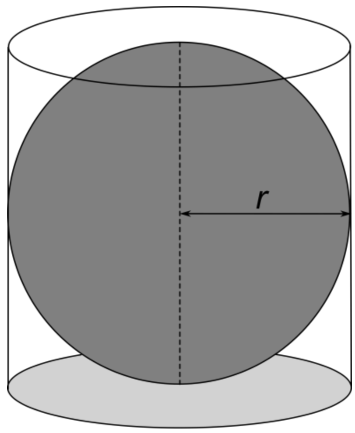
Therefore, output voltage $= \dfrac{P}{I} = \dfrac{500}{10} = 50\,\text{V}$

Number of turns on the secondary is $\dfrac{1500 \times 50}{250} = \dfrac{1500}{5} = 300$ turns

(Note that the fact that the transformer is 100% efficient is not information that you need to answer this question, as you are already given the output power.)

24 The correct answer is option **D**.

The volume of a cylinder is the base area times the height.



As the cylinder's length and internal diameter are the same as the diameter of the sphere, then both of these are equal to $2r$

So the volume of the cylinder $=$ base area $\times$ height $= \pi r^2 \times 2r = 2\pi r^3$

The volume of the sphere is $\frac{4}{3}\pi r^3$

The fraction of space inside the cylinder taken up by the sphere is $\dfrac{\frac{4}{3}\pi r^3}{2\pi r^3} = \dfrac{\frac{4}{3}}{2} = \dfrac{2}{3}$

25 The correct answer is option **C**.

The process of genetically engineering this bacterium requires a restriction enzyme to cut out the fluorescent gene from jellyfish DNA (option **B**). This gene needs to be put into an appropriate vector (option **A**), which uses a ligase (option **D**). However, it is the gene that is being added, not the protein that it codes for, so option **C** is incorrect.

26 The correct answer is option **E**.

There are several methods that will give the correct answer, one of which is shown below:

Number of moles of I $= \dfrac{63.5}{127} = 0.5$

Number of moles of O $= \dfrac{20.0}{16} = 1.25$

Therefore the ratio of I **:** O is 0.5 **:** 1.25, which is equivalent to 2 **:** 5

27 The correct answer is option **B**.

First, consider the microwaves travelling in air. We are told they have a wavelength of 12 cm $= 0.12$ m and a speed of 3.0×10^8 m/s, so the frequency can be calculated as:

$$\text{Frequency} = \frac{\text{speed}}{\text{wavelength}} = \frac{3.0\times10^8}{0.12} = \frac{3.0\times10^{10}}{12} = 0.25\times10^{10} = 2.5\times10^9\,\text{Hz}$$

Now consider the microwaves passing through the plastic. We know that the plastic will slow the waves down, therefore reducing the wavelength, but the frequency will remain unchanged.

Therefore, in the plastic, the frequency is 2.5×10^9 Hz but a wavelength shorter than 12 cm by a factor of $\frac{2}{3}$ to 8.0 cm.

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Cambridge Assessment
Admissions Testing
1 Hills Road
Cambridge
CB1 2EU
United Kingdom

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