

Surname	Centre Number	Candidate Number
First name(s)		0



**GCSE**

3440U20-1



**TUESDAY, 17 MAY 2022 – MORNING**

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

**FOUNDATION TIER**

1 hour 30 minutes

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

**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 7(b) is a quality of extended response (QER) question where your writing skills will be assessed.

The Periodic Table is printed on page 20 of this examination paper.



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Answer **all** questions.

1. There have been many advances in medical science since the discovery of the structure of DNA in the 1950s.

(a) Select the correct word or words from the list below to complete each of the following sentences.

genes      infra-red      DNA      ionising      Down's syndrome      cystic fibrosis

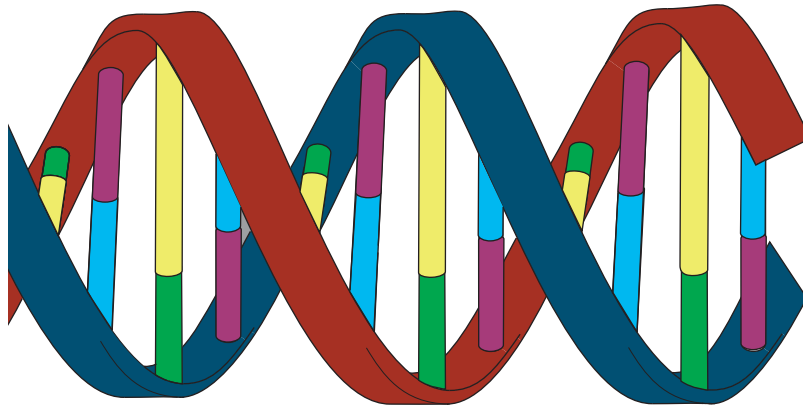
(i) Sections of DNA that determine inherited characteristics are called ..... [1]

(ii) Chromosomes contain ..... [1]

(iii) Exposure to ..... radiation can increase the chance of mutation in our DNA. [1]

(iv) Too many copies of one particular chromosome causes ..... [1]

(b) DNA has a ladder-like, double helix structure with bases (A, C, G and T) forming the rungs.



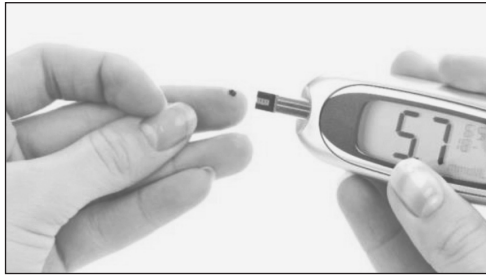
Complete the table below to show how the bases are paired. [1]

Base	Pair
A	.....
C	.....

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2. Jennie has type 1 diabetes. She monitors her blood glucose levels using an electronic meter.



Jennie's results for one day are given in the table below.

Meal	Glucose level before eating (units)	Glucose level two hours after eating (units)	Glucose levels within range (✓ / ✗)
breakfast	90	134	
lunch	95	152	
dinner	66	58	
supper	92	126	

- (a) Complete the data in the table above to show whether the blood glucose levels are within the target range of 70–140 two hours **after each meal**. [2]
- (b) After eating dinner, Jennie's glucose level is below the target range. State what Jennie will need to do to bring her level within range. [1]
- .....



(c) Jennie's uncle has type 2 diabetes and does not inject insulin.

(i) State how the causes of type 1 and type 2 diabetes are different. [2]

.....

.....

.....

(ii) Suggest how Jennie's uncle can control his diabetes. [1]

.....

.....

(d) A group of students tested some artificial urine samples for the presence of glucose.

Their results are shown in the table below.

Sample	Colour of reagent before testing	Colour of reagent after testing
<b>A</b>	blue	amber
<b>B</b>	blue	green
<b>C</b>	blue	blue
<b>D</b>	blue	brick red

(i) Underline the reagent used. [1]

**Benedict's    Biuret    Iodine**

(ii) State the letters (**A**, **B**, **C** or **D**) of **all** the samples that contained glucose. [1]

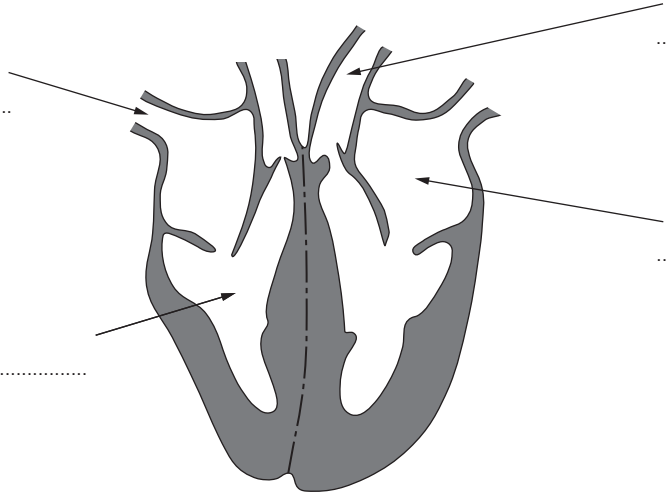
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3. The diagram below shows a cross-section through a heart.

(a) Label the diagram using the words in the box below. [4]

vein      atrium      ventricle      artery      valve



(b) The diagrams in the table below show the relative thickness of the walls of three different blood vessels. Complete the table. [4]

Diagram	Name	Description	Purpose
	Capillary	walls are only one cell thick	..... ..... .....
	.....	..... ..... .....	carries blood at a high pressure
	.....	thin walls with valves	..... ..... .....



4. Public Health Wales is encouraging people over the age of 50 to 'Steady on ... Stay SAFE' to reduce their risk of falling.

Falls are common, and a serious health issue for older people. Around a third of all people aged 65 fall at least once each year. This increases to 50% for those aged 80 and over.

Around 5% of falls lead to fractures of joints. A common fracture in people over 50 is a broken hip.

The table below shows the results of a study into the number of hip fractures at different ages.

Age	Number of hip fractures per year	
	per 10 000 men	per 10 000 women
30	<1	<1
40	<1	<1
50	3	3
60	5	10
70	30	50
80	80	130

- (a) Answer the following using the information in the table.

- (i) State the number of cases of hip fracture per year in women at 70 years of age. [1]

number of cases = ..... per 10 000

- (ii) There are approximately 500 000 women in the UK aged 70.  
Estimate the total number of women aged 70 who are likely to break a hip during a year. [2]

number of women aged 70 that break a hip = .....



(iii) I. A health magazine states that a 67-year-old man is at less risk of a hip fracture than a 60-year-old woman. Explain whether you agree or disagree with the magazine. [2]

.....

.....

.....

.....

II. State how this study could be improved to obtain a more definite conclusion for your answer above. [1]

.....

.....

(b) Older people sometimes need a replacement hip joint.

Complete the following sentences by underlining the correct word(s) in the brackets.

(i) The hip is an example of a (**hinge / fixed / ball and socket**) joint. [1]

(ii) Older people sometimes need a hip replacement due to (**osteoarthritis / diabetes / heart disease**). [1]

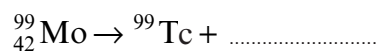
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5. Technetium-99m is a common radioactive tracer used in gamma camera imaging. It cannot be stored for very long because it has a short half-life of 6 hours. It is extracted from molybdenum-99 when required. Molybdenum-99 is a beta ( $\beta$ ) emitter with a much longer half-life that allows it to be stored for up to seven days.

- (a) Complete the decay equation for molybdenum-99. [2]



- (b) A sample of technetium-99m injected into a patient consists of 10 000 nuclei. The table below shows the number of nuclei remaining after each half-life.

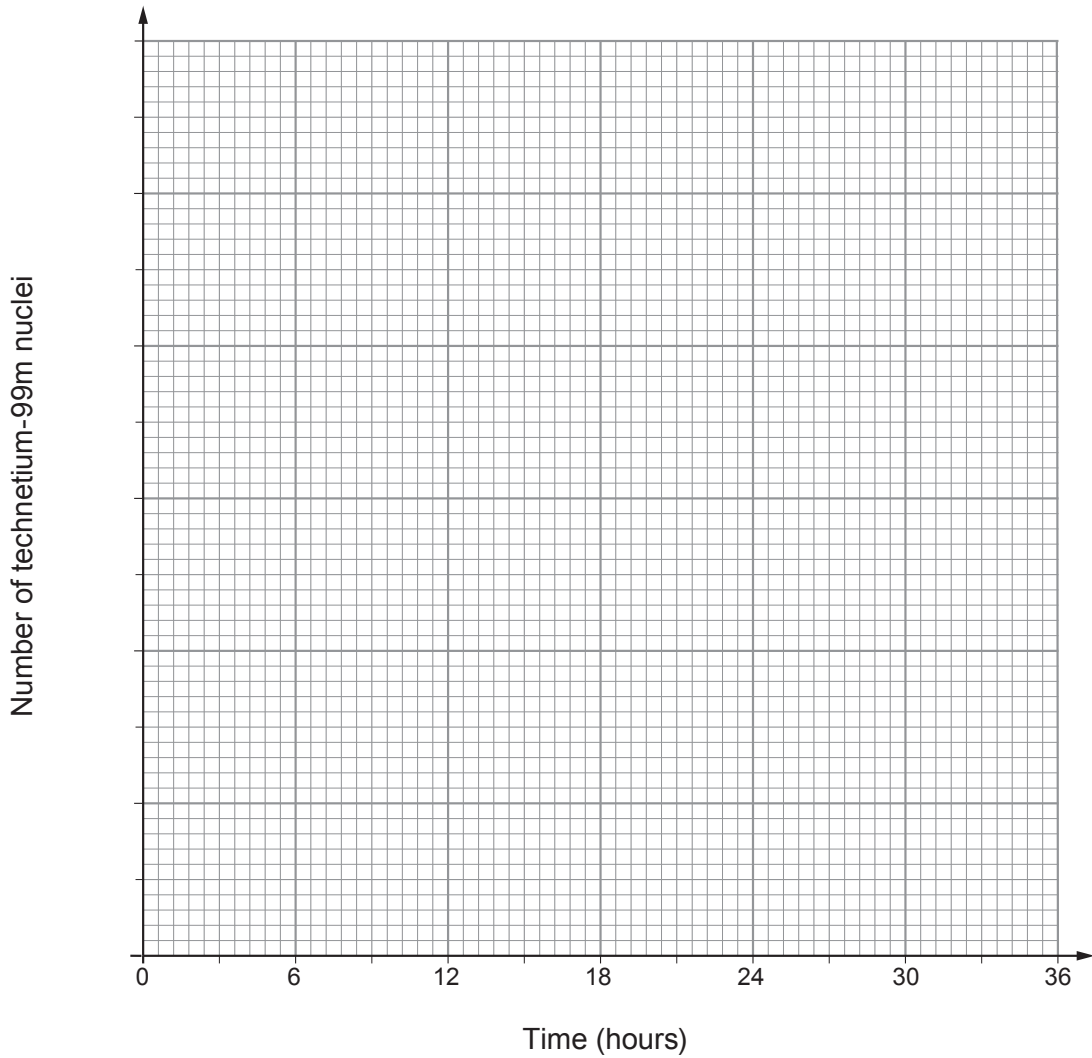
Time (hours)	Number of technetium-99m nuclei
0	10 000
6	5 000
12	2 500
18	.....
24	625
30	313
36	157

- (i) Complete the table. [1]





- (ii) Plot a graph on the grid below to show how the number of technetium-99m nuclei changes over a 36 hour period. Draw a suitable line. [4]



- (iii) Molybdenum-99 has a much longer half-life than technetium-99m.

**Sketch another line** on the grid to show the likely decay of molybdenum-99 if there were 10 000 nuclei at 0 hours. [2]

- (c) State **two** precautions that should be taken when using technetium-99m in gamma camera imaging. [2]

- 1. ....
- 2. ....



6. Wales has a long history of mining metal ores. Leakage from disused mines is a significant source of water pollution today.

Frongoch mine in Ceredigion produced lead and zinc ore during the 18<sup>th</sup> and 19<sup>th</sup> centuries. The Frongoch stream flows through the mine and into the River Ystwyth.

- (a) Long-term exposure to heavy metals such as zinc and lead can damage human health.

State **two** symptoms caused by this exposure. [2]

1. ....

2. ....

- (b) In 2011, Natural Resources Wales diverted Frongoch stream so it no longer flowed through the mine.

They collected the following data on the time taken for water to flow to the River Ystwyth.

	Distance stream flows (m)	Time taken for water to reach the River Ystwyth (s)	Volume of water entering the River Ystwyth per second (dm <sup>3</sup> /s)
Before Diversion	500	800	17
After Diversion	2000	4000	87

A local newspaper article stated that, following the diversion, the speed of the water flowing had increased.

- (i) Use the equation

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

to explain whether the newspaper was correct. [4]

.....  
.....



(ii) The newspaper also claimed that as the speed of the water increased the volume of water per second entering the River Ystwyth also increased. Explain whether you agree. [1]

.....

.....

.....

7



7. The symptoms of lung disease are shortness of breath, wheezing and constant coughing.

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

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

- (a) A large sample of people is used in this type of study.

**Tick (✓) the three correct statements below.**

[3]

A large number of people are studied to decrease the correlation of the results.

A large number of people are studied to improve the confidence in the results.

A result that does not fit the pattern is called an outlier.

The conclusion must be incorrect if there is one outlier.

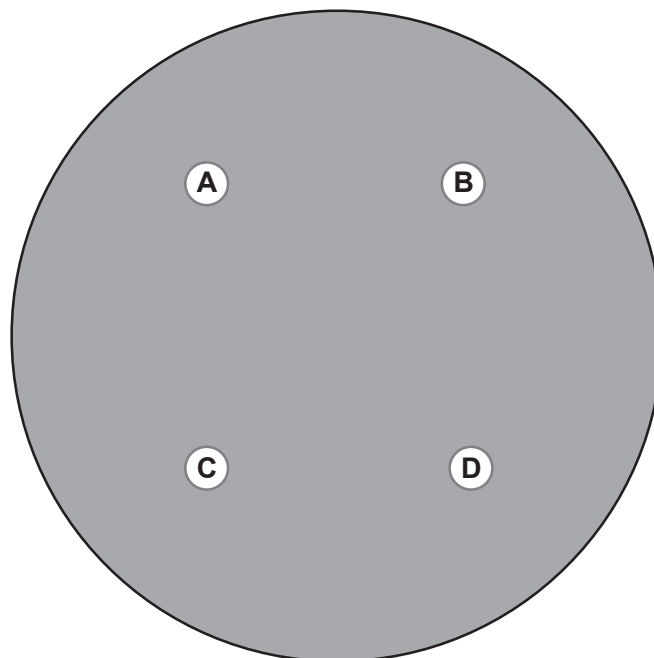
Correlation is a measure of how one variable relates to another.

A smaller number of people studied provide better evidence.





8. 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]

.....

.....

.....



(b) The students obtained the following results.

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

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

.....

.....

(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 = ..... cm<sup>2</sup>

(iii) It has been estimated that each 1 cm<sup>2</sup> 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]

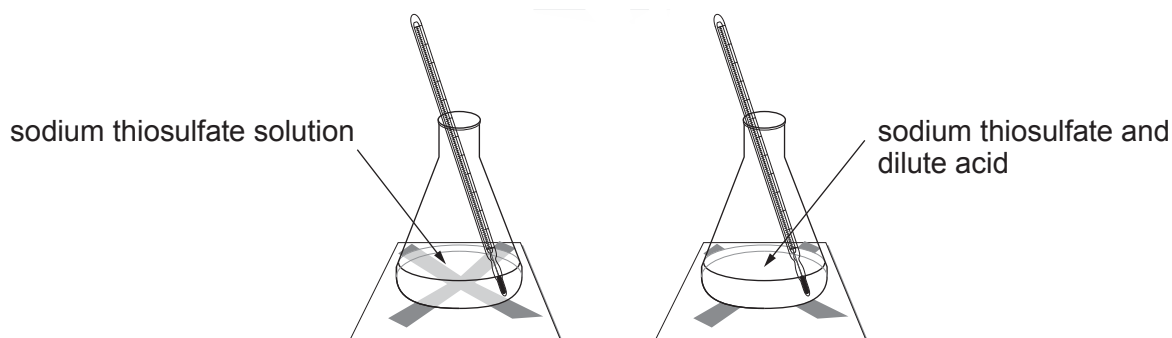
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9. A student carried out an experiment to investigate how concentration affects the rate of a chemical reaction. When hydrochloric acid (HCl) reacts with sodium thiosulfate solution a precipitate of sulfur is formed that makes the solution go cloudy. 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 <sup>3</sup> )	Volume of water (cm <sup>3</sup> )	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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