3.1 Exchange Surfaces

Total mark – 18

Question: 1

16. The Titicaca water frog, *Telmatobius culeus*, is an aquatic amphibian found in Lake Titicaca in sub-tropical South America. The water frog has an unusual appearance with large folds of skin as shown in Fig. 21.1.

Fig. 21.1

Like all amphibians, frogs are able to absorb oxygen through the skin as well as their lungs.

i. Suggest why the Titicaca water frog has evolved the unusually large folds of skin seen in Fig. 21.1.

---[2]

ii. When out of the water, the Titicaca water frog is able to use its lungs to absorb oxygen.

Lungs contain specialised gaseous exchange surfaces.

Describe and explain how **one** feature of the lungs provides an efficient gas exchange surface.

---[2]

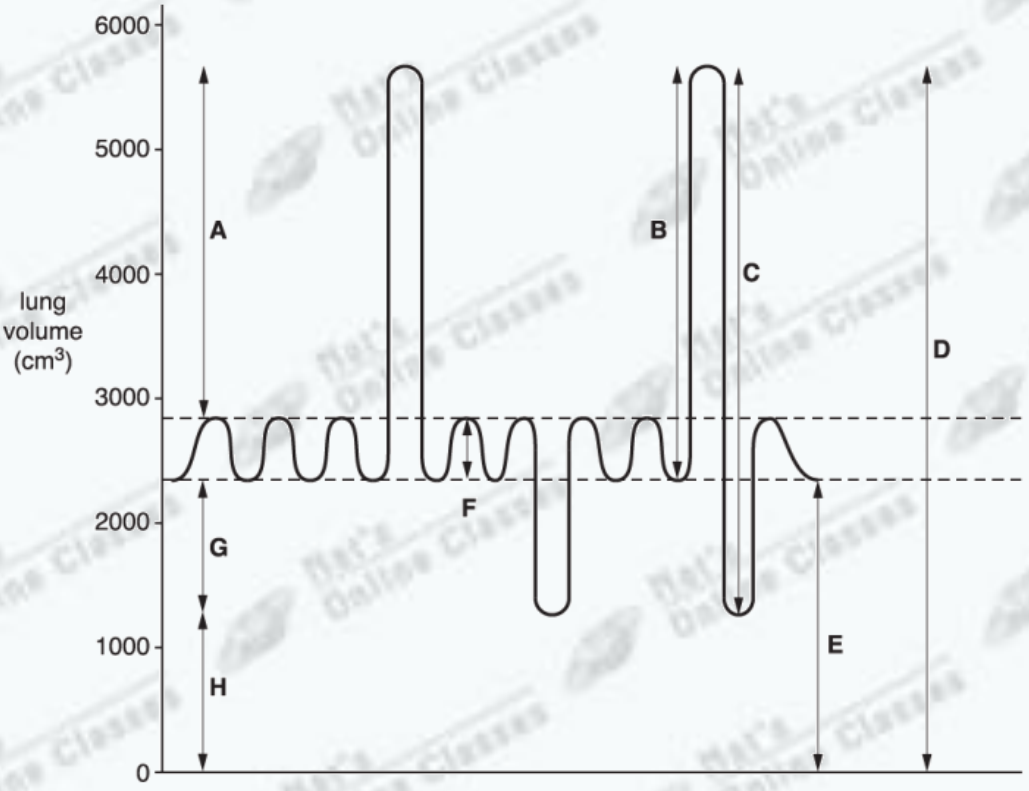
16		i	large / increase the, surface area / SA:Vol ratio ✓ *idea of*: increase (the rate of) oxygen absorption / described ✓ oxygen levels in the lake are low ✓	2 max	**ALLOW** 'for oxygen absorption' if mp1 given e.g. of description: 'for (more) oxygen to diffuse in (through skin)' **Examiner's Comments** This question relates the properties of a good exchange surface, to the conditions in the lake. The majority of candidates were able to suggest that the skin folds provided a larger surface are or a large surface area to volume ratio. More able candidates added that this enabled the frog to absorb more oxygen from the water. Candidates should be encouraged to make clear that extra surface area helps to absorb more oxygen, ie they should make their explanations comparative. Few candidates suggested that this was because the oxygen levels in the lake were not very high. Despite the clear link to oxygen absorption in the stem of the question there were some unusual suggestions. For example: the extra folds might be used like fins to help the frog swim; the folds are due to loss of elasticity in the skin due to old age. **Key** **AfL** Guidance to offer for future teaching and learning practice

		ii	**D** large surface area ✓ **E** for (maximum) diffusion ✓	2 max	Mark first **D** response or **E** response only For two marks the **E** mark must be linked to the **D** mark **IGNORE** increase surface area, ref to SA:Vol ratio **ALLOW** idea of more or faster diffusion

			D squamous, epithelium / cells OR alveolar wall, only 1 cell thick / thin ✓ **E** (providing) a short diffusion distance ✓ **D** good, blood supply / ventilation ✓ **E** maintaining / creating a (steep) concentration gradient ✓		**Examiner's Comments** This question no longer relates to the Titicaca frog but to a general point about the lungs. A range of correct responses was seen with large surface area and thin alveolar wall being the most common. Less able candidates often gave poor descriptions of a thin alveolar wall – simply stating 'thin surface'. Examiners were hoping to see more detail than this for a mark to be credited. In general candidates had a good understanding of the features of a good exchange surface and could provide valid explanations. When one feature is asked for, the examiner will mark the first feature described. Candidates should be encouraged to read the question carefully and not add additional features as this takes time that they may use better elsewhere in the examination.
			Total	**4**	

Question: 2

17. The figure represents the volume changes in the lung of a human.



i. Select the letter, **A** to **H**, that corresponds to each of the following lung volumes.

The first one has been done for you.

Lung volume	Letter
Inspiratory reserve volume	*A*
Residual volume	
Total lung capacity	
Tidal volume	
Vital capacity	

[4]

ii. Volume **C** can be measured using an instrument such as a spirometer.

What **breathing** instructions would be given to a person whose volume **C** was being measured?

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[2]

17		i	**H** ✓ **D** ✓ **F** ✓ **C** ✓	4	**Mark the first answer in each cell.** If an additional answer is given that is incorrect then = **0 marks** **IGNORE** correct combinations of letters that correspond to D (e.g. A + F + G + H) **IGNORE** correct combinations of letters that correspond to C (e.g. A + F + G or B + G) **Examiner's Comments** It was good to see so many correct responses for this question. It provided a useful scaffold with letter A provided (to emphasise the direction of the trace) but, nonetheless, the candidates did show a good grasp of the features displayed via the spirometer trace. It was interesting to note that a common error was to select E (the expiratory reserve volume) instead of the correct choice H for the residual

		ii	1 breathe in as deeply as possible / AW ✓ 2 (and) then force as much air out as possible ✓	2	**IGNORE** ref to using nose clip If they have the deepest breath out before the deepest breath in, then **max 1** (for correct mp 2) 1 e.g. 'breathe in as much as possible' 'inhale as much as you can' 'inhale to maximum' 'breathe in all the air that you can' 2. e.g.'breathe out as hard as possible' 'exhale as much as you can' 'exhale to maximum' 'breathe out all the air that you can' **DO NOT CREDIT** *all* of the air pushed out of lungs **Examiner's Comments** This question was generally answered really well. It demonstrates the emphasis on practical work and the fact that its assessment is now embedded in the question papers. Those with experience were better equipped to describe the process. However, a large minority struggled to link the 'as much as possible' idea to both inhalation and exhalation in terms of quality of expression. Unfortunately, some candidates described breathing out before breathing in and this limited their overall score to 1 mark for this question.
			Total	**6**	

Question: 3

18(a). Termites are highly social insects. They are thought to have evolved from earlier forms of insect at least 150 million years ago, in the Jurassic geological period. They are related to cockroaches.

i. How might scientists a century ago have known that termites evolved in the Jurassic geological period?

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[1]

ii. What new source of evidence might help today's scientists to find out how closely related termites are to cockroaches?

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[1]

(b). Fig. 5.1 shows a termite mound, the nest of approximately one million individuals. The photograph was taken in Queensland Australia, about 3000 kilometres south of the equator.

i. **Fig. 5.1** shows that the interior of the termite mound is full of interconnecting chambers. At the top of the mound some of these chambers open to the air outside.

Worker termites spend all their time working in brood chambers low in the mound, where eggs and larvae develop.

Explain how carbon dioxide produced in the respiring body cells of worker termites is removed to the air outside the termite mound.

Fig. 5.1

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[4]

ii. In Africa, closer to the equator, the mounds built by some species of termite are blade-shaped, with the long axis pointing North–South. **Fig. 5.2** shows an example of a termite mound in Africa.

Suggest why the African termites need to build mounds in this shape and orientation.

Fig. 5.2

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18	a	i	fossils in, known-age / Jurassic, strata / rocks	1	
		ii	DNA / cytochrome c	1	
	b	i	carbon dioxide diffuses down concentration gradient out of the respiring cell (1) carried through body from cell (to tracheoles) by blood passing out via tracheoles / trachea / spiracles (1) respiration generates heat (1) hot gases expand and are less dense so rise up by convection through the mound to vents at mound-top (1)	4	
		ii	*shape*, large or increased surface area to volume ratio (1) smallest area exposed to greatest heat (1)	2	Response **must** be linked to context of avoiding overheating / needing to get rid of heat.
			Total	**8**	