The gas exchange system and Smoking

Mark Scheme 5

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Gas exchange and smoking
Sub Topic	The gas exchange system and Smoking
Booklet	Theory
Paper Type	Mark Scheme 5

Time Allowed : **64 minutes**

Score : **/ 53**

Percentage : **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a** *max 1 if no ref. to TB and COPD or if correct definitions given and ref. to TB/COPD incorrect (TB is an infectious disease, COPD non-infectious)*

TB caused by, a pathogen / *Mycobacterium* / *M. tuberculosis* / *M. Bovis* **;** ora *for* COPD
A microorganism / bacterium / bacteria **I** virus / fungus / protoctist
A infectious disease is caused by a pathogen ora

TB is / COPD is not, transmissible / communicable / can be passed from one organism to another **;** *allow detail of TB transmission e.g. droplet infection* / *in contaminated milk*
A infectious disease is transmissible ora

COPD caused by, damage to / irritation of, lung tissue **;** AW
accept relevant ref. to tobacco smoking [2]

(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 <u>diffusion</u> distance / only <u>diffuse</u> 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, <u>capillaries</u> **;**
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]

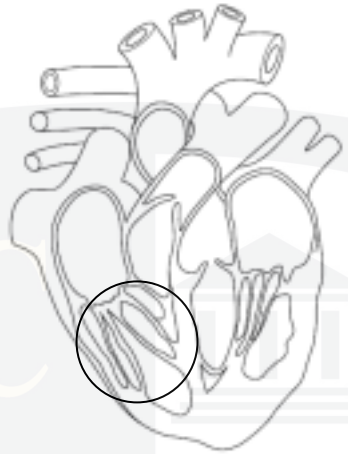
(c) 1 emphysema **;**
2 (alveolar walls broken down so) less surface area for, gas exchange / diffusion **;**
A impaired / AW, gas exchange / diffusion
3 difficulty in breathing / restriction in air flow / shortness of breath wheezing / rapid breathing **;**

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]

[Total: 12]

2 **(a)** **W** right atrium labelled in lumen / wall ;
X tricuspid valve labelled ; **A** valve flap / chordae tendinae *see encircled area on diagram*
Y aorta labelled ; [3]



(b) *needs to be a sequence, not events in the cardiac cycle e.g.* ***I*** *valves*

aorta, body (tissues / blood vessels) / capillaries / systemic circulation, vena cava ;
A body cells
<u>right</u> atrium and <u>right</u> ventricle ;
pulmonary artery (to lungs) ; **R** if blood comes from left ventricle [3]

(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 <u>capillaries</u> / network of <u>capillaries</u> ; **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 <u>diffusion</u> distance / only <u>diffuse</u> 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) <u>surfactant</u> ;
10 (so) reduces surface tension ; [max 4]

[Total: 10]

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]

4 **(a** **A** - mitochondrion ;
B - post-synaptic membrane ;
C - myelin sheath / Schwann cell ; [3]

(b) 1 produces ATP ; (1)
R produces energy
any two from
2 (for) ACh production ;
3 (for) vesicle formation ;
4 (for) vesicle movement ;
5 (for) exocytosis / described ;
6 (for) functioning of ion pumps ;
R calcium ions (2 max) [3 max]

(c) 1 fits into (membrane) <u>receptors</u> ;
2 not broken down (by enzymes) ;
3 (so) <u>action</u> <u>potentials</u> generated for a long time (in post-synaptic neurone) ;
ignore ref to increased frequency of action potentials
4 AVP ; e.g. causes release of other transmitters / stimulant and depressant / variable response [2 max]

[Total: 8]

5 **(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]