OCR AS GCE Biology *(18 pages)*

F211 Cells, Transport and Exchange

Mark schemes from January 2009-June 2012

Topics:

Module 2 Exchange and Transport

1.2.1 Exchange Surfaces and Breathing

Explain, in terms of surface area:volume ratio, why multicellular organisms need specialised exchange surfaces and single-celled organisms do not
Describe the features of an efficient exchange surface, with reference to diffusion of oxygen and carbon dioxide across an alveolus;
Describe the features of the mammalian lung that adapt it to efficient gaseous exchange;
Describe, with the aid of diagrams and photographs, the distribution of cartilage, ciliated epithelium, goblet cells, smooth muscle and elastic fibres in the trachea, bronchi, bronchioles and alveoli of the mammalian gaseous exchange system;
Describe the functions of cartilage, cilia, goblet cells, smooth muscle and elastic fibres in the mammalian gaseous exchange system;
Outline the mechanism of breathing (inspiration and expiration) in mammals, with reference to the function of the rib cage,intercostal muscles and diaphragm;
Explain the meanings of the terms *tidal volume* and *vital capacity;*
Describe how a spirometer can be used to measure vital capacity, tidal volume, breathing rate and oxygen uptake;
Analyse and interpret data from a spirometer

<table>
<tr><th colspan="3">Question</th><th>Expected Answers</th><th>Marks</th><th>Additional Guidance</th></tr>
<tr><td>4</td><td>(a)</td><td></td><td>large / active, organisms have high(er), demand for oxygen / need to remove CO_2 ;
small(er), <u>surface area to volume ratio / SA:V / surface area:volume</u> ;
surface area too small / distance too large / diffusion takes too long (to supply needs) ;</td><td>2 max</td><td>ACCEPT ORA throughout
IGNORE ref to nutrients

ACCEPT diffusion too slow
look for reason why diffusion not good enough</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td>create / maintain, (steep), diffusion / concentration, gradient ;
<table><tr><td></td><td></td></tr><tr><td>epithelium</td><td>short (diffusion) distance ;</td></tr><tr><td>capillaries</td><td>delivers carbon dioxide (to be removed from blood) / carries oxygen away (from alveoli) ;
short (diffusion) distance ;</td></tr><tr><td>diaphragm / intercostal muscles</td><td>ventilation / supply of oxygen (to alveoli) / removal of carbon dioxide (from alveoli) ;</td></tr></table></td><td>3 max</td><td>could give mark in any row as an additional mark – but only once

DO NOT ACCEPT any vague reference to ‘gases’ throughout

ACCEPT short diffusion distance here even if given above

ACCEPT breathing in and out / AW</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4</td><td>(c)</td><td></td><td>diaphragm (contracts / flattens and) moves downwards ;
intercostal muscles <u>contract</u> to move ribs, up / out ;
increase <u>volume</u> of thorax ;
reduce pressure inside thorax ;
to below atmospheric pressure/creates pressure gradient / AW ;</td><td>4 max</td><td>IGNORE ref to internal / external
ACCEPT increase volume of lungs / chest
ACCEPT decrease pressure in lungs / chest
must ensure the pressure gradient is in correct direction – lower in lungs</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Question			Expected Answers	Marks	Additional Guidance
4	(d)	(i)	a clear **X** placed on any part of trace where line is sloping down ;	1	**ACCEPT** label line with **X** **DO NOT ALLOW X** on tip of crest / trough
4	(d)	(ii)	3 dm^3 ;	1	correct units **must** be given **ACCEPT** litres
				[Total: 11]	

F211 Cells, Exchange and Transport

Question			Expected Answers	Marks	Additional Guidance
1	(a)	(i)	goblet / mucus (secreting) cell ; ciliated (epithelium) ;	2	**DO NOT ACCEPT** 'globlet' **DO NOT ACCEPT** 'cilia cell' 'ciliate'
1	(a)	(ii)	(A / goblet cells) release mucus / AW ; (mucus) traps, dust / particles / named particle ; ciliated cell / B / cilia, wave / waft / move, mucus ; to, top of trachea / back of mouth / AW ;	3 max	**ACCEPT** release / creates / produces / secretes **DO NOT ACCEPT** excrete **ACCEPT** bacteria / microorganisms / pathogens **IGNORE** dirt / germs **DO NOT ACCEPT** 'combines with' **ACCEPT** 'hair like projections' **DO NOT ACCEPT** 'hairs' Idea of up and out of lungs
1	(a)	(iii)	to constrict the bronchus / AW ;	1	example of AW e.g. reduce diameter of bronchus **DO NOT ACCEPT** 'ref to increasing diameter' – (note: if 'increase and decrease diameter' is used do not allow mark as it is contradiction) **ACCEPT** 'airways' **ACCEPT** 'control flow of air'

Question			Expected Answers	Marks	Additional Guidance
1	(b)	(i)	short, distance / path / AW ; (so that) diffusion / concentration, gradient is, high / steep ; high rate of, (gas) exchange / diffusion ;	2 max	**DO NOT ACCEPT** ref to number of cells / cell thickness or short space **DO NOT ACCEPT** short gradient **ACCEPT** high rate of movement of named gas in correct direction **ACCEPT** 'rapid' / fast / quick **ACCEPT** ref to efficient, gas exchange / diffusion **DO NOT ACCEPT** gas exchange occurs more 'easily'
	(b)	(ii)	recoil / expel air / prevent bursting ;	1	**ACCEPT** exhale more completely / force air out **DO NOT ACCEPT** 'exhale' (if used alone) **DO NOT ACCEPT** 'contract' **DO NOT ACCEPT** 'stretch' on its own **DO NOT ACCEPT** if response includes any ref to bronchus or smooth muscle
			Total	9	

Question			Expected Answers	Marks	Additional Guidance
2	(a)	(i)	collection / group, of cells (of one or more types) ;	2 max	**IGNORE** ref similar cells
			(cells), working together **OR** with, common / same, function ;		**ACCEPT** a group of cells with a function = 2 marks
			specialised (cells) ;		**DO NOT CREDIT** differentiated
2	(a)	(ii)	squamous / ciliated ;	1	**ACCEPT** endothelium / columnar **DO NOT ACCEPT** cilia, goblet cell, ciliated *cells*
2	(b)		(organ is) a collection of tissues / named tissues ;	2	Look for idea of more than one tissue **ACCEPT** two or more correctly named tissues from: epithelium, elastic, glandular, smooth muscle, blood, nervous, cartilage, connective
			(working together) to enable gas exchange / AW ;		**DO NOT ACCEPT** perform a function unqualified – we want to know *what* function (can be named or described) **DO NOT ACCEPT** respiration **IGNORE** breathing

Question			Expected Answers	Marks	Additional Guidance
2	(c)	(i)	(*release of energy*) mitochondria ;	1	
		(ii)	(*movement of cilia*) cytoskeleton ;	1	**ACCEPT** mitochondria if not used in **(i)**
		(iii)	(*secretion of mucus*) Golgi (vesicle) ;	1	**ACCEPT** cytoskeleton if not used in **(ii)** **ACCEPT** Golgi body / apparatus **DO NOT ACCEPT** Golgi vessel
			Total	**8**	

Question			Expected Answers	Marks	Additional Guidance
6	(a)	(i)	**diaphragm / intercostal** muscles, contract :		*First two points are marked independently* **DO NOT CREDIT** *internal* intercostal muscles contract
			diaphragm moves down / ribs move upwards and outwards ;		**DO NOT CREDIT** diaphragm flattens alone **ACCEPT** movement of diaphragm pushes digestive organs down
			volume of **thorax** increased ;		**DO NOT ACCEPT** expands (for increased volume)
			pressure inside thorax falls ;		**DO NOT ACCEPT** size for volume **ACCEPT** capacity for volume **ACCEPT** lungs / chest (cavity), for thorax
			to below atmospheric pressure (so air enters lungs) ;		**DO NOT CREDIT** pressure gradient alone - *direction* of gradient must be specified
			***2 max** for mechanism*		
			QWC: accept three technical terms used and spelt correctly ;	**3 max**	accept any **three** from: diaphragm, intercostal, volume, pressure, thorax, thoracic cavity

Question			Expected Answers	Marks	Additional Guidance
6	(a)	(ii)	it falls / goes down / AW ;	1	ACCEPT decreases in volume / volume gets smaller DO NOT CREDIT empties, closes, flattens, deflates, becomes smaller DO NOT ACCEPT amount for volume
6		(iii)	soda lime / sodium hydroxide / potassium hydroxide / calcium hydroxide ;	1	ACCEPT correct formulae NaOH / KOH / $Ca(OH)_2$ DO NOT ACCEPT calcium oxide ACCEPT limewater, lime soda
6	(b)		to ensure all air breathed comes from chamber OR to prevent, escape of air / entry of air, through nose ;	2 max	ACCEPT air may be breathed in or out through nose ACCEPT ensures breathes through mouth
			make results invalid ;		DO NOT ACCEPT ref accuracy, reliability, false results DO NOT ACCEPT invalid and accuracy / reliability (use of both terms) anywhere in the answer

Marks			Expected Answers	Marks	Additional Guidance
6	(c)		use (medical grade) oxygen / fresh air ;	2 max	*Note question relates to measuring vital capacity* ACCEPT ensure there is enough oxygen / air
			disinfect mouthpiece ;		ACCEPT change / wash mouthpiece
			ref. to health of subject ;		e.g. asthmatics
			ref to correct functioning of equipment ;		e.g. maintain constant temperature (so that volume of gases is not affected) ensure, valve / hinge, is working level of water correct no leaks / airtight / lips sealed around mouthpiece
			Total	9	

Question	Expected Answers	Marks	Additional Guidance
1 (c)	<table><tr><th>cell / tissue</th><th>function in the lungs</th><th></th></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td>recoil **OR** return to original, size / shape **OR** to help expel air **OR** prevents alveoli bursting</td><td>;</td></tr><tr><td></td><td>waft / wave / move / AW, mucus</td><td>;</td></tr><tr><td></td><td>secrete / release / produce, mucus</td><td>;</td></tr><tr><td></td><td>constrict the airway / AW</td><td>;</td></tr></table>	4	**IGNORE** stretch / expand **ACCEPT** ref to lungs, alveoli, airways recoiling etc **DO NOT CREDIT** ref trachea / bronchi recoiling **ACCEPT** transport / remove, mucus **DO NOT CREDIT** dirt particles without ref to mucus **DO NOT CREDIT** excrete mucus **ACCEPT** narrows lumen OR controls, airflow / diameter, of airways **DO NOT CREDIT** ref to alveoli OR greater airflow
	Total	11	

Question			Expected Answers	Marks	Additional Guidance
2	(a)		A = bronchiole ; B = alveolus / alveoli ;	2	**Mark the first answer for each letter.** If the first answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks.** **DO NOT CREDIT** bronchus **ACCEPT** phonetic spelling of alveolus and bronchiole e.g. aveoli
	(b)		1 large, surface area / SA :VOL ; 2 (alveolar) wall / epithelium, one cell thick ; 3 (made of) squamous, cells / epithelium ; 4 ref to surfactant ; *idea of:* 5 (very) close to, capillaries / blood supply **OR** rich blood supply / many capillaries ;	2 max	**Mark the first <u>two</u> suggestions only. Read as prose unless candidate has indicated two points by bullets or numbers – in this case mark the first comment in each bullet.** **ACCEPT** large SA / VOL, (alveoli) are small **and** in large number **DO NOT CREDIT** large amounts of tiny alveoli **ACCEPT** thin wall / thin barrier **DO NOT CREDIT** ref to cell wall / lining **IGNORE** alveolus one cell thick **ACCEPT** correct description of squamous cells (e.g. thin flat cell layer) **ACCEPT** pavement epithelium **IGNORE** reference to moist **DO NOT CREDIT** endothelium **IGNORE** ref to elastic fibres

Question	Expected Answer	Mark	Additional Guidance
1 (c)			allow **F** marks even if **C** mark not quite accurate
	C1 thin / **squamous**, **epithelium** ; **C2** thin **endothelium** (of capillary) ;		**C1/C2** **IGNORE** ref to alveolus / alveolar wall / capillary wall , without ref to epithelium / endothelium
	F1 (provides) short **diffusion** distance / described ;		**F1** **ACCEPT** diffusion barrier , thin / one cell thick **IGNORE** refs to speed or rate of diffusion **IGNORE** ref to reduces diffusion distance alone – must be in context of short distance **DO NOT CREDIT** ref to thin , cell walls / membranes
	F2 ref to **surfactant** (from epithelial cells) , reducing surface tension / preventing alveoli collapsing ;		**F2** **IGNORE** ref to moisture
	C3 blood / red blood cells / **erythrocytes** ;		**C3** **IGNORE** (named) blood vessel **ACCEPT** blood supply / supply of blood
	F3 transports (named) gas(es) , to / from , exchange surface / alveoli ; **C4** diaphragm / intercostals , **muscles** ;		**F3** **IGNORE** ref to lungs **IGNORE** description of gas exchange
	F4 (maintains / creates) **diffusion** / **concentration** , **gradient** ;		**F4** This can be awarded in context of **F3** or **C4**
	C5 **ciliated** epithelium / **goblet** cells / ciliated cells ; **F5** *idea of:* protection from / removal of , dust / bacteria / pollen / spores ;		**F5** **ACCEPT** trap , dust / bacteria / pollen / spores **IGNORE** dirt / germs
	C6 **cartilage** ; **F6** hold airway open ;		
	C7 smooth **muscle** ;		***continued***

Question	Expected Answer	Mark	Additional Guidance
continued			
	F7 constrict / control diameter of , airway / blood vessel ;		**F7** **ACCEPT** narrows lumen
	C8 elastic , fibres / tissue ; **F8** for recoil / aiding ventilation ;		**C8** **IGNORE** elastin / elasticated **F8** **ACCEPT** prevent alveoli bursting
	C9 **macrophage / neutrophil** ; **F9** engulf / destroy pathogens **or** protect from infection ;	**max 4**	**C9** **IGNORE** ref to white blood cell unqualified
	QWC ;	1	Any **three** with correct spelling and a suitable context from: **epithelium / epithelial**, **endothelium**, **cartilage**, **diffuse / diffusion**, **gradient**, **goblet**, **ciliated**, **concentration**, **squamous**, **macrophage**, **neutrophil**, **surfactant**, **muscle**, **erythrocyte**
	Total	**[11]**	

Question			Expected Answer	Mark	Additional Guidance
5	(a)	(i)	1 *idea of* not breathing through nose ; 2 subject breathes , evenly / normally / regularly ; 3 *idea of* (measure) height / amplitude , of waves (from trace) ; 4 measure at least three waves and calculate mean ; 5 detail of how spirometer works ;	max 3	1 e.g. subject wears nose clip / plug or holds nose 2 **IGNORE** at rest 3 **ACCEPT** (measure) difference between peak and trough **ACCEPT** annotated diagram / annotations on graph 5 e.g. as breathe <u>in</u> lid goes <u>down</u> / as breathe <u>out</u> lid goes <u>up</u> e.g. movement of lid recorded , on trace / by data logger e.g. pen attached to lid moves up/down as breathe **DO NOT CREDIT** description of water level changing **IGNORE** ref to using mouthpiece, soda lime, oxygen
5	(a)	(ii)	10 further waves drawn with similar heights ; trace falls ;	2	Look for 10 extra peaks and 10 extra troughs ***Note*** 'similar' means no wave drawn for vital capacity – all waves should be approximately same height

Question			Expected Answer	Mark	Additional Guidance
5	(a)	(iii)	1 measure , volume of oxygen used / decrease in volume in chamber ; 2 one detail of how to measure volume change ; 3 measure time taken (to use this oxygen) ; 4 divide (volume) by time taken ;	3	1 **ACCEPT** annotations on graph **ACCEPT** 'measure how much the trace has gone down' **or** 'measure decrease in trace' 2 e.g. draw line along tips of , peaks / troughs e.g. find difference in height from one , peak / trough , to another 3 **ACCEPT** (measure volume of oxygen used) in a given time 4 **ACCEPT** unit stated to indicate rate has been calculated e.g. dm^3s^{-1} / dm^3min^{-1} ***NOTE*** 'draw line along tips of, peaks / troughs **and** calculate gradient of line' = **3 marks (mark points 1, 3 & 4)**
5	(b)		1 check health of volunteer ; 2 oxygen used ; 3 new / sterilised / disinfected , mouthpiece (for each volunteer); 4 *idea of:* soda lime working ; 5 sufficient oxygen in chamber ; 6 water level not too high / water must not enter tubes ; 7 ensure valves working correctly ;	max 2	**Mark the first *two* factors.** 1 e.g. check medical history of volunteer ask about asthma / TB / pneumonia / flu / bronchitis / emphysema 3 **IGNORE** clean mouthpiece 4 **CREDIT** need to remove CO_2 / CO_2 accumulates 5 **IGNORE** enough air in chamber 6 **IGNORE** general ref to leaks
			Total	[10]	

Question			Answer	Mark	Guidance
1	(a)	(i)	alveoli ; to provide large(r), surface area / SA ;	2	**ACCEPT** alveolus / alvioli, alviolis **ACCEPT** large(r) surface area to volume ratio **OR** SA:VOL
		(ii)	squamous / pavement ;	1	Look for the name **ACCEPT** squamas, squamos, squarmous **DO NOT CREDIT** ref to ciliated
		(iii)	to prevent bursting ; recoil ; to return air sac to original, size / shape ; to help expel air ;	2 max	**IGNORE** stretch / contract **DO NOT CREDIT** in context of inhaling **IGNORE** ref to role returning airways back to size **IGNORE** ref to fibres returning to original size **DO NOT CREDIT** carbon dioxide / waste gas, expelled
	(b)	(i)	**1** increases, partial pressure / concentration, of oxygen (in the air sac) ; **2** so concentration of oxygen (in the air sac) is higher than that in the blood ; **3** decreases, partial pressure / concentration, of carbon dioxide (in air sac) ; **4** so concentration of CO_2 (in the air sac) is lower than that in the blood ;	2	**ACCEPT** (provides) high concentration of oxygen (in air sac) **IGNORE** 'maintains' throughout
		(ii)	**EITHER** **D1** (continuous) blood flow (in the capillaries) ; **E1** to, bring in (more) carbon dioxide / take away (more) oxygen ; **OR** **D2** oxygen combines with haemoglobin ; **E2** to keep concentration in, blood / plasma, low ;	2	idea of blood flow **ACCEPT** good / copious / continuous, blood supply **IGNORE** highly vascular / many capillaries present **IGNORE** short diffusion path / capillaries very close to alveoli
			Total	**9**	

Question			Answer	Marks	Guidance
5	(a)	(i)	tidal volume ;	1	
		(ii)	being stretched / stretching ;	1	**ACCEPT** lengthening **DO NOT CREDIT** relaxing **IGNORE** expanding 'stretching and contracting' = **CON**
	(b)		*between **B** & **C** expiration:* **1** (external) **intercostal** muscles / **diaphragm**, relax ; **2** rib cage / ribs, move down OR diaphragm, moves / pushed, up ; **3 volume** of, **thorax** / chest cavity / lungs, drops / decreases ; **4 pressure** inside, thorax / chest cavity / lungs, increases ; **5** above, external / atmospheric, pressure ; **6** air leaves down pressure **gradient** ; **7** (elastic) **recoil** of alveoli ; **3 max** QWC – **two** technical terms used in context and spelt correctly ; **1**	4 max	**1 ACCEPT** ref to internal intercostal muscles contracting **1 DO NOT CREDIT** ref to diaphragm relaxing and intercostal muscles (unqualified) contracting **2 IGNORE** 'diaphragm becomes domed / curved' **3 ACCEPT** 'space inside' or 'air in' for volume **5 ACCEPT** (pressure) higher than outside **Answers given in context of 'at B' or 'at C' – QWC not awarded.** Any **two** from **intercostal**, **diaphragm**, **recoil**, **volume** **thorax**, **pressure**, **gradient**
	(c)		12 ;;	2	Allow two marks for correct answer. If answer wrong allow one mark for working $\frac{60}{5}$

Question	Answer	Marks	Guidance
(d)	*idea that:* thorax / rib cage / lungs, cannot be completely , compressed / flattened ; trachea / bronchi, held open by cartilage ; bronchioles / alveoli, held open by elastic fibres ; AVP ;	2 max	**IGNORE** bronchioles or alveoli **IGNORE** bronchi or trachea eg absence of pressure gradient / atmospheric and thoracic pressures equal presence of surfactant in alveoli upward movement of diaphragm limited by collagen fibres
	Total	**10**	