

**T Level Technical Qualification in Health
(603/7066/X)**

Paper B Elements 12–13

Paper number: **P002371**Time allowed: **2 hours 30 minutes**Assessment date: **Thursday 14 December 2023**Time: **1:00pm – 3:30pm****Student instructions**

- Use black ink.
- Fill in the boxes at the bottom of this page.
- Answer **all** questions.
- Read each question carefully.
- You **must** write your responses in the spaces provided. There may be more space than you need.
- You may do rough work in this answer book. Cross through any work you do not wish to be marked.

Student information

- The marks available for each question are shown in brackets. This is to help you decide how long to spend on each question.
- The maximum mark for this paper is **118**.
- In questions **6, 7, 12, 18, 19** and **20**, you will be assessed on the quality of your written communication (QWC), specifically, your ability to:
 - use good English
 - express and organise ideas clearly and logically
 - use appropriate technical terms.
- You may use a calculator.

Do not turn over until the invigilator tells you to do so.**Please complete / check your details below**

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For the multiple-choice questions, write **A, B, C** or **D** in the answer space. Do **not** circle **A, B, C** or **D** in the question.

For example:

Answer **C**

If you change your mind about an answer, you must put a cross through your original answer and then write your new answer next to it.

For example:

Answer ~~**A**~~ **B**

Section A: Biology

This section is worth 42 marks, plus 6 marks for quality of written communication (QWC) and use of specialist terminology.

Answer **all** questions in the spaces provided.

1 Which of the following is synthesised in the integumentary system?

[1 mark]

A Antibody

B Antigen

C Vitamin C

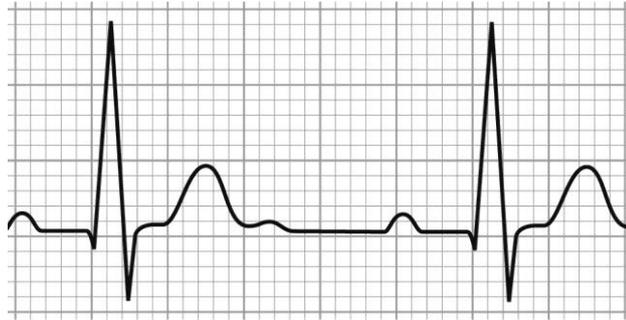
D Vitamin D

Answer _____



2 **Figure 1** shows the electrical activity of the heart taken from an electrocardiogram (ECG).

Figure 1: part of a trace from an electrocardiogram



(a)(i) Work out how many heart beats are represented by the trace.

[1 mark]

(a)(ii) State what would need to be added to **Figure 1** to enable the heart rate to be worked out.

[1 mark]

Please turn over for the next question.



2(b) The same person runs on a treadmill for 10 minutes before a second ECG trace.

Explain **two** ways in which the trace would change.

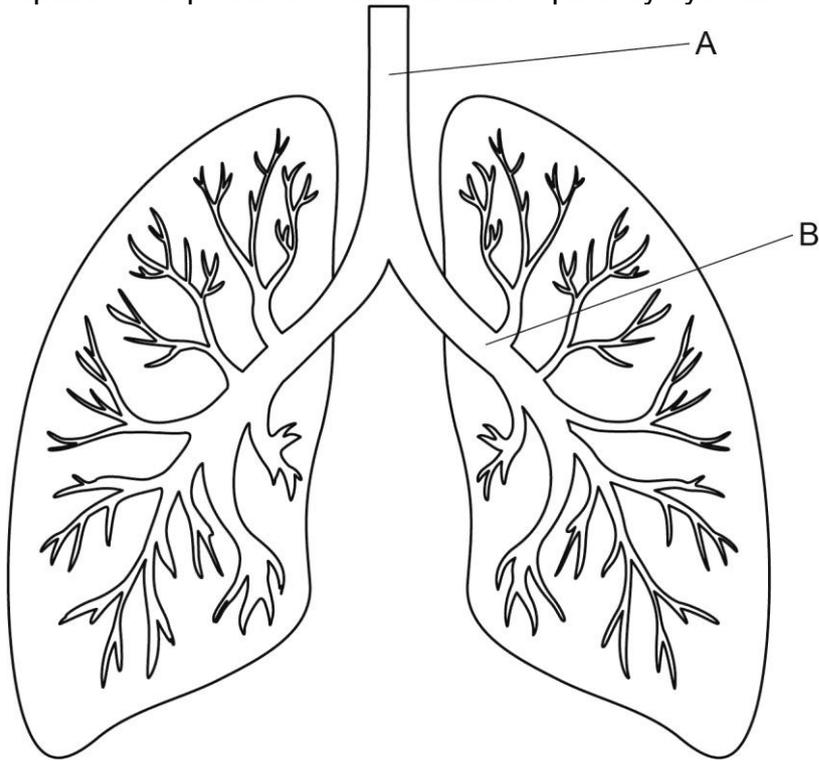
[4 marks]

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3 **Figure 2:** simplified components of the human respiratory system



(a) Identify components A and B.

[2 marks]

Please turn over for the next question.



3(b) An individual has an accident which paralyses the intercostal muscles and diaphragm.

Explain why the individual would not be able to breathe.

[4 marks]

4 The average total blood volume of an adult is 5 litres. 0.1 litres of this total volume can be found in the lung capillaries.

Calculate the percentage of total blood volume in the lung capillaries.

[2 marks]



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7 There are **two** forms of glucose:

- D glucose which occurs naturally in a wide range of foods and is a constituent of all polysaccharides
- L glucose which must be produced in a laboratory.

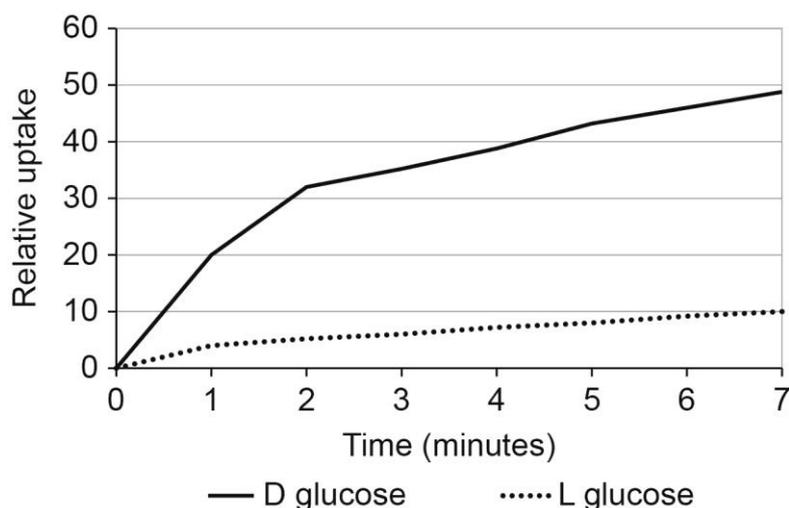
D glucose and L glucose have exactly the same taste, but the human body cannot metabolise L glucose and use it for energy.

A trial is being carried out to investigate if L glucose could be used as a healthy artificial sweetener by type 2 diabetics. The sweetener would help reduce their blood glucose levels but would allow them to eat sweet tasting foods.

Two volunteers each fasted for 6 hours, they then drank 100 ml of either 5% D glucose solution or 5% L glucose solution.

The relative rate that each type of glucose was absorbed into the blood stream is shown in **Figure 3**.

Figure 3: rate each type of glucose was absorbed



Using the information provided and your knowledge of:

- absorption of glucose from the gut
- control of blood glucose levels
- role of glucose in the body.

Discuss the potential use of L glucose as a healthy artificial sweetener for type 2 diabetics.

Your response should include reasoned judgements and conclusions.

[12 marks plus 3 for QWC]



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Section B: Chemistry

This section is worth 20 marks, plus 3 marks for quality of written communication (QWC) and use of specialist terminology.

Answer **all** questions in the spaces provided.

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- 8** Which one of the following is the property which allows a metal to be drawn into thin strips?

[1 mark]

- A** Conductive
- B** Ductile
- C** Malleable
- D** Sonorous

Answer _____

- 9** Which one of the following gives the products of an acid-base reaction?

[1 mark]

- A** Salt and hydrogen only
- B** Salt and hydrogen peroxide only
- C** Salt and water only
- D** Salt, oxygen and water only

Answer _____



- 10** A team of chemists is developing a new pain relief drug which can be used in a similar way to ibuprofen and paracetamol. They are interested in the acidity levels of the different drugs as this can affect how effective they are for patients. The table below shows the associated pH values of ibuprofen, paracetamol and the new drug.

Table 2: pH values of paracetamol, ibuprofen and the new drug when in solution.

Drug	pH
Paracetamol	6
Ibuprofen	3
New drug	4

- (a) Compare the hydrogen ion concentration of the drugs when in solution in **Table 2**. You should provide **two** comparisons.

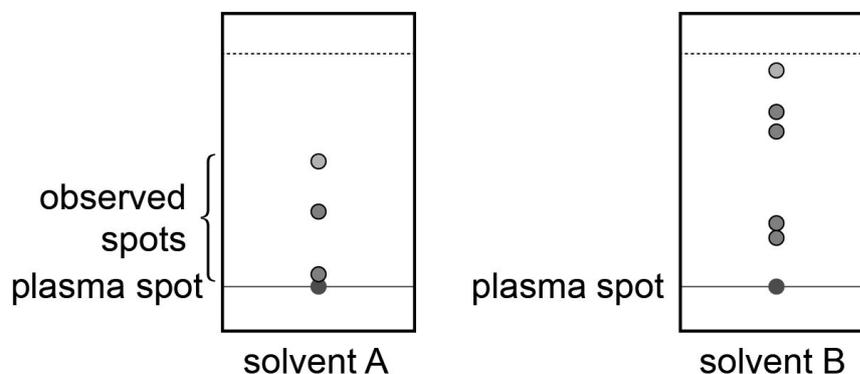
[2 marks]

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Another team of chemists are interested in the products released into the bloodstream as ibuprofen is broken down by the body. They obtain a blood plasma sample from a patient currently taking ibuprofen.

Figure 4: thin layer chromatography (TLC) chromatograms of a plasma sample in two different solvents.



(b) Explain the results shown on each chromatogram in **Figure 4**.

[4 marks]



11 A dentist has agreed to replace the two lower front teeth of a 24 year old patient. The dentist has decided to use dental implants. An apprentice, working with the dentist has been researching possible materials to use. They focus on two main materials: titanium metal and a ceramic named zirconia.

The apprentice discovers that zirconia implants tend to have a slightly higher resistance to bacterial infection than titanium and they can be coloured to meet the patient’s needs.

Table 3: a comparison between titanium and zirconia.

	Titanium	Zirconia
Average life span of implant	20–30 years	15–20 years
Success rate after 1 year	95.8%	90.9%

The apprentice suggests that zirconia implants may be the most appropriate to use as the implants are at the front of the mouth.

Using **Table 3** and your knowledge of ceramics, assess the apprentice’s suggestion.

[3 marks]



Section C: Physics

This section is worth 20 marks, plus 3 marks for quality of written communication (QWC) and use of specialist terminology.

Answer **all** questions in the spaces provided.

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13 Which of the following is a property of mains electricity in the UK?

[1 mark]

- A** Direct current
- B** Constant current of 50A
- C** Frequency of 60Hz
- D** Voltage of 230V

Answer _____

14 Some radioactive isotopes have very high count-rates.

Define the term "count-rate".

[1 mark]

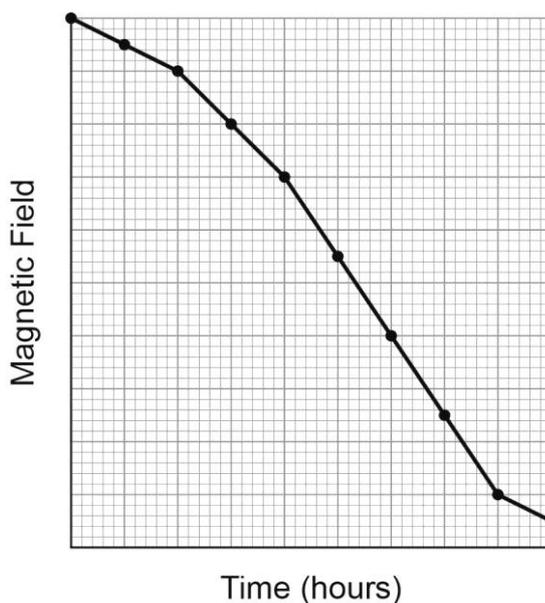


15 Electromagnets are commonly used in diagnostics such as magnetic resonance imaging (MRI).

A scientist is developing a new type of electromagnet. They begin by taking an iron bar and placing it inside a coiled wire. Then a current is passed through the coil.

The scientist records the magnetic field strength of the bar over a few hours and plots the following graph shown in **Figure 5**.

Figure 5: magnetic field strength after applied current



The scientist concludes that the current through the wire decreases over time.

Use the information from **Figure 5** to explain the scientist's conclusion.

[2 marks]



- 16** One use of ultrasound is to provide images of organs which can be used to guide surgeons during surgery.

A sonographer is conducting an ultrasound image of a patient's kidney. They use a high-speed sound wave with a velocity of 1560m/s and a wavelength of 0.00039m.

Using the following equation to help you, calculate the frequency of this sound wave. You must show your working and provide the correct unit for frequency.

$$v = f\lambda$$

[4 marks]



17 A trainee is assisting a GP with a 15 year old patient suffering with a facial wart. The GP is worried about scarring if the wart is removed by surgery.

The trainee decides to research complementary therapies. They find a study that used microwaves to cure a verruca in a 41 year old male.

The study reported that the verruca was fully healed after 3 weeks, two treatments were required and no scarring on the foot was present afterwards.

They think that as a verruca is type of wart, the same treatment could be considered for their patient.

Using the information above, assess the use of microwaves as a treatment for facial warts.

[3 marks]

Please turn over for the next question.



- 18 Radioisotopes are commonly used to treat bone cancers and are absorbed by bone cells. Each isotope emits energy destroying neighbouring cancerous cells.

A team of healthcare scientists are investigating three different radioisotopes for bone cancer treatments.

These are:

- Radium-223 (^{223}Ra)
- Strontium-89 (^{89}Sr)
- Iodine-131 (^{131}I).

The scientists are provided with the following data shown in **Table 5**.

Table 5: preliminary data of the radioisotopes studied.

Radioisotope	Ionising radiation emitted	Half-life (days)
^{223}Ra	alpha	11.4
^{89}Sr	beta	50.5
^{131}I	beta and gamma	8

A scientist suggests that ^{89}Sr is too dangerous to use because it has the longest half-life.

With reference to your knowledge of ionising radiation, radioactive decay and half-life, discuss the scientist's suggestion.

Your answer must include reasoned judgements and conclusions.

[9 marks plus 3 for QWC]



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To be completed by the examiner			
Question	Mark	Question	Mark
1		16	
2 (a) (i)		17	
2 (a) (ii)		18	
2 (b)		19	
3 (a)		20	
3 (b)			
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		TOTAL MARK	

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