

Surname	Centre Number	Candidate Number
First name(s)		0



GCSE

3440UB0-1



S23-3440UB0-1

TUESDAY, 16 MAY 2023 – 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.	9	
2.	10	
3.	9	
4.	13	
5.	7	
6.	10	
7.	8	
8.	9	
Total	75	

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ADDITIONAL MATERIALS

In addition to this paper you may 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. 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 **3(a)** is a quality of extended response (QER) question where your writing skills will be assessed.

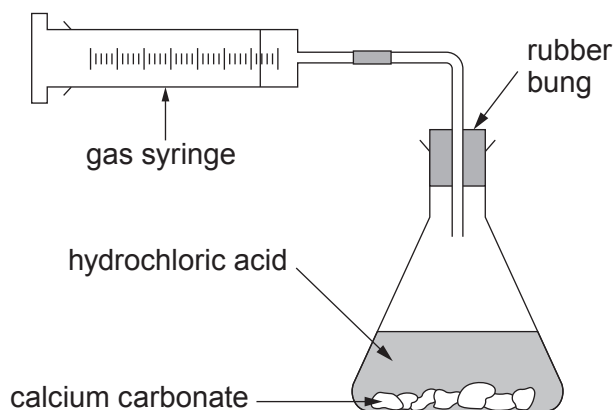
The Periodic Table is printed on page 20 of this examination paper.



JUN233440UB0101

Answer **all** questions.

1. 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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2. 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 her 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]

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3. Most human cells have a nucleus containing chromosomes and genes.

- (a) Explain why children from the same parents will inherit different characteristics. In your answer refer to chromosomes and genes. [6 QER]

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- (b) Down's syndrome is a genetic condition.

State the cause of Down's syndrome. [1]

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- (c) Explain the effect of ionising radiation on genes. [2]

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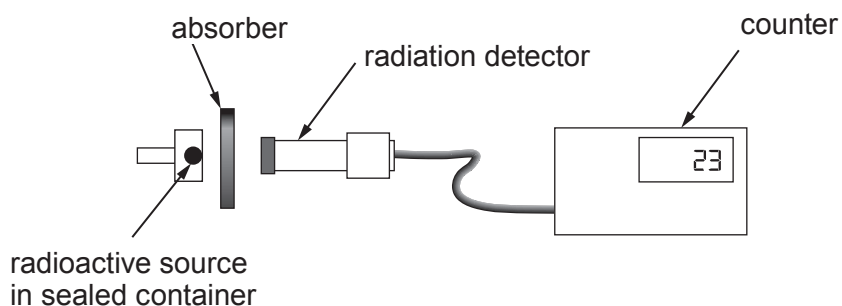
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4. Radioisotopes emit one or more types of alpha, beta and gamma radiation.

(a) In a practical investigation, the following apparatus was used.



The following data was obtained for one radioisotope, X, after taking background radiation into account.

Absorber	Count rate (counts per second)
no absorber	45
paper	23
aluminium	23

(i) Explain how the data shows that X emits alpha and gamma radiation. [2]

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(ii) State **one** precaution that should be taken when handling this isotope in the school laboratory. [1]

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- (b) Radioisotopes have many uses in medicine.

The table below gives details of some radioisotopes.

Radioisotope	Half life	Radiation emitted
A	46 mins	alpha
B	5.3 years	gamma
C	25 mins	beta
D	47 days	beta
E	2.9 years	alpha
F	125 years	alpha
G	28.8 years	beta
H	6 hours	gamma
I	73 hours	gamma

Select the most suitable radioisotope for the following applications and explain your answer in each case.

- (i) External radiotherapy to treat cancer just below the skin. [3]

Radioisotope:

Explanation:

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- (ii) Directly injecting the radioisotope into a very small tumour. [3]

Radioisotope:

Explanation:

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- (c) Radioisotope **B** is used to sterilise medical instruments. It has an original activity of 80 units and is changed when the activity drops to 5 units. Calculate how long this will take. [2]

time = years

- (d) Explain how chemotherapy is used in treating cancer. [2]

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5. Athletes often suffer injuries to bones, muscles and joints.
X-rays, ultrasound and MRI scans are methods of assessing injuries.

(a) Explain why MRI scans are preferred over X-rays to examine soft tissue injuries. [3]

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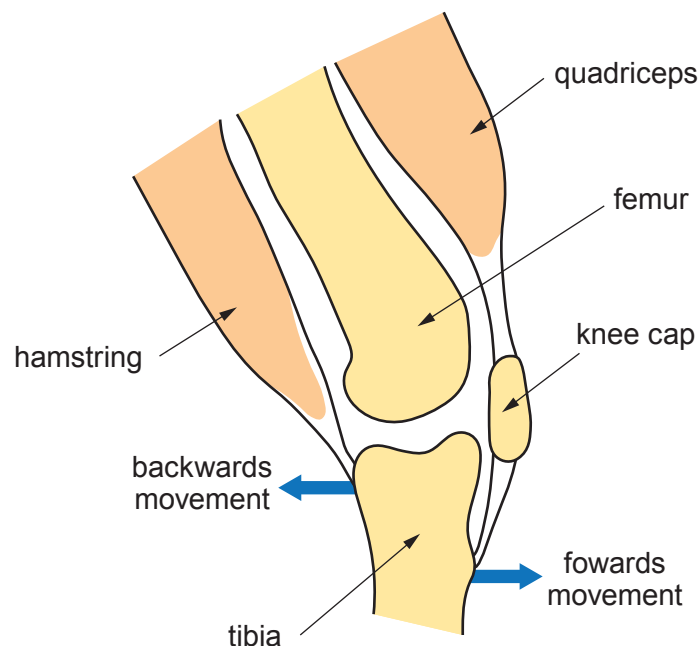
(b) (i) Describe how ultrasound can be used to produce an image of the knee. [2]

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(ii) A pair of antagonistic muscles called the hamstring and quadriceps are needed to move the tibia. These are shown in the diagram below.



Explain how these muscles move the tibia.

[2]

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6. In 2018, New York State declared a state of emergency following a severe outbreak of measles. The table below shows the number of confirmed cases of measles in New York State in selected years between 2000 and 2018.

Year	Confirmed measles cases in New York State
2000	0
2004	42
2008	120
2010	83
2012	79
2014	644
2018	1025

- (a) The population of New York State was 19.4 million in 2018. Health organisations usually quote the number of cases of disease per 100 000 of the population.

- (i) Give a reason why health organisations quote the number of cases per 100 000 of the population. [1]

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- (ii) Calculate the number of cases per 100 000 for New York State in 2018. [2]

number of cases per 100 000 =



(b) Explain the rise in measles cases.

[3]

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(c) People can only contract measles once. Describe how the body's immune system protects against diseases like measles.

[4]

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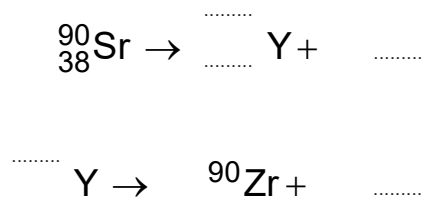
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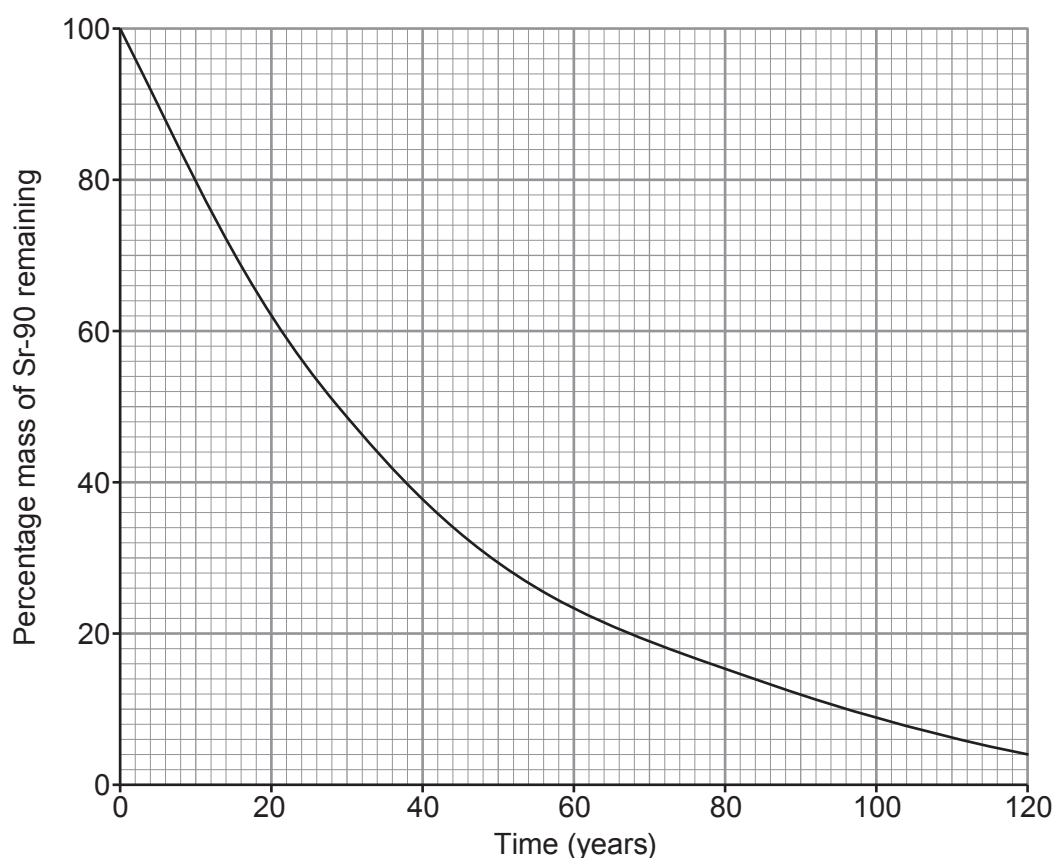
7. Uranium-235 (U-235) is used in most fission reactors. U-235 undergoes fission to produce strontium-90 (Sr-90) which is a beta emitter. Sr-90 decays to yttrium (Y), which then decays to the stable isotope zirconium-90 (Zr-90).

(a) Complete the decay equations shown below.

[4]



(b) The decay graph for Sr-90 is shown below.



- (i) By drawing on the graph, determine the half-life for strontium-90.

half-life = years.

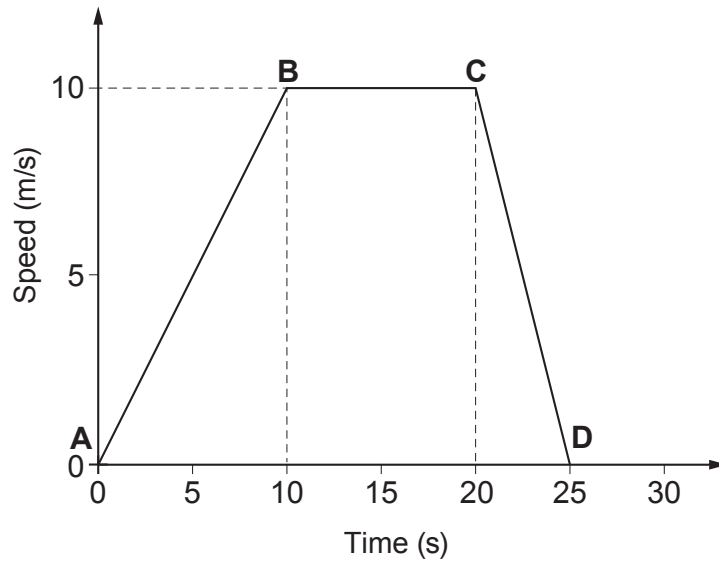
[2]

- (ii) Add a line to the graph to show how the percentage mass of the **decay products** of strontium-90 changes over 120 years.

[2]



8. Josie cycled from her back door to her garage. The graph of her journey is shown below.



- (a) Use data from the graph to describe the motion of Josie between **A** and **D**.
Calculations of distance are not required.

[3]

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- (b) Use the equation:

$$\text{reduction in speed} = \text{deceleration} \times \text{time}$$

to calculate Josie's deceleration between **C** and **D**.

[3]

Give the correct unit.

deceleration = unit

- (c) Gareth says Josie travelled twice as far between region **B–C** as she did between region **C–D**.

Explain, using calculations, whether you agree with Gareth's statement.

[3]

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END OF PAPER



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