

1. (i) *award both marks for correct answer*
 $\frac{3.14}{0.52}$;
 6:1; 2
- (ii) ratio for sphere **B** is three times smaller; ora
allow ecf if wrong calculation in (a)(i) 1
- (iii) *any two from the following:*
 living cells need to take in oxygen/ nutrients and remove (metabolic) waste;
 ref. passive processes / diffusion;
 rate of diffusion too slow if SA:V ratio too small; max 2
- [5]
2. *credit any five descriptions from the following:*
 many alveoli to produce large surface area;
 barrier, thin / only two cells thick;
 good blood supply / many capillaries;
 to carry dissolved gases to and from the alveoli;
 ventilation / air movement to refresh the air in the alveoli;
 (contains) elastic tissue to stretch and recoil to help expel air;
- [5]
3. (i) oxygen is used in respiration;
 carbon dioxide is released (in respiration);
 carbon dioxide is absorbed (by soda lime); 2
- (ii) vital capacity; 1
- [3]
4. (i) alveolus/alveolar air, sac/space; **A** *alveoli/air sac* **A** *squamous epithelium* 1

- (ii) large surface area to volume (ratio)/AW; **R** large area unqualified thin/one cell thick, wall/short diffusion distance/AW;
A appropriate figures for width
 squamous epithelium;
 permeable;
 blood supply, qualified;
 elastic tissue/recoil (after expansion);
 surfactant; 3 max

error carried forward – mark (ii) independently. E.g. candidates who put ‘capillary’ in (i) – could still get points 1 to 4 in (ii)

[4]

5. (a) (i) produce / secrete / release, mucus;
 prevent collapse of / hold open / support, airways;
A provide shape of bronchus
R gives wall, structure / strength 2

- (ii) cilia, destroyed / damaged; **R** cilia not working
 (epithelium replaced by) scar tissue / scarring;
 (smooth) muscle becomes thicker;
 mucous glands enlarge / larger goblet cells / more goblet cells;
R more mucus secreted
 inflammation of connective tissue;
 AVP; idea of tumour if it describes a structural change max 2

- (b) stretch, as air is inhaled / allow alveoli to expand during inhalation;
 to increase lung volume / surface area;
 prevents alveoli bursting;
 (elastic fibres) recoil, as exhale; **R** contract
 more, complete / rapid, expulsion (from the alveoli); **A** expel more air max 2

- (c) tidal volume is reduced / less air inhaled and exhaled / residual volume is larger / air trapped in alveoli / vital capacity smaller;
 more difficult to exhale;
 (as) alveoli cannot, stretch / recoil;
 rapid / shallow, breathing / breathlessness / wheezing;
 alveoli may burst;
 leaves gaps in tissue / larger air spaces / AW;
 less surface area (for gaseous exchange);
 blood / haemoglobin, less well oxygenated / less carbon dioxide removed;
R less able to do exercise / need to use oxygen max 4

[10]

6. many, air spaces / alveoli;
 large surface area; **R** ref to surface area to volume ratio

thin wall of, alveolus / capillary; **A** one cell thick **R** 'thin wall' on its own
 good blood supply / large capillary network;
 air passage / bronchiole;
 capillary close proximity to alveolus;

R refs. to cilia, mucus, elasticity

3 max

[3]

7. (i) *award two marks if correct answer (0.55 – 0.65) is given
 incorrect answer (or no answer) but correct working = 1 mark
 ecf rules apply for 1 mark max*

working; (marks on graph or calculation)

0.55 – 0.65;

2

- (ii) vital capacity;

1

[3]

8. (i) nucleus / nuclear envelope / nuclear membrane;

1

- (ii) (made up of) one type of / (squamous) epithelium, cell(s);

A same **R** similar alone

(group of) cells performing the same function(s); **A** task / job

1 max

- (iii) large surface area;

permeable;

thin / short, diffusion path;

moist;

good blood supply / close to blood;

well ventilated / in contact with respiratory medium;

2 max

[4]

9.

	pathogen;
	degenerative;
	aerobic; R aerobic respiration
	tidal;
	pandemic;

[5]

10. (a) *lugworm curve* *human curve*
- steeper ; shallow / gentle / sigmoid ;
 higher saturation at, low / same pp oxygen ;
 has max (saturation) at 2 kPa ; max at 13.5 - 14 kPa ;
 reaches 100% (saturation) ; (only) reaches 98% ;
(max 1 of above differences)
- lugworm haemoglobin has a high affinity for oxygen ;
 low oxygen in, lugworm habitat / water / ora ;
 lugworm haemoglobin, stores oxygen / only releases oxygen when pp
 O₂ very low ;
 two haemoglobins have different, structures / amino acid sequences ; 2 max

- (b) *differences (max 5)*
- D1** ref to lugworm gills **and** mammal, alveoli / lungs ;
D2 ref to internal **and** external, exchange surfaces ;
D3 less oxygen in, water / sand ; **A** ora
D4 lugworm haemoglobin adapted to, water / sand/ low O₂
 environment ; **A** ora
D5 lugworm has no red blood cells / ora ;
D6 detail of mammalian red blood cells ;
D7 lung ventilation tidal / lugworm, throughflow / unidirectional / AW ;
D8 AVP ; e.g. ref. water loss from lungs
- similarities (max 5)*
- S1** **both** (gas exchange surfaces have) large surface area ;
S2 **both**, thin / have short diffusion distance ;
S3 **both** well-vascularised ;
S4 **both** moist ;
S5 ref to diffusion of, oxygen / carbon dioxide / gases ;
S6 (blood carries) oxygen to tissues ;
S7 haemoglobin transports oxygen ;
S8 **both** move medium over gas exchange surface ;
S9 AVP ; 7 max
- QWC – legible text with accurate spelling, punctuation and
 grammar ;** 1

[10]

11. (i) X = (smooth) muscle; **A** involuntary muscle / non striated muscle
 Y = (ciliated) epithelium;
- (ii) Z = (branch of) blood vessel / artery / vein / arteriole / venule; **R** capillary 3

[3]

12. *cartilage*

- 1 in, trachea / bronchi;
- 2 holds airway open / prevents collapse;
- 3 prevents bursting (of trachea / bronchi as air pressure changes);
- 4 low resistance to air movement;

ciliated epithelium / cilia

- 5 move mucus;
- 6 ref to how movement brought about;
e.g. metachronal rhythm / wave / sweep / waft

goblet cells

- 7 secrete mucus;
- 8 trap, bacteria / dust / pollen / particles;
- 9 remove particles from lungs;

blood vessels

- 10 supply, oxygen / nutrients (to tissues of lung);
- 11 surround alveoli / good blood supply to alveoli;
- 12 deliver carbon dioxide / pick up oxygen;
- 13 ref to wall of capillary being thin;
- 14 ease of / rapid, gaseous exchange *or* short diffusion pathway;

smooth muscle

- 15 adjust size of airways (in, exercise / asthma);

connective tissue / elastin / elastic tissue

- 16 stretch (inhalation);
- 17 prevents alveoli bursting;
- 18 recoil; **R** contract
- 19 helps exhalation / forces air out (of lungs);

squamous epithelium / described

- 20 alveolus wall thin;
- 21 ease of / rapid, gaseous exchange *or* short diffusion pathway;
- 22 AVP; e.g. ref to large surface area of numerous alveoli
- 23 AVP; ref to macrophages removing pathogens

8 max

QWC – legible text with accurate spelling, punctuation and grammar;

1

[9]

13. diffusion / down a (concentration) gradient;
dissolves in the water film / goes into solution / AW;
crosses , cell(s) / named cell / cytoplasm / plasma / membrane(s) / wall
of alveolus *or* capillary; 2 max [2]
14. (a) (i) alveolus / alveoli; **R** air sac 1
- (ii) *no mark for diffusion alone*
down a gradient / from high to low (concentrations);
oxygen at high(er) concentration in lung / ora;
dissolves in / crosses, water film;
(aqueous) path short / short diffusion path;
reverse gradient for carbon dioxide;
ref. to random molecular movement involved in diffusion;
ref. to maintenance of a steep gradient; 3 max
- (b) (generally) larger / correct ref. to size;
surface area decreased relative to volume / ora;
lung / alveoli, gives increased area (for gas exchange);
need for more oxygen;
due to, high (metabolic) activity / much respiration / more energy need;
cannot exchange across outer surface / no alternative surface;
high demand for carbon dioxide removal / AW; 2 max [6]
15. (i) *award two marks if correct answer (77) is given – must be rounded up
award one mark for calculation – 2.3 / 3.0 or 76.7 if answer incorrect*
2.3 ÷ 3.0 / 76.7;
77; 2
- (ii) forced expiratory volume decreases / AW;
returns to initial value / fluctuates / AW;
figs to show a change with correct units / e.g. 2.3 dm³ s⁻¹ to 1.5 dm³ s⁻¹;
A ecf from (i)
vital capacity remains constant;
at 3.0 dm³; max 3 [5]

16. (a) cilia, beat / waft; **R** 'hairs' **A** ciliated epithelium, sweeps / AW
 move mucus;
 particles / bacteria / dust / spores / pathogen / microbe, in mucus;
treat 'dirt' as neutral
 (moves) away from alveoli / upwards / towards trachea / towards throat /
 towards mouth / out of lungs / out of bronchioles / AW; max 3

(b) (i) *mark (i) and (ii) together to max 3 – look for annotations*
 ref to (secretion / release of) histamine;
 mucus is not moved / AW;
more goblet cells;
 (goblet cells secrete / produce) more mucus / excess mucus;
 fewer cilia (per cell); **A** stunted, damaged, destroyed **R** dead
 (ii) thicker / more, (smooth) muscle; **A** larger / expands **R** swollen, swells
 (muscle) contracts; **R** constricts, spasm **A** 'muscle tenses'
 connective tissue, swells / enlarges / fills with fluid;
 lining of bronchiole thrown into deeper folds / AW; max 3

[6]

17. (a) (i) osmosis;
 down water potential gradient / from high to low water
 potential / implied;
 ref to partially / differentially / selectively, permeable membrane; 2 max
 (ii) lose water; **R** less uptake
 metabolism affected / (may) die / AW; **R** in context of salt uptake
 plasmolysis / flaccid / less turgid / description;
R shrivelled, dehydrated
 AVP; e.g. adaptive responses qualified, such as encysting /
 mobilise solute / refs to altering water potential to reduce
 water loss 2 max

(b) *credit answers explaining why Chlamydomonas does not need a
 water transport system*
 distance in tree is greater / AW;
 e.g. roots far from aerial parts / AW;
 not all tissues / cells in contact with water / AW;
 diffusion too slow / AW;
 AVP; e.g. outer layers waterproofed / ions carried in water /
Chlamydomonas has large surface area: volume
R refs to greater quantities needed 3 max

[7]