PEARSON EDEXCEL GCSE PHYSICS (HIGHER) · 1PH0

PHYSICS



EXAM QUESTION PACK

TOPIC 6: RADIOACTIVITY (PACK 3)

SCORE	PERCENTAGE
/51	%

STEMUP

These questions belong to Pearson Edexcel, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by Pearson Edexcel. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with Pearson Edexcel and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. Pearson Edexcel has not endorsed, approved or been involved in the production of it. Pearson Edexcel and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

Pearson Edexcel publishes its past papers, mark schemes and examiner reports. Always check the current specification at qualifications.pearson.com before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Q1.

What is the approximate size of a hydrogen atom?

(1)

☒ **A** 10^{-3} m

☒ **B** 10^{-10} m

☒ **C** 10^{-19} m

☒ **D** 10^{-31} m

(Total for question = 1 mark)

Q2.

What is the approximate size of a hydrogen atom?

(1)

☒ **A** 10^{-3} m

☒ **B** 10^{-10} m

☒ **C** 10^{-19} m

☒ **D** 10^{-31} m

(Total for question = 1 mark)

Q3.

Figure 7 shows the nuclei of four atoms.

$^{234}_{92}U$	$^{235}_{92}U$	$^{238}_{94}Pu$	$^{238}_{95}Am$
uranium-234	uranium-235	plutonium-238	americium-238

Figure 7

Which two nuclei have the same number of neutrons?

(1)

☒ **A** plutonium-238 and uranium-235

☒ **B** uranium-235 and americium-238

☒ **C** uranium-234 and americium-238

☒ **D** americium-238 and plutonium-238

(Total for question = 1 mark)

Q4.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

(i) In a controlled chain reaction of uranium-235, which of these could cause a

uranium-235 nucleus to undergo fission?

(1)

☒ **A** an alpha particle

☒ **B** a beta particle

☒ **C** a neutron

☒ **D** a proton

(ii) The kinetic energy of one of the particles released in a fission reaction is 1.2 × 10–11 J.

The mass of the particle is 1.4×10^{-25} kg.

Calculate the velocity of the particle.

(3)

velocity of the particle = ... m/s

(Total for question = 4 marks)

Q5.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Figure 7 represents a decay that can happen inside the nucleus of an atom.

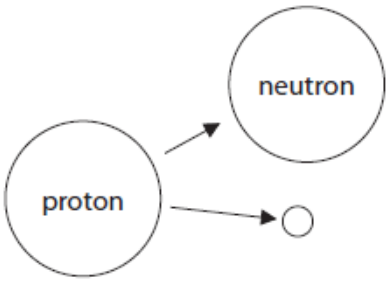


Figure 7

Which decay is represented in Figure 7?

(1)

☒ **A** alpha

☒ **B** beta minus

☒ **C** beta plus

☒ **D** gamma

(Total for question = 1 mark)

Q6.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Figure 9 represents a decay that can happen inside the nucleus of an atom.

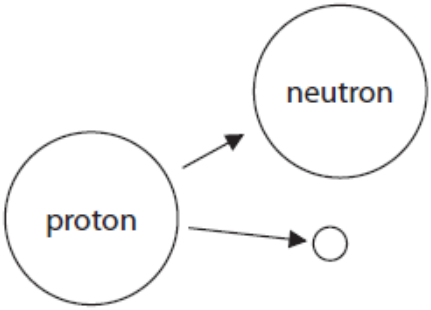


Figure 9

Which decay is represented in Figure 9?

(1)

☒ **A** alpha

☒ **B** beta minus

☒ **C** beta plus

☒ **D** gamma

(Total for question = 1 mark)

Q7.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Which of these describes isotopes of an element?

(1)

☒ **A**	same atomic number	different number of neutrons
☒ **B**	same atomic number	different number of protons
☒ **C**	same mass number	different number of neutrons
☒ **D**	same mass number	different number of protons

(Total for question = 1 mark)

Q8.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Which of these describes isotopes of an element?

(1)

☒ **A**	same atomic number	different number of neutrons
☒ **B**	same atomic number	different number of protons
☒ **C**	same mass number	different number of neutrons
☒ **D**	same mass number	different number of protons

(Total for question = 1 mark)

Q9.

Which of the following particles is absorbed and emitted during a nuclear fission reaction?

(1)

☒ **A** electron

☒ **B** neutron

☒ **C** positron

☒ **D** proton

(Total for question = 1 mark)

Q10.

The following descriptions describe waves from different parts of the electromagnetic spectrum.

Complete each description by adding the name of the wave.

Use the name of each wave only once. Each description refers to a different part of the electromagnetic spectrum.

(4)

Description 1

used in cooking

used in short-range communication

typical wavelength 900 nm

name of wave .....

Description 2

used in cooking

used in communication

typical wavelength 150 mm

name of wave .....

Description 3

used in communication

produced by oscillations in electrical circuits

typical wavelength 150 m

name of wave .....

Description 4

used in medical scanning

is emitted by the nucleus of an atom

typical wavelength 2.0×10^{-3} nm

name of wave .....

(Total for question = 4 marks)

Q11.

The following descriptions describe waves from different parts of the electromagnetic spectrum.

Complete each description by adding the name of the wave.

Use the name of each wave only once. Each description refers to a different part of the electromagnetic spectrum.

(4)

Description 1

used in cooking

used in short-range communication

typical wavelength 900 nm

name of wave .....

Description 2

used in cooking

used in communication

typical wavelength 150 mm

name of wave .....

Description 3

used in communication

produced by oscillations in electrical circuits

typical wavelength 150 m

name of wave .....

Description 4

used in medical scanning

is emitted by the nucleus of an atom

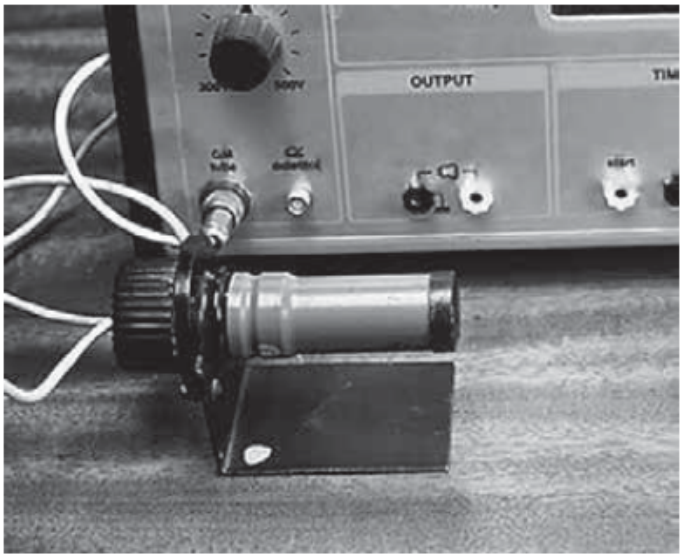
typical wavelength 2.0×10^{-3} nm

name of wave .....

(Total for question = 4 marks)

Q12.

Figure 4 shows a Geiger-Müller (GM) tube used for measuring radioactivity.



© Andrew Lambert Science Photo Library

Figure 4

Describe how a teacher should use a Geiger-Müller (GM) tube to compare the count-rates from two different radioactive rocks.

(4)

.....

.....

.....

.....

.....

.....

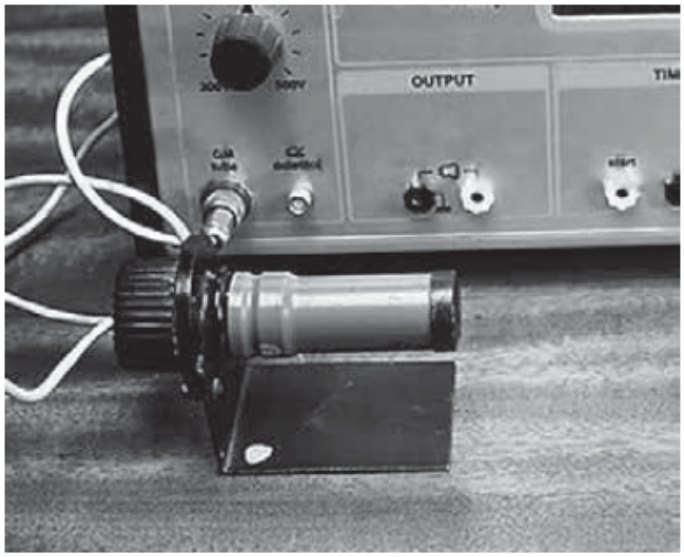
.....

.....

(Total for question = 4 marks)

Q13.

Figure 4 shows a Geiger-Müller (GM) tube used for measuring radioactivity.



© Andrew Lambert Science Photo Library

Figure 4

Describe how a teacher should use a Geiger-Müller (GM) tube to compare the count-rates from two different radioactive rocks.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 4 marks)

Q14.

(i) State the name of an instrument that can be used to measure radioactivity.

(1)

.....

(ii) State **two** sources of background radiation.

(2)

1 .....

2 .....

(Total for question = 3 marks)

Q15.

(i) State the name of an instrument that can be used to measure radioactivity.

(1)

.....

(ii) State **two** sources of background radiation.

(2)

1 .....

2 .....

(Total for question = 3 marks)

Q16.

Fusion and fission are nuclear reactions in which large amounts of energy are released.

* Nuclear fission is used in nuclear reactors in some power stations.

In the reactor, a fission chain reaction is maintained and controlled to produce a supply of energy to generate electricity.

Figure 14 is a diagram of a nuclear reactor.

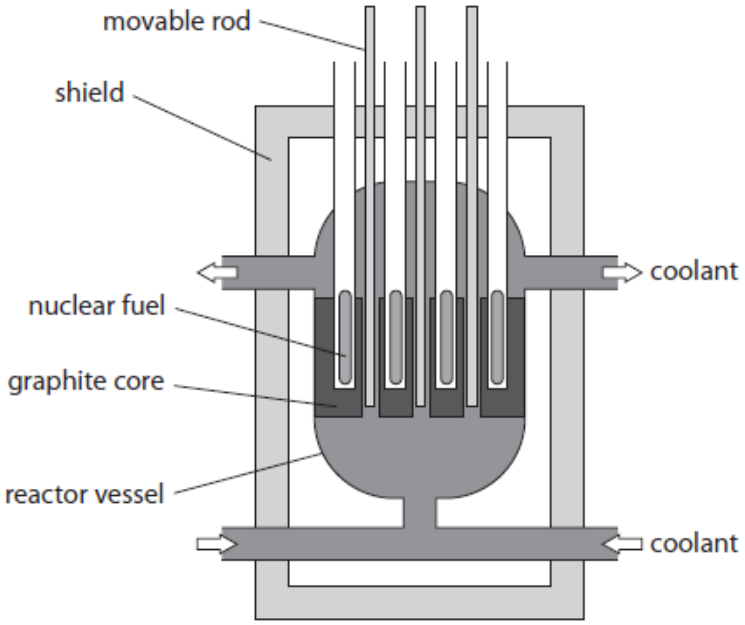


Figure 14

Explain how the graphite core and the movable rods are used to maintain and control the chain reaction.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 6 marks)

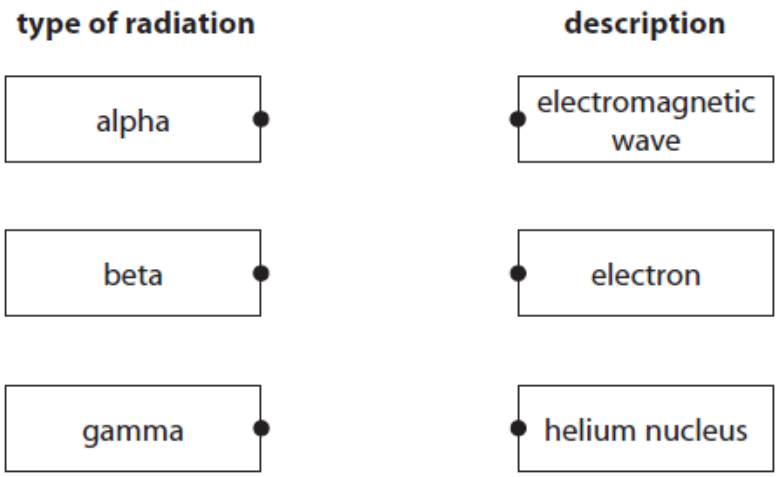
Q17.

Many countries generate electricity using nuclear fission.

(a) The decay products from nuclear fission emit different types of ionising radiation.

Draw **one** line from each type of radiation to its correct description.

(2)



(b) There are both fuel rods and control rods inside each fission reactor.

Explain how pushing control rods between the fuel rods changes the rate of nuclear fission in the reactor.

(2)

.....

.....

.....

.....

Q18.

Engineers are trying to generate electricity using the energy from nuclear fusion reactions.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

High temperatures and pressures are needed in a nuclear fusion reactor. This is to overcome

(1)

☒ **A** the kinetic energy of nuclei

☒ **B** the electrostatic repulsion of protons

☒ **C** the magnetic repulsion of neutrons

☒ **D** nuclear fission

(ii) Describe what happens to nuclei in a nuclear fusion reaction.

(2)

.....

.....

.....

.....

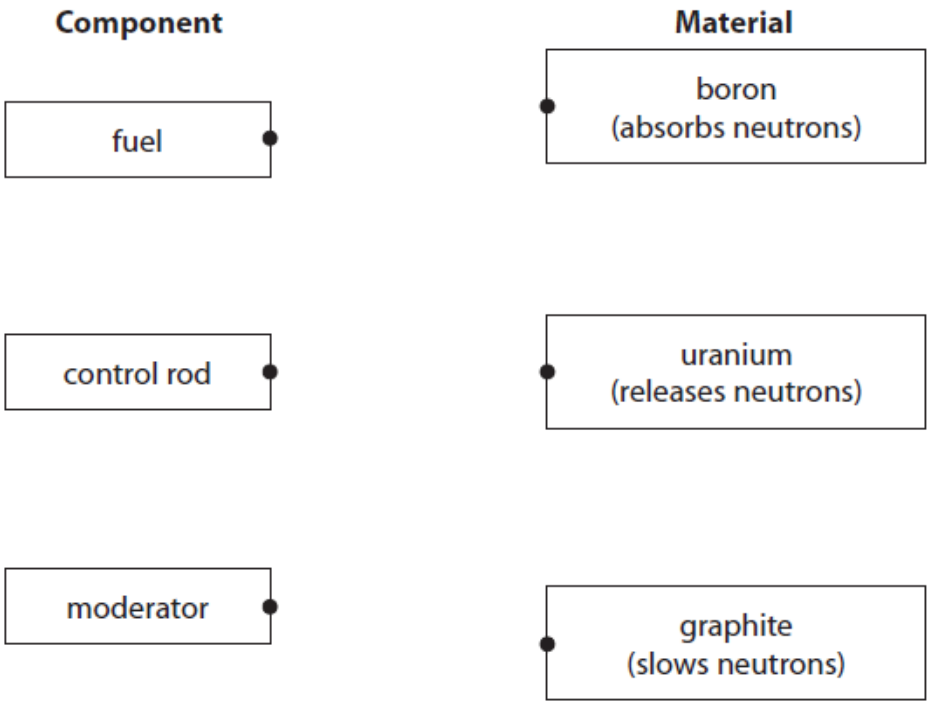
Q19.

(a) Fast neutrons are released during nuclear fission.

(i) Three different components of a nuclear fission reactor are shown. Three different materials used in a nuclear fission reactor are also shown.

Draw one line from each component to the material it contains.

(2)



(ii) Another type of nuclear reactor is a fusion reactor.
Nuclear fusion also releases fast neutrons.

Suggest why a nuclear fusion reactor does not need anything to slow these neutrons down.

(1)

.....

.....

(b) Both nuclear fission and nuclear fusion release thermal energy.

Describe how the thermal energy released could be converted into electrical energy in a power station.

(3)

.....

.....

.....

.....

.....

.....

*(c) Scientists and engineers are still trying to build a practical and economic nuclear fusion reactor.

They have not been able to sustain the extreme conditions needed for controlled nuclear fusion.

Explain what these conditions are and why they are needed.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

(Total for Question = 12 marks)

Q20.

Plutonium-238 is used in spacecraft to provide heat to power generators.

One of these generators contains 925 g of plutonium-238 when it is manufactured.

One gram of plutonium-238 has a power density of 0.54 W/g.

Plutonium-238 has a half-life of 87.7 years.

Calculate the average energy released per second by the generator after 263 years.

(4)

average energy released per second = ... (J)

(Total for question = 4 marks)

Q21.

One isotope of the element potassium is potassium-40.

A nucleus of potassium-40 is represented by:

$^{40}_{19}K$

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

The number of neutrons in a nucleus of potassium-40 is

(1)

☒ **A** 19

☒ **B** 21

☒ **C** 40

☒ **D** 59

(ii) Which of these symbols is correct for the nucleus of a different isotope of potassium?

Put a cross (☒) in the box next to your answer.

(1)

$^{39}_{19}K$ ☒ **A**

$^{40}_{20}K$ ☒ **B**

$^{19}_{40}K$ ☒ **C**

$^{39}_{20}K$ ☒ **D**

(iii) A sample of potassium-40 is left for a long time.

Some of the potassium-40 nuclei will emit gamma radiation as they turn into argon-40 nuclei.

Argon-40 nuclei never change.

Describe what information this gives about the isotope potassium-40.

(2)

.....

.....

.....

.....

Q22.

One isotope of the element potassium is potassium-40.

A nucleus of potassium-40 is represented by:

$$^{40}_{19}K$$

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

The number of neutrons in a nucleus of potassium-40 is

(1)

☒ **A** 19

☒ **B** 21

☒ **C** 40

☒ **D** 59

(ii) Which of these symbols is correct for the nucleus of a different isotope of potassium?

Put a cross (☒) in the box next to your answer.

(1)

$^{39}_{19}K$ ☒ **A**

$^{40}_{20}K$ ☒ **B**

$^{19}_{40}K$ ☒ **C**

$^{39}_{20}K$ ☒ **D**

(iii) A sample of potassium-40 is left for a long time.

Some of the potassium-40 nuclei will emit gamma radiation as they turn into argon-40 nuclei.

Argon-40 nuclei never change.

Describe what information this gives about the isotope potassium-40.

(2)

.....

.....

.....

.....

Q23.

The table gives the average dose of radiation a person received from various sources.

radiation source	average radiation dose (arbitrary units)
average yearly background	3000
one chest X-ray	20
one CT scan of the chest	6000
one whole body CT scan	20000
one PET scan	6000

(i) Explain why a CT scan of the chest gives a much higher dose of radiation than a chest X-ray.

(2)

.....

.....

.....

.....

(ii) Justify the use of medical procedures which give patients large doses of radiation.

(2)

.....

.....

.....

.....

Q24.

The table gives the average dose of radiation a person received from various sources.

radiation source	average radiation dose (arbitrary units)
average yearly background	3000
one chest X-ray	20
one CT scan of the chest	6000
one whole body CT scan	20000
one PET scan	6000

(i) Explain why a CT scan of the chest gives a much higher dose of radiation than a chest X-ray.

(2)

.....

.....

.....

.....

(ii) Justify the use of medical procedures which give patients large doses of radiation.

(2)

.....

.....

.....

.....

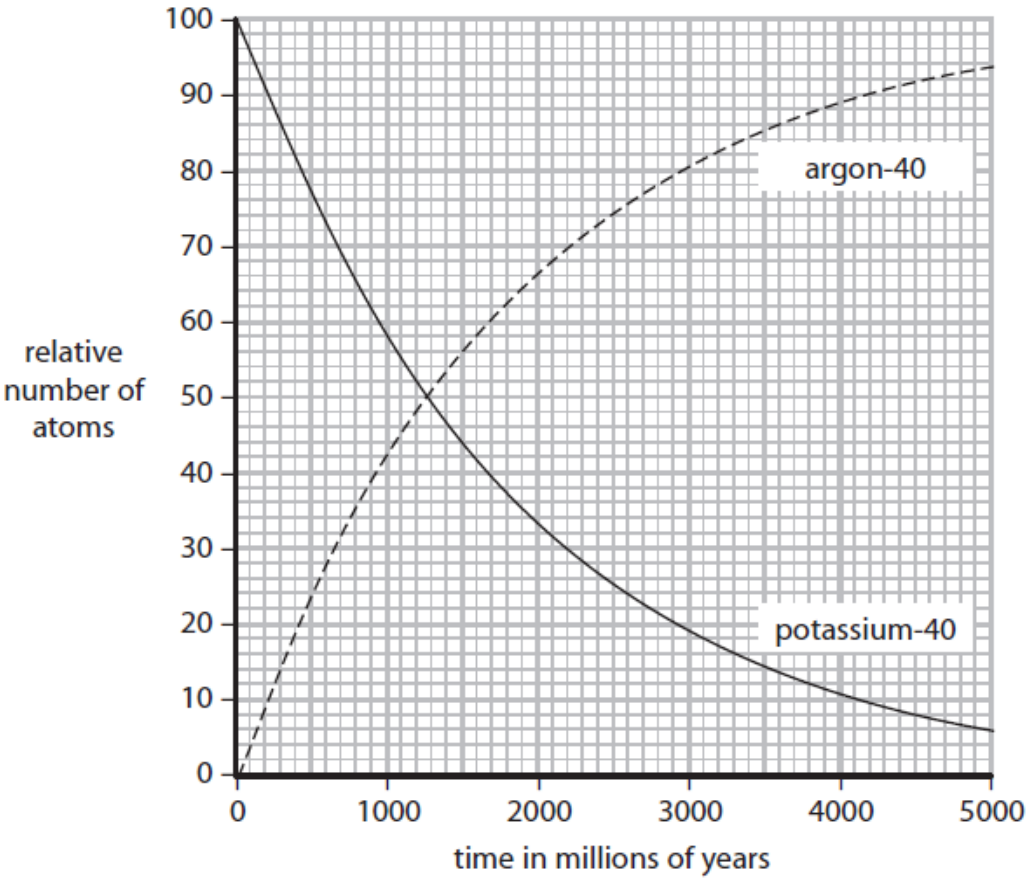
Q25.

Some rocks containing potassium were formed many millions of years ago.

There was no argon-40 in the rocks when they were formed.

When scientists analyse samples of these rocks, they find small amounts of argon-40 trapped inside.

The graph shows how the relative amounts of potassium-40 and argon-40 change over time.



(i) Use the graph to find the half-life of potassium-40.

(1)

half-life = ... million years

(ii) Scientists analyse a sample taken from inside a rock.

They find that there is exactly 3 times as much argon-40 as there is potassium-40.

Use the graph to find the age of the rock.

(2)

age of rock = ... million years

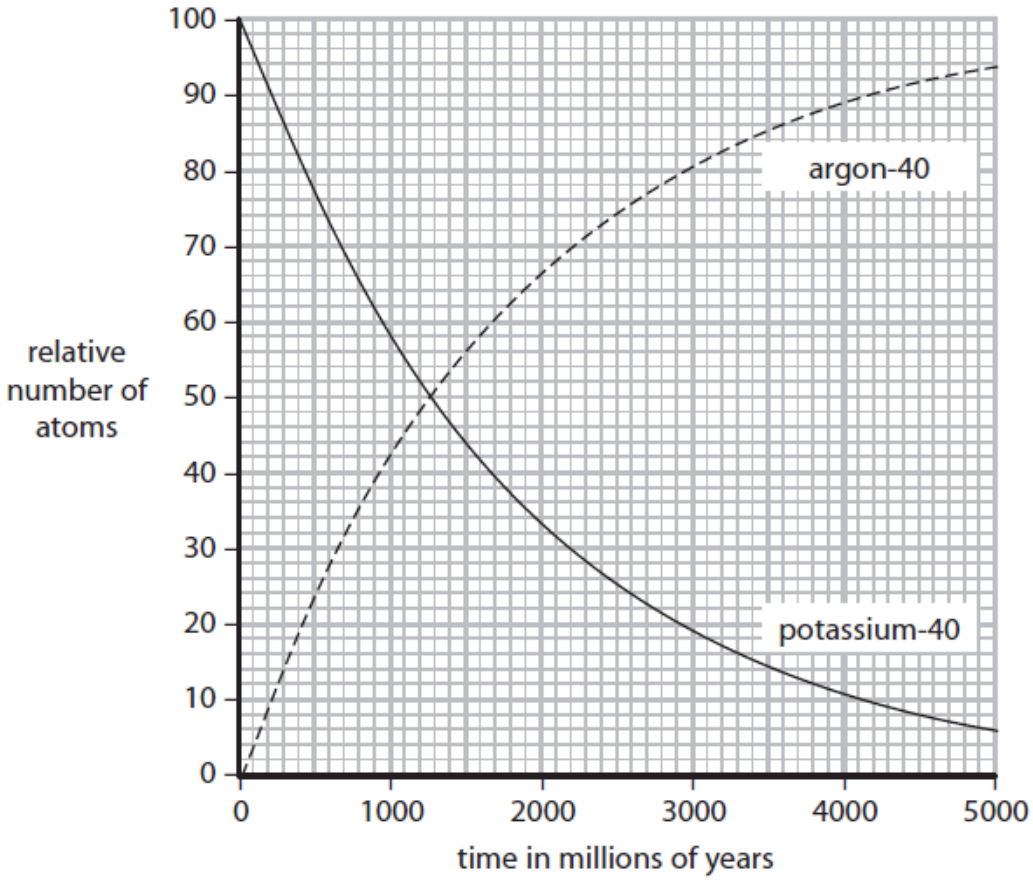
Q26.

Some rocks containing potassium were formed many millions of years ago.

There was no argon-40 in the rocks when they were formed.

When scientists analyse samples of these rocks, they find small amounts of argon-40 trapped inside.

The graph shows how the relative amounts of potassium-40 and argon-40 change over time.



(i) Use the graph to find the half-life of potassium-40.

(1)

half-life = ... million years

(ii) Scientists analyse a sample taken from inside a rock.

They find that there is exactly 3 times as much argon-40 as there is potassium-40.

Use the graph to find the age of the rock.

(2)

age of rock = ... million years

Q27.

Many different types of radioactive isotope are used for the diagnosis and treatment of medical conditions.

(i) Iodine-123 is used as a radioactive tracer to diagnose thyroid problems.

Complete the sentence by putting a cross (☒) in the box next to your answer.

This tracer must have a half-life of

(1)

☒ **A** a few days

☒ **B** a few hours

☒ **C** less than a second

☒ **D** several weeks

(ii) Pellets which contain radium-223 can be put inside the body to treat cancers.

Radium-223 has a half-life of 11.4 days and emits alpha radiation.

Explain why radium-223 is suitable for use inside the body to treat cancers.

(3)

.....

.....

.....

.....

.....

.....

Q28.

Many different types of radioactive isotope are used for the diagnosis and treatment of medical conditions.

(i) Iodine-123 is used as a radioactive tracer to diagnose thyroid problems.

Complete the sentence by putting a cross (☒) in the box next to your answer.

This tracer must have a half-life of

(1)

☒ **A** a few days

☒ **B** a few hours

☒ **C** less than a second

☒ **D** several weeks

(ii) Pellets which contain radium-223 can be put inside the body to treat cancers.

Radium-223 has a half-life of 11.4 days and emits alpha radiation.

Explain why radium-223 is suitable for use inside the body to treat cancers.

(3)

.....

.....

.....

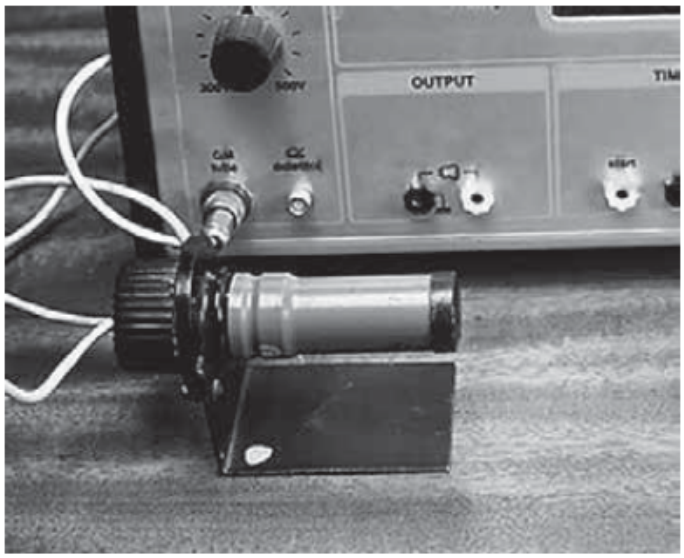
.....

.....

.....

Q29.

Figure 4 shows a Geiger-Müller (GM) tube used for measuring radioactivity.



© Andrew Lambert Science Photo Library

Figure 4

A hospital uses a radioactive isotope with a half-life of 6 hours.

A technician measures a count rate of 80 counts per minute (cpm) from this isotope.

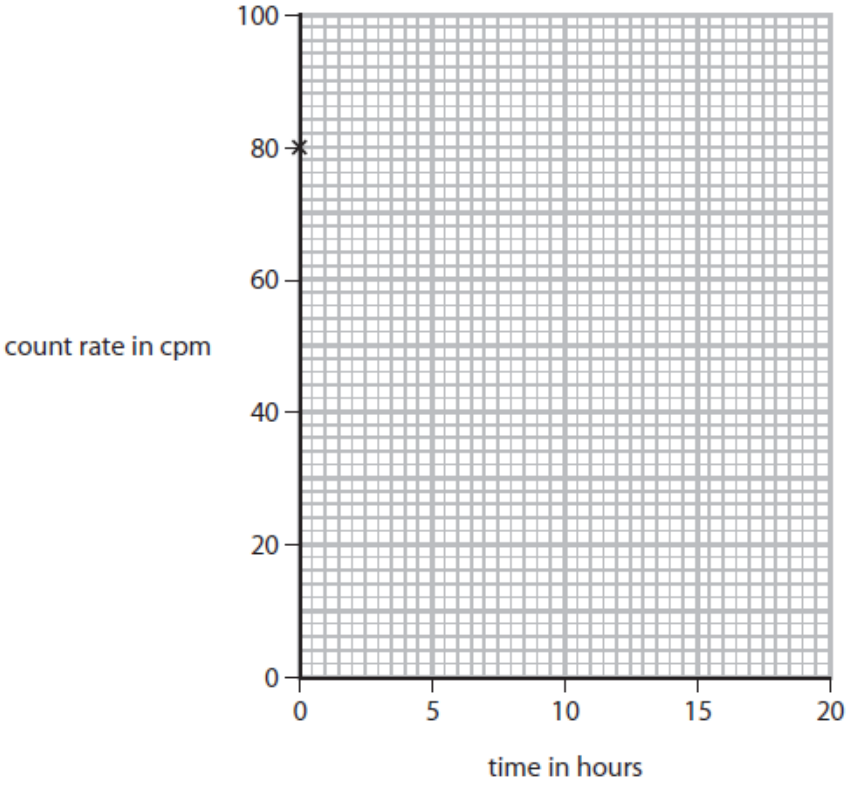


Figure 5

Complete the graph on Figure 5, as accurately as possible, to show how the count-rate from this isotope will change from the time of the first measurement.

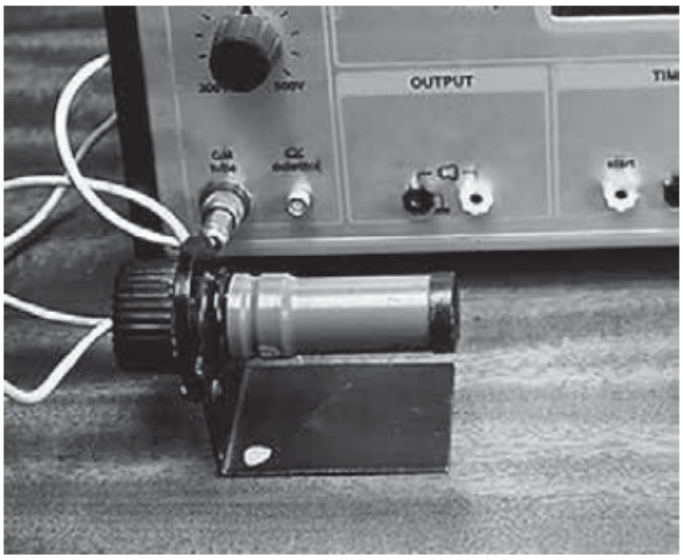
The first point is already drawn in Figure 5.

(3)

(Total for question = 3 marks)

Q30.

Figure 4 shows a Geiger-Müller (GM) tube used for measuring radioactivity.



© Andrew Lambert Science Photo Library

Figure 4

A hospital uses a radioactive isotope with a half-life of 6 hours.

A technician measures a count rate of 80 counts per minute (cpm) from this isotope.

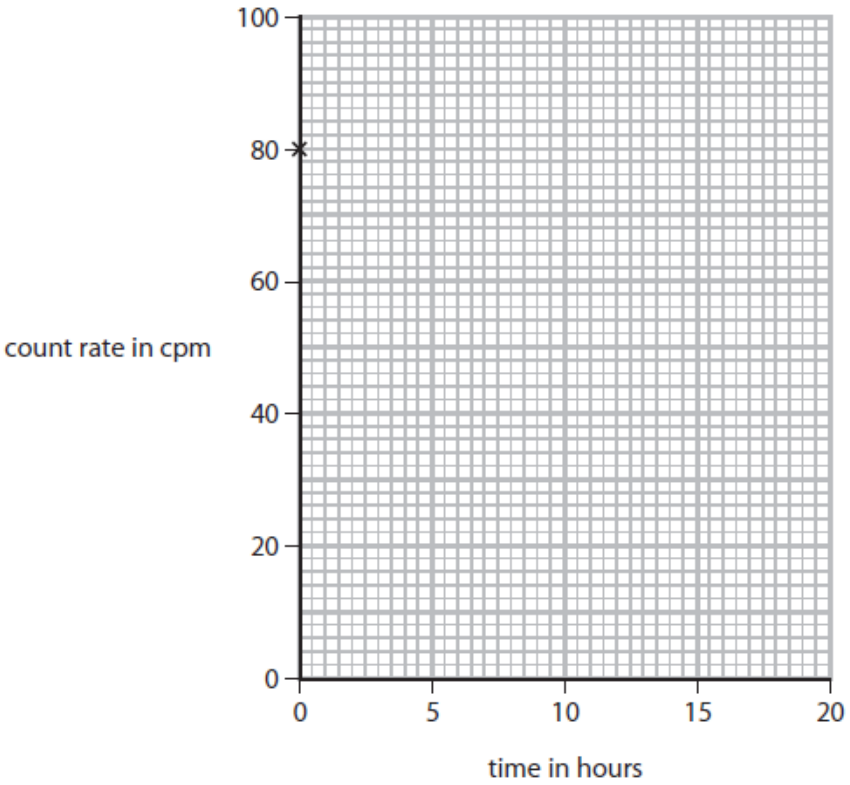


Figure 5

Complete the graph on Figure 5, as accurately as possible, to show how the count-rate from this isotope will change from the time of the first measurement.

The first point is already drawn in Figure 5.

(3)

(Total for question = 3 marks)

Q31.

Gamma radiation is part of the electromagnetic spectrum.

When the nucleus of an atom emits a gamma ray, the number of protons in the nucleus and the number of neutrons in the nucleus **do not** change.

State how the nucleus **does** change when it emits a gamma ray.

(1)

.....

.....

(Total for question = 1 mark)