

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Pearson BTEC
Level 3
Nationals
Diploma

Centre Number

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Learner Registration Number

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Tuesday 21 January 2020

Afternoon (Time: 50 minutes)

Paper Reference **31627H/1B**

Applied Science

Unit 5: Principles and Applications of Science II

Biology

SECTION A: ORGANS AND SYSTEMS

You must have:

A calculator and ruler.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and learner registration number.
- Answer **all** questions.
- Answer the questions in the spaces provided
– *there may be more space than you need.*

Information

- The exam comprises three papers worth 40 marks each.
Section A: Organs and systems (Biology).
Section B: Properties and uses of substances (Chemistry).
Section C: Thermal physics, materials and fluids (Physics).
- The total mark for this exam is 120.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

- 1 (a) The kidneys remove metabolic waste products, such as urea, from the body.

Identify the process of removing metabolic waste from the body.

(1)

- A excretion
- B selective reabsorption
- C tubular absorption
- D ultrafiltration

- (b) The kidneys also regulate the salt and water content of the blood.

Water is filtered from the blood and then the water that the body needs is reabsorbed.

Figure 1 shows how water is reabsorbed in the kidneys.

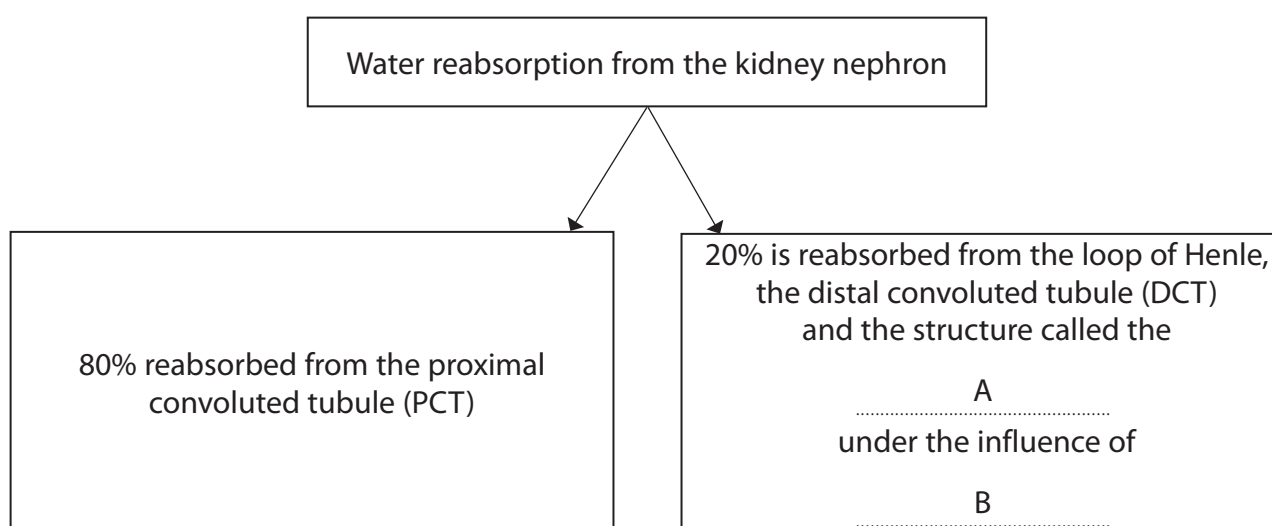


Figure 1

Identify the missing words, A and B, to complete Figure 1.

(2)

A.....

B.....



P 6 3 9 4 7 A 0 3 1 6

(c) A patient has kidney failure.

A doctor recommends renal dialysis, as shown in Figure 2.

Renal dialysis treats kidney failure.



© Medicshots / Alamy Stock Photo

Figure 2

A hospital technician measures the glucose and urea concentrations of the patient's blood, before and after dialysis.

Table 1 shows the results.

Substance	Before dialysis		After dialysis
	Concentration in the blood (mmol dm^{-3})	Concentration in the dialysis fluid (mmol dm^{-3})	Concentration in the blood (mmol dm^{-3})
glucose	7.5	7.5	J
urea	34.0	0.0	K

Table 1

(i) Identify J in Table 1.

(1)

- A** 0.0 mmol dm^{-3}
- B** 7.5 mmol dm^{-3}
- C** $26.5 \text{ mmol dm}^{-3}$
- D** $34.0 \text{ mmol dm}^{-3}$



(ii) There is no urea in the dialysis fluid before dialysis begins.

Give a reason why this is important.

(1)

(iii) Predict K in Table 1.

(1)

(d) When the kidneys detect a fall in blood pressure they secrete renin.

Paragraph 1 shows the renin-angiotensin-aldosterone mechanism.

When blood pressure drops, some cells in the kidney produce renin.

Renin converts angiotensinogen to angiotensin I.

Angiotensin I is converted to X by the enzyme

Y

The hormone aldosterone is then released.

More sodium ions are reabsorbed into the blood.

..... Z enters the blood.

Blood pressure increases.

Paragraph 1

Identify the missing words, X, Y and Z, to complete Paragraph 1.

(3)

X

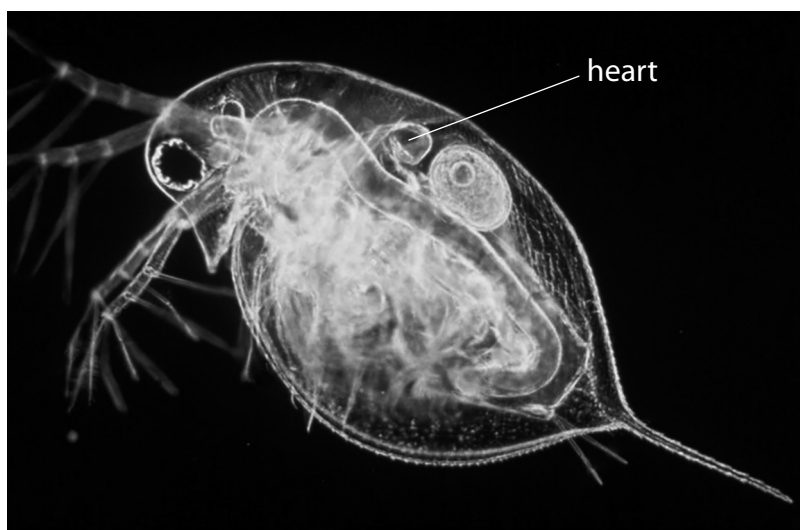
Y

Z

(Total for Question 1 = 9 marks)



- 2 A student investigated the effect of caffeine on the heart rate of the water flea, *Daphnia*. Figure 3 shows a *Daphnia* and the location of its heart.



© Credit : John Walsh / Science Photo Library

Figure 3

The student placed a *Daphnia* in a Petri dish containing pond water.

The student observed the *Daphnia* under a light microscope.

The student counted the number of *Daphnia* heartbeats per minute when the *Daphnia* was in pond water containing differing concentrations of caffeine.

The results are shown in Table 2.

trial	heart rate (beats per minute)		
	caffeine concentration (%)		
	0.00	0.01	0.05
1	234.0	354.0	384.0
2	249.0	357.0	393.0
3	240.0	363.0	405.0
4	243.0	354.0	390.0
5	237.0	366.0	405.0
6	240.0	354.0	390.0
mean	240.5	358.0	

Table 2



- (a) (i) Calculate the mean number of heartbeats for the *Daphnia* in 0.05% caffeine concentration.
Show your working. (2)

mean number of heartbeats = beats per minute

- (ii) Calculate the percentage increase in the mean *Daphnia* heart rate between 0.00% caffeine concentration and 0.01% caffeine concentration.
Show your working. (3)

percentage increase =%

- (b) Figure 4 shows the equation for cardiac output.

$$\text{cardiac output} = \text{heart rate} \times \text{stroke volume}$$

Figure 4

Explain how caffeine changes the cardiac output of the *Daphnia*. (4)

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(c) Figure 5 shows the human heart in longitudinal section, together with some of the main blood vessels.

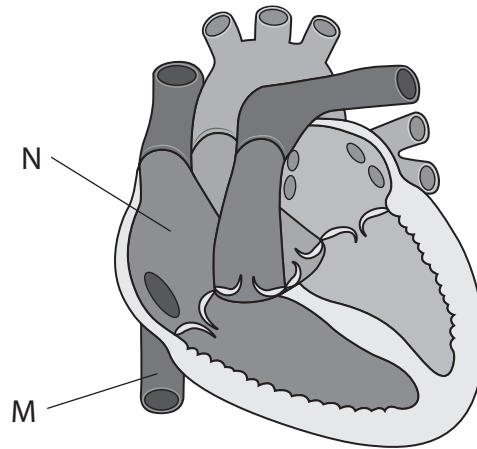


Figure 5

Identify the structures labelled M and N in Figure 5.

(2)

M.....

N.....

(d) Blood leaves the heart, in the aorta, to travel around the body.

	thickness of wall	size of lumen	pressure of blood
A	thick	large	low
B	thin	large	low
C	thick	small	high
D	thin	small	high

Table 3

Which row in Table 3 correctly outlines the features of the aorta?

(1)

- A
- B
- C
- D

(Total for Question 2 = 12 marks)



3 The two most important blood grouping systems for humans are the:

- ABO system
- rhesus system.

Table 4 lists the antigens and antibodies present in people of different ABO blood groups.

(a) Complete Table 4 for blood groups A and AB.

(4)

blood group	antigens on erythrocytes	antibodies in blood plasma
A		
B	B	anti A
AB		
O	none	anti A and anti B

Table 4

(b) Explain what happens if group B blood is transfused into a patient who is blood group O.

(2)

.....

.....

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.....



(c) The rhesus system relates to the presence or absence of D antigens on the surface of the erythrocytes.

Explain why, in an emergency, anyone can be given a transfusion with blood of type O rhesus negative.

(3)

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(Total for Question 3 = 9 marks)

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4 Pulmonary disease destroys alveoli.

Figure 6 shows the effect of destroying alveoli on the total surface area of the lungs.

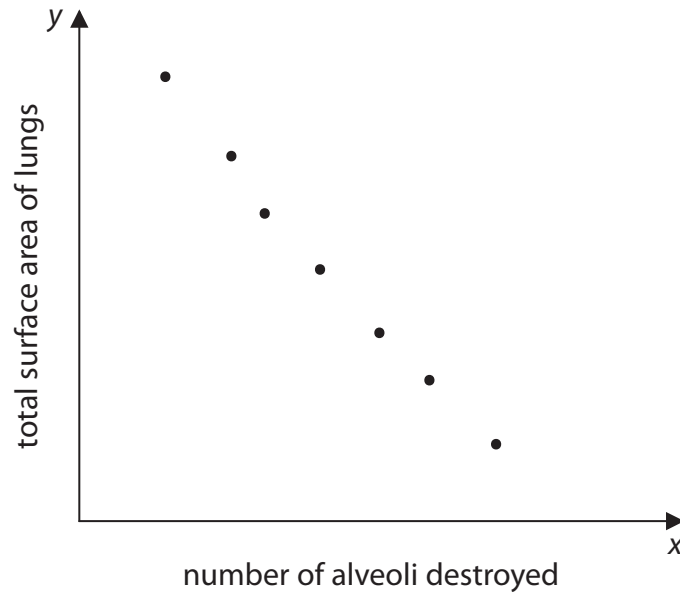


Figure 6

(a) Describe the relationship between the number of alveoli destroyed and the total surface area of the lungs.

(1)

(b) Explain why it is important for the walls of the alveoli to be moist.

(2)

(c) Identify an adaptation that **directly** enables efficient gaseous exchange in the human lungs.

(1)

- A The bronchioles do not contain cilia.
- B The capillary walls consist of one layer of endothelial cells.
- C The internal intercostal muscles only contract during forced expiration.
- D The lungs are protected by the rib cage.

(Total for Question 4 = 4 marks)



5 Substances may enter or leave cells by active transport and passive transport mechanisms.

Compare how substances move into and out of cells by both active and passive transport mechanisms.

You may include diagrams to support your answer.

(6)

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TOTAL FOR SECTION A = 40 MARKS





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