

# The gas exchange system and Smoking

## Mark Scheme 3

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 3

Time Allowed : 74 minutes

Score : / 61

Percentage : /100

Grade Boundaries:

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

1 (a)

1.	$\beta$ cells detect glucose levels	or	no detection of blood glucose conc.	;
2.	$\beta$ cells secrete insulin	or	no insulin released	;
3.	when blood glucose concentration rises	or	when blood glucose concentration rises	;
4.	(insulin causes) muscle cells / adipose tissue / liver cells	or	muscle cells / adipose tissue / liver cells	;
5.	to increase uptake of glucose from blood / increased membrane permeability to glucose	or	do not take up excess glucose	;
6.	(insulin causes liver cells) to convert glucose to glycogen	or	glucose not converted to glycogen (by liver cells)	;
7.	(insulin causes liver cells) to increase respiration of glucose	or	rate of respiration of glucose does not increase	;
8.	(if no $\beta$ cells) no control of blood glucose levels / AW	or	no control of blood glucose levels / AW	;

[4 max]

- (b) (i) 1. (yes) more people with infection have CFRD than those without infection ;  
 2. use of 'with CFRD' comparative figs ;  
**either** using number of people – 44 / 52 / 96 (**no** infection)  
 against 106 / 121 / 227 (with infection)  
**or** using  $FEV_1$  values – 71.1 / 53.6 / 124.7 (**no** infection)  
 against 49.0 / 42.0 / 91.0 (**with** infection)  
**or** 28.5% males against 35.8% females (**no** infection)  
**or** 38.9% males against 50.05% females (**with** infection)  
 3. AVP ; e.g. we do not know how the sample was chosen (so this may not be a valid conclusion) [2 max]

(ii)  $\frac{2.2}{71.4} \times 100$  ; = 3.08 / 3.1 ;  
**or**  
 $\frac{2.2}{73.6} \times 100$  ; = 2.99 / 3.0 ; [2]

- (iii) 1. more lung damage in females (with CFRD) than in males ;  
 2. females (with CFRD) have lower  $FEV_1$  than males ;  
 3. use of figures ; e.g. males  $FEV_1$  49 whereas female  $FEV_1$  42  
**or** female  $FEV_1$  1.16 times lower than male  $FEV_1$  [3]

- (c) 1. CFTR protein acts as chloride channel (in cell membranes) ;  
 with CF  
 2. faulty (CFTR) gene ;  
 3. faulty / non-functional, (CFTR) protein produced ;  
 4. chloride ions not able to move out (of cell) ;  
 5. by active transport ;  
 6. so less water passes out (of cell) ;  
 7. down water potential gradient ; **A** by osmosis  
 8. mucus secreted contains less water ; [4 max]

[Total: 15]

- 2 (a) *award two marks if correct answer (29) or (28) is given  
allow  $\pm 1$  mm in reading the line  
 $100\,000\ \mu\text{m} / 3\,500 = (28.57)$   
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]**

3 (a) one mark for each correct row ; ; ; ;

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

[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]

4 (a) 1 mark each correct row

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

;  
;  
;  
;  
;

[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]

- 5 (a) (i) (*nuclear envelope*) drawn with two membranes and a space and at least one nuclear pore ;  
(*mitochondrion*) two membranes with at least one crista attached or unattached ;  
mitochondrion drawn smaller than nucleus ; ora

*if wrongly labelled or both labels omitted, penalise once* [3]

- (ii) (to nearest whole number) (x) 2857 ;; **A** 2829 – 2886

*allow one mark for correct working if answer incorrect / not to whole number / no answer*  
length of scale bar in mm × 1000, divided by actual size  
e.g. 100 mm × 1000 / 35 (*scale bar 99–101 mm*) [2]

- (b) cell / plasma / cell surface, membrane(s) ; **R** membranes  
cytoplasm / cytosol ;  
ribosomes / 70S ribosomes / 18nm ribosomes ; **R** 80S / 20nm / larger, ribosomes  
DNA / genes ; **A** chromosome max]

- (c) (infected person) coughs / sneezes / spits / releases sputum / breathes out / exhales ;  
**A** releases mucus **R** talks  
aerosol / droplets / moist air, inhaled / breathed in (by uninfected person) ; [2]

- (d) 0.25 ; [1]

- (ii) *suggested reasons for high fatality ratios*

poor / dense / overcrowded, housing / accommodation ;  
low protein diets linked to lowered immunity ;  
not, diagnosed / treated, early enough ;  
DOTS / described, not used ;  
lack of vaccination / vaccinations ineffective ;  
antibacterial drugs / antibiotics / AW, not available / too expensive ;  
medical services not available, qualified e.g. in rural areas / AW ;  
idea of TB, linked to HIV/AIDS / opportunistic disease ;  
MDR – TB / XDR – TB / not completing the course of antibiotic treatment increases resistance ;  
no effective antibiotics to use ;  
no facilities for isolating people ;  
lack of, testing / treatment of, cattle / milk ; **A** unpasteurised milk  
difficulty in obtaining reliable data / AW ;  
*ignore references to, overcrowded / poor, countries* [4 max]

**[Total: 15]**