Surname

Other Names



GCE A LEVEL -NEW

1400U30-1

BIOLOGY – A2 unit 3 Energy, Homeostasis and the Environment

MONDAY, 12 JUNE 2017 - AFTERNOON

2 hours

For Examiner's use only			
Question	Maximum Mark	Mark Awarded	
1.	10		
2.	11		
3.	15		
4.	7		
5.	18		
6.	20		
7.	9		
Total	90		

ADDITIONAL MATERIALS

In addition to this paper, you will require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the continuation page at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The assessment of the quality of extended response (QER) will take place in question 7.

The quality of written communication will affect the awarding of marks.













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	um ion channels in a neurone membrane.
(a)	Describe the function of sodium ion channels in a neurone membrane in response to a stimulus. [2]
(b)	Explain how lidocaine acts as a local anaesthetic. [4]
The (c)	maximum allowable dose of lidocaine for a patient is 7 mg per kg of tissue (mg kg ⁻¹). Use the equation below to calculate the maximum dose volume for a 60 kg patient if the concentration of lidocaine is 2%.
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The (c) aximur olume	maximum allowable dose of lidocaine for a patient is 7 mg per kg of tissue (mg kg ⁻¹). Use the equation below to calculate the maximum dose volume for a 60 kg patient if the concentration of lidocaine is 2%. [2] n dose = maximum allowable $\times \frac{\text{mass of patient (kg)}}{10} \times \frac{1}{\text{concentration of lidocaine (%)}}$



Examiner (d) The marine cone shell, Conus magus, releases a chemical which blocks calcium ion channels on the pre-synaptic membrane of a synapse. This has a potential use as an anaesthetic. With reference to the **pre-synaptic neurone only**, describe and explain the mechanism by which this chemical could work as an anaesthetic. [3]



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1400U301 07

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only





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Examiner Diabetes insipidus is a condition that results in excessive thirst and production of large volumes of dilute urine. This condition is different from diabetes mellitus which may result in increased glucose concentration in the urine. One cause of diabetes insipidus is the patient not releasing ADH. Suggest how this causes diabetes insipidus. [1] (C)

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Another form of diabetes insipidus is nephrogenic diabetes insipidus. This is a genetic condition caused by a dominant allele (N). This results in a change in the shape of the receptor sites for ADH.

A heterozygous sufferer with this condition has a partner who is a non-sufferer. Draw a (d) suitable genetic diagram and use this to determine the probability of them having a child who would suffer from nephrogenic diabetes insipidus. [3]

probability =

15

only



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The scientist carried out the experiment again but counted the living bacteria present each hour for 60 hours.	Examiner only
 Describe and explain the expected shape of the population growth curve between 20 and 60 hours. 	
······	
(ii) Explain how the growth curve would differ if a total count had been used to measure the population density. Suggest a disadvantage of this technique. [2]	
	400U301







(b)



	.				
	••••••				
	(iii)	Suggest a suitable	control for these experime	nts. Give a reason for you	r answer. [2]
	······				
- o ob		ant partial aut bath	overview and the class		The mean
esult	stude ts are	ent carried out both shown in the table b	experiments and the clas elow.	s results were combined	. The mean
			Mean position of c	oloured liquid / mm	
		Time / minutes	Experiment 1 (with sodium hydroxide)	Experiment 2 (with water)	
		0	0	0	
		1	13	0	
		2	22	0	
		3	35	0	
		4	49	0	
		5	61	0	
(b)	(i)	Explain why the c experiment 2.	oloured liquid moved in	experiment 1 but did r	not move in [3]
	••••••				
	.				
	••••••				••••••
	.				

(ii) 	Explain the advantages of collecting results from the whole class. [2]
(iii)	In these experiments the diameter of the lumen of the capillary tube was 1.2 mm and the total mass of maggots was 0.5 g . Calculate the rate of oxygen consumption per g for the maggots during the 5 minutes of the experiment. Give the answer in mm ³ g ⁻¹ minute ⁻¹ to 1 decimal place. [3]
	The formula for the volume of a cylinder = $\pi r^2 h$
	$\pi = 3.14$
	rate of oxygen consumption = $mm^3 g^{-1} minute^{-1}$
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(c) Scientists can use the volume of carbon dioxide produced and the volume of oxygen consumed in a given time to give the respiratory quotient (RQ). The equation for working out the RQ is: $RQ = \frac{\text{number of molecules of CO}_2 \text{ produced}}{\text{number of molecules of O}_2 \text{ consumed}}$

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The equation for respiration of glucose is:

 $C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O$

As the equation shows, 6 molecules of CO_2 are produced and 6 molecules of O_2 are consumed when 1 molecule of glucose is respired.

The RQ value for glucose is 1.

The equation for respiration of the fat tripalmitin is:

 $2 C_{51}H_{98}O_6 + 145 O_2 \longrightarrow 102 CO_2 + 98 H_2O.$

(i) Calculate the RQ for tripalmitin.

[1]

Examiner

RQ =

(ii) Use the equation for respiration of tripalmitin to suggest why desert animals such as camels use fat as a substrate for respiration. [2]

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(iii)	The respiration of fat releases more energy than the respiration of glucose produced by the breakdown of glycogen.	or
	Explain why muscles use glycogen as an energy store rather than fat. [2]	
•••••		
•••••		
		1



Examiner only A group of scientists studied the sand dune ecosystem at Ynyslas, Ceredigion. They cleared a 6. 10 m by 10 m section of land in the dunes to expose the soil. The position of this cleared area is shown by the arrow in the photograph below. land cleared here (shown prior to clearance) Each year, they randomly selected twenty 1 m² areas in the study area and identified the different species present. They noted how many plants of each species were present. Describe how and explain why the sites are selected at random. [3] (a) (i)



Ragwort 3 Birdsfoot trefoil 6 Hairy hawkbit 2 Eyebright 9 Rosebay willowherb 4 Dandelion 2 Mouse ear 4 Restharrow 7 Kidney vetch 1 Groundsel 18 Grass species 1 4 Grass species 2 5 (ii) In the first year the scientists only found four different species in the area. Identify the type of succession that has taken place in the five years of the sture and explain why the number of plant species increased. (iii) Suggest what would happen to the number of animal species in this area. Expla your answer.		Species	Mean number of plants per m ²	
Birdsfoot trefoil 6 Hairy hawkbit 2 Eyebright 9 Rosebay willowherb 4 Dandelion 2 Mouse ear 4 Restharrow 7 Kidney vetch 1 Groundsel 18 Grass species 1 4 Grass species 2 5 (ii) In the first year the scientists only found four different species in the area. Identify the type of succession that has taken place in the five years of the stud and explain why the number of plant species increased. (iii) Suggest what would happen to the number of animal species in this area. Expla your answer.		Ragwort	3	-
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(iii) Suggest what would happen to the number of animal species in this area. Expla your answer.	(ii)	Grass species 1 Grass species 2 In the first year the scientists or Identify the type of succession and explain why the number of	5 hly found four different species in t that has taken place in the five y plant species increased.	the area. /ears of the stuc
	(ii)	Grass species 1 Grass species 2 In the first year the scientists or Identify the type of succession and explain why the number of	4 5 nly found four different species in t that has taken place in the five y plant species increased.	the area. /ears of the stud



Examiner (b) Birdsfoot trefoil and restharrow are legumes, therefore they have root nodules that contain only the bacterium Rhizobium. The scientists observed that they were two of the first plants to arrive in areas with nutrient poor soils. Explain why they are able to survive in soils with low nitrogen levels. [3] (i) (ii) Rhizobium contain the enzyme nitrogenase which is responsible for fixing atmospheric nitrogen. This enzyme is inhibited if oxygen levels are high. The root nodules of legumes contain a form of haemoglobin called leghaemoglobin. This has a very high affinity for oxygen. Suggest why leghaemoglobin is present in the root nodules of restharrow and birdsfoot trefoil. [3] (C) Close to Ynyslas is the peat bog of Cors Fochno. This is an area of poor drainage where soil is waterlogged. No trees grow on Cors Fochno. The climax community is bog, which is permanently dominated by the moss, Sphagnum. (i) Explain why bog is described as the climax community. [1] [2] (ii) Explain why trees are unable to survive in waterlogged soils.



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Examiner only

7. Fish farming is an important industry in Scotland, producing almost 180000 tonnes of fish in 2014. It provides employment and financial gain for the areas where it is carried out. The number and size of fish farms has increased as one way of preventing overfishing.

The table below shows the estimated use and loss of two elements during the production of fish in Scotland by fish farming.

Nutrient output per tonne of production	Nitrogen	Phosphorus
used in feed (kg)	86	18
lost as uneaten food (kg)	4	1
lost as organic matter in faeces (kg)	12	3
lost as inorganic products (e.g. ammonium ions and phosphate ions) (kg)	37	9

Adapted from "The Interaction between Fish Farming and Algal Communities of the Scottish Waters – A Review", Rydberg, Sjoberg and Stigebrandt. Research report 2003/04.

With reference to the information provided in the table and your own knowledge, explain the possible ecological impacts of fish farming in the areas where it takes place. Describe other ways to overcome the problem of overfishing. Explain how these methods are used to prevent overfishing. [9 QER]



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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.	Examiner only



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