

CHEMISTRY

UNIT 5(IAL)
2020 — 2025

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ANSWERS

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1 - (WCH11/5(IAL)_Summer_2020_Q1) - Transition Metals And Organic Nitrogen Chemistry

The heart is required for mass transport in mammals.

(a) Describe how the electrical activity of the heart controls the cardiac cycle.

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(b) Explain how electrocardiograms (ECGs) could be used to diagnose some forms of cardiovascular disease.

(2)

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- (c) The human growth factor FGF-I has been used to treat some patients with cardiovascular disease (CVD).

Describe how microorganisms could be genetically modified to produce human FGF-I.

(4)

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2 - (WCH11/5(IAL)_Summer_2020_Q2) - Transition Metals And Organic Nitrogen Chemistry

The eye is a sensory organ found in mammals.

(a) Light is detected using photoreceptors located in light-sensitive cells.

Put a cross ☒ in the box that completes each statement about photoreceptors.

(i) Light-sensitive cells are located in the

(1)

- ☒ **A** lens
- ☒ **B** optic nerve
- ☒ **C** pupil
- ☒ **D** retina

(ii) The photoreceptor in light-sensitive cells is located in

(1)

- ☒ **A** membrane bound organelles in the outer segment
- ☒ **B** membrane bound organelles in the synaptic region
- ☒ **C** the cytoplasm of the outer segment
- ☒ **D** the cytoplasm of the synaptic region

(iii) The pigment that forms the photoreceptor in the mammalian eye is

(1)

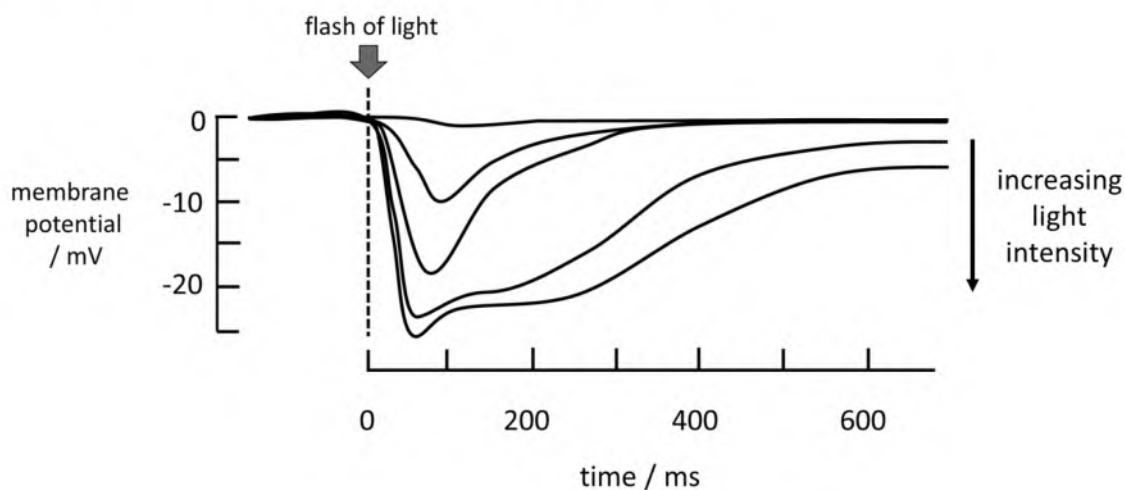
- ☒ **A** auxin
- ☒ **B** cytochrome
- ☒ **C** phytochrome
- ☒ **D** rhodopsin

(b) When stimulated by light, the light-sensitive cells become hyperpolarised.

In one investigation, the effect of a flash of light on membrane polarisation of light-sensitive cells was studied.

The graph below shows the results of this investigation.

Each line shows the response to a different light intensity.



(i) Using the information in the graph, describe the effect of light intensity on these light-sensitive cells.

(2)

(ii) Explain how increasing hyperpolarisation of light-sensitive cells results in impulses that can be interpreted by the brain.

(3)

3 - (WCH11/5(IAL)_Summer_2020_Q3) - Transition Metals And Organic Nitrogen Chemistry

Thermoregulation is a process that mammals use to regulate their body temperature.

(a) Thermoregulation is regulated by the central nervous system.

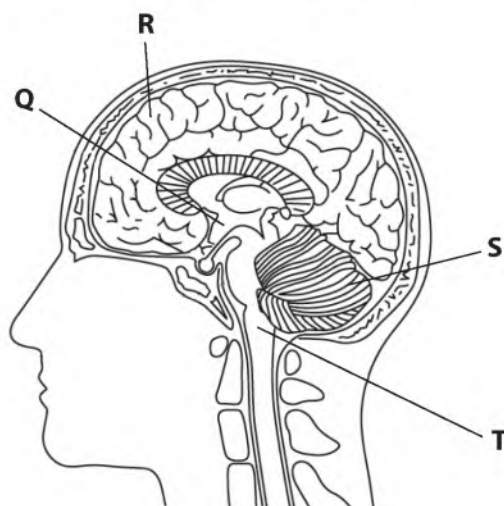
Put a cross ☒ in the box that completes each statement about thermoregulation.

(i) Thermoregulation is an example of

(1)

- ☒ **A** habituation
- ☒ **B** homeostasis
- ☒ **C** photoperiodism
- ☒ **D** respiration

(ii) The diagram shows a section through a human brain.



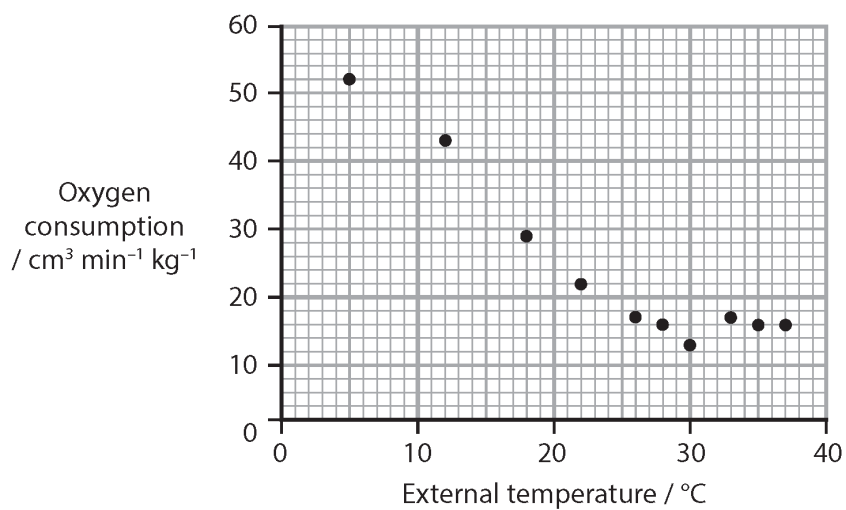
The structure that coordinates thermoregulation is labelled

(1)

- ☒ **A** Q
- ☒ **B** R
- ☒ **C** S
- ☒ **D** T

- (b) The relationship between oxygen consumption and external temperature has been investigated using mice.

The graph below shows the results of this investigation.



- (i) Describe the relationship between oxygen consumption and external temperature.

(2)

(ii) Explain the effect of external temperature on oxygen consumption.

(3)

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(iii) Explain how the results would change if the investigation used a larger mammal.

(2)

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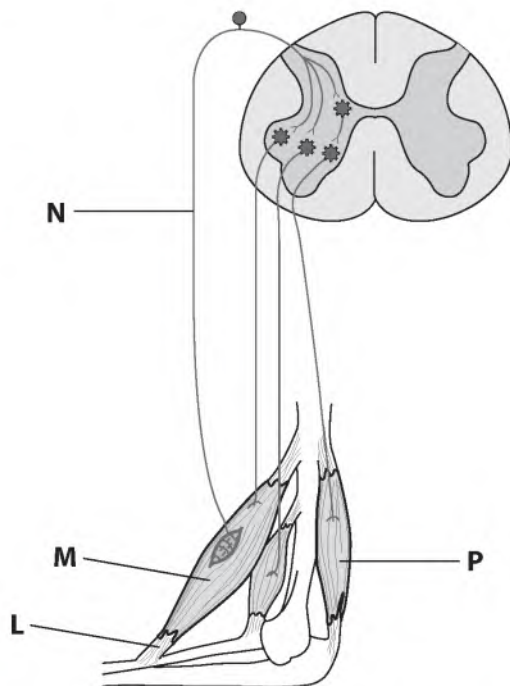
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4 - (WCH11/5(IAL)_Summer_2020_Q4) - Transition Metals And Organic Nitrogen Chemistry

Nervous communication is used to control the movement of bones at joints.

(a) The biceps reflex is a stretch reflex involving the muscles and bones in the elbow.

This reflex can be caused by tapping the arm above structure **L**, shown in the diagram below.



(i) Put a cross ☒ in the box next to the row that correctly describes the physical properties of structure **L**.

(1)

	Flexible	High elasticity
☐ A	No	No
☐ B	No	Yes
☐ C	Yes	No
☐ D	Yes	Yes

- (ii) Put a cross ☒ in the box next to the row that provides a correct description of the structures labelled **M**, **N** and **P**.

(1)

	N is a	M and P are
☒ A	motor neurone	muscles that contract together
☒ B	motor neurone	an antagonistic pair of muscles
☒ C	sensory neurone	muscles that contract together
☒ D	sensory neurone	an antagonistic pair of muscles

- *(b) Describe how an action potential is produced and the resting potential is restored in an axon.

(6)

- (c) Conduction of action potentials along motor neurones has been investigated in people with multiple sclerosis.

In one study, the time taken for an impulse to travel from the brain to the biceps was recorded for a group of people without multiple sclerosis and for a group of people with multiple sclerosis.

The time taken for an impulse to travel from the spinal cord to the biceps was also recorded for these two groups.

The table below shows the results of this study.

Group of people	Mean conduction time to the biceps $\pm$ SD / ms	
	From the spinal cord	From the brain
Without multiple sclerosis	5.9 $\pm$ 0.5	4.1 $\pm$ 0.6
With multiple sclerosis	5.3 $\pm$ 0.7	10.8 $\pm$ 5.3

- (i) Using the data in the table, describe the effect of multiple sclerosis on the speed of conduction of a nerve impulse.
- (ii) In multiple sclerosis, the immune system destroys the myelin sheath around neurones.

(2)

Explain the effect of multiple sclerosis on the speed of conduction of the impulse.

(3)

5 - (WCH11/5(IAL)_Summer_2020_Q5) - Transition Metals And Organic Nitrogen Chemistry

Plants detect and respond to changes in light conditions.

(a) Photoreceptors are involved in germination in some plants.

(i) Put a cross ☒ in the box that completes the statement about photoreceptors.

The photoreceptor in plants is called

(1)

- ☒ **A** auxin (IAA)
- ☒ **B** phytochrome
- ☒ **C** retinal
- ☒ **D** rhodopsin

(ii) The pincushion plant, *Diapensia lapponica*, is a plant adapted to an arctic habitat.

The table shows the percentage of seeds of *D. lapponica* that germinate under different conditions.

Hours of daylight	Percentage germination (%)			
	0 °C	10 °C	15 °C	20 °C
22	12	98	100	100
13	0	4	4	42
0	0	0	0	0

Put a cross ☒ in the box that identifies a correct statement about the day length and temperature required for germination of *D. lapponica* seeds.

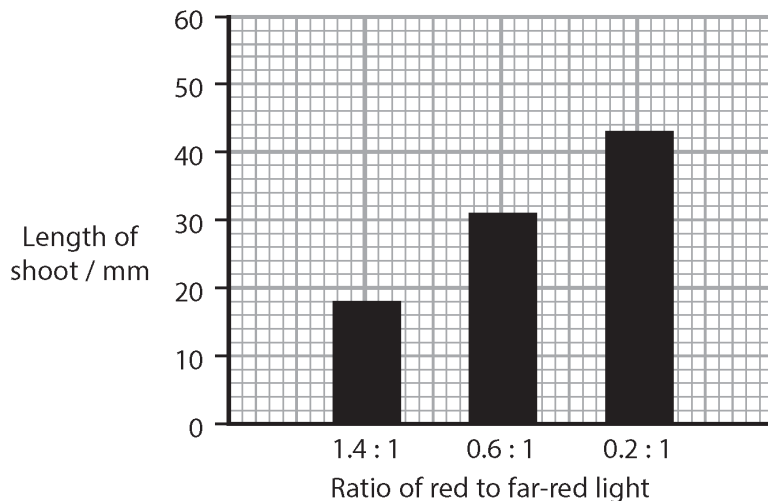
(1)

- ☒ **A** long day length at temperatures of 10 °C or above
- ☒ **B** long day length at temperatures of 10 °C or below
- ☒ **C** short day length at temperatures of 10 °C or above
- ☒ **D** short day length at temperatures of 10 °C or below

(b) The role of photoreceptors in the growth of plant shoots has been investigated.

Plant shoots were grown in different ratios of red and far-red light.

(i) The graph below shows the effect of different ratios of red to far-red light on the growth of plant shoots.



Calculate the percentage increase in the length of the shoots when the ratio of red to far-red light decreases from 1.4 : 1 to 0.2 : 1.

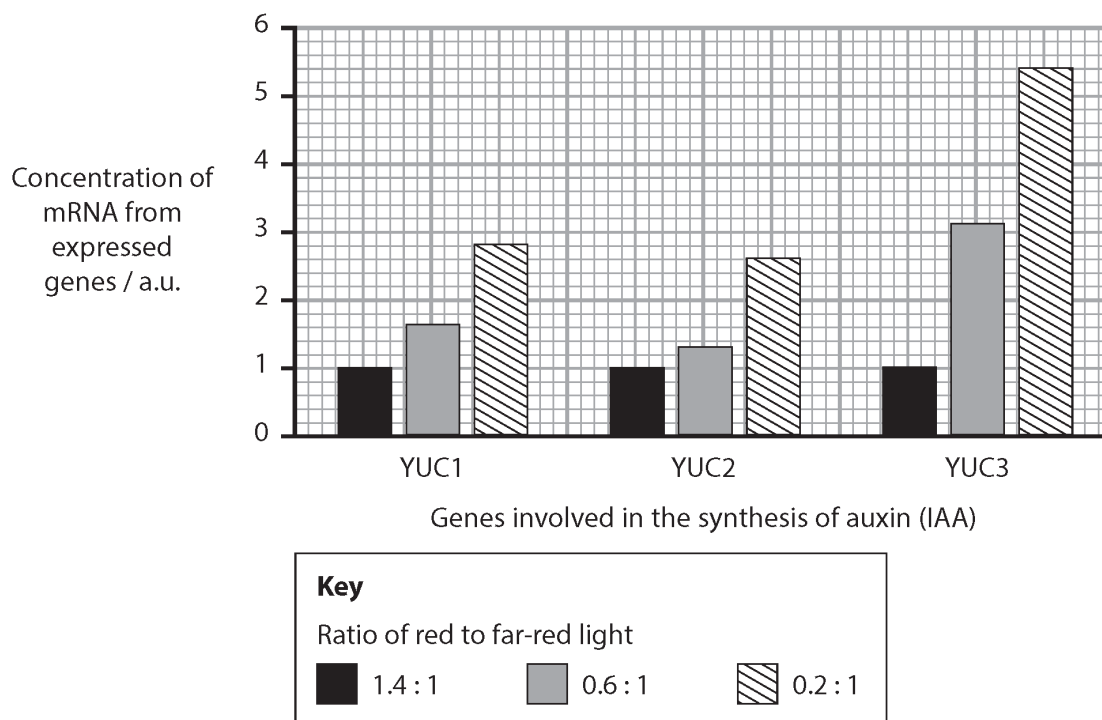
(2)

Answer %

- (ii) Three of the genes involved in the synthesis of auxin (IAA) are YUC1, YUC2 and YUC3.

The effect of different ratios of red to far-red light on the expression of these genes has been investigated.

The graph below shows the results of this investigation.



Using the information in the graph, describe the relationship between the ratios of red to far-red light and the expression of these genes.

(2)

- (iii) Using the information in the graph, explain why plant shoots grown in far-red light are taller than plant shoots grown in red light.

(4)

6 - (WCH11/5(IAL)_Summer_2020_Q6) - Transition Metals And Organic Nitrogen Chemistry

Cells produce ATP using anaerobic and aerobic respiration.

- (a) In aerobic respiration, organic molecules are oxidised in the Krebs cycle.

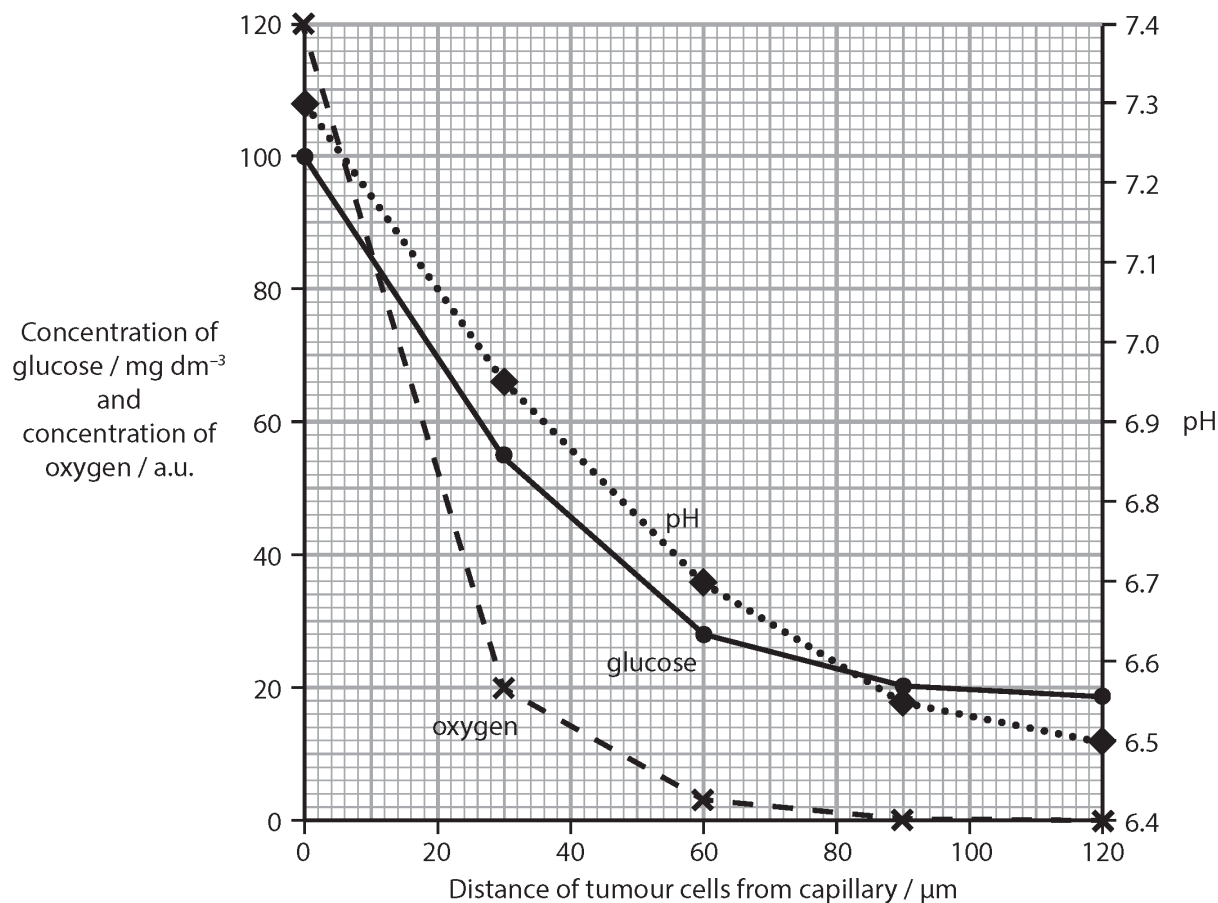
Describe how the products of the Krebs cycle are used in the production of ATP.

(5)

(b) In some tumours, cells grow rapidly and obtain nutrients from capillaries.

In one study, the concentration of glucose, the concentration of oxygen and the pH of fluid around tumour cells was investigated.

The graph below shows some of the results of this study.



(i) Calculate the percentage decrease in oxygen concentration when the glucose concentration has fallen by 50% of its highest concentration.

(3)

Answer %

(ii) Explain the changes in pH recorded in this study.

(3)

ANSWERS

1 - (WCH11/5(IAL)_Summer_2020_Q1) - Transition Metals And Organic Nitrogen Chemistry

Question Number	Answer	Additional Guidance	Mark
(a)	1. SAN initiates wave of depolarisation 2. idea that electrical impulses spreads across the atria/causes atria to contract ; 3. (wave of depolarisation) is delayed by AVN ; 4. wave of depolarisation spreads across ventricles/causes ventricles to contract ; 5. frequency at which heart muscle fibres contract is regulated by the frequency of electrical impulses arriving at the SAN / speed at which electrical impulses spread across the heart determines the length of the cardiac cycle} ;	ALLOW impulse	(3)

Question Number	Answer	Additional Guidance	Mark
(b)	1. an ECG is a recording of the electrical activity of the heart ; 2. decreased frequency of ECG peaks suggest a decrease in heart rate ; 3. change in/irregular distance between named parts of ECG trace suggest a change in the cardiac cycle ;	ALLOW converse e.g. longer time between Q and T suggests heart takes longer to recover between heart beats	(2)

Question Number	Answer	Additional Guidance	Mark
(c)	1. the FGF-1 gene is removed from (the DNA) of a human ; 2. gene/plasmid is cut using a restriction enzyme/endonuclease ; 3. gene and plasmid are joined using (DNA) ligase ; 4. plasmid with the FGF-1 gene is inserted into bacteria ; 5. credit additional information on method of inserting plasmid into the bacteria ;	ALLOW gene is synthesised based on known DNA sequence ALLOW other appropriate microorganisms e.g. yeast	(4)

2 - (WCH11/5(IAL)_Summer_2020_Q2) - Transition Metals And Organic Nitrogen Chemistry

Question Number	Answer	Additional Guidance	Mark
(a)(i)	D retina A is not correct. The lens focusses light on the retina at the back of the eye. B is not correct. The optic nerve transmits impulses from the retina to the brain. C is not correct. The pupil is an opening in the iris that allows light into the eye.		(1)

Question Number	Answer	Additional Guidance	Mark
(a)(ii)	A membrane bound organelles in the outer segment B is not correct. The membrane bound vesicles containing the photoreceptor is in the outer segment of the cell. C is not correct. The photoreceptor is located in membrane bound vesicles. D is not correct. The photoreceptor is located in membrane bound vesicles in the outer segment.		(1)

Question Number	Answer	Additional Guidance	Mark
(a)(iii)	D rhodopsin A is not correct. Auxin is a growth factor found in plant cells. B is not correct. Cytochrome is a pigment found in the electron transport chain C is not correct. Phytochromes are pigments found in plant cells.		(1)

Question Number	Answer	Additional Guidance	Mark
(b)(i)	- the more intense the light flash the more (hyper)polarised the cell membrane becomes / the greater the intensity the more negative the membrane potential becomes ; - the more intense the flash the longer the cell remains (hyper)polarised / the greater the intensity the longer the membrane potential stay negative ; - there is a maximum (hyper)polarisation so (very) high light intensity has no further effect on the size of the membrane potential / the more intense the light the more rapidly the cells are hyperpolarised ;	ALLOW membrane potential decreased more	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	- the greater the {hyperpolarisation/generator potential} the {less / no} {glutamate / neurotransmitter} is released (by the rod cell) ; - the greater the number of action potentials generated in the {bipolar cell / sensory neurone} ; - increased frequency of action potentials is interpreted as more intense light ; (by) the visual cortex/occipital lobe ;	ALLOW optic nerve	(3)

3 - (WCH11/5(IAL)_Summer_2020_Q3) - Transition Metals And Organic Nitrogen Chemistry

Question Number	Answer	Additional Guidance	Mark
(a)(i)	B homeostasis A is not correct. Habituation is a learned response. C is not correct. Photoperiodism is a response that is controlled by a light cycle. D is not correct. Respiration is a metabolic process.		(1)

Question Number	Answer	Additional Guidance	Mark
(a)(ii)	A Q B is not correct. R is the cerebrum. C is not correct. S is the cerebellum D is not correct. T is the medulla oblongata		(1)

Question Number	Answer	Additional Guidance	Mark
(b)(i)	1. inverse relationship (between temperature and oxygen consumption) for temperatures up to {26 °C / 30 °C} ; 2. no change in oxygen consumption for temperatures above {26 °C / 30 °C} ; 3. credit a quantitative statement to support mark point 1 ;	e.g. calculation of the gradient of the line between 5 and 26 °C ;	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	1. as temperature decreases mouse {loses heat faster / needs to produce more heat} ; 2. (as part of homeostatic response) (aerobic) respiration/metabolism increases ; 3. to provide ATP for increased {muscle contractions / shivering} ; 4. respiration produces heat (to help maintain body temperature) ;	Converse for all mps NOT energy unqualified	(3)

Question Number	Answer	Additional Guidance	Mark
(b)(iii)	1. a larger animal has a smaller surface area to volume ratio ; 2. the smaller the surface area to volume ratio the slower the rate of heat loss ; 3. idea that the graph will have a less steep gradient/ will level off at a lower oxygen consumption rate ;	ALLOW 'not as easily' ALLOW idea that less affected by change in (environmental) temperature / curve to the left of this data because lower metabolic rate	(2)

4 - (WCH11/5(IAL)_Summer_2020_Q4) - Transition Metals And Organic Nitrogen Chemistry

Question Number	Answer	Additional Guidance	Mark
(a)(i)	C Yes No A is not correct because L is a tendon and is flexible B is not correct because L is a tendon and is flexible but not elastic D is not correct because L is a tendon and is not elastic		(1)

Question Number	Answer	Additional Guidance	Mark
(a)(ii)	D N is a sensory neurone M and P are an antagonistic pair of muscles A is not correct because N is a sensory neurone and M and P are an antagonistic pair of muscles B is not correct because N is a sensory neurone C is not correct because M and P are an antagonistic pair of muscles		(1)

Question Number	Answer	Additional Guidance	Mark
* (b)	QWC emphasis on a logical sequence 1. (voltage gated) sodium (ion) channels open ; 2. allowing sodium ions to diffuse/move into the axon / neuron ; 3. the {axon/neuron} becomes {depolarised / positively charged inside} ; 4. (voltage-gated) sodium (ion) channels close ; 5. (voltage gated) potassium (ion) channels open ; 6. potassium ions {diffuse/move} out of the axon, repolarising the membrane ; 7. the membrane becomes hyperpolarised, closing (voltage gated) potassium (ion) channels ; 8. potassium ions {diffuse/move} back into the axon through the (non-gated) potassium (ion) channels, restoring the resting potential / Na⁺ K⁺ pump re-establishes resting potential ;		(6)

Question Number	Answer	Additional Guidance	Mark
(c)(i)	- no (significant) difference in conduction speed from spinal cord to biceps ; - conduction speed from brain to biceps is {slower/decreased} in people with multiple sclerosis ; - credit use of manipulated data to support mark points 1 or 2 ;	ALLOW ref to time IF comparable ALLOW idea that speed in PNS not affected ALLOW idea that speed in CNS is decreased	(2)

Question Number	Answer	Additional Guidance	Mark
(c)(ii)	- conduction speed is faster in myelinated neurones ; - because (in myelinated neurones) {action potentials jump between gaps in the myelin sheath / of saltatory conduction} ; - when myelin is removed action potentials have to move along the whole axon (slowing down the speed of conduction) ;	ALLOW converse argument ALLOW impulse	(3)

5 - (WCH11/5(IAL)_Summer_2020_Q5) - Transition Metals And Organic Nitrogen Chemistry

Question Number	Answer	Additional Guidance	Mark
(a)(i)	B phytochrome A is not correct. Auxin is a plant growth factor. C is not correct. Retinal is a part of the photoreceptor found in mammals D is not correct. Rhodopsin is the photoreceptor found in mammals.		(1)

Question Number	Answer	Additional Guidance	Mark
(a)(ii)	A long day length at temperatures of 10 °C or above B is not correct because very little germination occurred at °C C is not correct because significant germination only occurred with 22 hours of daylight D is not correct because significant germination only occurred with 22 hours of daylight at temperatures of 10 °C or above		(1)

Question Number	Answer	Additional Guidance	Mark
(b)(i)	1. $43 - 18 = 25$; 2. $(25 \div 18) \times 100 = 139$ (%)	ALLOW 138.9, 140, 139 Correct answer with no working gains both marks	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	1. as the ratio of red to far-red light decreases {gene expression / mRNA synthesis} (for all three genes) increases ; 2. the effect on YUC3 is greater (than on the other two genes) ; 3. appropriate manipulation of data to support MP1 or 2 ;	Eg. increasing red to far-red ratio from 1.4 :1 to 0.2:1 increases concentration of mRNA au in YUC1 by 1.8/ YUC2 by 1.6/YUC3 by 4.5	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(iii)	1. reference to phytochromes ; 2. conversion of phytochrome red to far-red or vice versa ; 3. as ratio of {red to far-red decreases / far-red to red increases} more mRNA synthesis ; 4. (more mRNA synthesis results in) more auxin (IAA) ; 5. more auxin stimulates more shoot growth / cell elongation ;	ALLOW protein in place of auxin	(4)

6 - (WCH11/5(IAL)_Summer_2020_Q6) - Transition Metals And Organic Nitrogen Chemistry

Question Number	Answer	Additional Guidance	Mark
(a)	1. reference to {reduced NAD / reduced FAD / reduced coenzymes} ; 2. transport {hydrogen atoms / (protons and) electrons} to the electron transport chain ; 3. electrons move along electron transport chain (in series of redox reactions) ; 4. energy (released) is used to pump {protons / H^+ / hydrogen ions} into the inter-membrane space ; 5. protons {diffuse/move} (down electrochemical gradient) through {ATP synthase / ATPase / stalked particle} (back into the matrix) ; 6. (catalysing the) formation of ATP from ADP and P_i ;	ALLOW electrons move along cytochromes ALLOW reference to chemiosmosis ALLOW phosphorylating ADP or equation $ADP + P_i \rightarrow ATP$ IGNORE producing ATP	(5)

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