OCR
RECOGNISING ACHIEVEMENT

SPECIMEN

Advanced Subsidiary GCE

HUMAN BIOLOGY

F221 QP

Unit F221: Molecules, Blood and Gas Exchange

Specimen Paper

Candidates answer on the question paper.

Time: 1 hour

Additional Materials:

Ruler (cm/ mm)
Scientific calculator

Candidate Name	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name, Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Do **not** write in the bar code.
- Do **not** write outside the box bordering each page.
- WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- You may use a scientific calculator.
- You are advised to show all the steps in any calculations.
- The total number of marks for this paper is **60**.

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
1	**10**	
2	**7**	
3	**9**	
4	**10**	
5	**15**	
6	**9**	
TOTAL	**60**	

This document consists of **14** printed pages and **2** blank pages.

Answer **all** the questions.

1 (a) Human blood contains erythrocytes and leukocytes. These cells are specialised to perform specific functions.

Fig. 1.1 shows a photomicrograph of blood cells.

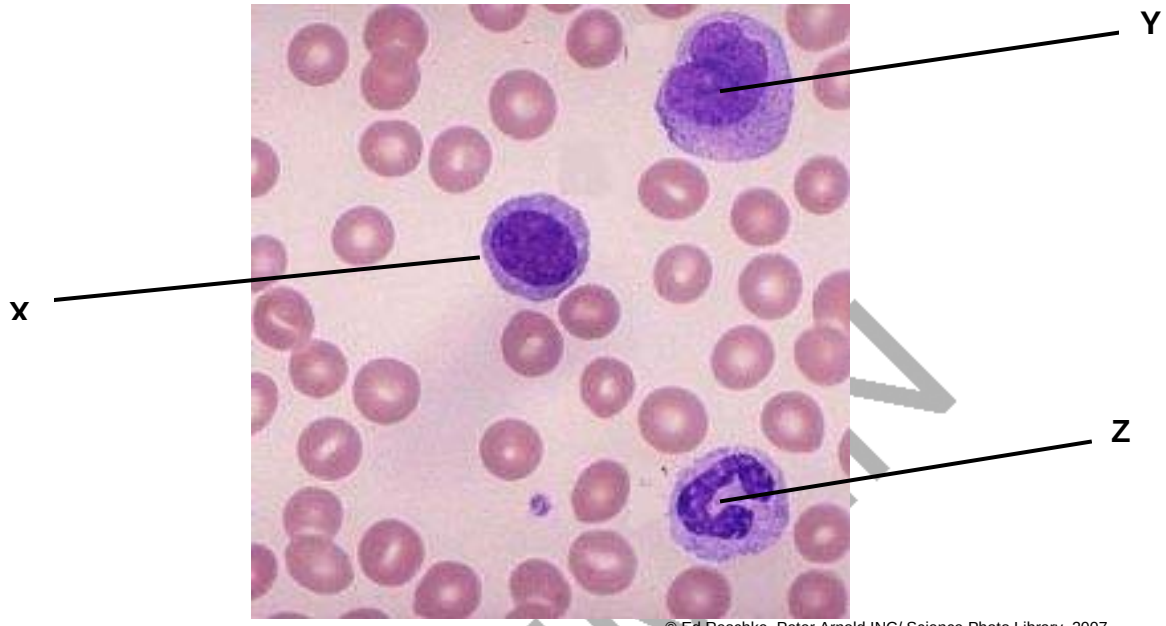

Fig. 1.1

Name the leukocytes **X**, **Y** and **Z**.

X .....

Y .....

Z ..... **[3]**

(b) The difference in composition between blood plasma and tissue fluid depends on the permeability of capillaries to different substances.

Table 1.1 shows the relative permeability of capillaries to substances found in blood plasma. Water is given a value of 1.

Table 1.1

substance	relative molecular mass	permeability
water	18	1
sodium ions	23	0.96
urea	60	0.8
glucose	180	0.6
albumin (a plasma protein)	69 000	0.000 01

Using the information in Table 1.1

(i) describe the relationship between relative molecular mass and permeability

.....

..... **[1]**

(ii) predict with reasons which of the above substances you would **not** expect to be present in tissue fluid.

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..... **[2]**

(c) Saline is used medically in a variety of ways. Saline also contains sodium ions.

(i) Give **one** common medical use of saline.

..... **[1]**

(ii) Explain why the concentration of sodium ions in saline used medically is the same as that in plasma.

.....

.....

.....

..... **[3]**

[Total: 10]

2 Proteins, polysaccharides and lipids are biological molecules present in the human body. These molecules all consist of smaller molecules that are joined together by different types of bond.

Fig. 2.1 shows three types of bond, labelled **A** to **C**, which occur in biological molecules.

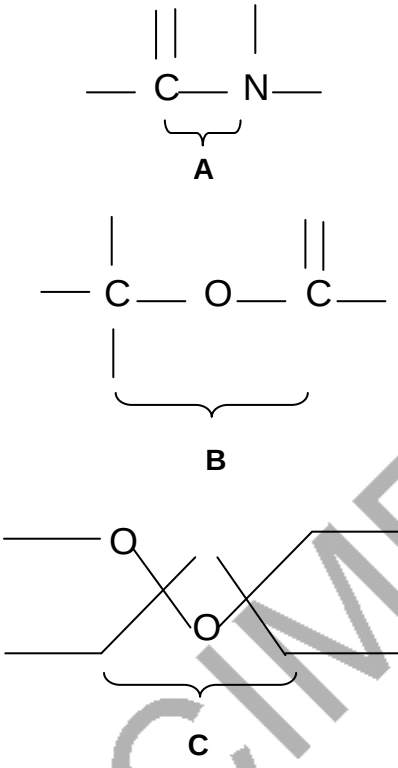

Fig. 2.1

(a) Give the letter of the bond that,

(i) joins together molecules of glucose in glycogen**;**

.....**[1]**

(ii) occurs in the primary structure of a protein such as insulin**;**

.....**[1]**

(iii) occurs in a lipid or phospholipid.

.....**[1]**

(b) Name the chemical process involved in breaking the bonds **A**, **B** and **C**.

In your answer, you should use an appropriate technical term spelled correctly.

.....**[1]**

(c) Glycogen is an insoluble polysaccharide and consists of branched chains of glucose molecules.

Explain how the properties and structure of glycogen adapt it to its function.

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.....

.....

.....

..... **[3]**

[Total: 7]

3 Airline passengers travelling on long haul flights are at risk of developing deep vein thrombosis (DVT).

A thrombus is a clot that develops inside a blood vessel If a thrombus breaks away from the wall of the vessel, it becomes an embolus and may lead to an embolism.

(a) Suggest how an embolism may become life threatening.

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.....

..... **[4]**

(b) Outline the mechanism of blood clotting.

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..... **[5]**

[Total: 9]

4 The bronchioles of the human lung transport air to and from the alveoli. The wall of the bronchioles are lined with two types of specialised cells. Fig. 4.1 shows an electron micrograph of the surface of a bronchiole with the two types of cells labelled.

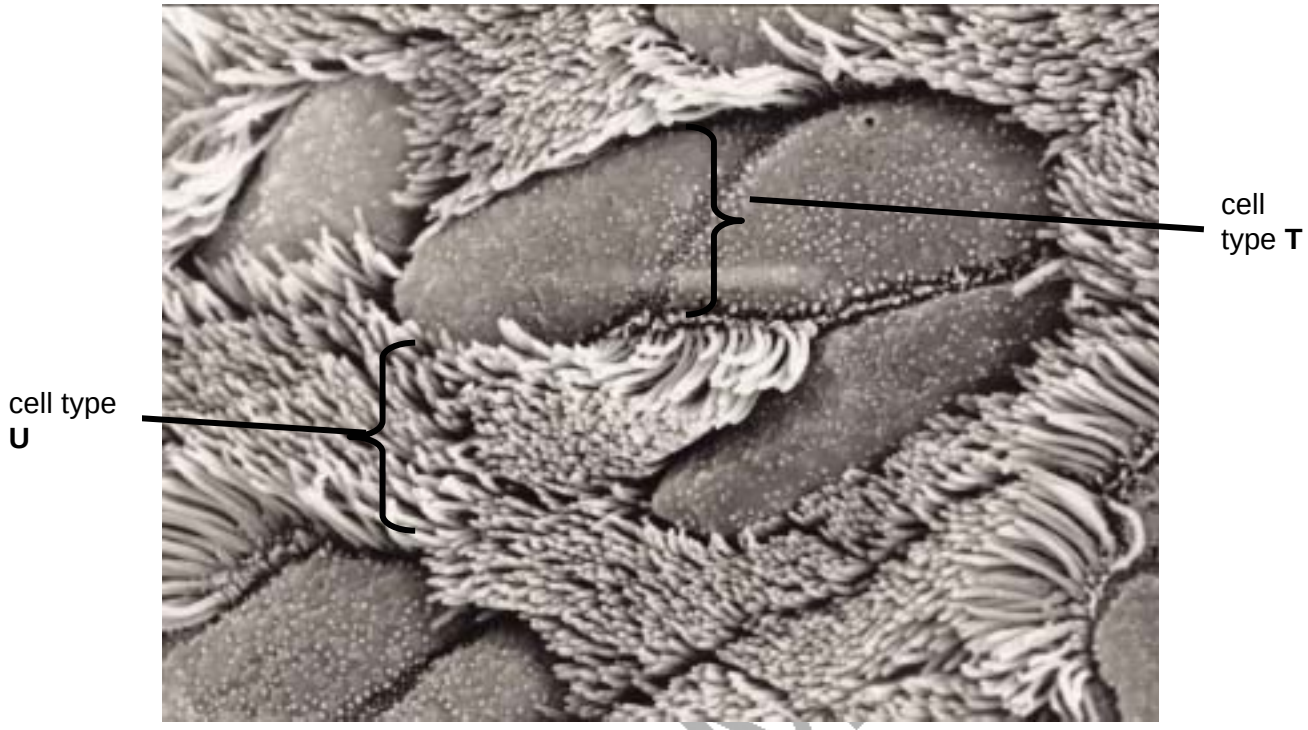

Fig 4.1

(a) **(i)** Name the two types of cell labelled.

In your answer, you should use appropriate technical terms, spelled correctly.

cell type **T** .....

cell type **U** ..... **[2]**

(ii) Describe how these cells work together to ensure that any particles present in the inspired air are trapped and transported out of the lungs.

.....

.....

.....

.....

.....

..... **[3]**

(b) A spirometer was used to investigate lung volumes.. Measurements of tidal volume were taken from the student. The measurements were used to calculate

- the alveolar ventilation rate, which is the volume of air reaching the gaseous exchange surface per minute.
- The air in the lungs which is not in contact with the gaseous exchange surface is called dead space. The dead space in this student is 150 cm^3.

The results of this investigation are shown in Table 4.1.

Table 4.1

breathing rate / breaths min^{-1}	tidal volume / cm^3	alveolar ventilation rate / cm^3 min^{-1}
30	200	
10	600	4500

The alveolar ventilation rate is calculated using the following formula:

alveolar ventilation rate = (tidal volume – dead space) x breathing rate

(i) Using this formula, calculate the alveolar ventilation rate at a breathing rate of 30 breaths min^{-1}. Show your working.

Answer = ...cm^3 min^{-1} **[2]**

(ii) Using a breathing tube such as a snorkel has the effect of increasing the dead space.

Predict what would happen to the breathing rate and tidal volume if the dead space is increased and explain the reason for the changes you have described.

..... **[3]**

[Total: 10]

5 Fig. 5.1 shows a diagrammatic view of the internal structure of a human heart.

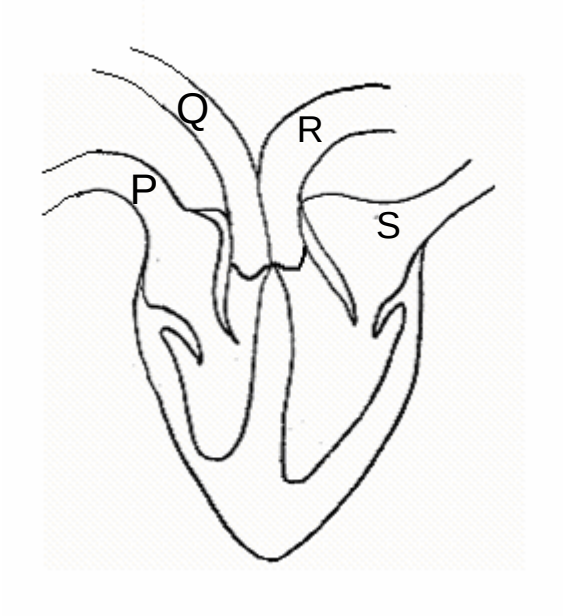

Fig 5.1

(a) Which of the blood vessels labelled **P** to **S** carries blood under highest pressure?

.....**[1]**

(b) The ventricles shown in Fig. 5.1 are filling with blood. Use evidence from Fig. 5.1 to explain why the ventricles are filling with blood.

.....

.....

.....

.....**[2]**

(c) Describe the functions of the following in co-ordinating the cardiac cycle:

(i) the SA node .....

.....**[2]**

(ii) the AV node .....

.....**[2]**

(iii) the purkyne tissue .....

.....

.....

.....**[2]**

(d) The pressure of blood in an artery varies during the cardiac cycle.

Explain what happens to the wall of the artery at different points during the cardiac cycle **and** the effect this has on blood flow.

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..... **[3]**

(e) Describe how reliable blood pressure measurements may be taken.

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..... **[4]**

[Total: 15]

6 Enzymes are globular protein molecules that are able to catalyse chemical reactions. Maintaining the body temperature at 37 ^{o}C optimises the activity of enzymes within the human body.

(a) Fig. 6.1 shows how the activity of an enzyme varies with temperature.

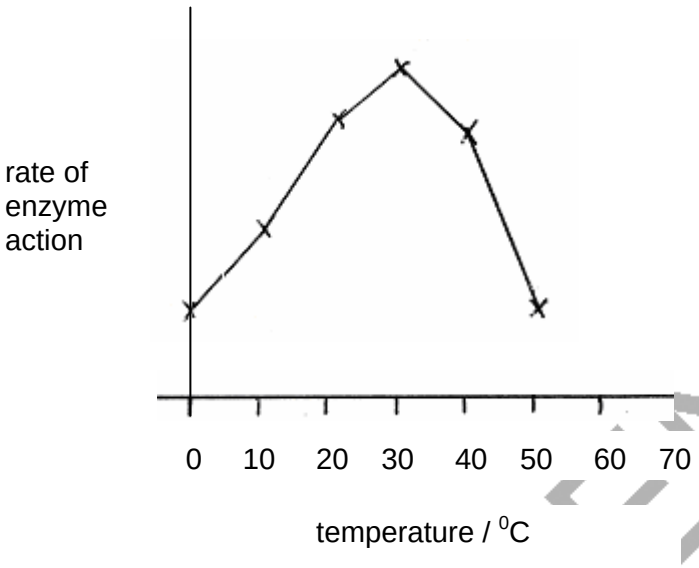

Fig. 6.1

Explain the reasons for the change in enzyme activity

(i) between 0 ^{o}C and 30 ^{o}C

.....

.....

..... **[2]**

(ii) between 30 ^{o}C and 50 ^{o}C.

.....

.....

.....

.....

.....

..... **[2]**

(b) Glycogen phosphorylase is an enzyme that breaks down glycogen in muscle cells. Glucose acts as a non-competitive inhibitor to glycogen phosphorylase.

Fig.6.2 shows representations of a glycogen phosphorylase and a glucose molecule.

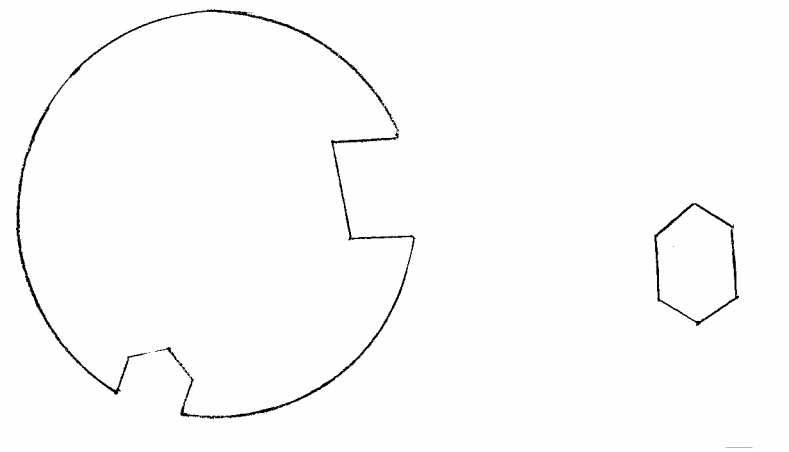

Fig. 6.2

(i) Draw a diagram based on the molecules in Fig. 6.2 to show how glucose acts as a non-competitive inhibitor to glycogen phosphorylase.

[2]

(ii) Suggest why the action of glucose as a non-competitive inhibitor is an advantage to muscle cells.

.....

.....

..... **[2]**

[Total: 8]

Paper Total [60]

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OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary GCE

HUMAN BIOLOGY F221

Unit F221: Molecules, Blood and Gas Exchange

Specimen Mark Scheme

The maximum mark for this paper is 60.

Question Number	Answer	Max Mark
1(a)	X lymphocyte; Y monocyte; Z neutrophil	[3]
(b)	*mark (i) and (ii) together* **(i)** as relative mass increases, the permeability decreases; **(ii)** albumin/ plasma protein; capillary walls not permeable to albumin;	[3]
(c)(i)	as intravenous fluid; wash wounds / burns; wash organs in surgery; AVP;	[1]
(c)(ii)	*accept reverse arguments* to give same **<u>water potential</u>**; correct ref isotonic; (too low sodium ion concentration) cells would burst; (due to) water enters; (by) osmosis;	[3]
	Total:	[10]

Question Number	Answer	Max Mark
2(a)(i)	C**;**	**[1]**
(ii)	A**;**	**[1]**
(iii)	B**;**	**[1]**
(b)	Hydrolysis (QWC)**;**	**[1]**
(c)	function is energy ,store**;** (insoluble) to prevent lowering water potential**;** **R** 'changing' (branched) for compact storage**;** **R** storage unqualified (branched) for rapid breakdown**;** **R** breakdown unqualified AVP**;** e.g. many terminal glucose molecules for hydrolysis	**[Max 3]**
	Total:	**[7]**

Question Number	Answer	Max Mark
3(a)	blocks / reduces circulation / blood flow (to certain tissues)**;** (leading to)death of, tissue / named tissue / organ**;** in coronary artery causes heart attack / MI**;** (due) to lack of, oxygen / glucose**;** causes stroke**;** in lungs, pulmonary embolism**;** inability to absorb oxygen**;** AVP**;**	**[4]**
(b)	enzyme controlled process**;** role of platelets**;** damaged tissue**;** roles of thromboplastin**;** calcium ions**;** prothrombin**;** thrombin**;** fibrinogen**;** fibrin**;**	**[5]**
	Total:	**[9]**

Question Number	Answer	Max Mark
4(a)(i)	T goblet cell**;** U ciliated epithelium *QWC spelling of ciliated epithelium must be correct*	**[2]**
(ii)	particles trapped in mucus**;** cilia move in co-ordinated way/ AW**;** **R** "movement" alone m creates a current / force**;** mucus (with particles) moves upwards**;**	**[3]**
(b)(i)	(200-150) x 30 = 1500**;;** *one mark for correct working but wrong answer*	**[2]**
(ii)	(both) increase**;** maintain alveolar ventilation rate**;** (so that) diffusion gradient maintained**;** ref oxygen for aerobic respiration**;** ref removal of carbon dioxide**;**	**[3]**
	Total:	**[10]**

Question Number	Answer	Max Mark
5(a)(i)	R	[1]
(b)	valve between artery and ventricles / SL valve, closed; valve between atria and ventricles / AV valve, open; AVP; e.g.ventricle walls, look relaxed / in diastole	[2]
(c)(i)	SA node initiates impulse / AW; electrical activity spreads across atria; atria contract;	[2]
(ii)	electrical activity reaches AV node; impulse delayed; fibrous tissue prevents conduction form atria to ventricles;	[2]
(iii)	impulse transmitted by Purkyne tissue; to base of ventricles; contraction of ventricles from base / apex upwards;	[2]
(d)	The walls contain elastin fibres / AW; stretch when pressure is high; recoil when pressure is low; maintains blood flow in between ventricular systole / AW	[3]
(e)	ref to arm supported/subject relaxed; cuff placed around (upper) arm / AW, cuff inflated; stethoscope placed over artery cuff deflated; systolic pressure is pressure heard as a soft tapping sound; diastolic pressure is measured as sound disappears; AVP, e.g. ref to automated machines, repeat measurements	[4]
	Total:	[16]

Question Number	Answer	Max Mark
6(a)(i)	kinetic energy / velocity of molecules, increases; more collisions between enzyme and substrate molecules; more enzyme substrate complexes formed	[2]
(ii)	kinetic energy higher; hydrogen bonds broken; tertiary structure changed; active site shape changed; substrate no longer fits; ref to denaturing	[3]
(b)(i)	glucose drawn in allosteric site; active site shape changed	[2]
(ii)	when high glucose concentration (in muscle cells); glycogen in muscle preserved / stores maintained /AW; when low glucose concentration (in muscle cells); glycogen broken down; releasing glucose for muscle cells to use	[2]
	Total:	[9]
	Paper Total:	[60]

Assessment Objectives Grid (includes QWC)

Question	AO1	AO2	AO3	Total
1(a)	3			**3**
1(b)(i)		2		**2**
1(b)(ii)			1	**1**
1(c)(i)		1		**1**
1(c)(ii)	1	2		**3**
2(a)(i)		1		**1**
2(a)(ii)		1		**1**
2(a)(iii)		1		**1**
2(b)	1			**1**
2(c)	3			**3**
3(a)		4		**4**
3(b)	5			**5**
4(a)(i)		2		**2**
4(a)(ii)	3			**3**
4(b)(i)			2	**2**
4(b)(ii)		3		**3**
5(a)(i)		1		**1**
5(b)		2		**2**
5(c)(i)	2			**2**
5(c)(ii)	2			**2**
5(c)(iii)	2			**2**
5(d)		3		**3**
5(e)			4	**4**
6(a)(i)	1	1		**2**
6(a)(ii)	1			**2**
6(b)(i)	1	1		**2**
6(b)(ii)		2		**2**
Totals	**25**	**28**	**7**	**60**