

## University of Oxford, Biomedical Sciences Admissions Test – Answer Keys

### Item 1 Maths

Topic M3.8 Define percentage as ‘number of parts per hundred’.

Interpret percentages and percentage changes as a fraction or a decimal and interpret these multiplicatively.

Express one quantity as a percentage of another. Compare two quantities using percentages.

Work with percentages greater than 100%.

Solve problems involving percentage change, including percentage increase/decrease, original value problems and simple interest calculations.

Testing Point – Ability to apply knowledge of calculation of the percentage in the context of discounted price calculation.

Stem	<p>A store offers a 20% discount on the label price of all products. For every purchase of more than 5 units of the same product, an additional 25% discount is given on the discounted price. (The second discount is not applied to the first 5 products).</p> <p>How many pounds will a customer pay if they buy 8 units of a product with a tag price of £15 in this store?</p>
Diagram	N/A
Option A	85
Option B	81
Option C	88
Option D	87
Option E	83
Answer Key	D
Explanation/Rationale and assumed knowledge	$15 \times 20/100 = 3$ , $12 \times 25/100 = 3$ $(£15 - 3) \times 5 + (£12 - 3) \times 3 = £87$

## Item 2 Maths

Topic M3.9 Understand and use direct and inverse proportion, including algebraic representations.

Recognise and interpret graphs that illustrate direct and inverse proportion.

Set up, use and interpret equations to solve problems involving direct and inverse proportion (including questions involving integer and fractional powers).

Understand that  $x$  is inversely proportional to  $y$  is equivalent to  $x$  is proportional to  $1/y$ .

Testing Point – Ability to apply knowledge of recognising inverse proportion in the context of working hour calculation.

Stem	How many days does it take for a worker to produce the same amount of product that they would produce in 10 days at 72% capacity and working 15 hours a day, if they are working at 90% capacity and 6 hours a day?
Diagram	N/A
Option A	25
Option B	20
Option C	9
Option D	15
Option E	10
Answer Key	B
Explanation/Rationale and assumed knowledge	Reverse proportional 72% 15h 10 days a job 90% 6h b days a job  $72 \times 15 \times 10 = 90 \times 6 \times b$ $b = 20$

### Item 3 Maths

Topic M4.10 Identify and interpret gradients and intercepts of linear functions ( $y=mx + c$ ) graphically and algebraically.

Identify pairs of parallel lines and identify pairs of perpendicular lines, including the relationships between gradients.

Find the equation of the line through two given points, or through one point with a given gradient.

Testing Point – Ability to apply knowledge of finding equation ( $y=mx+c$ ) from the given graph and reciprocal function in the context of linear functions.

Stem	Given the graph of the function $y=f(x)$ below, what is $f(4) \cdot f^{-1}(2)$ equal to?
Diagram	
Option A	1
Option B	-1
Option C	3
Option D	-3
Option E	$1/3$
Answer Key	D
Explanation/Rationale and assumed knowledge	$f(x) = (-5x+15)/3$ $f^{-1}(x) = (3x-15)/-5$ $f(4) = (-20 + 15)/3 = -5/3$ $f^{-1}(2) = 9/5$ $9/5 \cdot -5/3 = -3$

**Item 4 Maths**

Topic M4.13 Interpret graphs (including reciprocal graphs and exponential graphs) and graphs of non-standard functions in real contexts to find approximate solutions to problems, such as simple kinematic problems involving distance, speed and acceleration.

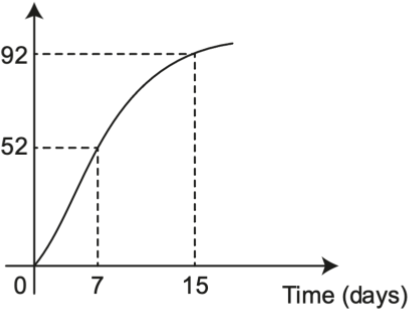
Testing Point – Ability to apply knowledge of using nonlinear graph and estimate solutions by using it in the context of simple kinematic problems.

Stem	The graph below shows the speed of a motorcycle over time. Which of the following can be an estimate for the distance the motorcycle travelled in the first 16 seconds?
Diagram	
Option A	155
Option B	276
Option C	315
Option D	443
Option E	645
Answer Key	B
Explanation/Rationale and assumed knowledge	<p>Travelled distance is calculated by the area under the curve. An estimate value can be calculated by dividing the area to triangles and rectangles.</p> $(10 \times 10) / 2 + (2 \times 12) / 2 + (2 \times 24) / 2 + (34 \times 2) / 2 + 2 \times 10 + 22 \times 2 + 46 \times 2$ $=$ $276$

### Item 5 Maths

Topic M4.14 Calculate or estimate gradients of graphs and areas under graphs (including quadratic and other non-linear graphs) and interpret results in cases such as distance–time graphs, speed–time graphs and graphs in financial contexts.

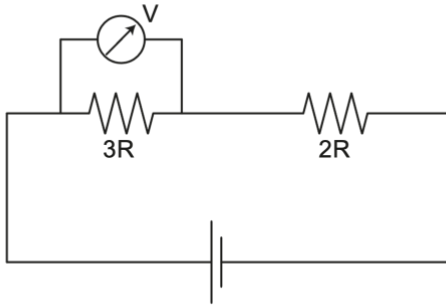
Testing Point – Ability to apply knowledge of calculating average from the graph in the context of trading.

Stem	The graph below illustrates the amount that sales change during the launch period of a new product. Based on the graph, what is the average number of sales of this product between days 7 and 15?
Diagram	<p style="text-align: center;">Amount sold (in thousands)</p> 
Option A	15
Option B	12
Option C	10
Option D	9
Option E	8
Answer Key	D
Explanation/Rationale and assumed knowledge	Average of change = change in y/change in x $(92-20)/(15-7) = 9$

## Item 1 Physics

Topic P1.2 Electric circuits

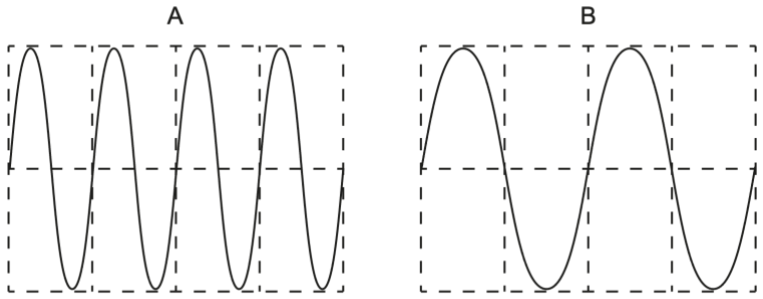
Testing Point – Ability to apply knowledge of Ohm’s Law in the context of electric circuits.

Stem	In the circuit shown in the figure, if the voltage reader attached to the 3R resistor measures a potential difference of V, what is the potential difference across the battery?
Diagram	
Option A	8V/3
Option B	5V
Option C	5V/3
Option D	4V/5
Option E	2V
Answer Key	C
Explanation/Rationale and assumed knowledge	$V = i \times 3R$ $V_{2R} = i \times 2R = 2V/3$ $V_{tot} = 2V/3 + V = 5V/3$

## Item 2 Physics

### Topic P6.4 Sound Waves

Testing Point – Ability to apply knowledge of the relation of loudness to amplitude and pitch to frequency of longitudinal waves in the context of sound waves.

<p>Stem</p>	<p>The representation of sound waves A and B propagating in the same medium is shown in the figure. According to this:</p> <ol style="list-style-type: none"> <li>I. The intensity of the A wave is greater than the intensity of the B wave.</li> <li>II. The A wave is heard as having a higher pitch (thinner) than the B wave.</li> <li>III. The propagation speed of the A wave is greater than the propagation speed of the B wave.</li> </ol> <p>Which of these statements is correct? (Dashed lines are equally spaced)</p>
<p>Diagram</p>	
<p>Option A</p>	<p>Only I</p>
<p>Option B</p>	<p>Only II</p>
<p>Option C</p>	<p>Only III</p>
<p>Option D</p>	<p>I and II</p>
<p>Option E</p>	<p>II and III</p>
<p>Answer Key</p>	<p>B</p>
<p>Explanation/Rationale and assumed knowledge</p>	<p>Wave length of A is half of the wave length of B therefore, I and III are not correct.</p>

### Item 3 Physics

#### Topic P4.4 Heat capacity

Testing Point – Ability to apply knowledge of the calculation of heat capacity and the effect of energy transferred to an object on its temperature in the context of thermal physics.

Stem	Given two objects A and B with the specific heat capacities $c$ and $3c$ and masses $2m$ and $m$ respectively, and assuming they are heated from temperature $T$ to $2T$ , if the amount of heat received by object A is $Q$ , what is the amount of heat received by object B?
Diagram	N/A
Option A	$Q$
Option B	$2Q/3$
Option C	$3Q/2$
Option D	$2Q$
Option E	$3Q$
Answer Key	C
Explanation/Rationale and assumed knowledge	$Q = c \cdot 2m \cdot T = 2cmT$ (A) $Q_B = 3c \cdot m \cdot T = 3cmT = 3Q/2$



## Item 4 Physics

### Topic P7.3 Ionising radiation

- Know the relative penetrating abilities of alpha, beta and gamma radiation.
- Know the relative ionising abilities of alpha, beta and gamma radiation.
- Understand qualitatively the deflection of alpha, beta and gamma radiation in electric or magnetic fields.
- Know and appreciate the existence of background radiation.
- Understand the applications and hazards of ionising radiation.

Testing Point – Ability to apply knowledge of alpha, beta, and gamma rays in the context of an unstable nucleus and ionizing radiation.

Stem	An ${}^{244}_{92}\text{X}$ nucleus emits alpha, beta, and gamma rays sequentially, which of the following statements are correct?  I- It turns in to ${}^{240}_{90}\text{X}$ nucleus. II- Electromagnetic waves are emitted. III- The energy of the nucleus decreases. IV- During gamma ray emission, the radiation was the greatest range in the air.
Diagram	N/A
Option A	III and IV
Option B	I and III
Option C	I, II and III
Option D	II, III and IV
Option E	I, II, III and IV
Answer Key	D
Explanation/Rationale and assumed knowledge	${}^{240}_{91}\text{X}$ should be the final nucleus. Therefore, the answer is D.

## Item 5 Physics

Topic P3.1 Kinematics:

- Know and understand the difference between scalar and vector quantities.
- Know and understand the difference between distance and displacement and between speed and velocity.
- Know and be able to apply: speed = distance, time velocity = change in displacement time
- Know and be able to apply: acceleration = change in velocity time
- Interpret distance–time, displacement–time, speed–time and velocity–time graphs.
- Perform calculations using gradients and areas under graphs.
- Know and be able to apply: average speed = total distance total time
- Know and be able to apply the equation of motion:  $v^2 - u^2 = 2as$

Testing Point – Ability to apply knowledge of kinematic equations to determine acceleration and time in the context of an accident.

Stem	One night, a careless driver crashes into a lamppost while driving at a speed of 108 km/h. As a result of the collision, the car comes to a stop after the front parts are compressed by 0.45 m. What is the deceleration of the car? (Assume the car's deceleration is constant.)
Diagram	N/A
Option A	-1000 m/s <sup>2</sup>
Option B	-100 m/s <sup>2</sup>
Option C	-10 m/s <sup>2</sup>
Option D	-900 m/s <sup>2</sup>
Option E	-90 m/s <sup>2</sup>
Answer Key	A
Explanation/Rationale and assumed knowledge	108 km/h = 30 m/s $V_f^2 = V_0^2 + 2ad$ $0 = (30)^2 + 2a(0.45)$ $-900 = 0.9a \quad a = -1000 \text{ m/s}^2$

## Item 1 Chemistry

Topic C1.3 Know and be able to use the terms atomic number and mass number, together with standard notation (e.g.  $^{12}\text{C}$ ), and so be able to calculate the number of protons, neutrons and electrons in any atom or ion.

Testing Point – Ability to apply knowledge of the terms atomic number and mass number, calculation the number of protons, neutrons and electrons together with standard notation in the context of atomic structure.

Stem	Which of the following statements about atom $^{35}_{17}\text{Z}$ and $^{37}_{17}\text{Z}^{-1}$ ion is correct?
Diagram	N/A
Option A	They have an equal number of neutrons.
Option B	$^{37}_{17}\text{Z}^{-1}$ has a larger mass number than $^{35}_{17}\text{Z}$ .
Option C	They have a different number of protons.
Option D	$^{35}_{17}\text{Z}$ has a greater number of electrons than $^{37}_{17}\text{Z}^{-1}$ .
Option E	They have a different atomic number.
Answer Key	B
Explanation/Rationale and assumed knowledge	$^{37}_{17}\text{Z}^{-1}$ has a mass number of 37 and $^{35}_{17}\text{Z}$ has 35 which is correct. $^{37}_{17}\text{Z}^{-1}$ has a neutron number of 20 and $^{35}_{17}\text{Z}$ has 18 so they don't have equal neutron numbers. They both have 17 protons and same atomic number. $^{37}_{17}\text{Z}^{-1}$ has one electron more than $^{35}_{17}\text{Z}$ .

## Item 2 Chemistry

Topic C3.5 Understand that often chemical reactions can be reversible and do not go to completion. All of the reactants do not turn fully into the products, but the reaction reaches a state of equilibrium in a closed system.

- Know the factors that can affect the position of an equilibrium (concentration of reactants/products, temperature, overall pressure).
- Predict the effect of changing these factors on the position of equilibrium.

Testing Point – Ability to apply knowledge of the factors that can affect the position of an equilibrium in the context of a reversible chemical reaction.

Stem	The equilibrium reaction of I <sub>2</sub> , H <sub>2</sub> and HI gases at a fixed volume at a certain temperature is $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \xrightleftharpoons{1} 2\text{HI}(\text{g})$ Which of the following processes gives the wrong result when applied to this system in equilibrium at the same temperature?
Diagram	N/A
Option A	The addition of H <sub>2</sub> gas shifts the equilibrium towards 1.
Option B	The addition of HI gas shifts the equilibrium towards 2.
Option C	The withdrawal of HI gas shifts the equilibrium towards 2.
Option D	The withdrawal of H <sub>2</sub> gas shifts the equilibrium towards 2.
Option E	The withdrawal of I <sub>2</sub> gas shifts the equilibrium towards 2.
Answer Key	C
Explanation/Rationale and assumed knowledge	The withdrawal of HI gas shifts the equilibrium towards 1 as the concentration of HI will be less than I <sub>2</sub> and H <sub>2</sub> .

### Item 3 Chemistry

#### Topic C5. Oxidation, reduction and redox

Testing Point – Ability to apply knowledge of balancing reactions, determining the oxidation states of the elements and the terms oxidizing agent and reducing agent, and be able to identify them in reactions in the context of a redox reaction.

Stem	Which of the following statements is incorrect for the balanced reaction shown below? $3\text{P} + 5\text{HNO}_3 + 2\text{H}_2\text{O} \Rightarrow 3\text{X} + 5\text{NO}$
Diagram	N/A
Option A	X is $\text{H}_3\text{PO}_4$
Option B	It is a redox reaction.
Option C	$\text{HNO}_3$ is an oxidizing agent.
Option D	P atom is oxidized.
Option E	P atom in X has the oxidation state of +4.
Answer Key	E
Explanation/Rationale and assumed knowledge	P atom oxidized from 0 to +5 so the answer is E. N atom is reduced from +5 to +2 so it is an oxidizing agent.

## Item 4 Chemistry

Topic C13.6 Carboxylic acids:

Testing Point – Ability to apply knowledge of chemical properties of carboxylic acids in the context of carboxylic acids and their reactions.

Stem	<p>Which of the following statements is true about the molecules listed below?</p> <p>I- B is a carboxylic acid.            II- Reaction of A with NaOH produces water and C<sub>2</sub>H<sub>4</sub>COONa.            III- A is a weak acid.            IV- In the presence of an acid, A and B react to produce ester.            V- A has a higher boiling point than B.</p>
Diagram	<p style="text-align: center;"> <math>\begin{array}{c} \text{H} \\   \\ \text{H}-\text{C}-\text{C} \\   \quad // \\ \text{H} \quad \text{O} \\ \quad \quad   \\ \quad \quad \text{O}-\text{H} \end{array}</math> <span style="margin-left: 100px;"> <math>\begin{array}{c} \text{H} \quad \text{H} \\   \quad   \\ \text{H}-\text{C}-\text{C}-\text{O}-\text{H} \\   \quad   \\ \text{H} \quad \text{H} \end{array}</math> </span> </p> <p style="text-align: center;">A <span style="margin-left: 150px;">B</span></p>
Option A	II, IV and V
Option B	I, II and IV
Option C	III, IV and V
Option D	I, II, IV and V
Option E	II, III, IV and V
Answer Key	C
Explanation/Rationale and assumed knowledge	<p>B is an alcohol molecule.            Reaction of A with NaOH produces water and C<sub>2</sub>H<sub>3</sub>COONa.            A is a carboxylic acid so it is a weak acid.            Alcohol and carboxylic acid react to form esters in the presence of an acid.            Carboxylic acids have a higher boiling point than carbonyl compounds and alcohols due to the presence of intramolecular hydrogen bonding. Therefore, the answer is C.</p>

## Item 5 Chemistry

### Topic C12. Electrolysis

Testing Point – Ability to apply knowledge of anode, cathode and their reactions in the context of electrolysis.

<p>Stem</p>	<p>A diagram of a galvanic cell with its reaction is given below. Which of the following statements is true about this galvanic cell?</p> $2\text{Ag}^+(\text{aq}) + \text{Mg}(\text{s}) \rightleftharpoons 2\text{Ag}(\text{s}) + \text{Mg}^{2+}(\text{aq})$ <p>I- In the Y half-cell, there is a solution containing <math>\text{Ag}^+</math> ions.</p> <p>II- The mass of the Mg electrode in the X half-cell decreases over time.</p> <p>III- Ag is the cathode and therefore reduction occurs in the Y half-cell.</p> <p>IV- Electrons are given to the external circuit from the Mg electrode.</p>
<p>Diagram</p>	<p>The diagram shows a galvanic cell with two half-cells. The left half-cell (X) contains a magnesium (Mg) electrode in a solution. The right half-cell (Y) contains a silver (Ag) electrode in a solution. The two half-cells are connected by a salt bridge containing potassium nitrate (<math>\text{KNO}_3(\text{aq})</math>). An external circuit connects the two electrodes through a voltmeter (V).</p>
<p>Option A</p>	<p>I and II</p>
<p>Option B</p>	<p>II and III</p>
<p>Option C</p>	<p>II, III and IV</p>
<p>Option D</p>	<p>I, II and III</p>
<p>Option E</p>	<p>I, II, III and IV</p>
<p>Answer Key</p>	<p>D</p>
<p>Explanation/Rationale and assumed knowledge</p>	<p>Electrons are given to the external circuit from the battery, not from any electrode. The rest is correct.</p>

## Item 1 Biology

### Topic B8 Enzymes

Testing Point – Ability to apply knowledge of the mechanism of enzyme action in the context of enzymatic reaction.

















Stem	Which of the changes in the graphs below occur during the progression of an enzymatic reaction from its initiation to the formation of the final product?
Diagram	<p>The diagram consists of four separate graphs, each with a vertical y-axis and a horizontal time axis labeled 't'.      Graph I: The y-axis is labeled 'Enzyme-substrate complex'. The curve starts at a high point, dips to a minimum, and then rises again.      Graph II: The y-axis is labeled 'Product'. The curve starts at zero and rises in a sigmoidal (S-shaped) curve, eventually leveling off.      Graph III: The y-axis is labeled 'Substrate'. The curve starts at a high point and decreases in a sigmoidal shape, eventually leveling off at zero.      Graph IV: The y-axis is labeled 'Free enzyme amount'. The curve starts at zero, rises to a peak, and then falls back to zero.</p>
Option A	I and IV
Option B	II and III
Option C	II, III and IV
Option D	I, II and III
Option E	I, II, III and IV
Answer Key	B
Explanation/Rationale and assumed knowledge	<p>The enzyme-substrate complex should initially increase as the substrate binds to the enzyme, and then decrease as the substrate is converted into the product and the complex dissociates. Therefore, the amount of free enzyme should first decrease and then increase as the substrate is converted into product. – I and IV are false.</p>



## Item 2 Biology

### Topic B4.3 Monohybrid crosses

Testing Point – Ability to apply knowledge of expressing outcome as in phenotypes the context of monohybrid crosses.

Stem	The phenotypes of normal and wrinkled peas are illustrated below. Given that the wrinkled phenotype in peas is due to a recessive homozygous genotype, which of the following crosses cannot produce a pea with the specified phenotype?
Diagram	
Option A	<p>P:  x </p> <p>F<sub>1</sub>: </p>
Option B	<p>P:  x </p> <p>F<sub>1</sub>: </p>
Option C	<p>P:  x </p> <p>F<sub>1</sub>: </p>
Option D	<p>P:  x </p> <p>F<sub>1</sub>: </p>
Option E	<p>P:  x </p> <p>F<sub>1</sub>: </p>
Answer Key	E

Explanation/Rationale and assumed knowledge	The wrinkled phenotype is the result of a recessive homozygous gene, so option E is not possible.
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### Item 3 Biology

Topic B2.1 Know and understand the processes of diffusion, osmosis and active transport, including examples in living and non-living systems.

Testing Point – Ability to apply knowledge of the processes of diffusion, osmosis and active transport in the context of movement across membranes.

Stem	<p>An amoeba with a glucose concentration of 3% was placed in the solution as shown below. Given that no glucose or starch molecules were detected in the container after a while, which of the below statements are correct?</p> <p>I- The amoeba absorbed all the glucose molecules through active transport.</p> <p>II- The amoeba ingested the starch molecules consuming energy in the process.</p> <p>III- The amoeba is definitely alive.</p>
Diagram	
Option A	Only I
Option B	Only II
Option C	II and III
Option D	I and III
Option E	I, II and III
Answer Key	C
Explanation/Rationale and assumed knowledge	<p>I is false - The amoeba had a lower glucose concentration than the outside environment, so it initially used passive transport to equalize the glucose concentration. Once equilibrium was reached, it then employed active transport.</p> <p>The other options are correct.</p>

## Item 4 Biology

Topic B9.2 e. Excretory system

Testing Point – Ability to apply knowledge of function of kidneys in the context of understanding the role of the kidneys in homeostasis

Stem	<p>The excretory system plays a crucial role in maintaining homeostasis in humans. Which of the following functions are part of its responsibilities?</p> <ul style="list-style-type: none"> <li>I- adjusting blood volume and pressure</li> <li>II- removal of digestive wastes from blood</li> <li>III- regulation of red blood cell production</li> <li>IV- maintaining minerals in blood plasma at specific threshold values</li> </ul>
Diagram	N/A
Option A	I and II
Option B	II and IV
Option C	I, II and III
Option D	I, III and IV
Option E	I, II, III and IV
Answer Key	E
Explanation/Rationale and assumed knowledge	<p>Kidneys have crucial role in homeostasis:</p> <ul style="list-style-type: none"> <li>- maintaining minerals in blood plasma at specific threshold values (K<sup>+</sup>, HCO<sub>3</sub><sup>-</sup>, Na<sup>+</sup> etc)</li> <li>- adjusting blood volume and pressure</li> <li>- regulation of red blood cell production by the release of erythropoietin hormone.</li> <li>- removal of nitrogenous wastes from blood</li> </ul> <p>All true.</p>

## Item 5 Biology

### Topic B9.3 Homeostasis

Testing Point – Ability to apply knowledge of the regulation of blood glucose levels, including the role of insulin and glucagon in the context of homeostasis.

Stem	The change in blood sugar levels of a healthy person over time, along with the indication of the normal amount, is shown below. Accordingly, which of the following statements cannot be made about the time intervals?
Diagram	
Option A	At t1, the person had sugary food.
Option B	At t2, insulin is being effective.
Option C	At t3, blood sugar decreased due to excessive insulin secretion.
Option D	At t4, glucagon might be effective.
Option E	At t5, the person is hungry.
Answer Key	C
Explanation/Rationale and assumed knowledge	Insulin is released to bring the blood sugar back to its normal level. Therefore, the answer is C.