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.

(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.

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.

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.

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.

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.

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]

(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.

(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.

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.

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

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]

(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.

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.

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]

(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.

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.

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.

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 and 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]

(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]

(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.

(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.

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]