

# CHEMISTRY

UNIT 5(IAL)  
2020 — 2023

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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.

(3)

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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)

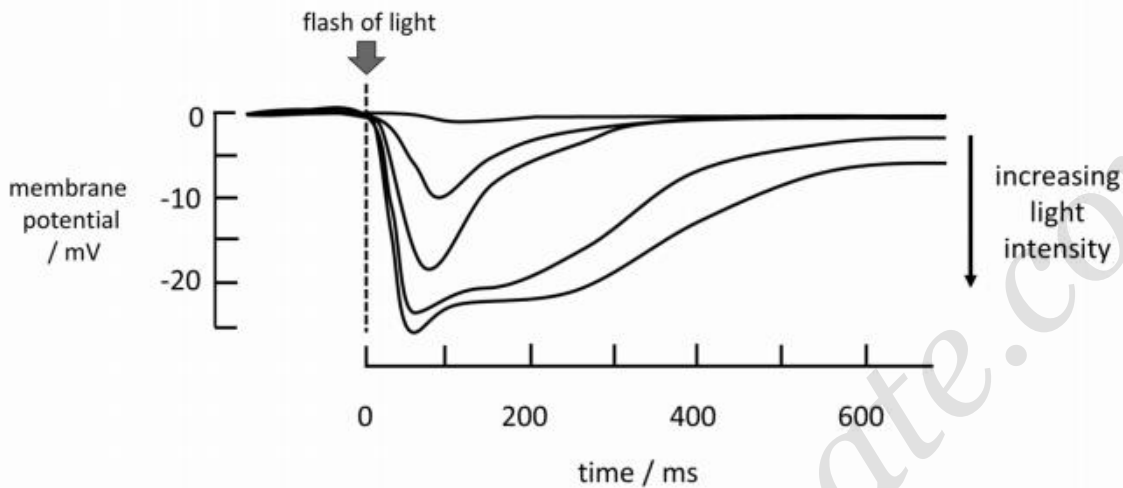
- A** auxin
- B** cytochrome
- C** phytochrome
- D** rhodopsin

(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.

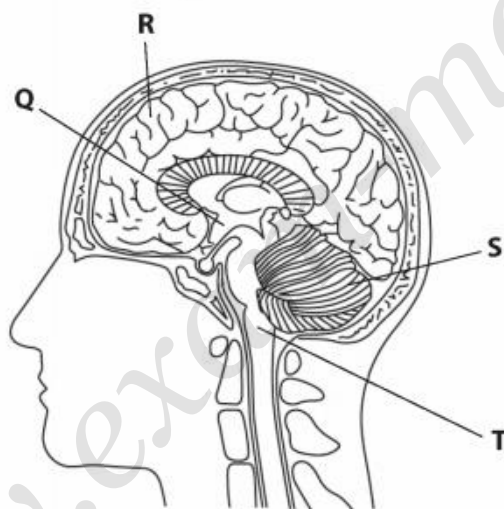
Put a cross  in the box that completes each statement about thermoregulation.

(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.



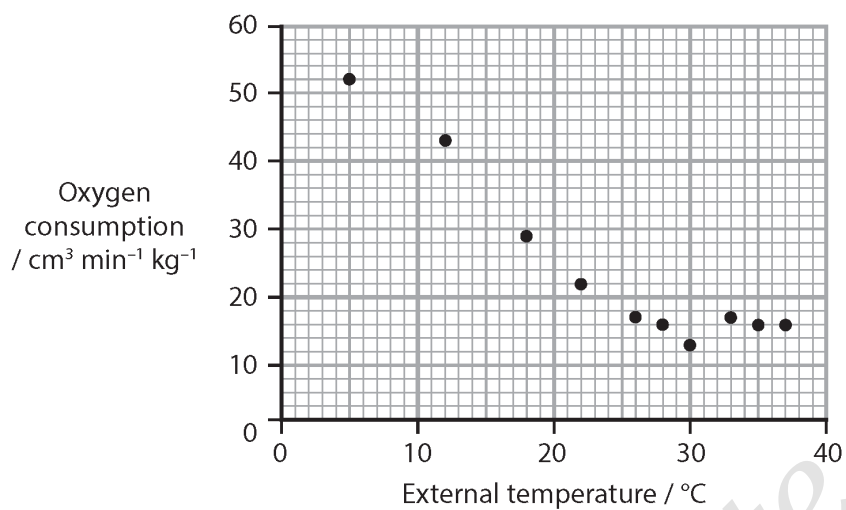
The structure that coordinates thermoregulation is labelled

(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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# ANSWERS

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## 1 - (WCH11/5(IAL)\_Summer\_2020\_Q1) - Transition Metals And Organic Nitrogen Chemistry

Question Number	Answer	Additional Guidance	Mark
(a)	<ol style="list-style-type: none"> <li>SAN initiates wave of depolarisation</li> <li>idea that electrical impulses spreads across the atria/causes atria to contract ;</li> <li>(wave of depolarisation) is delayed by AVN ;</li> <li>wave of depolarisation spreads across ventricles/causes ventricles to contract ;</li> <li>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] ;</li> </ol>	ALLOW impulse	(3)

Question Number	Answer	Additional Guidance	Mark
(b)	<ol style="list-style-type: none"> <li>an ECG is a recording of the electrical activity of the heart ;</li> <li>decreased frequency of ECG peaks suggest a decrease in heart rate ;</li> <li>change in/irregular distance between named parts of ECG trace suggest a change in the cardiac cycle ;</li> </ol>	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)	<ol style="list-style-type: none"> <li>the FGF-1 gene is removed from (the DNA) of a human ;</li> <li>gene/plasmid is cut using a restriction enzyme/endonuclease ;</li> <li>gene and plasmid are joined using (DNA) ligase ;</li> <li>plasmid with the FGF-1 gene is inserted into bacteria ;</li> <li>credit additional information on method of inserting plasmid into the bacteria ;</li> </ol>	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)	<b>D retina</b>  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)	<b>A membrane bound organelles in the outer segment</b>  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)	<b>D rhodopsin</b>  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)	<ol style="list-style-type: none"> <li>1. 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 ;</li> <li>2. the more intense the flash the longer the cell remains (hyper)polarised / the greater the intensity the longer the membrane potential stay negative ;</li> <li>3. 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 ;</li> </ol>	ALLOW membrane potential decreased more	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	<ol style="list-style-type: none"> <li>1. the greater the {hyperpolarisation/generator potential} the {less / no} {glutamate / neurotransmitter} is released (by the rod cell) ;</li> <li>2. the greater the number of action potentials generated in the {bipolar cell / sensory neurone} ;</li> <li>3. increased frequency of action potentials is interpreted as more intense light ;</li> <li>4. (by) the visual cortex/occipital lobe ;</li> </ol>	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>B homeostasis</b>  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)	<b>A Q</b>  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)	<ol style="list-style-type: none"> <li>inverse relationship (between temperature and oxygen consumption) for temperatures up to {26 °C / 30 °C} ;</li> <li>no change in oxygen consumption for temperatures above {26 °C / 30 °C} ;</li> <li>credit a quantitative statement to support mark point 1 ;</li> </ol>	e.g. calculation of the gradient of the line between 5 and 26 °C ;	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	<ol style="list-style-type: none"> <li>as temperature decreases mouse {loses heat faster / needs to produce more heat} ;</li> <li>(as part of homeostatic response) (aerobic) respiration/metabolism increases ;</li> <li>to provide ATP for increased {muscle contractions / shivering} ;</li> <li>respiration produces heat (to help maintain body temperature) ;</li> </ol>	Converse for all mps  NOT energy unqualified	(3)

Question Number	Answer	Additional Guidance	Mark
(b)(iii)	<ol style="list-style-type: none"> <li>a larger animal has a smaller surface area to volume ratio ;</li> <li>the smaller the surface area to volume ratio the slower the rate of heat loss ;</li> <li>idea that the graph will have a less steep gradient/ will level off at a lower oxygen consumption rate ;</li> </ol>	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)	<p><b>C Yes No</b></p> <p>A is not correct because L is a tendon and is flexible</p> <p>B is not correct because L is a tendon and is flexible but not elastic</p> <p>D is not correct because L is a tendon and is not elastic</p>		(1)

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

Question Number	Answer	Additional Guidance	Mark
* (b)	<p>QWC emphasis on a logical sequence</p> <ol style="list-style-type: none"> <li>(voltage gated) sodium (ion) channels open ;</li> <li>allowing sodium ions to diffuse/move into the axon / neuron ;</li> <li>the {axon/neuron} becomes {depolarised / positively charged inside} ;</li> <li>(voltage-gated) sodium (ion) channels close ;</li> <li>(voltage gated) potassium (ion) channels open ;</li> <li>potassium ions {diffuse/move} out of the axon, repolarising the membrane ;</li> <li>the membrane becomes hyperpolarised, closing (voltage gated) potassium (ion) channels ;</li> <li>potassium ions {diffuse/move} back into the axon through the (non-gated) potassium (ion) channels, restoring the resting potential / Na<sup>+</sup> K<sup>+</sup> pump re-establishes resting potential ;</li> </ol>		(6)

Question Number	Answer	Additional Guidance	Mark
(c)(i)	<ol style="list-style-type: none"> <li>no (significant) difference in conduction speed from spinal cord to biceps ;</li> <li>conduction speed from brain to biceps is {slower /decreased} in people with multiple sclerosis ;</li> <li>credit use of manipulated data to support mark points 1 or 2 ;</li> </ol>	<p>ALLOW ref to time IF comparable</p> <p>ALLOW idea that speed in PNS not affected</p> <p>ALLOW idea that speed in CNS is decreased</p>	(2)

Question Number	Answer	Additional Guidance	Mark
(c)(ii)	<ol style="list-style-type: none"> <li>conduction speed is faster in myelinated neurones ;</li> <li>because (in myelinated neurones) {action potentials jump between gaps in the myelin sheath / of saltatory conduction} ;</li> <li>when myelin is removed action potentials have to move along the whole axon (slowing down the speed of conduction) ;</li> </ol>	<p>ALLOW converse argument</p> <p>ALLOW impulse</p>	(3)

5 - (WCH11/5(IAL)\_Summer\_2020\_Q5) - Transition Metals And Organic Nitrogen Chemistry

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

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

Question Number	Answer	Additional Guidance	Mark
(b)(i)	<ol style="list-style-type: none"> <li>1. <math>43 - 18 = 25</math> ;</li> <li>2. <math>(25 \div 18) \times 100 = 139</math> (%)</li> </ol>	<p><b>ALLOW 138.9, 140, 139</b></p> <p>Correct answer with no working gains both marks</p>	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	<ol style="list-style-type: none"> <li>1. as the ratio of red to far-red light decreases {gene expression / mRNA synthesis} (for all three genes) increases ;</li> <li>2. the effect on YUC3 is greater (than on the other two genes) ;</li> <li>3. appropriate manipulation of data to support MP1 or 2 ;</li> </ol>	<p>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</p>	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(iii)	<ol style="list-style-type: none"> <li>1. reference to phytochromes ;</li> <li>2. conversion of phytochrome red to far-red or vice versa ;</li> <li>3. as ratio of {red to far-red decreases / far-red to red increases} more mRNA synthesis ;</li> <li>4. (more mRNA synthesis results in) more auxin (IAA) ;</li> <li>5. more auxin stimulates more shoot growth / cell elongation ;</li> </ol>	<p><b>ALLOW</b> protein in place of auxin</p>	(4)

6 - (WCH11/5(IAL)\_Summer\_2020\_Q6) - Transition Metals And Organic Nitrogen Chemistry

Question Number	Answer	Additional Guidance	Mark
(a)	<ol style="list-style-type: none"> <li>1. reference to {reduced NAD / reduced FAD / reduced coenzymes} ;</li> <li>2. transport {hydrogen atoms / (protons and) electrons} to the electron transport chain ;</li> <li>3. electrons move along electron transport chain (in series of redox reactions) ;</li> <li>4. energy (released) is used to pump {protons / H<sup>+</sup> / hydrogen ions} into the inter-membrane space ;</li> <li>5. protons {diffuse/move} (down electrochemical gradient) through {ATP synthase / ATPase / stalked particle} (back into the matrix) ;</li> <li>6. (catalysing the) formation of ATP from ADP and Pi ;</li> </ol>	<p><b>ALLOW</b> electrons move along cytochromes</p> <p><b>ALLOW</b> reference to chemiosmosis</p> <p><b>ALLOW</b> phosphorylating ADP or equation <math>ADP + Pi \rightarrow ATP</math> <b>IGNORE</b> producing ATP</p>	(5)