

88126003

## BIOLOGY HIGHER LEVEL PAPER 3

Monday 19 November 2012 (morning)

1 hour 15 minutes



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Examination code

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#### **INSTRUCTIONS TO CANDIDATES**

- · Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from two of the Options.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is [40 marks].

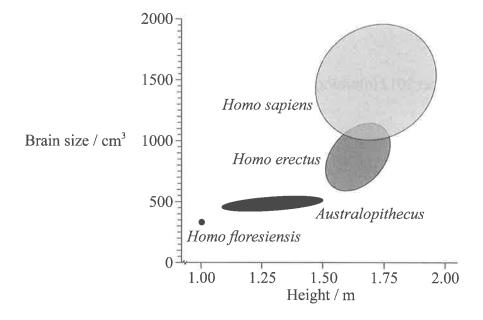




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# Option D — Evolution

D1. The diagram shows the range of heights and brain sizes found in four groups of hominids.



[Source: adapted from M M Lahr and R Foley, (2004), Nature, 431, pages 1043-1044]

(a)	State the range in orain size of H. erectus.	[1]
	a sia anamana kina kina manamana kina manamana kina manamana kina manamana kina manamana kina manamana kina ma	
(b)	Distinguish between the characteristics of the <i>Australopithecus</i> and <i>H. erectus</i> using the data.	[2]



# (Question D1 continued)

(c)	brain size necessary.	[3]
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(d)	State two ways, apart from brain volume, by which the skulls of the Australopithecus	
()	and H. erectus would differ in appearance.	[2]
	1.	
	2	



(a)	(i)	Define the term gene pool.	[1]
	(ii)	State <b>two</b> examples of barriers between gene pools.	[1
		<ol> <li>1.</li> <li>2.</li> </ol>	
(b)	Des	cribe sickle-cell anemia as an example of balanced polymorphism.	[2
(c)	Dur	ing a screening campaign of 281884 babies in Sao Paulo, Brazil, it was found	
	that	the frequency of the sickle-cell anemia allele was 0.02. Calculate the expected aber of babies <b>not</b> carrying the allele.	[2
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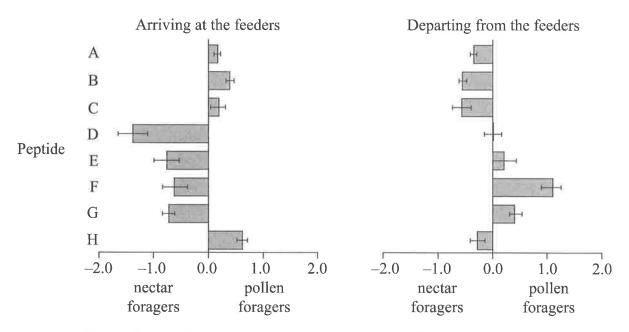


Explain the conclusions about evolution that can be drawn from the universality of DNA and protein structures, and variations in specific molecules.	
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### Option E — Neurobiology and behaviour

In order to investigate the hypothesis that honeybees (Apis mellifera) have an instinct to forage for either nectar or pollen, but not both, researchers installed different feeders containing either nectar alone or pollen alone. They collected four different groups of honeybees (those arriving at the nectar feeders, arriving at the pollen feeders, departing from the nectar feeders and departing from the pollen feeders) and measured the abundance of eight peptides in their brains. The relative difference of these brain peptides was then calculated by subtracting the abundance in nectar foragers from the abundance in pollen foragers and is shown by the bars on the graphs below.



Change in peptide abundance between nectar and pollen foragers / arbitrary units

[Source: adapted from A Brockmann, et al., (2009), PNAS, 106 (7), pages 2383–2388]

(a)	Identify which peptide shows the greatest difference between pollen foragers and nectar foragers departing from the feeders.	[1]



(Question E1 continued)

(b)	Distinguish between the difference in abundance of peptides in nectar and pollen foragers arriving at the feeders.	[2]
(c)	Evaluate the hypothesis that honeybees have an instinct to forage for <b>either</b> nectar <b>or</b> pollen, but not both.	[2]
(d)	Discuss how this type of foraging behaviour could optimize food intake.	[2
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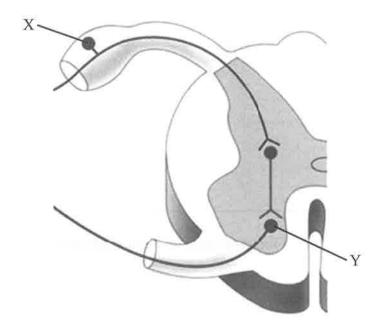


**E2.** (a) Outline **one** function for each of the following parts of the brain.

[2]

Part of brain	Function
Cerebellum	
Medulla oblongata	

(b) The following diagram shows a section through the spinal cord.



[Source: adapted from N A Campbell and J B Reece, (2005), Biology, Seventh Edition, page 1013]

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(Question E2 continued)

(ii) ——	Outline the direction of nerve impulses through the cells labelled X and Y.	[1]
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(iii)	Define the term <i>reflex</i> .	[1

(c) State whether the following psychoactive drugs are excitatory **or** inhibitory, using the table below. [2]

Psychoactive drug

Alcohol

Amphetamines

Benzodiazepines

Nicotine

E3.	Explain how the structures of the human ear allow for sound perception.	[6]
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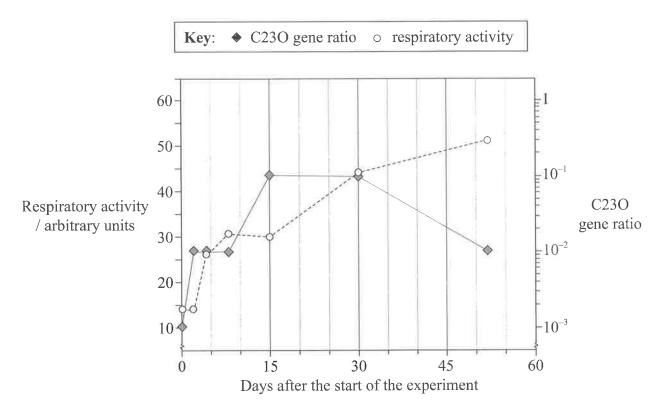


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#### Option F — Microbes and biotechnology

F1. Soil contaminated with crude oil contains a very high amount of hydrocarbons, which may be an environmental hazard. In order to understand how bacteria could be helpful to remedy such a situation, scientists created laboratory samples of soil contaminated with crude oil and analysed the bacteria growing in it by measuring the respiratory activity and C23O gene ratio. The respiratory activity is an indication of the total amount of live bacteria in soil. The C23O gene ratio is an indication of the proportion of soil bacteria capable of hydrocarbon degradation compared to the total amount of bacteria.



[Source: adapted from M Zucchi, et al., (2003), Journal of Applied Microbiology, 94(2), pages 248–257]

(a)	State the respiratory activity when the C23O gene ratio first reached its highest level.	[1]
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(Question F1 continued)

(b)	Describe the respiratory activity as the soil treatment progresses.	[2]
(c)	The data in the graph indicates that hydrocarbon degradation occurred during the first 30 days of the experiment. Explain the evidence for this conclusion.	[2]
(d)	Using your knowledge, state the energy source category of the bacteria used in this experiment.	[1]
	The state of the s	
(e)	Scientists are interested in inserting the C23O genes into bacteria to clean up oil spills in the sea. State the term used to qualify the bacteria that are able to survive in a saline habitat.	[1]



(a)	Draw a labelled diagram of a filamentous cyanobacterium.	[
(b)	Define the term <i>epidemiology</i> .	
	.,, ., .,	
(c)	Distinguish between endotoxins and exotoxins.	
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(d)	Explain how the use of high sugar concentrations can preserve food.	
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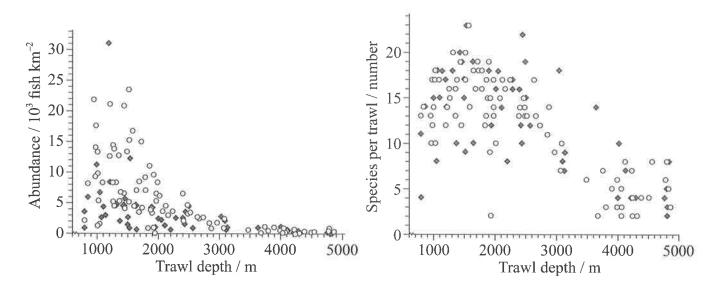
F3.	Discuss the prion hypothesis for the cause of spongiform encephalopathies.	[6]
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### Option G — Ecology and conservation

G1. Knowledge of deep-water fish is important for fisheries and marine reserve management. Scientists analysed data from scientific trawls made from 1977 to 1989 (early period) and from 1997 to 2002 (late period). These were at depths from 800 m to 4800 m in the Porcupine Seabight and Porcupine Abyssal Plain area southwest of Ireland. The graphs represent the abundance of fish and the number of species for each of these trawls.

**Key**: • 1977 to 1989 (early period) • 1997 to 2002 (late period)



[Source: adapted from D M Bailey, et al., (2009), Proceedings of the Royal Society B, 276 (1664), pages 1965–1969]

(a)	State the depth at which the maximum number of species per trawl were caught.	[1]



(Question G1 continued)

b)	(1)	late period (1997 to 2002).	[2]
	(ii)	Suggest <b>one</b> reason for the difference in the abundance of fish at depths down to 2000 m between the early period and the late period.	[1]
(c)		cuss the evidence in these data for a decline in the biodiversity of fish between the y period and the late period.	[2]
	\$0.4 (\$). \$1.4 (\$).		
(d)	Stat	e <b>two</b> types of interactions that are most likely to occur among deep-water fish.	[1]
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		(This question continues on the following p	oage!



(Question G1 continued)

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(a)	Define the term biomagnification.	
(b)	Scientists measured the following values for a young pine plantation in England.	
	Respiration 38 900 kJ m <sup>-2</sup> year <sup>-1</sup>	
	Net primary production 31 400 kJ m <sup>-2</sup> year <sup>-1</sup>	
	[Source: adapted from E P Odum, (1971), Fundamentals of Ecology, Third Edition, page 46]	
	(i) Calculate the value for the gross primary production.	
	**************************************	
	(ii) Define the term <i>biomass</i> .	
(c)	Describe <b>one</b> technique used to estimate the population size of mice.	
		(1)



G3. Discuss the differences between r-strategies and K-strategies, including the environmental

conditions that favour each of them.	[6]
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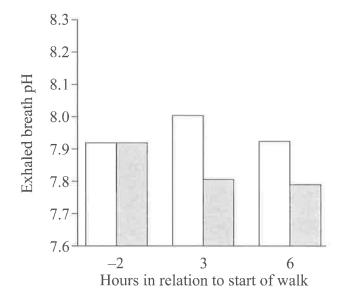
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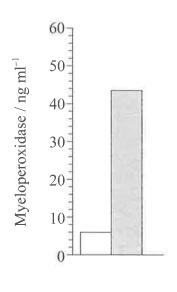
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### Option H — Further human physiology

**H1.** Researchers explored the effects of roadside traffic exposure in London on people with asthma. Each participant walked for two hours through Hyde Park, a large traffic-free park, and on a separate occasion along Oxford Street, where diesel-powered buses and taxicabs are permitted. The researchers measured the pH of the participants' exhaled breath two hours before each walk and three hours and six hours after the start of each walk. The level of an inflammation indicator, myeloperoxidase, was also measured the day after the experiment.





**Key**: □ Hyde Park □ Oxford Street

[Source: adapted from J McCreanor, et al., (2007), New England Journal of Medicine, 357, pages 2348–2358]

(a)	Calculate	the	percentage	increase	of	myeloperoxidase	between	Hyde	Park	and
	Oxford St	reet	for participa	nts.						

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(This question continues on the following page)

[1]



(Question H1 continued)

(i)	Compare the changes in exhaled breath pH caused by walking through Hyde Park and along Oxford Street.	I
(ii)	Explain the changes in exhaled breath pH caused by walking along Oxford Street	
	in people with asthma.	
(iii)	Some of the participants reported more symptoms of asthma after walking along Oxford Street. Evaluate the hypothesis that an asthma attack is associated with bronchiole congestion and inflammation.	
	e two possible causes of an asthma attack, other than those suggested by this criment.	
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[3]

**H2.** The table shows the death rate due to coronary heart disease (CHD) in two different countries.

Country	Deaths / 10 <sup>-5</sup> individuals
USA	97.6
Japan	32.1

(a) Using the table below, outline **three named** factors that could be responsible for the differences between the two populations.

Factor	Outline



(Question H2 continued)

(1)	State	e f	οι	ır		gl	a	r	10	ds	S	S	e	c	r	e	ti	r	18	5	d	li	g	e	es	st	i	V	e	,	jı	1	ic	26	25	3	<u>i</u> 1	1	tc	)	tl	16	=	a	1i	ir	n	e:	n	ta	ır	У	(	ce	ır	18	1 _	•														1
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Answers written on this page will not be marked.

