

**Biology**  
**Standard level**  
**Paper 2**

Wednesday 15 November 2017 (afternoon)

Candidate session number

1 hour 15 minutes

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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.
- Section A: answer all questions.
- Section B: answer one question.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[50 marks]**.



Please **do not** write on this page.

Answers written on this page  
will not be marked.



### Section A

Answer **all** questions. Answers must be written within the answer boxes provided.

- 1. Chronic Obstructive Pulmonary Disease (COPD) is characterized by progressive airflow limitation. Classification of COPD as mild, moderate or severe is based on measurement of Forced Expiratory Volume (FEV), which is the maximum volume of air that can be exhaled in one second.

The table shows the numbers of individuals in each COPD class and their mean FEV for a Swedish study of 349 people.

	Normal	Mild COPD	Moderate COPD	Severe COPD
Never smoked	96	12	6	0
Ex-smokers	95	29	19	3
Regular smokers	32	18	17	2
Occasional smokers	11	8	1	0
FEV / litres	2.9 ± 0.68	2.6 ± 0.60	2.0 ± 0.46	1.3 ± 0.24

[Source: Reproduced with permission of the © ERS 2012. *European Respiratory Journal* Apr 2012, 39 (4) 839–845; DOI: 10.1183/09031936.00064611]

- (a) State the level of COPD that has the lowest FEV. [1]

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- (b) Explain how a low FEV can be used to indicate emphysema. [2]

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**(Question 1 continued)**

The elasticity and resilience of the lungs are mainly provided by the protein elastin. Degradation of elastin produces peptides called desmosines.

Desmosines in urine or blood plasma have been proposed as biomarkers of lung degradation. The relationship between urine desmosines, plasma desmosines and COPD severity in patients was assessed.

Disease severity	Urine desmosines / nmol mmol <sup>-1</sup> of creatinine	Plasma desmosines / nmol L <sup>-1</sup>
	Median	Median
No disease	2.5 (1.3–5.7)	0.46 (0.16–1.4)
Mild COPD	2.6 (1.5–5.0)	0.49 (0.30–1.3)
Moderate COPD	2.9 (1.7–6.0)	0.55 (0.33–1.2)
Severe COPD	2.8 (2.0–4.1)	0.64 (0.47–1.1)

[Source: Reproduced with permission of the © ERS 2012. *European Respiratory Journal* Apr 2012, 39 (4) 839–845; DOI: 10.1183/09031936.00064611]

(c) State the disease severity group that has the highest range of plasma desmosines. [1]

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(d) Evaluate which of the two biomarkers would be the most useful indicator of COPD severity. [2]

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**(Question 1 continued)**

- (e) Elastin is also an important component of other tissues such as arteries and ligaments. Evaluate how these other sources of elastin could affect the interpretation of the biomarker as an indicator of COPD. [2]

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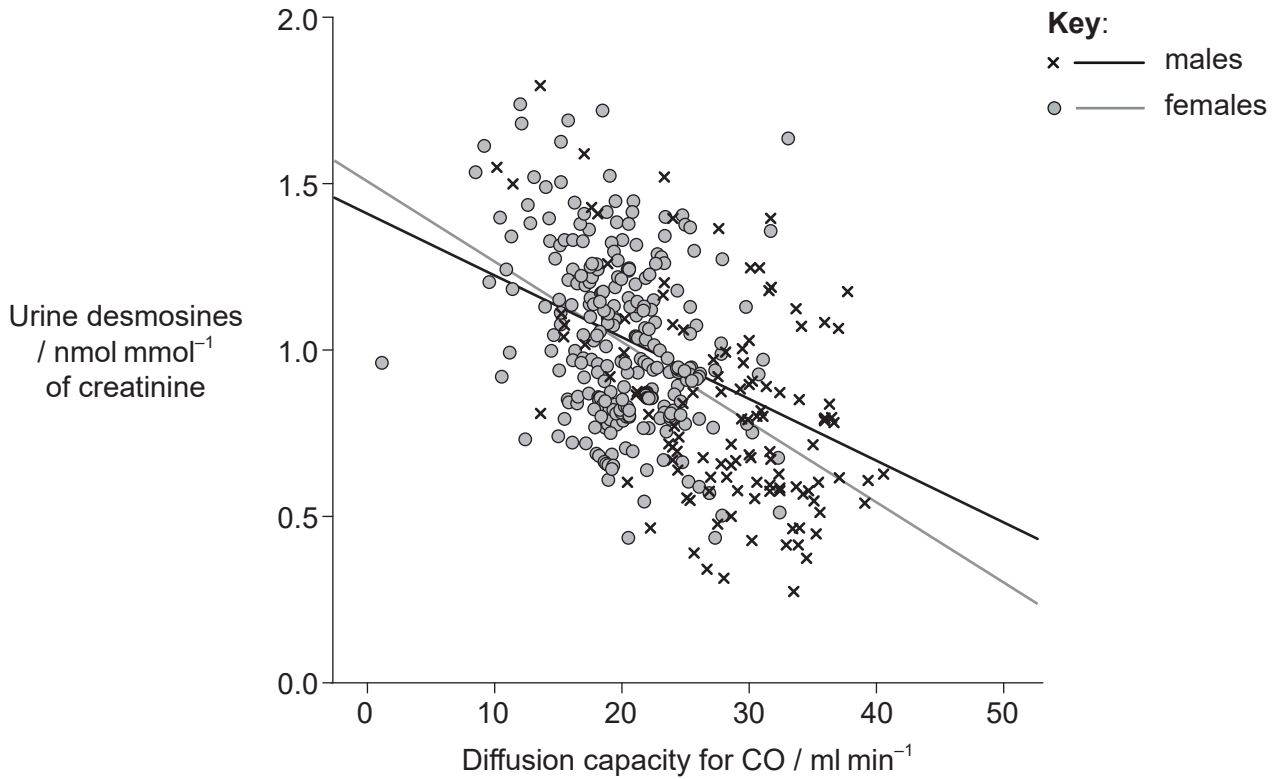
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(Question 1 continued)

- (f) The graph shows the relationship between the diffusion capacity of the lungs for carbon monoxide (CO) and urine desmosines.



[Source: Reproduced with permission of the © ERS 2012. *European Respiratory Journal* Apr 2012, 39 (4) 839–845; DOI: 10.1183/09031936.00064611]

State the relationship between diffusion capacity and urine desmosines.

[1]

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**(Question 1 continued)**

- (g) Other studies on pulmonary diseases have shown a wide variety of results. Apart from age, sex and severity of COPD, list **two** other factors that may explain the inconsistent results between studies. [2]

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- (h) Discuss whether measurements of desmosine concentration would be useful for monitoring changes in the health of a patient. [3]

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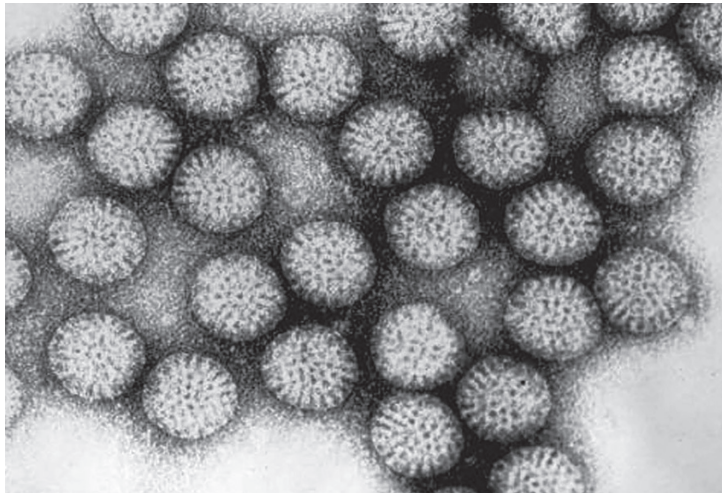
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2. The figure shows a transmission electron micrograph of rotavirus particles. Each rotavirus is about 70 nanometres in diameter.



[Source: CDC / Dr. Erskine L. Palmer]

- (a) State a reason for using an electron microscope to view this virus rather than a light microscope.

[1]

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- (b) Rotavirus causes diarrhea and vomiting. Explain why viral diseases cannot be treated using antibiotics.

[2]

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- (c) State an application of plasmids in biotechnology.

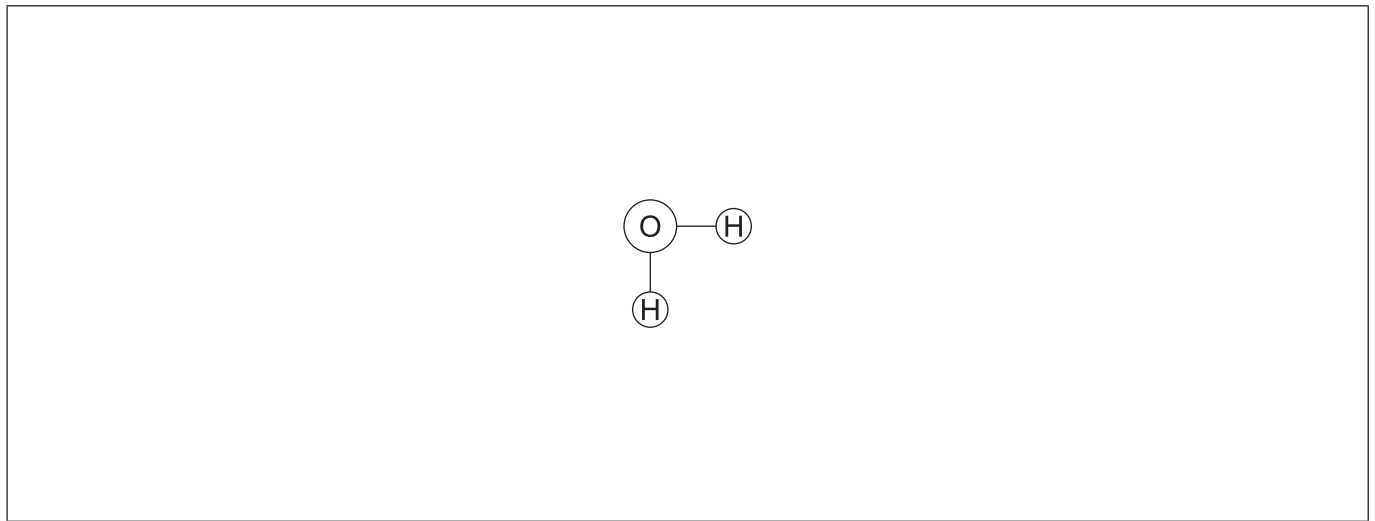
[1]

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3. The figure represents a water molecule.



- (a) Draw a second water molecule to show how bonds can form between water molecules, including the name of the bond. [2]
- (b) Water has important solvent properties. Explain these properties using an example to illustrate your answer. [3]

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4. The diagram shows a leaf from *Dryopteris arguta*.



[[https://commons.wikimedia.org/wiki/File:E20161208-0001%E2%80%94Dryopteris\\_arguta\\_\(Reverse\)%E2%80%94RPG\\_\(30698925004\).jpg](https://commons.wikimedia.org/wiki/File:E20161208-0001%E2%80%94Dryopteris_arguta_(Reverse)%E2%80%94RPG_(30698925004).jpg), E20161208-0001—*Dryopteris arguta* (Reverse)—RPG  
Source: [https://www.flickr.com/photos/john\\_d\\_rusk/30698925004/](https://www.flickr.com/photos/john_d_rusk/30698925004/)  
Author: John Rusk from Berkeley, CA, United States of America, licensed under Creative Commons licence:  
<https://creativecommons.org/licenses/by/4.0/legalcode>]

(a) (i) State the phylum of this plant. [1]

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(ii) State **two** characteristics of plants from the phylum you stated in (a)(i). [2]

1. ....  
2. ....

(b) Outline why the number of trophic levels is limited in a food chain. [1]

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5. (a) State **one** disaccharide and the **two** monomers from which it can be synthesized. [2]

Disaccharide: .....

Monomers: ..... and .....

(b) Discuss the roles of the enzymes secreted by the pancreas during digestion. [3]

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(c) Compare and contrast cis-fatty acids and trans-fatty acids. [2]

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### Section B

Answer **one** question. Up to one additional mark is available for the construction of your answer. Answers must be written within the answer boxes provided.

6. Reproduction in eukaryotes can be sexual or asexual.
- (a) Describe the origin of eukaryotic cells according to the endosymbiotic theory. [4]
  - (b) Explain how hormones are used to control the human menstrual cycle. [8]
  - (c) Outline natural methods of cloning in some eukaryotes. [3]
7. Plants have widespread influences, from food chains to climate change.
- (a) Draw a diagram of a palisade mesophyll cell labelling only the structures that would **not** be present in a pancreatic cell. [3]
  - (b) Explain the process of photosynthesis. [8]
  - (c) Describe the process of peat formation. [4]



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16EP13

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16EP14

A large rectangular area with a dotted grid pattern, intended for writing answers.



16EP15

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