

Surname	Centre Number	Candidate Number
First name(s)		0



GCSE

3440UB0-1



TUESDAY, 17 MAY 2022 – MORNING

**APPLIED SCIENCE (Single Award)
UNIT 2: Science to Support our Lifestyles**

HIGHER TIER

1 hour 30 minutes

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	11	
2.	8	
3.	12	
4.	9	
5.	7	
6.	11	
7.	11	
8.	6	
Total	75	

ADDITIONAL MATERIALS

In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

Question 4(a) is a quality of extended response (QER) question where your writing skills will be assessed.

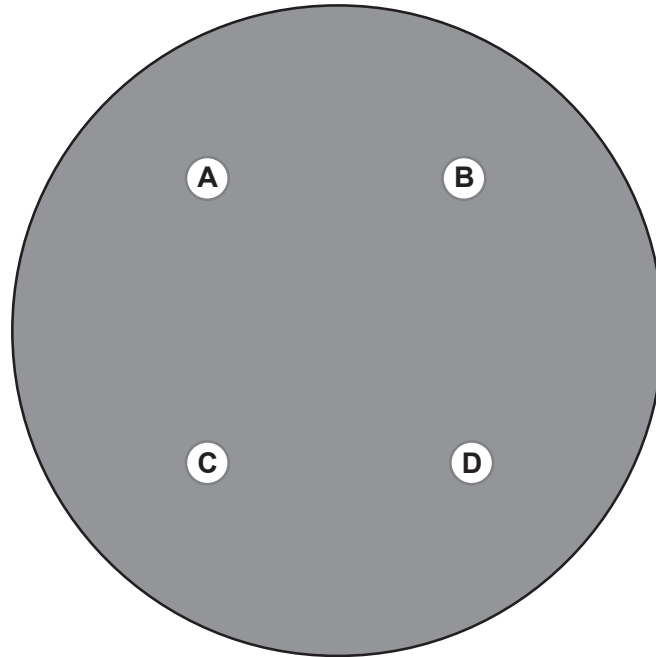
The Periodic Table is printed on page 16 of this examination paper.



JUN223440UB0101

Answer **all** questions.

1. A group of students investigated how different antibiotics affected the growth of bacteria. An agar plate was inoculated with bacteria and small discs containing different antibiotics (**A**, **B**, **C** and **D**) were placed onto it.



The following procedure was followed to add the antibiotic discs to an agar plate inoculated with bacteria.

1. Pick up the filter paper disc containing antibiotic **A** using forceps.
2. Place the antibiotic disc on to the plate.
3. Repeat steps 1 and 2 for antibiotic discs **B**, **C** and **D**.
4. Place a lid on the agar plate.
5. Turn the plate upside down and incubate for 3 days at 20°C.
6. Record the radius of the clear zone around each disc.

- (a) State **two** ways the students could reduce the contamination by unwanted bacteria. [2]

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(b) The students obtained the following results.

Antibiotic disc	Radius of clear zone (cm)
A	1.2
B	0.7
C	1.4
D	0.2

(i) Explain which antibiotic is least effective. [2]

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(ii) Use the equation

$$\text{area} = 3.14 \times \text{radius}^2$$

to calculate the area of the clear zone for antibiotic **C** to **three** significant figures. [3]

area = cm²

(iii) It has been estimated that each 1 cm² on this plate contains 50 000 bacteria.

Calculate how many bacteria were present in the area cleared by antibiotic **C** at the start of the experiment. [2]

number of bacteria =

(iv) Robert says that antibiotic **C** is **twice** as effective as antibiotic **B**.
 Jeremy says that antibiotic **C** is **four** times as effective as antibiotic **B**.
 Explain whether you agree with Jeremy or Robert. [2]

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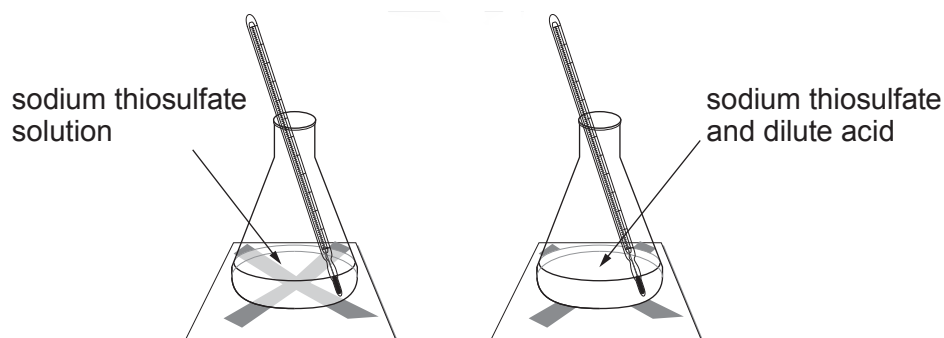
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2. A student carried out an experiment to investigate how concentration affects the rate of a chemical reaction.
- When hydrochloric acid (HCl) reacts with sodium thiosulfate solution a precipitate of sulfur is formed that makes the solution go cloudy.
- The student made different concentrations of hydrochloric acid by adding water to hydrochloric acid. These were then added to a sodium thiosulfate solution at 20 °C. The time for the cross to disappear was then measured.



The following results were obtained.

Volume of HCl (cm ³)	Volume of water (cm ³)	Time for cross to disappear (s)
25	0	2
20	5	9
15	10	37
10	15	75
5	20	153

- (a) State **two** variables that need to be controlled in this experiment. [2]

1.

2.

- (b) Explain the results in terms of particles. [3]

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(c) Explain, in terms of particles, what would happen to the results if the experiment was carried out at 5 °C. [3]

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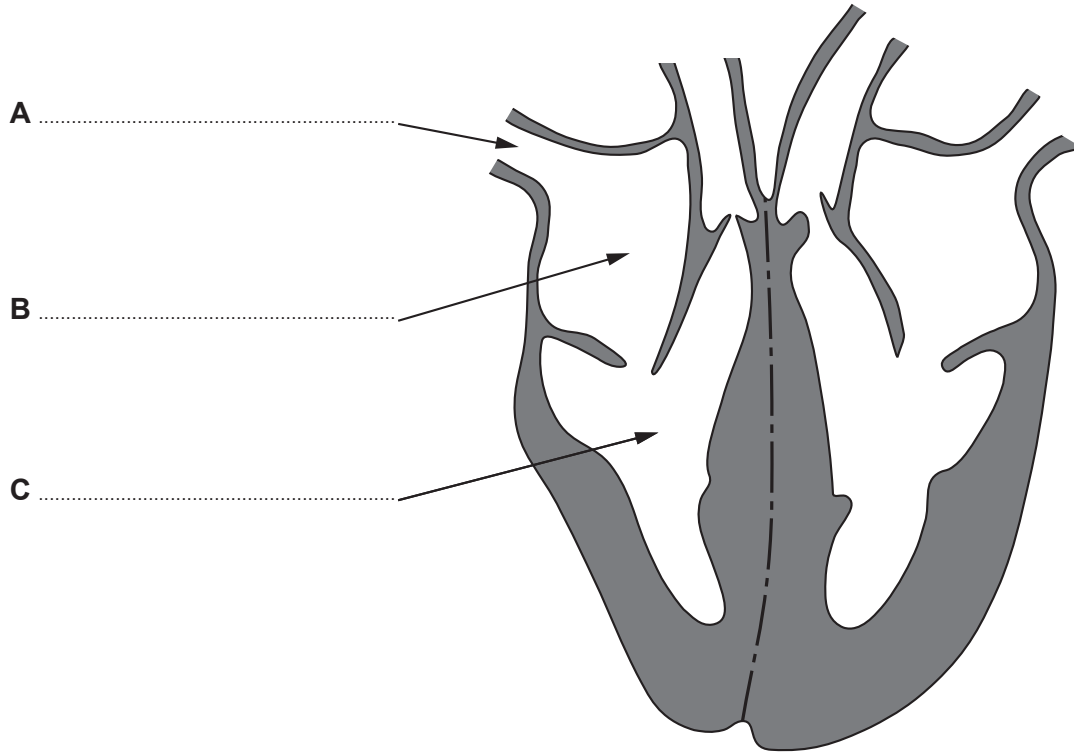
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3. The circulatory system consists of the heart and blood vessels.

(a) The diagram below shows a cross-section through a heart.



Label **A**, **B** and **C** on the diagram of the heart. [3]

(b) (i) Explain how the structure of a capillary is adapted to its function. [2]

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(ii) Compare the structure and purpose of arteries and veins. [4]

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(c) Blood contains different types of cells. Describe how white blood cells defend the body against pathogens. [3]

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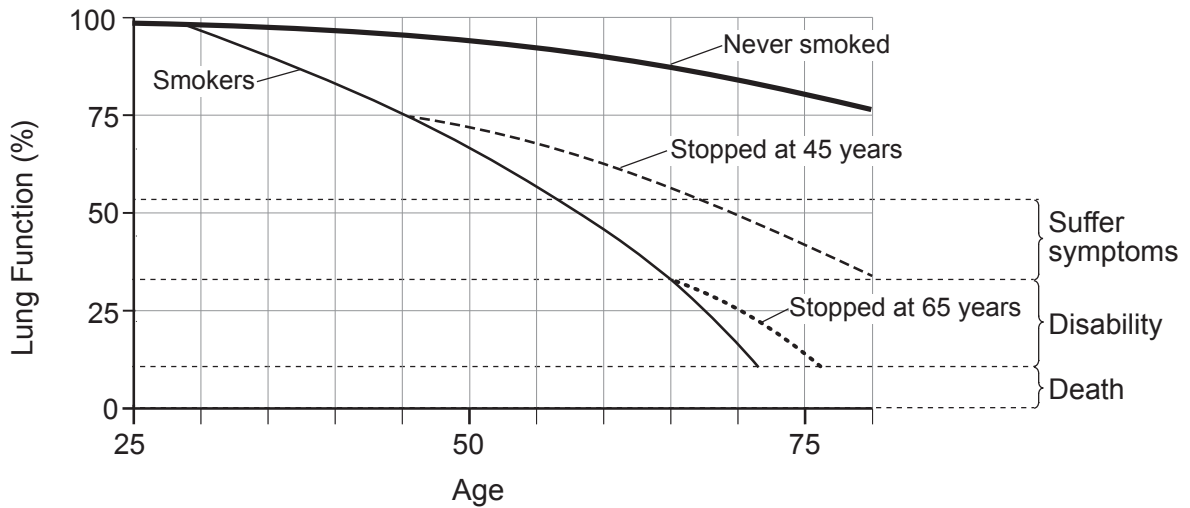
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5. A study has been conducted into the effect of smoking on lung function. The lung function of four different groups of people was measured:

- people who smoke
- people who did smoke but gave up at the age of 45
- people who did smoke but gave up at the age of 65
- people who have never smoked.

The results of the study are shown in the graph below.



(a) John is 45 and is considering giving up smoking. Use the information in the graph to explain to John the benefits of giving up. [3]

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(b) Bryn is 60 years old and has smoked since he was a teenager. He has recently developed shortness of breath. By adding to the graph, show how his lung function would change if he gives up smoking. [2]

(c) Llinos says her grandmother smoked throughout her life and she died at 90, therefore the study is not valid. Explain whether you agree with Llinos. [2]

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6. Public Health Wales is encouraging people aged over 50 years old to 'Steady on ... Stay SAFE' to reduce their risk of falling. Falls are a serious health issue for older people, with around a third of all people aged 65 and over falling each year, increasing to half of those aged 80 and over. Each year there are around 255 000 fall-related emergency hospital admissions among patients aged 65 and over. In around 5% of these cases a fall leads to a fracture.

(a) Fractures in adults can be either simple or compound.

(i) State the difference between simple and compound fractures. [1]

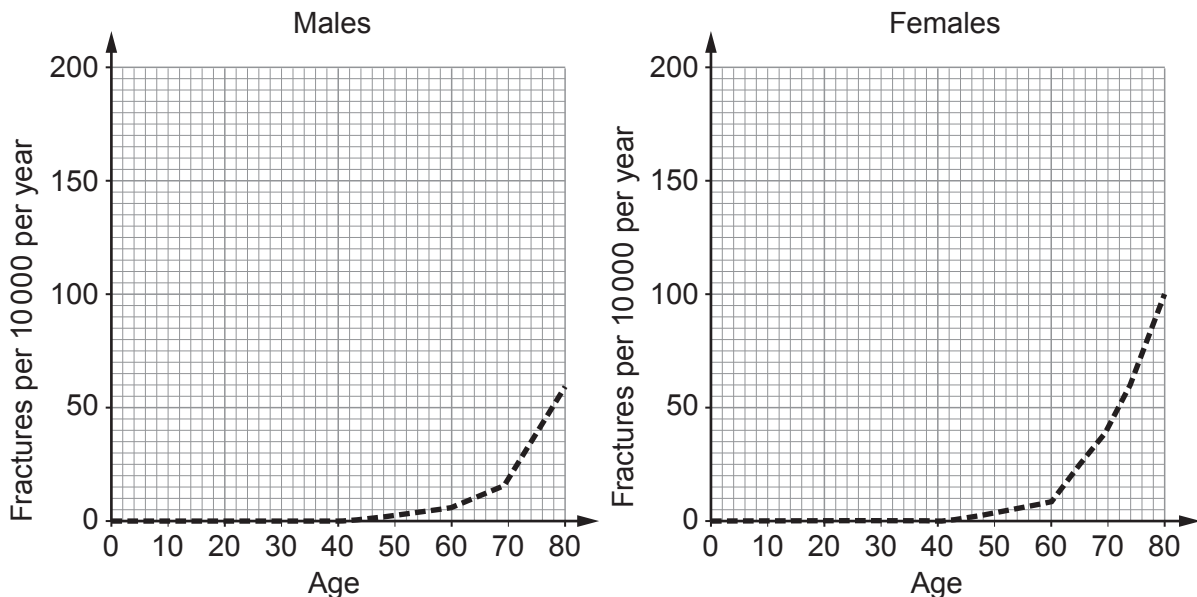
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(ii) Calculate the approximate number of fractures that occur in patients 65 and over per year. [2]

number of fractures per year in patients 65 and over =

(b) The incidence of hip fractures with age is shown below.



(i) Compare the incidence of hip fractures for males and females. [2]

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(ii) There are approximately 6 million women in the UK aged between 65 and 80. Use the graph to calculate the approximate number of fractures that occur in women in this age range per year. [4]

number of fractures =

(c) Osteoarthritis is another condition which can affect the hip joint. Explain how osteoarthritis affects the hip joint so that replacement becomes necessary. [2]

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11



7. Technetium-99m (^{99}Tc) is a radioisotope which is commonly used in medical imaging. It is a gamma emitter which cannot be stored for very long as it only has a half-life of 6 hours. It is obtained from molybdenum-99 by beta decay when required. Molybdenum-99 has a half-life of 66 hours.

(a) (i) State the nature **and** origin of a beta particle. [2]

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(ii) Give the decay equation for molybdenum-99 ($^{99}_{42}\text{Mo}$). [2]

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(b) A sample of technetium-99m containing 1.6×10^8 nuclei is injected into a patient.

(i) Calculate the number of nuclei remaining 24 hours later. [3]

number of nuclei =

(ii) The radiation from technetium-99m will be undetectable once its activity drops to 1/32 of its original value. Colin suggests that this will happen after 2 days. Explain whether you agree. [2]

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(c) State **two** reasons why molybdenum-99 is not suitable for use in medical imaging. [2]

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only

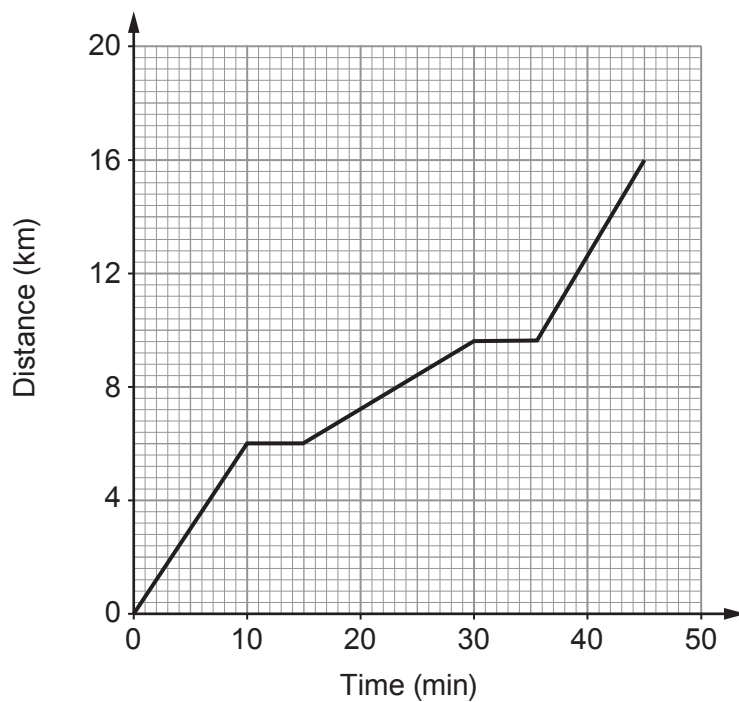
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TURN OVER FOR QUESTION 8

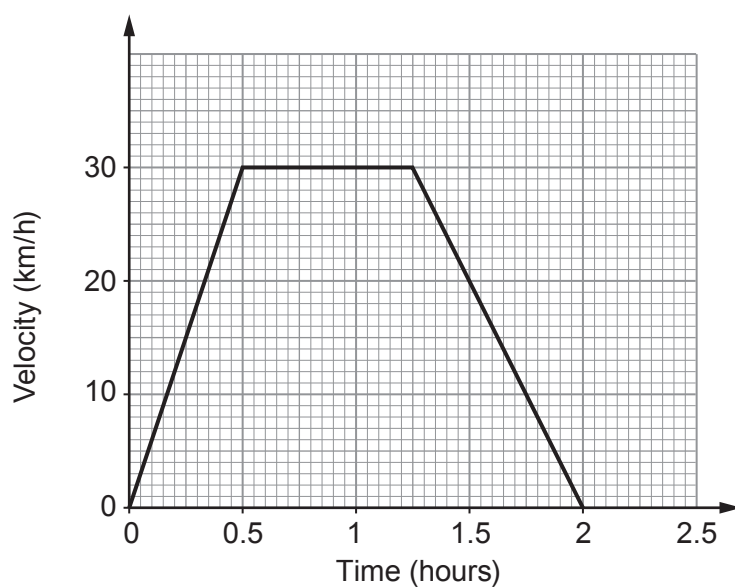


8. The graphs show some information about two cycle journeys, **A** and **B**.

Distance-time graph for journey **A**



Velocity-time graph for journey **B**



The cyclist thought his mean speed for journey **B** was greater.

Use the graphs and the equations:

$$\text{distance} = \text{speed} \times \text{time}$$

$$\text{distance} = \text{area under velocity-time graph}$$

to explain whether the cyclist's conclusion was correct.

[6]

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END OF PAPER

6





THE PERIODIC TABLE

Group 1 2 3 4 5 6 7 0

7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1	11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12	27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	35.5 Ar Argon 18	40 Ca Calcium 20
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Ni Nickel 28
86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	106 Pd Palladium 46
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	195 Pt Platinum 78
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
			65 Zn Zinc 30	63.5 Cu Copper 29	59 Ni Nickel 28	108 Ag Silver 47	112 Cd Cadmium 48	127 I Iodine 53
			70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
			115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
			204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86

Key

relative atomic mass

Ar
Symbol
Name
Z

atomic number