CAMBRIDGE INTERNATIONAL AS & A LEVEL BIOLOGY · 9700

BIOLOGY



MARK SCHEME

9 GAS EXCHANGE

SCORE	PERCENTAGE
/	%

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Paper 1 Multiple Choice Answers: Gas Exchange

Question	Paper	Q. No.	Answer
1282	9700_m20_qp_12	33	C
1283	9700_m20_qp_12	34	C
1284	9700_s20_qp_11	33	B
1285	9700_s20_qp_11	34	B
1286	9700_s20_qp_12	32	D
1287	9700_s20_qp_13	33	C
1288	9700_w20_qp_11	32	B
1289	9700_w20_qp_11	33	D
1290	9700_w20_qp_11	34	C
1291	9700_w20_qp_12	32	D
1292	9700_w20_qp_12	33	B
1293	9700_w20_qp_12	34	B
1294	9700_w20_qp_12	35	B
1295	9700_w20_qp_13	32	C
1296	9700_w20_qp_13	33	B
1297	9700_w20_qp_13	34	A
1298	9700_m19_qp_12	28	C
1299	9700_m19_qp_12	33	D
1300	9700_s19_qp_11	35	C
1301	9700_s19_qp_11	36	A
1302	9700_s19_qp_12	29	B
1303	9700_s19_qp_12	31	B
1304	9700_s19_qp_12	32	A
1305	9700_w19_qp_11	34	B
1306	9700_w19_qp_12	32	B
1307	9700_w19_qp_12	33	C
1308	9700_w19_qp_13	34	C
1309	9700_w19_qp_13	35	C
1310	9700_m18_qp_12	35	C
1311	9700_s18_qp_11	31	C
1312	9700_s18_qp_11	32	C
1313	9700_s18_qp_12	34	C
1314	9700_s18_qp_13	34	A
1315	9700_s18_qp_13	35	D
1316	9700_w18_qp_11	33	D
1317	9700_w18_qp_11	34	D
1318	9700_w18_qp_12	33	A
1319	9700_w18_qp_13	32	D
1320	9700_m17_qp_12	36	B
1321	9700_s17_qp_11	37	A
1322	9700_s17_qp_11	38	B
1323	9700_s17_qp_12	31	A
1324	9700_s17_qp_12	33	C
1325	9700_s17_qp_13	31	B
1326	9700_s17_qp_13	32	C
1327	9700_s17_qp_13	33	A

Paper 1 Multiple Choice Answers: Gas Exchange (continued)

Question	Paper	Q. No.	Answer
1328	9700_s17_qp_13	34	C
1329	9700_w17_qp_11	30	C
1330	9700_w17_qp_11	31	B
1331	9700_w17_qp_11	32	B
1332	9700_w17_qp_11	33	A
1333	9700_w17_qp_12	34	C
1334	9700_w17_qp_12	35	D
1335	9700_w17_qp_13	35	D
1336	9700_m16_qp_12	29	D
1337	9700_m16_qp_12	34	D
1338	9700_s16_qp_11	33	A
1339	9700_s16_qp_11	34	D
1340	9700_s16_qp_11	35	D
1341	9700_s16_qp_12	32	C
1342	9700_s16_qp_12	34	B
1343	9700_s16_qp_13	33	A
1344	9700_s16_qp_13	34	D
1345	9700_w16_qp_11	33	A
1346	9700_w16_qp_11	34	C
1347	9700_w16_qp_11	35	C
1348	9700_w16_qp_12	34	C
1349	9700_w16_qp_12	35	D
1350	9700_w16_qp_12	36	C
1351	9700_w16_qp_13	32	C
1352	9700_s15_qp_11	31	A
1353	9700_s15_qp_12	27	B
1354	9700_s15_qp_12	31	A
1355	9700_s15_qp_13	33	C
1356	9700_w15_qp_11	32	C
1357	9700_w15_qp_12	31	A
1358	9700_w15_qp_13	32	D
1359	9700_w15_qp_13	33	A
1360	9700_w15_qp_13	34	D
1361	9700_m20_qp_12	32	A
1362	9700_s20_qp_11	35	C
1363	9700_s20_qp_12	33	B
1364	9700_s20_qp_12	34	D
1365	9700_s20_qp_13	34	D
1366	9700_s20_qp_13	35	B
1367	9700_s20_qp_13	36	C
1368	9700_m19_qp_12	34	D
1369	9700_s19_qp_11	34	D
1370	9700_s19_qp_12	33	D
1371	9700_w19_qp_11	35	B
1372	9700_w19_qp_12	34	A
1373	9700_m18_qp_12	34	C

Paper 1 Multiple Choice Answers: Gas Exchange (continued)

Question	Paper	Q. No.	Answer
1374	9700_s18_qp_11	33	C
1375	9700_s18_qp_11	34	D
1376	9700_s18_qp_12	35	C
1377	9700_s18_qp_13	36	C
1378	9700_s18_qp_13	37	A
1379	9700_w18_qp_11	35	A
1380	9700_w18_qp_12	34	C
1381	9700_w18_qp_12	35	D
1382	9700_w18_qp_13	34	C
1383	9700_m17_qp_12	37	B
1384	9700_s17_qp_12	32	D
1385	9700_s17_qp_12	34	B
1386	9700_w17_qp_11	34	A
1387	9700_w17_qp_12	36	D
1388	9700_w17_qp_13	36	A
1389	9700_m16_qp_12	33	B
1390	9700_s16_qp_11	36	D
1391	9700_s16_qp_12	33	D
1392	9700_s16_qp_13	35	A
1393	9700_w16_qp_13	33	C
1394	9700_w16_qp_13	34	C
1395	9700_s15_qp_11	32	C
1396	9700_s15_qp_11	33	A
1397	9700_s15_qp_12	32	B
1398	9700_s15_qp_12	33	D
1399	9700_s15_qp_13	31	B
1400	9700_s15_qp_13	32	A
1401	9700_w15_qp_11	34	B
1402	9700_w15_qp_12	32	C
1403	9700_w15_qp_12	33	D

159. 9700_m20_ms_22 Q: 4

(a)	*trachea and bronchus (max 1):* C-shaped cartilage rings in trachea vs, irregular / plates of, cartilage in bronchus ; more mucous glands in trachea / fewer mucous glands in bronchus ; pseudostratified / description, epithelium in trachea vs columnar epithelium in bronchus ; *bronchus and bronchiole (max 1):* cartilage in bronchus **or** no cartilage in bronchiole ; many goblet cells in bronchus vs few or no goblet cells in bronchiole / more goblet cells in bronchus / fewer goblet cells in bronchiole ; mucous glands in bronchus **or** no mucous glands in bronchiole ; more smooth muscle in bronchus / less smooth muscle in bronchiole ; *bronchiole and alveolus (max 1):* ciliated epithelium / ciliated cells / cilia / columnar epithelium / cuboidal epithelium, in bronchiole **or** squamous / pavement, epithelial cells in alveolus ; thick wall / wall of several layers, in bronchiole, vs, thin / single layered, wall in alveolus ; smooth muscle in bronchiole **or** no smooth muscle in alveolus ;	**3**
(b)	*one mark for correct order:* G_1, S, G_2 ; *G_1 phase:* transcription **or** translation **or** polypeptide / protein / enzyme, synthesis **or** (named) organelle synthesis ; *S phase:* DNA replication / formation of 2 (sister) chromatids ; *G_2 phase:* as G_1 **or** microtubule synthesis **or** centriole replication **or** mitochondria division **or** check for / correct, errors in replication of DNA ;	**4**

160. 9700_s20_ms_21 Q: 4

(a)	*any four from:* carbaminohaemoglobin ; **A** combined with haemoglobin hydrogencarbonate ions / HCO_3^- ; **R** HCO_3 CO_2 dissolved in the plasma ;	**2**
(b)	*any four from:* 1. correct direction of movement for oxygen and carbon dioxide ; e.g. oxygen, moves from, alveolus / **W**, to, capillary / blood / red blood cells, and carbon dioxide moves from, capillary/ blood /plasma to alveolus / blood to **W** ; 2. diffusion of, oxygen / carbon dioxide / respiratory gases ; **A** movement down, partial pressure / concentration, gradient **A** from high(er), partial pressure / concentration, to low(er), partial pressure / concentration **I** along a concentration gradient 3. use of data from Table 4.1 to support movement of oxygen or carbon dioxide ; *needs ref. to kPa once* *allow ecf from mp2* 4. (diffusion) through, alveolar wall / squamous epithelium ; 5. (diffusion) through, endothelium / capillary wall ; 6. AVP ; e.g. haemoglobin binding oxygen	**4**
(c)	*any four from:* alveoli / alveolar walls, stretch / expand, during, inspiration / AW ; arteries / arterioles / blood vessels, stretch / expand, as blood, volume / pressure, increases ; stretch to prevent (alveoli / arteries), bursting / rupture / AW ; **A** prevent overstretching recoil during expiration / AW, to help, expel / force out, air ; ***AW** in context of alveoli* recoil to apply pressure to blood so maintaining blood pressure ; *in context of arteries* AVP ; e.g. allows trachea / bronchus / bronchioles, to expand during inspiration	**4**
(d)(i)	$\frac{50}{86} \times 100$; 58(%) ; *if extracted values are different allow ecf for calculated answer* *accept ± 1 mm when reading from graph (49 to 51 and 85 to 87)*	**2**
(d)(ii)	*allow 'volume of blood' for 'mean volume of blood per kg body mass'* *any four from:* *description to max 3* 1. trend is / overall / AW, increase in volume of blood, over time / AW *or* increase in volume of blood over time except between 0 and 1–2 months ; 2. trend is / overall / AW, increase in red blood cell volume, over time / AW ; *or* increase in red cell volume over time except between 7–8 and 12 months ; 3. *ref. to* percentage of mean blood volume represented by red blood cells / haematocrit ; e.g. fluctuates / mainly increasing / decreases between 1–2 and 3–4months / decreases between 7–8 and 12 months ; *4.* any comparative use of, figures / percentages ; *to support mp1, mp2 or mp3* *explanation to max 3* 5. lower partial pressure of oxygen at high altitude / less oxygen in inhaled air ; 6. lower oxygen saturation of haemoglobin / haemoglobin has lower oxygen affinity ; 7. compensation *or* *idea that* changes occur to make up for less, oxygen taken in / transported to tissues **R** *idea of* body getting more oxygen than at sea level 8. (over time) more red blood cells produced so more haemoglobin / AW ; 9. (over time) proportion of red cells / concentration of haemoglobin, increases so, take up / AW, greater volume of oxygen ; **A** more red blood cells per unit time passes through, lungs to take up oxygen / tissues to deliver oxygen 10. AVP ; e.g. *ref. to* erythropoietin / EPO	**4**

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161. 9700_s20_ms_22 Q: 4

(a)	much / AW, rough endoplasmic reticulum / rough ER / RER for, polypeptide / protein / collagen, synthesis ; **A** for translation many mitochondria provide, energy / ATP, for, polypeptide / protein / collagen, synthesis ; large nucleus indicates, active cell / (much) transcription ;	**2**
(b)(i)	*any two from* in trachea ; in, bronchus / bronchi ; *if only one correct structure named, allow one qualification mark* *trachea* C-shaped / incomplete, rings ; surround smooth muscle ; *bronchus* plates / irregular ;	**2**
(b)(ii)	*any two from* keep airways open ; provides support ; allow flexibility ; *allow described e.g. bending neck, swallowing food* rings allow, lengthening / widening, during, breathing in / inspiration / inhalation ;	**2**
(c)(i)	peptide (bond) ;	**1**
(c)(ii)	*any three from* collagen, structural / fibrous, protein *or* collagen gives strength / flexibility ; glycine / gly, small / smallest, amino acid ; **A** has H as, R-group / side chain glycine / gly, regular / every third amino acid ; (so) triple helix tightly packed / three polypeptides closely associated / AW ; *ref. to* (peptide bond) NH of gly can form hydrogen bond with (peptide bond) C=O of adjacent amino acid (in other polypeptide) ;	**3**

162. 9700_s20_ms_23 Q: 3

(a)(i)	**X** = artery **Y** = vein ;	**1**
(a)(ii)	*any two from* cross section not regular / no defined shape / AW ; **A** not circular tunica intima smooth; **A** inner layer *for tunica intima* **A** not, crinkly / wavy thin / thinner (than **X**) tunica media ; **A** thin middle layer wide lumen diameter relative to wall thickness / relatively large lumen / AW ; tunica, externa / adventitia, as thick / thicker, than tunica media ;	**2**
(b)(i)	*any two from* tissue fluid and blood plasma do not have red blood cells ; **A** blood contains red blood cells red blood cells are too large to pass through endothelial pores ; *idea of* tissue fluid and blood plasma similar viscosity / blood more viscous ; AVP ; *ref. to* similar colour (versus blood is red)	**2**
(b)(ii)	*any one from* taken up by / transported into / AW, (body) cells (from tissue fluid) ; used by (body) cells to, synthesise polypeptides / proteins / enzymes ;	**1**
(c)	*any two from* contraction and relaxation ; changes diameter of (lumen) of, trachea / bronchus / bronchiole ; **A** (contraction causes) constriction control of air flow (in the bronchioles) ; AVP ; e.g. changed size of lumen during coughing / forced air out	**2**

163. 9700_w20_ms_21 Q: 5

(a)	*any **one** from :* (*when the air pressure lowers inside bronchus*) holds, bronchus / airway open ; **A** supports, bronchus / airway ; prevents, bronchus / airway, from collapsing ;	**1**
(a)(ii)	*idea that* (cartilage arranged as) incomplete / C-shaped, rings in the trachea ; *idea of* more regular distribution (of incomplete rings) along the length of trachea ;	**1**
(a)(iii)	*max 1 if cilia or mucus linked to incorrect cell* (ciliated epithelial cells have) cilia, to, waft / sweep / AW, mucus, away / up the trachea / AW ; (goblet cells that) secrete mucus to trap, dust / bacteria / pathogens ;	**2**
(b)(i)	the larger elephant has a smaller surface area to volume ratio ; **ora**	**1**
(b)(ii)	*any **three** from:* are multicellular / have many cells ; need a large quantity of / enough, oxygen to supply, every cell / all parts of body ; active so high demand for, oxygen / removal of CO_2 ; diffusion across body surface is not fast enough (to meet needs) ; AW long diffusion distance (so diffusion is not fast enough to meet needs) ;	**3**
(b)(iii)	*any **four** from:* three polypeptide chains ; (three polypeptides) form triple helix ; **A** coil around each other **R** *ref. to* alpha helix hydrogen bonds hold the three. polypeptides / strands. together ; the three polypeptides, lie close together / form a tight coil / are tightly wound ; every third amino acid (in the polypeptide chain) is glycine / many glycine-proline alanine repeats / many gly-pro-ala repeats ; glycine is found on the inside of each, polypeptide / strand; AVP ; e.g. detail hydrogen bonds, between peptide bond NH (of a glycine) and C=O group in adjacent polypeptide	**4**
(b)(iv)	*allow reference to collagen fibrils instead of collagen molecules, in correct context (collagen molecules form fibrils, which form fibres)* *any **one** from:* (many) collagen molecules lie parallel ; *no weak points because* strong / covalent, (cross) links between molecules ; (ends of) molecules (in, fibril / fibre), are staggered ;	**1**

164. 9700_w20_ms_22 Q: 3

(a)	irregular / plates / AW, of cartilage ; **A** cartilage not C-shaped rings *other features* *any **two** from:* smooth muscle ; elastic, tissue / fibres ; mucous glands ; thick wall / wall many layers ; large lumen (relative to thickness of wall) ; large size relative to surrounding alveoli ; **I** surrounded by alveoli	**3**
(b)	*evidence must match stated structure* blood vessel ; *plus any **one** from:* presence of tunica media / circular layers of smooth muscle ; three layers in wall ; similar to structure on left, which has blood cells ; not bronchiole, qualified ; e.g. as no ciliated epithelium not rounded shape / no definite shape **OR** artery ; **A** arteriole *plus any **one** from:* small lumen relative to thickness of wall ; **A** small lumen with thick wall thick, tunica media / muscle layer ; thick tunica externa ; **OR** vein ; *plus any **one** from:* no definite shape / not rounded / not oval / AW ; large lumen relative to thickness of wall **/** large lumen and thin wall ; thin tunica media ;	**2**
(c)	goblet cells, produce / secrete / AW, mucus to trap, pathogens / AW ; **A** dust / dirt / particles etc for AW cilia, waft / moves / carries / push, mucus, to back of throat / AW ;	**2**

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165. 9700_m19_ms_22 Q: 2

(a)	*any **four** from:* 1 globular protein ; **A** spherical / ball-shaped **I** circular 2 acts as a catalyst ; 3, 4 further detail ; ; e.g. increases the rate of a reaction (cf. to no enzyme) **A** speeds up a reaction / makes the reaction go faster does not get used up (in the reaction) **I** does not take part in the reaction **A** can be re-used **A** is not changed (by the reaction) does not alter the (chemical) equilibrium (between reactants and products) 5 lowers the, activation energy / energy needed for substrate to reach transition state ; 6 detail ; e.g. holds substrate to place strain on bond (for bond to break) holds substrates, in position / close, for bonds to form facilitates transfer of, electrons / protons 7 effective in tiny quantities / AW ; 8 shows specificity / active site shape complementary to substrate / forms enzyme–substrate complex / lock and key or induced fit mechanism of action ; 9 AVP ; e.g. may need, cofactor / coenzyme / prosthetic group, to function each has an optimum, temperature / pH	**4**
(b)	carbon dioxide / CO_2 + water / H_2O ; body tissues ⇌ lungs ; carbonic acid / H_2CO_3 ; *one mark for each side of the equation* *allow one mark only if, wrong way round / carbonic acid shown as proceeding to dissociate*	**2**
(c)	*any **four** from:* *primary:* sequence of amino acids not shown ; **A** cannot see primary structure of amino acids *secondary:* alpha / α, -helices shown ; beta / β, -pleated sheets shown ; (areas of) random arrangement shown ; *tertiary*: folding / coiling, (of polypeptide chain) shown / ref. to 3-D configuration ; globular shape shown ; interactions between, R-groups / side-chains, (of amino acids) not shown ; ref. to any two bond types not shown ; e.g. H bonds / disulfide bridges / ionic bonds / hydrophobic interactions folding allows presence of zinc / AW ;	**4**

166. 9700_s19_ms_22 Q: 2

<table>
<tr><td>(a)</td><td>mucous gland cells / mucous gland(s) ; I mucosa
goblet cell(s) ;
list containing trachea and / or bronchus and / or bronchioles I and allow to two max
BUT if alveoli stated or incorrect cell types (e.g. ciliated cells) max 1</td><td>2</td></tr>
<tr><td>(b)</td><td>any one from:

Golgi (body / complex / apparatus) ;
rough endoplasmic reticulum ; A rough ER / RER R SER I ER</td><td>1</td></tr>
<tr><td>(c)</td><td>two marks to complete table
<table><tr><td>first process</td><td>transcription</td></tr><tr><td>second process</td><td>translation</td></tr><tr><td>third process</td><td>glycosylation</td></tr><tr><td>fourth process</td><td>exocytosis</td></tr></table>allow one mark if transcription first process and exocytosis last process but other two wrong way round
allow one mark if transcription and translation wrong way round and other two correct</td><td>2</td></tr>
<tr><td>(d)</td><td>accept symbol Ψ for water potential
three from:
1 chloride presence outside cell causes water potential (outside cells) to, decrease / become more negative / become lower
or
chloride leaving cell causes water potential (in cell) to increase / AW ;
2 water potential gradient, created / present (between inside and outside of cell) ;
3 water leaves cell by osmosis (to be taken up by mucin to form mucus) ;
4 from higher to lower water potential / AW ; R if term gradient included</td><td>3</td></tr>
<tr><td>(e)</td><td>any three from:

to produce, new / daughter, cells…
1 that are genetically identical ;
2 to replace, old / damaged / dead, cells ; A named cells
3 to repair (damaged / injured / diseased) tissue ;
A named tissue
if mp 2 and 3 not gained, allow 1 mark for replacing damaged tissue

4 ref.to function ; in context
5 AVP ; idea of increase in number of cells / growth, to accommodate increase in size of gas exchange system in growing infants / AW</td><td>3</td></tr>
</table>

167. 9700_s19_ms_23 Q: 2

(a)	correctly stated formula ; e.g. actual diameter = image length / magnification magnification = image length / actual diameter allow a magnification triangle 1750 (μm) ; (*for 70 mm*) *credit also measurements made to 0.5 mm* **A** 1700 (μm) (*for 68 mm*) **A** 1725 (μm) (*for 69 mm*) **A** 1775 (μm) (*for 71 mm*) **A** 1800 (μm) (*for 72 mm*)	**2**
(b)(i)	squamous epithelial (tissue) ; **A** pavement epithelial (tissue)	**1**
(b)(ii)	*any two from:* (alveoli have) thin wall / wall is one cell thick ; **A** wall composed of thin cells **R** thin membrane **R** thin cell wall *idea of* short diffusion distance ; *in context of between alveolar space and, blood / capillary* elastic tissue, qualified ; **A** elastin / elastic fibres e.g. stretch and recoil for, ventilation / inhalation and exhalation maintaining steep, diffusion / partial pressure, gradient (many) alveoli provide a large surface area (for diffusion) ; **I** *idea that a single alveolus has a large surface area* AVP ; surfactant, prevents alveolar collapse / maintains inflation **I** *ref. to* moist lining	**2**
(c)	*any three from:* 1 loosely packed spongy mesophyll cells / spongy mesophyll cells surround air spaces / air spaces between spongy mesophyll cells ; 2 large, surface / area, for evaporation (of water to air space) ; *In context of spongy mesophyll cells, surfaces / cell walls* 3 (cells arranged so that), air spaces above the stomata / sub-stomatal air spaces ; 4 *ref. to* evaporation creates saturated air spaces / water vapour collects in air spaces ; 5 *idea of* creates water potential gradient between air in air spaces and air in external environment ; 6 AVP ; e.g. guard cells situated in epidermis to form stomatal pore *ref. to* xylem, close proximity to spongy mesophyll cells for passage of water / passes on water to spongy mesophyll cells	**3**
(d)(i)	*accept au for arbitrary units and first hour etc. for 08.00 etc.* *any three from:* 1 between 08.00 and 09.00, steep increase / increase from 2.5 au to 5 au ; 2 highest rate / peak, at 09.00 ; **A** maximum rate is at 09.00 3 fluctuates / AW, between 10.00 and 15.00 ; 4 (continued) decrease between 15.00 and 19.00 ; **A** steep /steepest, decrease between 15.00 and 16.00 **A** less steep (than 15.00 to 16.00) decrease between 16.00 and 19.00 5 comparative data quote for decrease ; e.g. 3.8 au at 15.00 to 0.5 au at 19.00 **or** 3.8 au at 15.00 to 2.00 au at 16.00 **or** 2.0 au at 16.00 to 0.5 au at 19.00	**3**
(d)(ii)	*any two from:* *change in external environmental factor* decrease in light intensity / AW ; **A** (less sunlight because it was) cloudy decrease in temperature / AW ; *temperature decreased because it was cloudy is mp2 only* decrease in, wind speed / air movement / AW ; increase in humidity / raining / AW ; stomata, decrease in (aperture) size / open less wide ; decreased evaporation (rate) ; water vapour diffuses out less rapidly / less steep water potential gradient ; AW AVP ; e.g. suggestion of xerophytic feature occurring in response to increased, temperature / light intensity (to 09.00)	**2**

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168. 9700_w18_ms_22 Q: 1

(a)	bronchiole ; **I** respiratory / terminal, before bronchiole	1
(b)	(actual diameter) = image / observed, length, ÷ magnification ; **A** (A =) I ÷ M **or** magnification triangle 300 □m ; (12 000 / 40) **A** 275 □m (11 000 / 40) **A** 288 □m (11 500 / 40) **A** 313 □m (12 500 / 40) **A** 325 □m (13 000 / 40)	2
(c)	*any four from* *in healthy lungs* **1** correct direction of movement of <u>both</u> respiratory gases ; e.g. oxygen from alveolus towards blood and carbon dioxide from blood to alveolus ; oxygen enters the blood system and carbon dioxide leaves **A** red blood cell / haemoglobin, *as ref. to blood* **2** diffusion (of, oxygen / carbon dioxide) **or** movement, down a concentration gradient / from high(er) to low(er) concentration ; **A** implied e.g. oxygen enters blood from a high<u>er</u> concentration **I** diffusion of gases **3** detail of pathway ; **R** *ref. to* cell walls e.g. across, alveolar wall / squamous (epithelial) cells across endothelium / capillary wall ; **A** squamous cells *in context of capillary* crosses two layers of cells (*alveolar wall and capillary wall)* *comparison healthy with diseased – look for ora* **4** higher rate of exchange / increased rate of diffusion / steeper concentration gradient ; **A** more oxygen to blood per unit time / more carbon dioxide to alveolus per unit time **I** more efficient gas exchange **I** better gas exchange / faster diffusion **5, 6** AVP ; ; e.g. larger surface area (for, gas exchange / diffusion) shorter diffusion distance *ref. to* (greater) ability to, stretch / recoil (for ventilation to maintain gradient) **or** *ref. to* elasticity *(more v fewer elastic fibres is not sufficient)*	4

169. 9700_s16_ms_21 Q: 3

(a) (i) **N** ciliated ; **A** pseudostratified **I** columnar / cuboidal **R** cilia [1]

(ii) **O** mucous glands ; **A** mucus glands / serous glands [1]

(iii) **P** cartilage ; [1]

(b) **I** more air can enter unqualified
- **1** more air / oxygen, reaches the, alveoli / gas exchange surface ;
- **2** more gas exchange / greater absorption of oxygen / excretes more carbon dioxide ; AW
  A maximises oxygen obtained
- **3** satisfies increased demand for oxygen / AW ;
- **4** trachea / bronchi / airways, widen / AW ;
  e.g. dilate / expand / enlarge **A** diameter of lumen increases
- **5** reduces resistance to air flow ; **R** rate of air flow increases [max 2]

(c) *collagen has*
three <u>polypeptides</u> / a quaternary structure ;
I more than one polypeptide unqualified
glycine is every third amino acid ; **I** at regular intervals **R** roughly / approximately
(triple) helix / helical (shape) ; **I** regular coils' **R** alpha helix [max 2]

[Total: 7]

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170. 9700_s16_ms_22 Q: 4

(a) blood contained in (blood) vessels AW
or
blood contained in *any three of*
heart, arteries, veins, capillaries **;**

systemic and pulmonary, systems / circulation **; A** 'systematic'
A described *if circulations not named*
e.g. for each complete circuit (round the body) passes through heart twice
from heart to lungs and back, then to (rest of) body and back **[2]**

(b) **W** = aorta / aortic arch **;**
X = pulmonary vein **;**
Y = right atrioventricular / tricuspid, (valve) **;**
Z = left, atrium / auricle **;** **[4]**

(c) red blood cells **;** **A** rbc
A platelets
A plasma proteins / named **[1]**

(d) **1** *idea of* carbon dioxide out (of blood to alveolus) and oxygen in (to alveolus from blood) **;**

2 diffusion / diffuses
or
(movement from) high concentration to low concentration / down a concentration gradient **; A** diffusion / pressure, gradient

3 (across) squamous epithelium / squamous cells (of alveolar wall) **;**
A pavement cells

4 (and) endothelium / endothelial cells (of capillary wall) **;**
A squamous cells *but must be clear that this is for capillary wall*

5 oxygen, into / AW, red blood cells **; I** oxygen binds to Hb

6 steep gradient maintained by, ventilation / uptake by haemoglobin / blood carries oxygen away / blood arrives with carbon dioxide / deoxygenated blood arriving low in oxygen **[max 4]**

(e) **(i)** **F** = nucleolus **; A** nucleus
G = cell surface / plasma, membrane **;** **[2]**

(ii) transport / transporter / carrier, protein **; R** pump protein

specific protein **;**
glucose, binding site / AW **; I** glucose binds **R** glucose receptor
specific binding site (in protein) = 2 marks

(glucose binding causes) conformational change **;** AW, e.g. changes shape

passive / no energy required / no ATP required **;**

movement is, down the concentration gradient / from high to low concentration **;** *must be in context of through the membrane protein* **[max 3]**

[Total: 16]

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171. 9700_w15_ms_22 Q: 1

(a) (i) mitochondria **;** **A** mitochondrion [1]

(ii) can change shape / fluid membrane structure / *ref. to* flexible **;**
different orientation when section taken / AW **;** **A** different sections cut
some may be dividing / *ref. to* mitochondrial fission; **I** growing [max 1]

(b) (i) ribosomes **;** **A** ribosome **I** *ref. to* size e.g. 70 S / 80 S [1]

(ii) *circle around* 0.025 μm **;** [1]

(c) (i) plasmodesmata **;** **A** plasmodesma [1]

(ii) *assume answer is in context of between adjacent cells but* **R** if within a cell
I incorrect naming of plasmodesmata
I description of cytoplasmic strands

facilitates / more rapid / allows / AW, transport / communication / exchange / transfer (of substances) **;**
substances do not need to cross, cell (surface) membranes / cell walls **;**
for, movement / AW, of, substances / materials / nutrients / water **;**

named example **;**
e.g. movement / diffusion / AW, of sucrose to sieve tube (from companion / transfer, cell)
water travels by, symplastic pathway **I** incorrect mechanism e.g. osmosis
water avoids, apoplastic / cell wall, pathway
proteins too large to cross, cell wall / cell surface membrane

A *idea of* substances moving in and out of cells *only if plasmodesmata given in* ***(i)*** [max 1]

(d) **I** descriptions e.g. extensions / hair-like

microvilli / **A** microvillus **R** villi / villus **R** cilia

and *one from:*

absorption / uptake of products of digestion
secretion / release of (extracellular), enzymes / other named secretion
digestion (at the cell surface) / breakdown of (ingested) food / AW
excretion / release of, waste / excess, substances
increases surface area **;** [1]

[Total: 7]

172. 9700_w20_ms_23 Q: 1

(a) *one mark per row*
A if *names and labels reversed* — **4**

description	name of part of gas exchange system	label from Fig. 1.1
supported by incomplete (C-shaped) rings of cartilage	trachea	B ;
lined by ciliated epithelium and supported by blocks of cartilage	bronchus **A** bronchi	C / J ; **A** C and J
lined by squamous epithelium	alveolus / alveoli	M ;
lined by ciliated epithelium, but not supported by cartilage	bronchiole(s) **I** terminal / respiratory	H ;

(b) **A** mutagen(s) / carcinogen(s) ; **A** tar **A** named carcinogens — **5**
B nicotine ;
C carbon monoxide ;
D tar ;
E nicotine ;

173. 9700_m19_ms_22 Q: 4

(a) *any **three** from:* — **3**

right ventricle pumps blood to lungs (and back to heart) and left ventricle pumps blood to (rest of) body (and back to heart) / AW ;

(so) short(er) / less, distance (for blood to travel) / ora ;

less resistance (to, flow / overcome) / ora ;

less force / lower pressure, required / ora ;

(b) *any **two** from:* — **2**

ventilation / breathing (movements) / inspiration / inhalation, brings in oxygen ;
blood flow (in pulmonary capillaries) removes oxygen ;

oxygen binding to haemoglobin / oxyhaemoglobin formation, (removes oxygen) ;
deoxygenated blood arriving / blood arriving low in oxygen ;

(c)(i) *any **one** from:* — **1**

in context of, airways / trachea / bronchi:
less air because:
diameter of lumen decreases / ref. to smooth muscle contraction ;
inflammation ;
thicker layer of mucus ;

smoke present in inhaled air (so lower proportion of air) ;

AVP ;

(c)(ii) *any **two** from:* — **2**

carbon monoxide (present in smoke) binds to haemoglobin ;
ref. to competitive / permanent / irreversible, binding ;
presence of carbon monoxide (from smoke) lowers affinity of haemoglobin for oxygen ;
ref. to carboxyhaemoglobin formed ;
comparatively less haemoglobin per red blood cell to bind oxygen ;

174. 9700_w19_ms_21 Q: 6

(a)	*three from* joins a nucleotide to extending, polynucleotide / strand ; (only allows) complementary base pairing ; forms phosphodiester bonds (between nucleotides) / forms the sugar phosphate backbone ; proofreading the new strand ; repairs any mismatched base pairs ;	**3**
(b)(i)	stops, cell cycle / mitosis / cell division / cell replication / AW ;	**1**
(b)(ii)	thymine only present in DNA / no thymine in RNA ; uracil (nucleotide) replaces thymine (nucleotide) in transcription ;	**1**
(c)(i)	cytokinesis ;	**1**
(c)(ii)	*three from* tobacco smoke / tar, contains (named) carcinogens ; cause, damage to DNA / mutations ; detail ; e.g. proto-oncogenes to oncogenes / tumour suppressor genes switch off (in) epithelial cells in the, trachea / bronchus / gas exchange system / lungs ; uncontrolled, mitosis / cell division ; AVP ; e.g. forms a mass of undifferentiated cells / AW cells do not respond to signals	**3**

175. 9700_w19_ms_22 Q: 2

(a)	EMRO and SEARO / Eastern Mediterranean and South-East Asia (Regions)	**1**
(b)	*max 1 (tar data mark or nicotine makes platelets sticky) if tar / CO also stated* *any two from:* (AFRO) has more nicotine ; **R** has more, tar / tar and nicotine / CO and nicotine (*see below)* nicotine makes platelets sticky / AW ; **A** damages endothelial lining (so turbulent blood flow) so increases clotting risk **R** if also state tar makes platelets sticky 0.92 and 0.77–0.79 mg (per cigarette) **or** 9.2 v. 7.7–7.9 mg (per cigarette) **or** (AFRO) 1.3–1.5 mg (per cigarette) higher ; *correctly extracted numerical data for tar is alternative to gain mp 3 ecf* 12.5–12.7 v. 11.3–11.5 mg / (AFRO) 1.0–1.4 mg higher	**2**
(c)	*allow, Hb / hb, for haemoglobin and allow CO for carbon monoxide* *any four from:* **1** haemoglobin, has a higher affinity for / binds more readily with, carbon monoxide (than oxygen) ; **A** carbon monoxide displaces oxygen from haemoglobin **A** carbon monoxide binds to Hb and decreases its affinity for oxygen **2** carboxyhaemoglobin formed ; **3** binding is, (mainly) irreversible / permanent / (more) stable (than oxygen binding) / AW ; **4** decreases saturation of haemoglobin with oxygen (in the lungs) / less haemoglobin available to bind oxygen ; **A** less oxyhaemoglobin formed / less oxygen binds to haemoglobin *cigarette smoke:* **5** low concentration of oxygen in inhaled cigarette smoke ; **6** *ref. to* (in airways), narrowed lumen / inflammation / increased mucus / accumulated, mucus ; **A** bronchial constriction **7** (so) lower concentration of / less, oxygen, reaching alveolus / in alveolar air **or** (so) less oxygen, diffuses / AW, (from alveolus) into bloodstream / reaches red blood cells / reaches haemoglobin (in red blood cells) ; **R** *ref. to* consequence of emphysema *must be in context of mp 5 or 6* **8** AVP ; e.g. nicotine causes vasoconstriction and reduces blood supply (to extremities)	**4**

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176. 9700_m17_ms_22 Q: 5

(a)	bronchus } ; trachea } bronchiole ; alveolus ; **I** same structure written on more than one line	**3**
(b)	*two from:* 1 (tobacco) smoke contains, tar / carcinogens / named carcinogen ; 2 causes mutations / mutagenic / described mutation e.g. protooncogene to oncogene / oncogene forms / tumour suppressor gene switched off ; 3 uncontrolled mitosis / AW ;	**2**
(c)	*three from:* 1 many layers v few(er) layers ; **A** one layer / thicker 2 cells all the same v more than one type of cell / goblet cells and (epithelial) cells ; **A** no goblet cells 3 cells, flatter / smaller / cubical / AW v columnar cells ; 4 reference absence of cilia ; 5 large / prominent, nuclei / ORA ;	**3**

177. 9700_s17_ms_22 Q: 5

(a)(i)	trachea / windpipe + bronchus / bronchi + bronchiole / bronchioles ; *treat as neutral type of bronchiole*	**1**
(a)(ii)	goblet ;	**1**
(b)	*D = accept points from diagram* **1D** recognition / AW / binding / attachment, (of macrophage) to, bacterium / *S. pneumoniae* / (bacterial) antigen ; **A** detects / identifies *(D) must label, bacteria / S. pneumoniae, or macrophage and show bacterium attached* **2** endocytosis / phagocytosis ; **3D** described ; e.g. engulfing / enveloping / pseudopodia surround phagocytic / endocytotic, vacuole formed **A** phagosome **A** vesicle **4D** fusion of lysosome(s) (to vacuole) ; *(D) must label lysosome* **5D** breakdown / destruction / digestion / AW, of bacterium / *S. pneumoniae* ; **A** kills *(D) annotated on diagram* **6D** *ref. to*, hydrolytic / digestive, enzymes ; **A** named digestive enzymes *must be in context of lysosome (D) labelled as such*	**max 3**
(c)	elastin broken down / elastic fibres damaged ; **A** elastic fibres broken down **A** less, elastin / elastic fibres *detail e.g.* (alveolar) wall becomes overstretched / AW weakened (alveolar) wall / AW e.g. cannot withstand higher pressure ; bursts on inhalation (bronchioles collapse) on exhalation, trapped / remaining, air bursts alveoli	**2**
(d)	*accept (the) glycoprotein for GM-CSF throughout* **1** (excess surfactant) stimulates immune system cells ; **2** release / secretion, of, GM-CSF ; **I** produce **3** GM-CSF is a signal **or** GM-CSF is a signalling, molecule / protein / glycoprotein ; **A** messaging molecule **4** binds to / combines with / AW, (cell surface membrane) receptors (on alveolar macrophages) ; **5** *ref. to* specificity ; **A** described as GM-CSF receptor complementary shape for GM-CSF **6** leads to / sets off / triggers / AW, response (in the cell) / removal of surfactant ; *in context of macrophage* **A** stimulates **7** detail ; e.g. triggers secondary messenger activates enzymes / enzyme cascade signal transduction phosphorylation events	**max 4**
	Total:	**11**

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178. 9700_s17_ms_23 Q: 1

(a)	blood contained in (blood) vessels AW **or** blood contained in *any three of* heart, arteries, veins, capillaries ; systemic and pulmonary, systems / circulation ; **A** described *if circulations not named* e.g. for each complete circuit (round the body) blood passes through heart twice blood transported from heart to lungs and back, then to (rest of) body and back	**2**
(b)	2 4 1 3 5 1st and 5th boxes (2 and 5) correct ; 2nd and 4th boxes (4 and 3) correct ;	**2**
(c)(i)	*assume answer refers to arteries unless stated otherwise* withstand / AW, higher pressure (of blood) ; prevent rupturing / bursting (from high blood pressure) ; **I** collapsing *one from* thicker / AW, tunica media ; more elastic, tissue / fibres, and (smooth) muscle tissue ; more / AW, elastic, tissue / fibres, to maintain, blood pressure / blood flow ; more (smooth) muscle to maintain, blood pressure / blood flow ;	**max 2**
(c)(ii)	*carbon monoxide max 3* forms carboxyhaemoglobin ; **A** binds to haemoglobin less haemoglobin available to bind oxgen / haemoglobin has greater affinity for carbon monoxide / AW ; reduces, percentage saturation of haemoglobin (with oxygen) / AW **A** less oxygen binds to haemoglobin **I** prevents oxygen binding **or** reduces oxygen carrying capacity of, haemoglobin / blood ; *nicotine max 3* increases heart rate ; increases blood pressure ; constricts, arteries / arterioles ; **A** vasoconstriction makes platelets sticky / promotes clotting / promotes thrombosis ; *for either* damages, endothelium / tunica intima / lining of blood vessels ;	**max 4**
	Total:	**10**

179. 9700_m16_ms_22 Q: 6

(a) trachea / windpipe
bronchus / bronchi
bronchiole / bronchioles
alveolus / alveoli

} *all correct two marks* ; ;

one mark for:
one structure, incorrect / missing, but others in correct order
or
trachea and alveolus correct but bronchus and bronchiole wrong way round

[2]

(b) emphysema ;
<u>chronic</u> bronchitis ;

[2]

[Total: 4]

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180. 9700_s16_ms_23 Q: 1

(a) (i) letter **X** written in space above cilia **;** **A** label line into this space [1]

(ii) nucleus **;** [1]

(iii) cilia **;**
columnar / tall / not flat / not thin **;**
nuclei rounded / AW **;**
presence of goblet cells **;** [max 1]

(b) (i) mitosis **;** [1]

(ii) *presence of any 3 of:*
1 shorter / no / fewer / damaged, cilia **;** **A** paralysed
2 undifferentiated / AW, cells **;**
3 flattened / squamous, cells / epithelium **;**
4 scar tissue **;** **A** scar tissue forms
5 enlarged goblet cells **;**
6 excess / accumulated / AW, mucus **;** **A** excess mucus secreted
7 tar deposits **;** **A** description of tar on lining
8 phagocytes **;**
9 AVP **;** e.g. inflammation (of bronchial lining)
[max 3]

[Total: 7]

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181. 9700_w16_ms_21 Q: 6

(a)

	cartilage	cilia	elastic fibres	
trachea	✓	✓	✓	;
bronchioles	×	✓	✓	;
alveoli	×	×	✓	;

[3]

(b) *changes max 2*
fewer / no / damaged / AW, cilia ; **A** paralysed / destroyed **R** killed
A ciliated (epithelial) cells destroyed
scar tissue, develops / replaces ciliated (epithelial) cells / AW ;
goblet cells enlarged ;

increased risk max 2
thicker layer / more, mucus traps bacteria ;
mucus not removed (by cilia action) so, (trapped) bacteria remain / longer time for bacteria to infect cells / AW ;
bacteria multiply / bacterial population growth, in mucus (so increases chance of infection) ; [3]

(c) *four from*
oxygen used up in (aerobic) respiration (in tissues) ;
low(er) / decrease in, partial pressure of oxygen / AW ;
allosteric mechanism / described ;
small decrease in partial pressure leads to a large dissociation of oxygen ;

ref. to decrease in haemoglobin affinity for oxygen (so oxygen released) ; AW

high(er) CO_2, partial pressure / AW ;
haemoglobinic acid formation / H^+ combines with haemoglobin (causes oxygen release) ;
AVP ; e.g. H^+ from carbonic acid dissociation
A H^+ results from action of carbonic anyhydrase to form carbonic acid
effects of carbaminohaemoglobin formation [4]

(d) too large to pass through, (endothelial) pores / capillary walls ; [1]

[Total: 11]

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182. 9700_w15_ms_23 Q: 5

(a) **I** *ref. to* walls, unqualified **I** *ref. to* vasoconstriction

nicotine
1 damages the, endothelium / (inner) lining / tunica intima ;
2 increases blood pressure (which can damage the endothelium) ;
3 increases risk of, blood clotting / thrombus formation ;
A thrombosis, **A** increases stickiness of platelets

carbon monoxide
4 damages the, endothelium / inner lining / tunica intima ;
allow even if mp1 given
5 so increases risk of, blood clotting / thrombus formation ;
A thrombosis
6 *idea of* overall reduced oxygen supply to coronary artery walls ;
7 AVP ; e.g. inflammation / (increases risk of) atheroma *or* plaque *or* atherosclerosis [max 3]

(b) **(i)** (the by-pass vessels) supply (oxygenated) blood from the aorta ;
supply oxygen to, cardiac / heart / ventricle, muscle ;
supply, glucose / fat / fatty acids ;
reduce / prevent, anaerobic respiration ;
A so (muscles) can (continue to) respire aerobically
prevent death of, muscle / heart cells / heart tissue
A prevents angina [max 3]

(ii) **I** lifestyles, healthy or otherwise
I 'better health care'

education
early education / educate children (about heart disease)
or
leaflets / posters / continuing education, about effects of heart disease ;

diet
encourage / educate about, healthy eating / balanced diet ;
ref. to labelling of foodstuffs ;
tax on, sugar / fats **ora** e.g. reduce cost of 'healthy' foods
or
idea of regulation against foods with, high sugar / fat ;
A junk food

smoking
educate about dangers of smoking / anti-smoking campaigns ;
provide ways to stop smoking / example ; e.g. tax on cigarettes / nicotine patches / E-cigarettes
smoking bans ;

exercise
finance use of / build more, activity centres / AW ;
encourage, greater activity / exercise ;

medical
idea of, check-ups / screening population (at risk of heart disease / high blood pressure / high cholesterol) ;

provide / subsidise, drugs to, reduce blood pressure / lower cholesterol ;

research
funding research into heart disease ; [max 3]

[Total: 6]

Q1.

6 (a) *Two correct letters required for a mark for each column if list given; mark first 2 letters.*

Alcohol	Caffeine	Nicotine	Heroin
U V Y Z	S T Z	S T W X Z	U Y W

4

(b) decrease in response to drug/effect of drug becomes less (intense);
decrease in sensitivity of receptors/more receptors are made;
drug is metabolised/becomes part of body's metabolism; more drug necessary to achieve the same effect/sensation/euphoria; **max 2**

(c) *award marks from any annotated diagrams*
Either
inhibitor fits site other than active site/allosteric site; tertiary/3D structure or shape changes/any two bonds mentioned break; (ionic, van der Waals, hydrophobic, hydrogen, disulphide, covalent)
active site changes shape;
substrate no longer fits/binds/active site no longer complementary to substrate/E.S. complex not formed;

or
inhibitor fits permanently/irreversibly into active site;
substrate can no longer bind/substrate blocked/no E.S. complex formed;
increasing substrate has no effect; **max 3**

Either mark scheme as appropriate – do not mix marking points from both mark schemes

[Total 9]

Q2.

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(b) increases heart rate;

increases blood pressure;

constricts, arterioles/arteries; **A** narrows diameter/lumen **R** ref to blood vessels

reduces blood flow to, periphery/hands/fingers/AW;

increases 'stickiness' of platelets; **R** blood cells

ref to atheroma, plaque, atherosclerosis, cardiovascular disease, damage to endothelium;

Generally, mark 1st 2 sentences (look for full stops!). However if 2 correct points in 1st sentence allow this. **[max 2]**

(c) mark two parts together

(in every country) the death rate for men is higher than that for women; **R** ref to % of death

in some countries where many people smoke there are low death rates from lung cancer;

data quote to support either part;

Here we need to be very precise! We can accept male or female data quoted in the correct context. R any 'ADDITIVE %s'!/incorrect units. **[max 3]**

(d) age;

how long men have been smoking/age at which start smoking;

how many cigarettes are smoked per day; **A** heavy/light smokers

any 2 risk factors that are linked with lung cancer;;

e.g. Hereditary/running in families;

working environment (pollution/passive smoking/exposure to other carcinogens/radiation);

type of cigarette(tar levels/cigars/cigarettes smoked/brand of cigarette/whether filtered/unfiltered);

depth of inhalation;

R refs to diet/alcohol/lifestyle/stress. **[max 2]**

Q3.

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1 **(a)**

function	Structure
facilitated diffusion of glucose	**B**
creates a current to move mucus	**A** ;
aerobic respiration	**C** ;
makes ribosomes	**E/C** ;
a site of transcription	**G/E/C** ;
packages proteins into lysosomes	**J** ;

[5]

(b) *alveoli – accept ora for bronchus*

thin, cells/walls/epithelial lining/epithelium (for alveoli) ; **A** 1 cell thick **A** 0.5µm
short diffusion distance ;
well supplied/better supplied, with blood/capillaries ;
(alveoli provide) large surface area (when expanded) ;
less/no/thinner layer of, mucus ; [max. 3]

(c) less/no/damaged, cilia ; **A** paralysed/not beating **R** killed
flat cells/squames/squamous epithelium ;
layers of cells ; **R** thicker unqualified
scar tissue ;
much mucus ;
inflamed ; **R** infected **A** goblet cells enlarged
deposits of tar (idea of) ; [max. 3]

[Total: 11]

Q4.

(c) *accept once only for either nicotine or carbon monoxide*
damages lining of arteries ;
promotes, atheroma / atheromatous plaques / fatty plaques / arteriosclerosis / atherosclerosis ;

nicotine
increases heart rate ;
increases blood pressure ;
makes platelets 'sticky' ;
increases chance of blood clotting / promotes thrombosis ;
decreases flow of blood to, extremities / AW ;
constriction of blood vessels ; **R** contraction **R** capillaries (2 max)

carbon monoxide
combines with haemoglobin / forms carboxyhaemoglobin / higher affinity for haemoglobin (than oxygen); **R** absorbed, reacts with, bonds to
reduces oxygen carrying capacity (in context of, haemoglobin / blood) ;
promotes release of damaging free radicals / peroxides / super oxides / oxidising agents ;
causes platelets and neutrophils to stick together / platelets to stick to endothelium ;
hypoxia can damage heart muscle ; (2 max) [4 max]

[Total: 11]

Q5.

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4 **(a)** volume of air breathed, in / out, with one breath ; **A** volume of air exchanged in one breath
ignore refs to at rest [1]

(b) (tidal volume and) vital capacity are measurements associated with, exercise / fitness ;
vital capacity is total volume of air that can be expired after maximum inspiration / vital capacity is sum of inspiratory reserve + tidal volume + expiratory reserve ;
differences between the groups (in tidal volume) could be due to larger, lung / vital, capacity ;
AVP ; [2 max]

(c) before / after recovery from, exercise ;

either
measure tidal volume, by breathing out into a bag ;
multiply by number of breaths per minute ; **A** total tidal volume in x minutes ÷ x

or
use a spirometer / described ;
ref to taking recordings from a trace / use of a, kymograph / datalogger ; [2 max]

Q6.

(b) smoke / tar, is carcinogenic / contains carcinogens ; **A** named carcinogen e.g. benzpyrene / phenol
genes control, cell division / mitosis ;
mutation / change to DNA (in these genes) ; **A** DNA damaged **A** ref. to mutagenic
gene expression affected / AW ; e.g. ref to oncogenes / proto – to onco – / tumour suppressor genes switched off
cells, grow / divide, uncontrollably / continuously ; **A** uncontrolled mitosis
cancer cells do not respond to signals ;
(and) form a (malignant) tumour ;
(tar) settles on bronchial, epithelial cells / epithelium ; [4 max]

(c) idea of, a long time gap / years, qualified ; e.g. before symptoms of, cancer / tumour, appear
between decreased number smoking and lower mortality rates
correct ref. to data to support above ; *trends must be anchored in both graphs*
if data is used, must be anchored in both graphs and numerically correct
increasing mortality rate
increase in lung cancer deaths linked to rise in smoking in 1930s+ ;
valid ref. to other direct risk factors (for lung cancer) in 1930s+ ; e.g. air pollution, mass chest X-ray screening

decreasing mortality rate because
earlier diagnosis (so fewer die) ;
improved, health care / treatment (extends life) ;

ref. to epidemiological evidence linking smoking and lung cancer / almost all cases of lung cancer, are caused by smoking / occur in smokers ; [3 max]

Q7.

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2 **(a)** *award two marks if correct answer (29) or (28) is given*
allow +/– 1 mm in reading the line
100 000 µm / 3 500 = (28.57)
or (28.29 if measured 99 mm) or (28.86 if measured 101 mm)
29 ;; **A** 28 only if 99 mm measured
award one mark if correct measurement is divided by the magnification or if answer is given to one or more decimal places [2 max]

(b) **(i)** stretch / expand / lengthen, on inspiration and, recoil / shorten, on expiration ;
A alternatives for inspiration and expiration but **R** contract and relax
(stretch) to increase, surface area / volume of air, for, diffusion / gas exchange ;
(recoil) to (help), expel air / force air out ; **ignore** contract
prevent alveoli, bursting / breaking / AW ; **R** collapsing [2 max]

(ii) *ignore moist*
correct ref. to diffusion of, carbon dioxide / oxygen ; **A** absorb / lose / AW
(many alveoli) large surface area ;
surrounded by, (many) capillaries / capillary network / AW ;
short diffusion distance (between air and blood) ;
blood maintains concentration gradient ;
epithelium / alveolar wall / AW, thin / squamous ; **A** alveolus one cell thick
A alveolus has a thin wall
R cell wall e.g. alveolar cell wall is thin
idea that very little between, epithelium and endothelium / AW ;
e.g. alveolus and capillary are close together [4 max]

(c) **(i)** *assume answers are about person with emphysema, accept ora if clear*
fewer alveoli / (large) 'holes' ;
A alveolar walls broken down / fewer air sacs / alveoli burst / destroyed
less / destroyed / broken, elastic tissue / elastin ; **ignore** damaged
R no, elastin / elastic fibres
small(er) surface area ;
fewer capillaries ;
named change(s) to bronchial tissue ; e.g. enlarged goblet cells, more mucus, scar tissue, scarred, narrow lumen in airways, inflammation, damaged / no, cilia
ref. to tar deposits ;
R collapsed lung tissue [2 max]

(ii) shortness of breath (when exercising) / breathlessness ;
A breathing difficulty
wheezing / AW (on inspiration) ;
rapid breathing rate / hyperventilation / decreased ability to hold breath ;
R heavy breathing
chest, tightness / pain ;
cyanosis / bluish appearance to the skin / AW ; **A** pale
fatigue / tiredness / lethargy / weakness / dizziness / AW ;
coughing / coughing up blood ;
lots of mucus produced / much phlegm ;
expanded / barrel, chest ;
R ref. to oxygen concentration of the blood
R small vital capacity [2 max]

[Total: 12]

Q8.

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5 (a) *one mark for each correct row ; ; ; ;*

	cartilage	ciliated epithelium	elastic fibres	goblet cells	smooth muscle
A	✓		✓		✓
B	✓	✓		✓	✓
C	×	✓	✓		
D		×	✓	×	

[4]

(b) *goblet cells to max 3*
synthesise/produce/secrete/release, mucus ;
mucus, sticky/AW ;
(mucus) traps/AW, pathogens/AW , dust/particles/AW, pollen ;
A named organism types/microorganisms
R cilia traps
increased secretion when, inflamed / infection ;

qualified ref. to role of mucus ; e.g.
increases distance (e.g. of pathogen) to reach (epithelial) cells
acts as barrier/prevents, entry/attachment to, cells
prevent, infections/pathogens reaching alveoli *allow once only in either section*

cilia to max 3
waft/move/AW, mucus ;
synchronous/metachronal, rhythm ; AW
movement towards back of throat for, swallowing/coughing out ;
qualified ref. to role of cilia in health ; e.g. ref. to, normal air flow/ventilation/keeping airways clear [4 max]

[Total: 8]

Q9.

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6 (a) *1 mark each correct row*

	lined with cilia	reinforced with cartilage	site of gas exchange	contains smooth muscle	
trachea	✓	✓		✓	;
bronchus	✓	✓	✗	✓	;
bronchiole	✓	✗	✗		;
alveoli	✗	✗	✓	✗	;

[4]

(b) good/circulating, blood supply ;
good ventilation/breathing movements ; [2]

(c) **(i)** stretch/expand/lengthen, on inspiration and, recoil/shorten, on expiration ;
A alternatives for inspiration and expiration
R contract and relax
(stretch) to increase, surface area/volume of air, for, diffusion/gas exchange ;
(recoil) to help, expel air/force air out ; ***ignore*** contract
prevent alveoli, bursting/breaking/AW ; **R** collapsing [1 max]

(ii) emphysema ; [1]

(d) (cause) mutations ;
uncontrollable, division/mitosis/cell replication/cell growth ;
lack of contact inhibition/no apoptosis *or* described/(proto)oncogenes ;

goblet cells secrete, excess/more/AW, mucus ;
destroys/weakens/paralyses/AW, cilia ;
development of scar tissue ;
inflammation ;
increased chance of infection/AW ; [3 max]

[Total: 11]

Q10.

1 (a) *award two marks if correct answer (4500) is given*
allow +/- 1 mm in reading the line
accept anything within range 4400 to 4600

max 1 mark if unit is given

award one mark if incorrect measurement just beyond acceptable range is divided by the actual length (10 μm) using same unit

expect calculation from measurement of scale bar, but look out for alternative method, e.g. measuring the image and then using the scale bar to determine the width in μm

$\frac{45\,000}{10}$ $\frac{45\times10^{-3}}{10\times10^{-6}}$ $\frac{4.5\times10^{-2}}{10\times10^{-6}}$

4500 ;; [2]

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(b) **A** = goblet cell(s), **B** = cilia / ciliated cell ;

A / goblet cell, secrete / make / produce / release, mucus / mucous ;
R excrete
bacteria / pathogens / dust / viruses / particles / dirt / AW, stick (to mucus) / trapped (in mucus) ; **A** collects **R** 'contains'

B / cilia, move mucus, up(wards) / away from alveoli *or* bronchioles / away from lungs / up the trachea / to larynx / to mouth / to throat / AW ;
bacteria / pathogens / dust / AW, do not accumulate / can be swallowed / do not cause infection (in the trachea) ; **A** 'stops infections' **I** 'in the lungs'
must be in context of cilia or cilia and mucus [max 4]

(c) *marks can be taken from labels / annotations*

1 chromatids / chromosomes / chromatin, condense / become shorter / become thicker / coil / supercoil / AW ; **A** 'become (more) visible'
2 centrioles, move to / reach, opposite poles ; **R** ends
3 nucleolus disappears ;
4 spindle is formed ; **A** 'more developed' **A** *description in terms of spindle fibres*
5 ref to assembly of microtubules ; **A** 'makes' microtubules **R** 9+2
6 nuclear envelope, disintegrates / breaks down / destroyed / AW ; **A** membrane
7 chromosomes, move to / at, equatorial plate / equator / metaphase plate / AW ; *ignore* middle / centre
8 centromeres attach to, spindle / fibres ;
9 ref to random arrangement of chromosomes ; **A** 'not in pairs' **R** scattered [max 5]

[Total: 11]

Q11.

6 **(a)** ref. to coronary arteries ; *in correct context*
makes platelets sticky, so causing blood to clot ;
increases risk of thrombosis in, coronary arteries / arteries to heart (muscle) ;
leading to plaque / atheroma / atherosclerosis / AW ;
increases heart rate ;
increased blood pressure ;
damage to, tunica intima / endothelium /endothelial lining / arterial lining ; [max 4]

(b) *any one valid statement for 1 mark*

agree
less addicted to smoking cigarettes so fewer smoked ;
fewer smoked, so reduced risk of smoking-related diseases ; **A** named disease
fewer smoked so reduced risk from, (effects of) tar / carbon monoxide ;

disagree as people may smoke more
may smoke more to, increase their nicotine levels / satisfy need for nicotine / AW ;
more smoked, so increased risk of smoking-related diseases ; **A** named disease
may smoke more so increased risk from, (effects of) tar / carbon monoxide ;

AVP ; *for either agree or disagree*
e.g. disagree as may still smoke and there are still other carcinogenic chemicals such as tar
[max 1]

[Total: 5]

Q12.

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(b) **R** way in which cancer develops / epidemiological evidence
A beagles for dogs

1 tar painted on skin of, mice / rabbits / rats / (small) mammal, led to development of (cancerous / malignant) tumour ;
2 dogs that smoked (plain) cigarettes developed, cancer / tumour ;
3 dogs that smoked filter-tipped cigarettes did not develop cancer / tumour ;
A developed precancerous changes
4 control group / dogs, which did not smoke and did not develop, cancer / tumour ;
5 AVP ;
e.g. evidence from any other named mammal
e.g. inhaling substances from, tar / tobacco [max 3]

(c) *similarities*
1 all (named) countries, increase and decrease / reach a peak and decrease ;

differences
2 peaks / AW, have occurred at different years in at least two countries ;
3 all maximum mortality rates are different ;
4 any comparative, data quote / calculation, with units given at least once ;
e.g. dates and mortality rates for at least two countries
e.g. mortality rates for one country at two different dates [max 3]

accept a range or a single figure within the ranges given

countries	peak mortality rate	year
USA	53–57	1984–1990
Spain	45-48	1993–1997
Finland	69–71	1970–1973
UK	72–75	1970–1975
Hungary	83–87	1996–2000

[Total: 9]

Q13.

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Question	Expected Answers	Marks
1 (a)	correct measurement of scale bar used as basis for finding magnification with appropriate working; A. 1.7 - 1.9 cm for length of scale bar e.g. $\frac{\text{xx mm x 1 000}}{10}$ = X xxxx; A. any fig. between x 1700 - 1900	2
	N.B. award one mark if correct answer given without any working shown	
(b)	movement of air / oxygen into alveoli; concentration gradient (between alveolar air and blood) / AW (for either oxygen or carbon dioxide); oxygen dissolves in film of liquid / surfactant fluid; diffusion; oxygen and carbon dioxide exchanged (idea of); squamous / alveolar / pavement epithelium; } A. alveolar/capillary endothelium (of capillary); } wall once red blood cell; ref to short diffusion distance into capillary / one cell thick / 2-3 µm; R. thin wall	4 max
(c)	B lymphocyte / B cell / plasma cell;	1
(d)	secretion of mucus by, goblet cells / glands; fluid leaks from capillaries; R. capillaries permeable contraction of (smooth) muscle / muscle spasm; congestion / blocking / narrowing / AW, of airways / bronchioles; increased resistance to air flow / air flow restricted;	3 max
		[Total : 10]

Q14.

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Question	Expected Answers	Marks
6 (a)	anaerobic; R. inaerobic, R. unaerobic lactate / lactic acid; liver; debt; R. deficit aerobic; resting;	6
		[Total : 6]

Q15.

(c)	destroys / paralyses / inhibits / weakens cilia; R. kill mucus glands / goblet cells produce more mucus; tar contains carcinogens / chemicals which damage DNA / genes / oncogenes; ref cancer / tumour; epithelium / lining replaced by scar tissue;	max 3

Q16.

Question	Expected Answers	Marks
6 (a)	greater / increased / more demand for energy / ATP; in muscles; aerobic respiration;	max 2
(b)	oxygen debt; R. deficit A. dept lactate / lactic acid; respired in the liver; A. heart converted to glucose / pyruvate / glycogen; (re)oxygenation of myoglobin; (re)oxygenation of haemoglobin; increased / still high rate of, metabolism / respiration (after exercise);	max 4
(c)	rejection / ref to immune system; R. may not match unqualified shortage of donors; shortage of, trained personnel / appropriate facilities; idea of high cost of surgery / aftercare / drugs; A. expensive greater risk of surgery;	max 2

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Q17.

Question		Expected Answers	Marks
1	(a)	**A** – Golgi, body/apparatus/complex; **B** - Nucleolus; **C** – Mitochondrion.	[3]
	(b)	Trachea/bronchus; **A** bronchiole **R** nasal epithelium etc.	[1]
	(c)	**P** to line between 2 amino acids; **G** to line between 2 sugars *or* between first sugar and amino acid.	[2]
	(d)	Lines surface (of epithelium); Sticky; Traps, dust/spores/bacteria/AW; Moved by cilia; Towards throat/away from lungs; Protects, alveoli/gas exchange surface.	max [3]
	(e)	Cell recognition site; Receptor/receptor molecule; For cell adhesion; Stabilise membrane structure/form hydrogen bonds with water molecules; (Cell surface) antigen; **A** cell marker.	max [1]
			[Total: 10]

Q.18.

3 (a)	**A** to cilia; **R** basal body **B** to nuclear membrane; **C** to ER; **must have label lines which touch appropriate place**		[3]
	(b)	cilia are, absent/destroyed/damaged/not functioning; **R** killed mucus is not moved/swept away; mucus, remains/accumulates, in airways qualified e.g. lungs/alveoli/bronchi; pathogens/bacteria/viruses/fungi, are not carried away/are trapped; pathogens, reproduce/divide/multiply/spread; ref to conditions for their growth;	[max 3]

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(c) there is no positive correlation AW e.g. no link/no direct connection,between increased cigarette consumption and number of deaths;
use of comparative figures to support this; **both no of cigarettes and deaths must be quoted (2 sets of figs needed)**

Any one other valid mark from the following:
people die before COPD develops (sufficiently);
only 20 countries;
cause of death may not be recorded accurately/maybe other cause(s) recorded on death certificate;
COPD contributed to death but not main cause;

maybe other factors contribute to developing COPD eg. air pollution/occupation/ climate/population density;

maybe other factors involved with smoking are more important e.g. number of years smoked/number of cigarettes smoked by smokers;

ref to correlation coefficient;
for the data it is 0.05 **[max 3]**

[Total: 9]

Q19.

(b) nicotine,
increases heart rate / raises blood pressure / constriction of blood vessels /
increases stickiness of platelets (so cause clots) /
decrease in blood flow to, hands / feet / fingers / extremities /
is addictive / damages, endothelium / lining of blood vessels ;

carbon monoxide,
combines with haemoglobin to form carboxyhaemoglobin / reduces amount of oxygen that can be transported in the blood ;

carcinogens / named carcinogen (e.g. benzpyrene / phenol), cause mutations / AW ;

tar,
inhibits / weakens action of / destroys / paralyses, cilia / stimulates, goblet cells /
mucous glands, to secrete more mucus ;
A excess [3 max]

Q20.

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2 (a)

structure	trachea	bronchus	bronchiole	alveolus
ciliated epithelium	✓	✓	✓	×
goblet cells	✓	✓	✓ / ×	×
cartilage	✓	✓	×	×
smooth muscle	✓	✓	✓	×

one mark each row [4]

(b) (i) athlete takes a deep breath and then breathes out as much air as possible / AW ;
suitable method to record this, e.g. spirometer / breathing out into a bell jar of water ; [2]

(ii) 0.5 dm^3 / 500 cm^3 ; [1]

(c) reduced supply of blood to, heart / cardiac, muscle ;
reduced supply of glucose (to cardiac muscle) ; **R** no
reduced supply of oxygen (to cardiac muscle) ; **R** no
less aerobic respiration / (more) anaerobic respiration (of cardiac muscle) ;
build up of, lactate / carbon dioxide ;
ref. limited cardiac output ;
AVP ; e.g. ref. to consequences to (muscles of) body with reduced blood supply, ref. to pain caused by angina **R** heart attack / AW [3]

(d) damages, lining of arteries / endothelium ; *accept once*
speeds up (atheromatous / fibrous) plaque development ; *accept once*
increases chance of blood clotting / promotes thrombosis ; *accept once*

nicotine
increases heart rate / AW ;
increases blood pressure ;
makes platelets 'sticky' ;
decreases blood flow to, extremities / AW ;
constriction of blood vessels ; (max 2)

carbon monoxide
combines with haemoglobin / forms carboxyhaemoglobin / higher affinity for haemoglobin (than oxygen) ;
reduces oxygen-carrying capacity / AW (in context of, haemoglobin / blood) ;
promotes release of damaging free radicals / peroxides / superoxides / oxidising agents ;
causes, platelets and neutrophils to stick together / platelets to stick to endothelium ;
ref. hypoxia damage to cardiovascular system ; (max 2) [max 3]

[Total: 13]

Q21.

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6 (a) (i) squamous / pavement (epithelial) ; [1]

(ii) stretch / expand, on inspiration and recoil on expiration ; **R** contraction

(stretch) to increases, surface area / volume of air, for, diffusion / gas exchange ;

(recoil) to help, expel air / force air out ; **A** carbon dioxide
A if destroyed then cannot expel air

prevent alveoli, bursting / breaking / AW ;

ref. to emphysema if elastic fibres destroyed ; [max 2]

(b) *award two marks if correct answer (anything in range 336–346)*
allow +/– 1 mm in reading the line (74–76 mm)

75000 μm / 220 μm =
341 ;;

if answer incorrect, award one mark for correct measurement with unit and division by 220
award one mark if correct answer given to one or more decimal places [2]

(c) *look for two ideas – follow usual rules for marking numbered answer lines*

thin, alveolar wall / epithelial lining / AW ;
A short diffusion distance (between air in alveolus and blood in capillary)
A squamous cells are thin
R thin, membrane / cell membrane **R** large surface area

surrounded by, capillaries / capillary network ;
A close contact with, capillaries / blood (vessels / cells)
A many capillaries
A large area of alveolus in contact with, capillaries / blood [2]

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(d) ***max 3 if no ref. to diffusion***

(named) gas(es), diffuse down, pressure gradients / concentration gradient / AW ;
A from high(er) partial pressure to low(er) partial pressure
A high(er) concentration to low(er) concentration
ignore 'along a concentration gradient'

in the answers accept the following AWs
capillaries / haemoglobin for blood
lungs for alveoli
body for tissues

lungs

valid statement linking information in table below – 1 mark for each row

comparison in partial pressure may be 'higher / lower' not both or high and low, but if not then figures have to be given

blood	**ref. to gas**	**blood partial pressure**	**alveolar air partial pressure**	**gas exchange**	
in pulmonary artery / entering alveolar capillaries	pO_2	5.33 / lower	13.87 / higher	into blood from alveolus	;
	pCO_2	6.00 / higher	5.33 / lower	out of blood into alveolus	;

respiring tissue

valid statement linking information in table below – 1 mark for each row

blood	**ref. to gas**	**blood partial pressure**	**tissue partial pressure**	**gas exchange**	
in systemic artery / entering tissue capillaries	pO_2	13.33 / higher	< 5.33 / lower	into tissue from blood	;
	pCO_2	5.33 / lower	> 6.00 / higher	out of tissue into blood	;

[max 4]

R differences between pO_2 and pCO_2 in the same place

[Total: 11]

Q22.

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5 (a) 1 thin (alveolar) walls / one cell thick / thin epithelium / squamous epithelium ;
A pavement epithelium
R thin cell wall
R thin layer

2 short diffusion distance (between air and blood) ;

3 elastin / elastic fibres ;

4 stretch to increase surface area / increase surface area on inspiration / recoil to expel air ;

5 ref. to maintaining, diffusion / concentration, gradient ; *linked to marking points above*

6 large surface area for, diffusion / AW ;

7 some cells secrete surfactant ;

8 prevent collapse ; [max 3]

(b) (i) (cigarette / tobacco) smoking ;
infection ;
inflammation / detail of inflammation ;
(excessive) coughing ; [max 1]

(ii) *max 1 for structure*
fewer alveoli ; **A** alveolar walls broken down / fewer air sacs / alveoli burst / alveoli destroyed / reduced surface area **R** elastin broken down
or
fewer capillaries ;

effect
less gas exchange / less uptake oxygen / less removal carbon dioxide ; [2]

(c) *look for symptoms*

shortness of breath / breathlessness / AW ; **A** breathing difficulty
wheezing (on inspiration) ;
rapid breathing rate / hyperventilation / decreased ability to hold breath ;
R heavy breathing
chest, tightness / pain ;
cyanosis / bluish appearance to the skin / AW ; **A** pale
fatigue / tiredness / lethargy / weakness / dizziness / reduced mobility / AW ;
coughing / coughing up blood ;
lots of / AW, mucus produced / much phlegm ;
expanded / barrel, chest ;
R refs to oxygen concentration of the blood
R small vital capacity [max 3]

Q23.

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1 **(a)** **(i)** cilia ; **R** cilla **R** ciliated epithelium *mark first on line* [1]

(ii) transport / exchange / AW, oxygen / carbon dioxide ; **R** air [1]

(b) *mark first feature on line if more than one feature given unless nothing written on other line*

smooth / AW, muscle; **A** smooth muscle cells
cartilage ;
connective tissue ; **A** elastic, fibres / tissue **A** collagen fibres
A collagen and elastic fibres **A** elastin and collagen fibres
mucous gland ; **A** mucus-secreting cells **R** goblet cells [max 2]

(c) emphysema ; [1]

(d) **1** no / few / damaged / destroyed / AW, cilia / **A** ; **R** killed / dead
allow ecf from ***(a)(i)***
2 scar tissue ;
3 fewer / damaged / AW, (columnar) epithelial cells / epithelium ;
A ciliated cells *epithelial cells replaced by scar tissue = 2 marks*
4 goblet cells, enlarged / AW ;
5 enlarged mucous glands ;
6 more (smooth) muscle ;
7 large numbers of white blood cells ; **A** macrophages, phagocytes
8 inflammation ; **A** swelling *in context of inflammatory response* [max 4]

(e) **1** pathogens / AW, enter from, inhalation / external atmosphere / AW ; **R** germs
2 (sticky) mucus traps pathogens ; AW
3 mucus, accumulates / not swept away (because cilia destroyed) ;
4 pathogens / AW, remain / multiply (in gas exchange system) ;
5 increased time leads to increased opportunity to gain entry into cells / AW ; [max 2]

[Total: 11]

Q24.

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5 (a) (smokers smoking) 25 and above (g day^{-1}) ; *must be in correct context* [1]

(b) **1** epidemiological (evidence) ;
2 increase in tobacco smoked increased death rate in, coronary thrombosis / lung cancer ;
3 use of data to show increasing death rate (with increased tobacco smoked) ;
4 non-smoker lower death rate than smoker for, coronary thrombosis / lung cancer ;
5 use of numerical data for non-smoker versus smoker for coronary thrombosis / lung cancer ;
6 no clear link between smoking and cardiovascular disease / AW ;
7 comment on disease of other diseases of gas exchange system, 25g and above ;
8 (mp 6 / 7) use of data e.g. non-smokers, higher death rate / 2.23, than, 1–14g / 2.07 or 15–24g / 1.58, smokers ;
9 no females included in the survey ;
10 other aspects of smoking tobacco not included ;
11 lack of information e.g. on deaths as a proportion of the sample ;
12 AVP ; [max 4]

[Total: 5]

Q25.

3 (a) *look at quoted data to confirm qualitative statements if unclear*

1 people who never smoked have the lowest percentage of deaths (due to lung cancer) ; *must be comparative*

for age
2 *either*
the younger / earlier the person starts smoking the higher the percentage of deaths
or
the older / later the person starts smoking the lower the percentage of deaths (due to lung cancer) ;

for number of cigarettes per day
3 *either*
increasing / AW, the number of cigarettes smoked per day increases the percentage of deaths
or
decreasing / AW, the number of cigarettes smoked per day decreases the percentage of deaths ;

different 'start' ages for the two types of smokers
4 highest percentage deaths is for those with an early start <u>and</u> smoke, 21–39 (cigarettes per day) / the most / AW ;

5 greatest difference in percentage deaths occurs in those that start smoking early ; **ora** [max 4]

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(b) (i) 1 forms carboxyhaemoglobin ;
2 reduces affinity of Hb for oxygen / Hb has higher affinity for CO than for oxygen ;
ignore 'picks up CO rather than oxygen', if mp3 is given then allow
3 reduces quantity of oxygen transported (in blood) / AW ;
R prevents
4 damages lining of arteries ;
A promotes / AW, atheroma / atherosclerosis / plaque [max 2]

(ii) raises, heart rate / blood pressure ;
reduces diameter of arterioles ;
decreases blood flow to body extremities ;
increases 'stickiness' of platelets / promotes, blood clotting / thrombosis ; [max 2]

(iii) *goblet cells*
enlarge / swell up ;
A become bigger / dilate
R inflamed
produce more / excess, mucus ;
A lots of
AVP ; e.g. any cellular detail such as more mitochondria / Golgi bodies or vesicles

cilia:
paralysis / destruction ;
A damages **R** kills ***ignore*** 'tar coats…'
no / less beating / sweeping (action) / moving mucus ;
R in context of moving air [max 4]

[Total: 12]

Q26.

(b) (i) 1 lining / epithelium / wall, is thin / one cell thick / squamous ;
I thin interstitium
R cell walls of alveoli
R alveoli are one cell thick
R endothelium / membrane
2 (so) short diffusion distance / only diffuse through two cells ;

3 (collectively / many, so) large surface area for diffusion ;
R an alveolus has a large surface area
I high SA:V ratio / increase SA

4 surrounded by / many / network of, capillaries ;
I good blood supply
5 red blood cells are very close to air (in alveoli) ;

6 (so) maintain, diffusion / concentration / partial pressure, gradient(s) ;

7 elastin / elastic fibres, allow(s) alveoli to, increase in volume / expand / stretch / stop bursting / recoil ;
I alveoli are elastic
R contract [max 3]

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(ii) *allow microorganisms or named type of microorganism or infectious agent for pathogens*

1 recognise, non-self / foreign, antigens, (on pathogen) ;

2 receptors (on macrophage) bind antigens (on pathogen) ;

3 (or), pathogen / AW, adheres / 'sticks', to (cell surface) membrane ;

4 infolding of (macrophage cell surface) membrane around / engulf / phagocytosis of, pathogen ; **R** engulf antigen

5 vacuole / vesicle / phagosome, forms ;

6 ref. to lysosomes ;

7 hydrolytic / digestive / named, enzymes ;
e.g. lysozyme / protease / nuclease
A pathogen broken down by enzymes

8 hydrolysis of named compound(s) ;

9 ref. to destroying / killing, pathogen ;

10 ref. to antigen presentation ;
accept idea even though does not occur in alveoli [max 4]

(c) 1 emphysema ;
2 (alveolar walls broken down so) less surface area for, gas exchange / diffusion ;
A impaired / AW, gas exchange / diffusion
3 difficulty in breathing / restriction in air flow / shortness of breath wheezing / rapid breathing ;

4 blood is less well oxygenated / less oxygen reaches, tissues / muscles ;

5 any two other, signs / symptoms ;;
6 e.g. lethargy / tiredness / fatigue / constraints on mobility or activity
wheezing
persistent / AW, coughing
chest tightness ; **R** chest pain
more prone to / frequent, chest / respiratory, infections
A more frequent colds / influenza ('flu)
weight loss
swollen, ankles / feet
increase in thickness of, right ventricle / right side of heart
increase in blood pressure in pulmonary artery [max 3]

Q27.

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(c) *max 2 for structural features*
I *fast diffusion, efficient diffusion, reduces diffusion distance*
mps 4, 6, 8 and 10 – can be awarded if related structure is not given but is implied

1 many alveoli ;
2 large surface area ; **I** high SA:V ratio / increase SA
3 many capillaries / network of capillaries ; **I** good blood supply
4 (so) maintain, diffusion / concentration / partial pressure, gradient(s) ;
5 lining / epithelium / wall, of, alveoli / gas exchange surface, is thin / one cell thick / squamous ; **I** thin interstitium
R 'cell walls of' **R** lungs **R** alveoli are one cell thick **R** endothelium / membrane
6 (so) short diffusion distance / only diffuse through two cells ;
7 ref. to, elastin / elastic fibres ; **I** alveoli are elastic
8 (so) allows alveoli to, increase in volume / expand / stretch / stop bursting / recoil ;
R contract
9 (alveolar type II cells secrete) surfactant ;
10 (so) reduces surface tension ; [max 4]

Q28.

(b) **1** increases heart rate ;
A heart, pumps / beats faster

2 increased blood pressure / hypertension ;

3 damage to, endothelial / arterial, lining ;
A damage to, tunica intima / lining of veins

4 (so) contributes to plaque / atheroma ;
A atherosclerosis

5 vasoconstriction
or
constricts / reduces diameter of, arterioles / blood vessels ;
A more resistance to blood flow *must be in context*

6 reduced blood flow to extremities / AW ; [max 3]

Q29.

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1 **(a)** pulmonary artery ; **A** pulmonary arteries [1]

(b) phagocyte / macrophage ;
A neutrophil / polymorphonuclear leucocyte **R** PMN
R leucocyte / white blood cell unqualified
R any incorrect qualification [1]

(c) B-lymphocyte / (effector) B (cell) / plasma (cell) ; **R** lymphocyte alone
R effector cell unqualified [1]

(d) goblet (cell) ; [1]

(e) cartilage ; ignore plates / rings [1]

[Total: 5]

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