

Surname	Centre Number	Candidate Number
First name(s)		0



GCSE

3440U20-1



S23-3440U20-1

TUESDAY, 16 MAY 2023 – MORNING

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

FOUNDATION TIER

1 hour 30 minutes

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.

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. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

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

Question **7** 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.

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	6	
2.	7	
3.	10	
4.	6	
5.	7	
6.	14	
7.	6	
8.	9	
9.	10	
Total	75	

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Answer **all** questions.

1. Down's syndrome is a genetic condition caused by an irregularity in the chromosomes found in human cells.

- (a) In humans, most cells contain 23 pairs of chromosomes.

Tick (✓) the correct statement for individuals with Down's syndrome.

[1]

There are fewer chromosomes in individuals with Down's syndrome.

☐

The chromosomes are longer in individuals with Down's syndrome.

☐

There are more chromosomes in individuals with Down's syndrome.

☐

- (b) Complete the following sentences using the words below.

DNA nucleus alleles heterozygous glucose

- (i) Chromosomes are found in the of a cell.

[1]

- (ii) Chromosomes contain genes that are made of a molecule called
..... .

[1]

- (iii) Different forms of genes are called

[1]

- (c) The genetic make-up of a cell can be changed by mutations.

Complete the sentences below by underlining the correct term in brackets.

- (i) Mutations can be caused by (**radiowaves** / **ionising radiation** / **visible light**).

[1]

- (ii) Mutations can cause (**cancer** / **measles** / **bronchitis**).

[1]



2. Athletes can suffer injuries to bones, muscles and joints.

Ultrasound and MRI scans can be used to investigate damage to knee joints.

- (a) (i) State **one other** method that can be used to image the knee joint. [1]

.....

- (ii) Choose the correct statement (**A**, **B** or **C**) which describes how an ultrasound scan produces an image of the knee. [1]

A. Ultrasound waves pass through the knee undeflected

B. Ultrasound waves are only reflected by bones

C. Ultrasound waves are reflected at the boundaries of different tissues

answer =

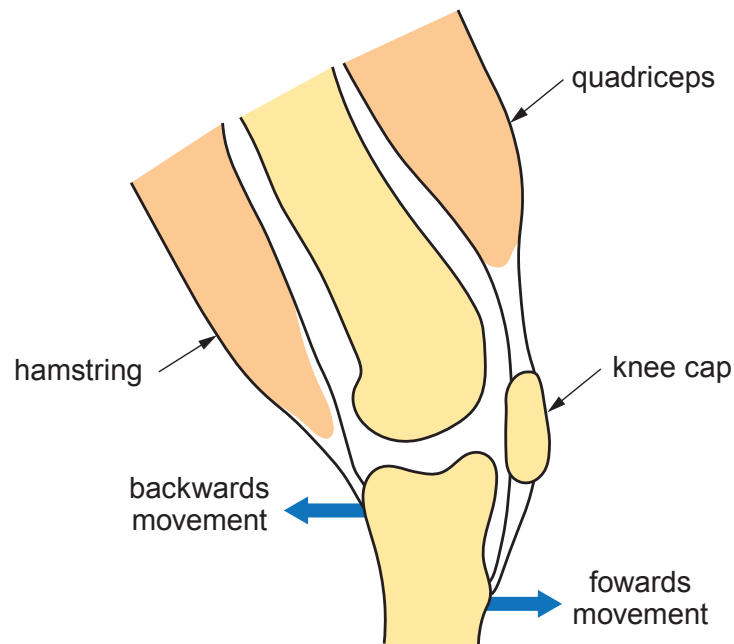
- (iii) State **one** advantage of using MRI over ultrasound for investigating the knee joint. [1]

.....

.....



- (b) The diagram shows a knee joint.



- (i) State the name of this **type** of joint.

[1]

.....

- (ii) Two muscles are needed to bend the knee joint. Complete the table by ticking (✓) the boxes next to the **three** correct statements about how these muscles act to move the leg.

[3]

Statement	Tick (✓)
The quadriceps contract to straighten the leg.	
The quadriceps and hamstring relax at the same time.	
The quadriceps and hamstring contract at the same time.	
The quadriceps and hamstring are an antagonistic pair of muscles.	
The hamstring relaxes when the leg straightens.	
Muscles push bones.	



3. Radioisotopes are used in medicine to diagnose and treat cancer.

- (a) Name another type of treatment for cancer that uses drugs to kill cancer cells. [1]

.....

- (b) The table below gives details of some radioisotopes used in medicine.

Radioisotope	Half-life	Radiation emitted
bismuth-213	46 minutes	alpha
cobalt-60	5 years	gamma
iodine-125	25 minutes	beta
thallium-201	73 hours	gamma
technetium-99m	6 hours	gamma

Use the information in the table to answer the questions below.

- (i) I. Give **one** reason why cobalt-60 is too dangerous to use as a tracer inside the body. [1]

.....

- II. Give the name of **one** other radioisotope from the table that should not be used as a tracer. [1]

.....

- (ii) Technetium-99m is a radioisotope which is a gamma emitter and has a short half-life. Explain why it can be used inside the body as a tracer. [2]

.....

.....



- (iii) Iodine-125 can be used inside the body to treat cancer.

The patient is isolated from other people until its activity drops to a sixteenth ($\frac{1}{16}$) of its original value.

- I. Calculate how many half-lives are needed to drop from an activity of 1 to $\frac{1}{16}$. [2]

number of half-lives =

- II. Iodine-125 has a half-life of 25 minutes.
Calculate the time the patient needs to be isolated from other people. [2]

time = min

- (iv) Give **one** reason why cobalt-60 has not decayed to a safe level after 10 years. [1]

.....



4. In 2018, New York declared a state of emergency following a severe outbreak of measles.

- (a) In the ten-year period leading to the state of emergency, the number of measles cases increased from 50 to 640.

- (i) Calculate the increase in the number of cases. [1]

increase in cases =

- (ii) Use the equation:

$$\text{percentage increase} = \frac{\text{increase in cases}}{50} \times 100$$

to calculate the percentage increase in cases. [2]

percentage increase =

- (b) In the year 2000 there were no cases of measles in New York. Since then the measles vaccination rate has dropped and the number of measles cases has increased.

- (i) Suggest **one** reason why the number of cases of measles has increased. [1]

.....

- (ii) Suggest **one** reason why the rate of vaccination has dropped. [1]

.....

- (c) State why most people can catch flu many times but measles only once. [1]

.....



5. Sion is investigating his recovery time. He does this by monitoring his heart rate using the method below.

1. While at rest, count the number of heartbeats for 5 seconds.
2. Carry out exercise.
3. Count the number of heartbeats immediately after the exercise.
4. Count the number of heartbeats after 15 seconds of rest.
5. Calculate the heart rate in beats per minute for each result.

(a) Sion obtained the following results.

Activity	Number of beats in 5 seconds	Heart rate (beats per minute)
before exercise	6	72
immediately after exercise	9	108
after 15 seconds of rest	8	

(i) Complete the results table. [1]

(ii) Describe the changes in Sion's heart rate during this investigation. [2]

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(iii) Explain why the heart rate changes during exercise. [2]

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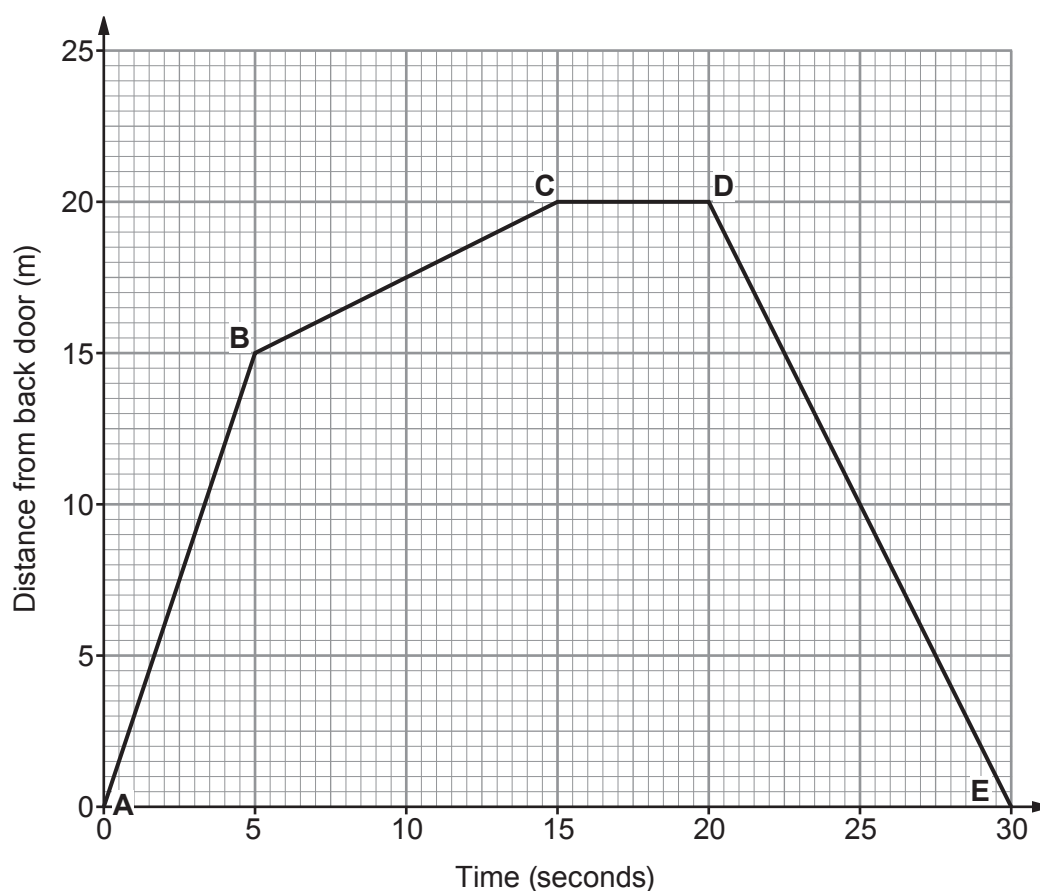
(b) State **one** improvement Sion needs to make to his method in **both** Step 1 **and** Step 4. [2]

Step 1:

Step 4:



6. Josie walked from her back door to the bottom of the garden and back. The graph of Josie's journey is shown below.



- (a) (i) State the length of time that Josie was stationary. [1]

time = s

- (ii) State the length of time that Josie took to return to her house from the bottom of the garden. [1]

time = s

- (iii) I. State the region of the graph (**AB**, **BC**, **CD** or **DE**) where Josie was moving fastest. [1]

.....

- II. Give a reason for your answer. [1]

.....



(iv) Use the equation

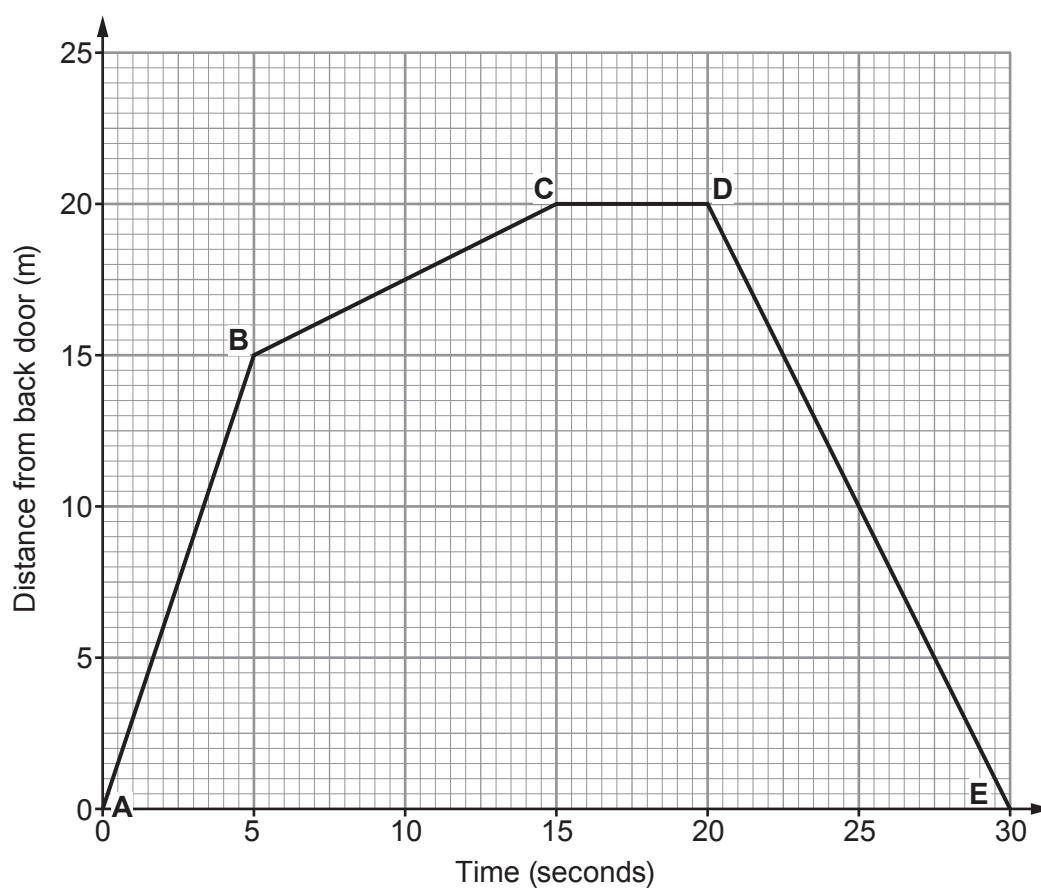
$$\text{mean speed} = \frac{\text{distance}}{\text{time}}$$

to calculate her mean speed while walking from **A** to **C** on the graph.

[4]

mean speed = m/s

(b) The graph of Josie's journey is shown again below.



Add a straight line to show what would happen if Josie returned to the house twice as fast.

[2]



- (c) Josie's twin brother Jacob, thinks that Josie will have a higher BMI than him because she is shorter.

Use the data in the table and the equation below to explain if he is correct.

[4]

	Jacob	Josie
height (m)	1.7	1.5
mass (kg)	74	50

$$\text{BMI} = \frac{\text{mass}}{\text{height}^2}$$

.....

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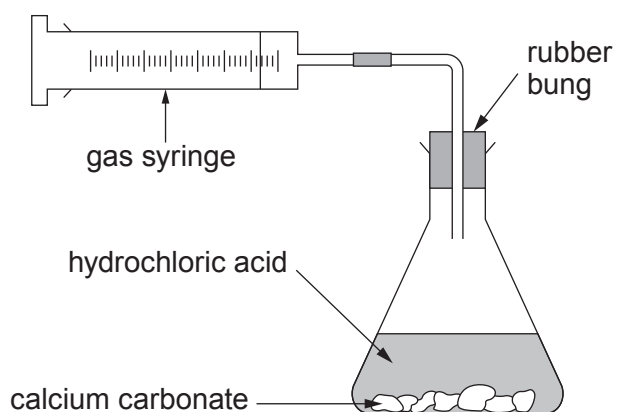
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[6 QER]

8. Malcolm carried out an investigation to find how the rate of reaction between hydrochloric acid and calcium carbonate depended on whether the calcium carbonate was in chip or powder form. The volume of gas produced was measured in a gas syringe.



He obtained the following results.

Time (s)	Volume of gas produced (cm ³)	
	chips	powder
0	0	0
60	14	28
120	27	38
180	34	40
240	38	40
300	40	40
360	40	40



(a) State **three** variables that should be controlled in this experiment. [3]

1.
2.
3.

(b) (i) State the volume of gas produced when the reaction had finished. [1]

volume = cm^3

(ii) Using data from the table, Malcolm calculated the mean rate of reaction when using chips to be $0.133 \text{ cm}^3/\text{s}$.

Calculate the mean rate of reaction when using powder. [2]

mean rate of reaction = cm^3/s

(c) State the conclusion that can be drawn from Malcolm's experiment **and** explain it using collision theory. [3]

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.....



9. Rhian goes shopping in a local supermarket and buys two ready meals with the following traffic-light labels. The percentages shown are of an adult's guideline daily amount (GDA).

Meal A

Each serving (100 g) contains

Energy 1046 kJ 250 kcal	Fat 3.0 g LOW	Saturates 1.2 g LOW	Sugars 34 g HIGH	Salt 0.9 g MED
12.5%	4.3%	6%	38%	15%

of an adult's Guideline Daily Amount (GDA)

Meal B

Each serving (150 g) contains

Energy 1852 kJ 422 kcal	Fat 20.4 g MED	Saturates 9.6 g HIGH	Sugars 6.7 g LOW	Salt 1.39 g MED
21%	29%		7.4%	23%

of an adult's Guideline Daily Amount (GDA)

Use the information in the labels to answer the following questions.

- (a) (i) There are 9.6 g of saturates in meal **B**. The GDA for saturates is 20 g.
Calculate the amount of saturates in each serving of meal **B** as a percentage of the GDA. [2]

% of GDA

- (ii) Calculate the GDA for sugars for meal **A**. [2]

GDA for sugars =g



- (b) On Monday Rhian eats 3 servings of meal **A** and on Thursday she eats 2 servings of meal **B**. She is concerned about the effect of salt on blood pressure. She thinks that the effect on her blood pressure will be greater on Monday than on Thursday.

Use the information to explain whether you agree.

[3]

.....

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.....

.....

.....

- (c) Rhian wants to ensure that she uses the energy from the ready meals.

The table shows the energy used for different exercises.

Type of exercise	Energy used (kcal/min)
jogging	8.5
cycling	5.5
swimming	5.3

In order to work off all the calories in the food she has eaten, Rhian would rather cycle than do any other exercise.

Calculate how much longer she would need to cycle rather than jog if she eats **one** serving of meal **A**.

[3]

.....

END OF PAPER

10



[illegible]

[illegible]



THE PERIODIC TABLE

Group

1 2

3

4

5

6

7

0

1 H Hydrogen 1														4 He Helium 2																															
7 Li Lithium 3																			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														27 Al Aluminium 13					28 Si Silicon 14		31 P Phosphorus 15		32 S Sulfur 16		35.5 Cl Chlorine 17		40 Ar Argon 18																		
39 K Potassium 19														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 Co Cobalt 27		59 Ni Nickel 28		63.5 Cu Copper 29		65 Zn Zinc 30		70 Ga Gallium 31		73 Ge Germanium 32		75 As Arsenic 33		79 Se Selenium 34		80 Br Bromine 35		84 Kr Krypton 36	
86 Rb Rubidium 37														89 Y Yttrium 39		91 Zr Zirconium 40		93 Nb Niobium 41		96 Mo Molybdenum 42		99 Tc Technetium 43		101 Ru Ruthenium 44		103 Rh Rhodium 45		106 Pd Palladium 46		108 Ag Silver 47		112 Cd Cadmium 48		115 In Indium 49		119 Sn Tin 50		122 Sb Antimony 51		128 Te Tellurium 52		127 I Iodine 53		131 Xe Xenon 54	
133 Cs Caesium 55														139 La Lanthanum 57		179 Hf Hafnium 72		181 Ta Tantalum 73		184 W Tungsten 74		186 Re Rhenium 75		190 Os Osmium 76		192 Ir Iridium 77		195 Pt Platinum 78		197 Au Gold 79		201 Hg Mercury 80		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

