Mark Scheme (Results)

June 2022

Pearson Edexcel International Advanced Level In Biology (WBI15)
Paper 01
Respiration, Internal Environment,
Coordination and Gene Technology

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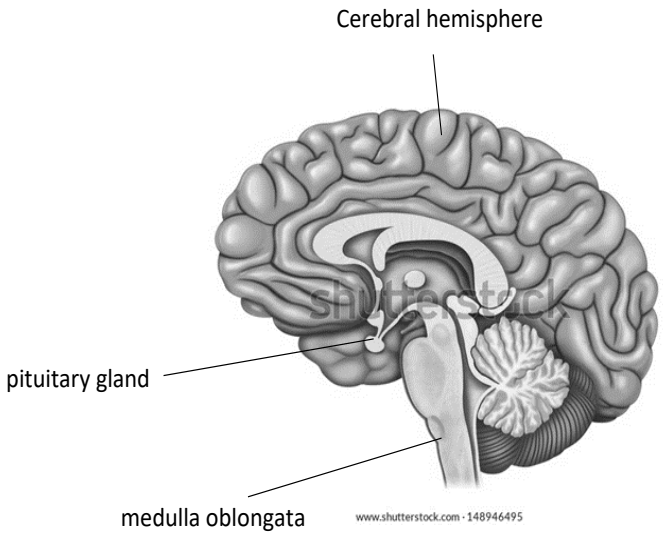
June 2022
Question Paper Log Number P70955A
Publications Code WBI15_01_2206_MS

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question number	Answer	Additional guidance	Mark
1(a)	• correctly labelled pituitary gland (1) • correctly labelled medulla oblongata (1) • correctly labelled cerebral hemisphere / cerebrum (1)	 do not accept two lines from a label do not accept cerebellum label	**(3)**

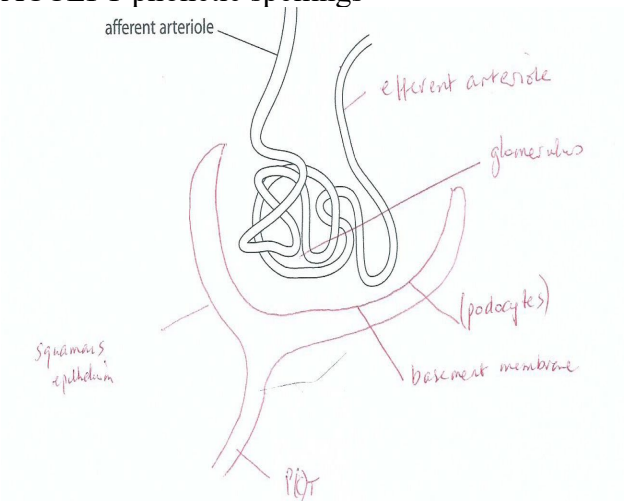
<table>
<tr><th>Question number</th><th>Answer</th><th>Additional guidance</th><th>Mark</th></tr>
<tr><td>1(b)</td><td>
<table>
<tr><th>Part of the brain</th><th>Function</th></tr>
<tr><td>cerebellum</td><td>(coordination of voluntary) movements</td></tr>
<tr><td>medulla oblongata</td><td>control of heartbeat and breathing</td></tr>
<tr><td>cerebral hemisphere (cerebrum)</td><td>(control of) voluntary behaviour / site of intelligence</td></tr>
</table>
</td><td>2 marks maximum

ACCEPT posture, balance and speech
ignore co-ordination unqualified

ACCEPT pons / medulla

ACCEPT memory / learning / thinking/ emotions / imagination / voluntary response/ motor skills (only if they refer to cerebral cortex)

all 3 spaces correct = 2 marks
2 spaces correct = 1 mark
1 space correct = 0 mark</td><td>(2)</td></tr>
</table>

Question number	Answer	Additional guidance	Mark
2(a)(i)	• correct shape given (1) • one correct labelled feature (1) • second correctly labelled structure (1)	cup shaped around glomerulus doesn't need to completely envelop / must have PCT possible labels: efferent arteriole glomerulus PCT proximal (convoluted)tubule/tube podocytes basement membrane squamous epithelium ACCEPT phonetic spellings  	**(3)**

	Answer	Mark
2(a)(ii)	The correct answer is B • A is not the correct answer because amylose is not found in blood • C is not the correct answer because haemoglobin is too big a molecule to be filtered • D is not the correct answer because prothrombin is too big a molecule to be filtered	**(1)**

	Answer	Mark
2(a)(iii)	The correct answer is D • A is not the correct pathway • B is not the correct pathway • C is not the correct pathway	**(1)**

Question number	Answer	Additional guidance	Mark
2 (b)	A description that includes the following points: • occurs in proximal (convoluted) tubule (1) • using {transport molecules / transporters/ active transport} (in the membrane of the nephron) (1) • (co transport) with sodium ions (1) • diffuse into blood (capillaries) {down /along} concentration gradient (1)	ACCEPT channel proteins / carrier proteins ignore ref to sodium pump ACCEPT facilitated diffusion	**(3)**

Question number	Answer	Additional guidance	Mark
2 (c)	The correct answer is C • A is not the correct answer • B is not the correct answer • D is not the correct answer		**(1)**

Question number	Answer	Additional guidance	Mark
3(a)(i)	An answer that includes the following point: B is the correct answer • A is not the correct answer as adrenal glands do not produce ADH • C is not the correct answer as the medulla oblongata does not produce ADH • D is not the correct answer as the pituitary gland does not produce ADH		**(1)**

Question number	Answer	Additional guidance	Mark
3(a)(ii)	An answer that includes the following point: B is the correct answer • A is not the correct answer as ADH does not act on the capillaries • C is not the correct answer as ADH does not act on the proximal tubules • D is not the correct answer as ADH does not act on the ureters		**(1)**

Question number	Answer	Additional guidance	Mark
3(a)(iii)	An answer that includes the following point: C is the correct answer • A is not the correct answer as the countercurrent multiplier does not control plasma volume • B is not the correct answer as habituation is a behavioural response • D is not the correct answer as control of plasma volume is not a positive feedback		**(1)**

Question number	Answer	Additional guidance	Mark
3(a)(iv)	• osmoreceptors	ACCEPT osmotic receptor	**(1)**

Question number	Answer	Additional guidance	Mark
3(b)(i)	An answer that includes the following points: • increasing concentration of the gibberellin increases {length / growth} (of all internodes) (1) • increase is mostly in the length of the first internode (1)	ACCEPT positive correlation ignore gibberellin increases plant growth unqualified ACCEPT {least / smallest} effect on the last/3rd internode	**(2)**

Question number	Answer	Additional guidance	Mark
3(b)(ii)	An answer that includes three of the following points: • gibberellin {enters the nucleus / binds to cell surface receptors} (1) • gibberellin {acts as a transcription factor / activates transcription factor} (1) • effect of transcription factor (1) • (causing) cell elongation / cell division (and causes internode elongation) (1)	ACCEPT secondary messenger e.g. activates protein synthesis / stimulates amylase production / amylase breaking starch down into glucose for respiration	**(3)**

Question number	Answer	Additional guidance	Mark
4(a)	An explanation that includes three of the following points: • dopamine cannot cross the blood brain barrier (1) • this drug ensures more L-dopa {is present in blood /can cross the brain barrier / reaches the brain} (1) • resulting in (a greater) increase in dopamine levels in the brain (1) • statement about why increased dopamine would help treat Parkinson's (1)	ACCEPT larger ignore large ACCEPT L-dopa (only) converted to dopamine in the brain e.g. transmission of electrical impulses to post synaptic neurones / increase in motor responses	**(3)**

Question number	Answer	Additional guidance	Mark
4(b)(i)	An explanation that includes the following points: • {control gene / genetic engineering process} has no effect (on L-dopa synthesis) (1) • MYB12 gene has {little / no} effect on L-dopa synthesis (1) • The CYP76 gene causes a {big/ 9mg} increase in concentration of L-dopa (because it codes for a protein involved in the production of L-dopa) (1) • combination of MYB12 and CYP76 produce largest concentration of L-dopa because {MYB12/ the transcription factor} increases production of CYP76 protein (1)	ACCEPT it increases it by 1.25 times/eq ACCEPT CYP76 gene gives {most / more / larger} L-dopa when used individually NOTE if they state CYP76>MYB12>control then award mp3	**(4)**

Question number	Answer	Additional guidance	Mark
4(b)(ii)	A description that includes the following points: • {the gene / CYP76} that converts tyrosine to L dopa is {extracted / isolated} (1) • use of same {endonuclease / restriction enzyme} to cut genetic material of plasmid (and isolated gene) (1) • method of insertion of vector into a {tomato/host} cell (1)	ACCEPT {isolate / extract / cut out / synthesise} the gene ACCEPT description of method of insertion e.g. use of {gene gun /heat shock/ liposomes / CRISPR} e.g. infect using {non-lytic virus / Agrobacterium tumefaciens}	**(3)**

Question number	Answer	Additional guidance	Mark
5(a)(i)	An answer that includes the following point: • D is the correct answer • A is not the correct answer as an axon is not the space between sensory and relay neurone • B is not the correct answer as a cell body is not the space between sensory and relay neurone • C is not the correct answer as a post synoptic membrane is not the space between sensory and relay neurone		**(1)**

Question number	Answer	Additional guidance	Mark
5(a)(ii)	An answer that includes three of the following points: Similarities • both transmit (electrical) impulses (1) • both may synapse with relay neurones (1) Differences • sensory neurone impulses go towards the {CNS/relay neurone} whereas motor neurone impulses go away from {CNS/relay neurone} (1) • sensory neurones transmit impulses from {receptor /sensory} cells whereas motor neurone transmit impulses to {effector/muscle} cells (1)	do not piece together – has to be in same / adjacent sentences (but not separate paragraphs) do not accept messages / signals for S1, D1 and D2 ACCEPT both release neurotransmitters (in synapse) ignore brain Note: sensory sends impulses from receptor to CNS and motor brings impulse from CNS to effector = both D1 and D2	**(3)**

Question number	Answer	Additional guidance	Mark
5(b)	An answer that includes three of the following points: • {loss of / no} (insulating) myelin (1) • decreases speed of nerve impulse / depolarisation no longer just occurs at nodes of Ranvier (1) • motor neurones {no longer transmit impulses / impulses are transmitted slower} (causing loss of function in the affected area) (1) • impulses from receptors do not reach CNS / impulses are not transmitted along sensory neurones to CNS (1)	ACCEPT nerve impulses take longer as has to go through all neurone not just nodes of Ranvier ACCEPT saltatory conduction does not occur ignore impulses being lost ACCEPT {fewer/slower} impulses reaching {effector /muscles} (so loss of function) (slower both mp2&3) ACCEPT fewer impulses from receptors reach CNS	**(3)**

Question number	Answer	Additional guidance	Mark
5(c)	An explanation that includes four of the following points: • a mutation changes {the base sequence (of this gene) / the amino acid sequence} (of the calcium ion channel protein) (1) • {resulting in a change in shape / prevents the opening} of the calcium ion channel (1) • this stops influx of calcium ions (across presynaptic membrane) (1) • (fewer calcium ions result in) fewer vesicles containing neurotransmitter fusing with presynaptic membrane (1) • fewer {nerve impulses/action potentials} generated at post synaptic {membrane / neurone} (1)	ACCEPT stops calcium ions passing through {membrane / ion channel} ACCEPT prevents release of neurotransmitter /less neurotransmitter will be released (into synapse) ACCEPT less depolarisation of post synaptic {membrane / neurone}	**(4)**

Question number	Answer	Mark
6(a)	An answer that includes the following point: B 1 is the correct answer • A, 0 is not the correct answer as the third statement only is correct • C, 2 is not the correct answer as the third statement only is correct • D, 3 is not the correct answer as the third statement only is correct	

Question number	Answer	Additional guidance	Mark
6(b)(i)	A calculation showing the following steps: • calculation of cardiac output / min (1) • conversion to dm^3 and output per hour and given to two significant figures (1)	(77x70) = 5390 ((5390 x 60) /1000)) = 320 Correct answer gains 2 marks x60 first and do the x70 afterwards. e.g. 1 mark for 4620 if they don't get the correct answer	**(2)**

Question number	Answer	Additional guidance	Mark
6(b)(ii)	A calculation showing the following steps: • calculation of cardiac output (1) • correct unit stated (1) • calculation of cardiac index (1)	 mp1 for (1.49 x 2.8)= 4.2 /4.17 / 4.172 mp2 for $dm^3min^{-1}m^{-2}$ ACCEPT dm^3 m^{-2} min^{-1} ACCEPT dm^3 per min per m^2 Mp3 for (6.9/1.92) =3.5 / 3.49 / 3.489 ACCEPT values / units in working if table is empty (or by formula)	**(3)**

Question number	Answer Additional guidance	Mark
6(b)(iii)	An answer that includes the following points: **Indicative content** - description from graphs and experimental data **Heart rate:** • as the concentration of adrenaline increases, the increase in heart rate increases in both groups • this increase is (slightly) {greater in the older group of people / lower in younger people} • at all concentrations of adrenaline the older group have greater {change/heart rate} / at all concentrations of adrenaline the younger group have smaller {change/heart rate} --- • but there are no error bars to judge whether or not this difference is significant • due to stated effect of aging on heart – weaker muscle/effect on SAN/lower stroke volume **Cardiac index:** • as the concentration of adrenaline increases, the increase in cardiac index increases in both groups • the increase is the same at {20 / 40} ng kg^{-1} min^{-1} • at concentrations above 40 ng kg^{-1} min^{-1} the increase is {lower in older people / greater in younger people} • overall the increase cardiac index is {lower for the older people / greater for younger people} --- • due to lower cardiac output / increased body surface area/lower stroke volume / (accept converse for younger people) • but there are no error bars to judge whether or not this difference is significant	**(6)**

Change in blood pressure

- blood pressures decrease and then increase in both groups (as adrenaline concentration increases)
- a concentration of 20 ng kg^{-1} min^{-1} decreases the blood pressure in both groups
- a concentration of **{84-120} ng kg^{-1} min^{-1}** increases the blood pressure in older people
- in older people lower change in blood pressure (in response to higher concentrations of adrenaline) / converse for younger people

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- due to stated changes of aging on heart muscle/ blood vessels/baroreceptors
- no overlap of error bars between older and younger people indicate that these differences are significant (at all concentrations of adrenaline) / the error bars overlap for some concentrations for older people meaning that these differences are not significant / the error bars do not overlap for some concentrations for younger people meaning that these differences are significant

Level 1:

1 or 2 graphs commented on changes in heart rate/cardiac index/blood pressure as concentration of adrenalin increases

Level 2:

2 or 3 graphs commented on, including details of the effect of adrenaline on older people

Level 3:

All 3 graphs commented on, including details of the effect of adrenaline on older people and discussion of the significance of the data.

Question number	Answer	Additional guidance	Mark
7(a)	• correct magnification (1) • magnification given in correct standard form (1)	(98±1 ÷ 0.00075) = 130 600 1.3 x 10^5 / 1.31 x 10^5 / 1.306 x 10^5 ACCEPT 97 ÷ 0.00075 = 1.29 x 10^5 99 ÷ 0.00075 = 1.32 x 10^5 Correct answer scores full marks	**(2)**

Question number	Answer	Additional guidance	Mark
7(b)(i)	C 3 nmol mg^{-1} min^{-1} A, B and D are not correct because the correct answer is 60 ÷ 20 = 3		**(1)**

Question number	Answer	Additional guidance	Mark
7(b)(ii)	An explanation that includes four of the following points: Sample 1: • (carbon dioxide is produced) because pyruvate can be used (as a substrate) for {aerobic respiration / link reaction} (in mitochondria) (1) Sample 2: • ADP increases rate of (aerobic) respiration (1) • because there is (sufficient) ADP for synthesis of ATP (1) Sample 3: • the pyruvate transport inhibitor stops pyruvate being taken into the {mitochondria/matrix} (1)	ACCEPT pyruvate releases carbon dioxide when forming acetyl CoA ACCEPT ADP increases rate of Krebs cycle ACCEPT ADP is converted to ATP ACCEPT ADP is not limiting ACCEPT the pyruvate transport inhibitor stops pyruvate entering {link reaction / Krebs cycle} ACCEPT pyruvate is not converted into acetyl CoA / acetyl CoA doesn't **form** (in sample 3)	**(4)**

Question number	Answer	Additional guidance	Mark
7(c)(i)	An explanation that includes the following points: • slow twitch muscle fibres have more mitochondria (than fast twitch muscle fibres) (1) • because they rely on (ATP from) aerobic respiration (1) • (slow twitch fibres have more mitochondria) because oxygen supply is sufficient / more capillaries carrying oxygenated blood / cells contain (more) myoglobin (1)	ACCEPT converse ACCEPT fast twitch relies on (ATP from) {anaerobic respiration / creatine phosphate} ACCEPT converse	**(3)**

Question number	Answer	Additional guidance	Mark
7(c)(ii)	A description that includes the following points: • ATP binds to the myosin head (1) • {releasing the myosin head from the actin strand/breaking the cross-bridge} (1) • ATP is hydrolysed (by the myosin head) (1) • providing energy to move the myosin head {back/upright} (1)	ACCEPT ATP broken down into ADP ACCEPT change shape of myosin head / return to original position Do not accept the power stroke	**(4)**

Question number	Answer	Additional guidance	Mark
8(a)	A description that includes four of the following points: • Chemoreceptors detect {pH of blood / blood CO_2 concentration} (1) • send (fewer) impulses to the {respiratory centre / ventilation centre / medulla} (1) • decreased frequency of impulses to {intercostal muscles/diaphragm} (1) • allowing (breathing muscles) to {relax / contract less frequently} (1) • rate set by the {respiratory centre / ventilation centre / medulla / pons} (1) **OR** • As air enters the lungs, stretch receptors in the lungs are activated (1) • Send impulses to inhibit inspiratory centre (1) • (resulting in) {no/fewer} impulses to {intercostal muscles/diaphragm} (1) • allowing (breathing muscles) to {relax / contract less frequently} (1) • rate set by the {inspiratory centre / expiratory centre / medulla / pons} (1)	Do not accept message / signal ACCEPT impulses sent via parasympathetic nervous system ignore ventilation centre	**(4)**

Question number	Answer	Additional guidance	Mark
8(b)	An explanation that includes three of the following points: • receptors on post-synaptic membrane (1) • (receptors) have (different) three-dimensional shapes/ are specific for (different) neurotransmitters (1) • description of response once the neurotransmitter has bound to the receptor (1)	ACCEPT {ion channel / gates} on post-synaptic membrane ACCEPT (receptors have) complementary shape to specific neurotransmitter e.g. opening of sodium channels / causing an action potential / depolarising membrane / inhibitory neurotransmitter prevents {depolarisation /action potential}	**(3)**

Question number	Answer	Additional guidance	Mark
8(c)	An answer that includes two of the following points: • release neurotransmitters (1) • that act on white blood cells / (stimulate) {spleen/thymus/lymph nodes} (1) • to {release (more/ less) cytokines / release white blood cells into blood / recruit white blood cells from blood} (1)	ACCEPT release of named neurotransmitter e.g. noradrenaline / adrenaline / epinephrine / acetylcholine ignore release of chemicals ACCEPT release (more/ less) of named chemical e.g. histamine	**(2)**

Question number	Answer	Additional guidance	Mark
8(d)	An explanation that includes the following points: • record ECG before and (for 10 minutes) after changing {posture / position} (1) • count the number of a named peaks in one minute (1) • description of how POTS is identified (1)	ACCEPT calculate heart rate e.g. {heart rate / peaks per minute} will increase by 30 bpm / heart rate will be above 120 bpm (within 10 minutes of posture change)	**(2)**

Question number	Answer	Additional guidance	Mark
8(e)	An explanation that includes four of the following points: • bolus acts as a stimulus/ receptor detects bolus (1) • motor neurone transmits (electrical) impulse to (smooth) muscle (1) • detail of how nerve impulse stimulates muscle contraction (1) • therefore {circular muscle contracts / longitudinal muscles relax} {around/above} bolus (1) • therefore {circular muscle relax / longitudinal muscles constrict} in {front/below} of bolus (1)	ACCEPT description of food stretching gut wall ACCEPT release of neurotransmitter ACCEPT {circular muscle contracts / longitudinal muscles relax} in {propulsive / proximal} segment ACCEPT {circular muscle relax / longitudinal muscles constrict} in receiving segment	**(4)**

Question number	Answer	Additional guidance	Mark
8(f)	• inadequate blood supply to a {tissue / organ} (1)	ACCEPT a named organ e.g. heart ACCEPT {inadequate / decreased / no} blood supply	**(1)**

Question number	Answer	Additional guidance	Mark
8(g)	An answer that includes one of the following points: • mutation (in gene expressed by embryological ENS) (1) • (embryological ENS) do not have surface {antigens/ receptors} that allow them to locate to bowel (1)	 ACCEPT so embryological ENS do not differentiate (into working neurones) ACCEPT conditions in the bowel may not be suitable for the growth of the embryonic cells	**(1)**

Question number	Answer	Additional guidance	Mark
8(h)	An explanation that includes three of the following points: • environmental factor changes conditions in the gut / causes a change in the gut flora (1) • therefore microbial {chemicals/toxins} released (1) • (chemicals / toxins / microbes) stimulate an {inflammatory response / immune response} (1) • explanation of how the inflammatory response occurs (1)	ACCEPT new microorganism / pathogen / microbe / bacteria ACCEPT release of {histamine / cytokines} e.g effect of histamine such as vasodilation / oedema occurs / recruitment of inflammatory cells / recruitment of white blood cells	**(3)**

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