Questions

Q1.

Describe how the emissions from radioactive substances can be dangerous to living things.

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Q2.

Medical staff who use radioactive materials need more protection than their patients.

Describe some precautions that medical staff can take to ensure their safety from radioactive materials.

(3)

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Q3.

(i) X-rays can be used in diagnosis and treatment from outside the body. Some x-rays are

absorbed by bone as they travel through the body.

Figure 4 shows how the intensity of the x-ray beam gets less as the x-rays travel further through the bone.

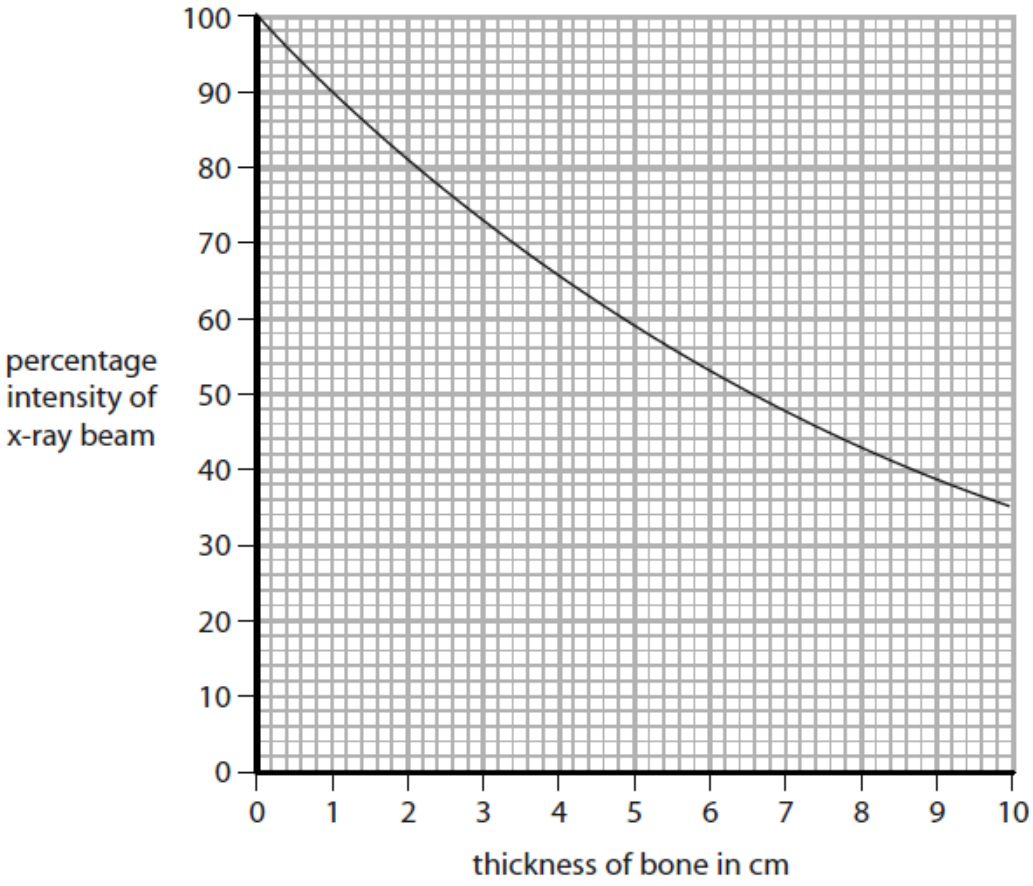


Figure 4

Use the graph to determine the thickness of bone that will reduce the percentage intensity of the x-ray beam by half.

(2)

thickness = ... cm

(ii) Radioactive isotopes may be placed inside the body for treatment.
The energy absorbed by tissue in the body needs to be known.

The number of joules of energy absorbed by each kilogram of tissue is measured in one of the units shown.

This unit is

(1)

☒ **A** kg/W

☒ **B** J/kg

☒ **C** kg/J

☒ **D** W/kg

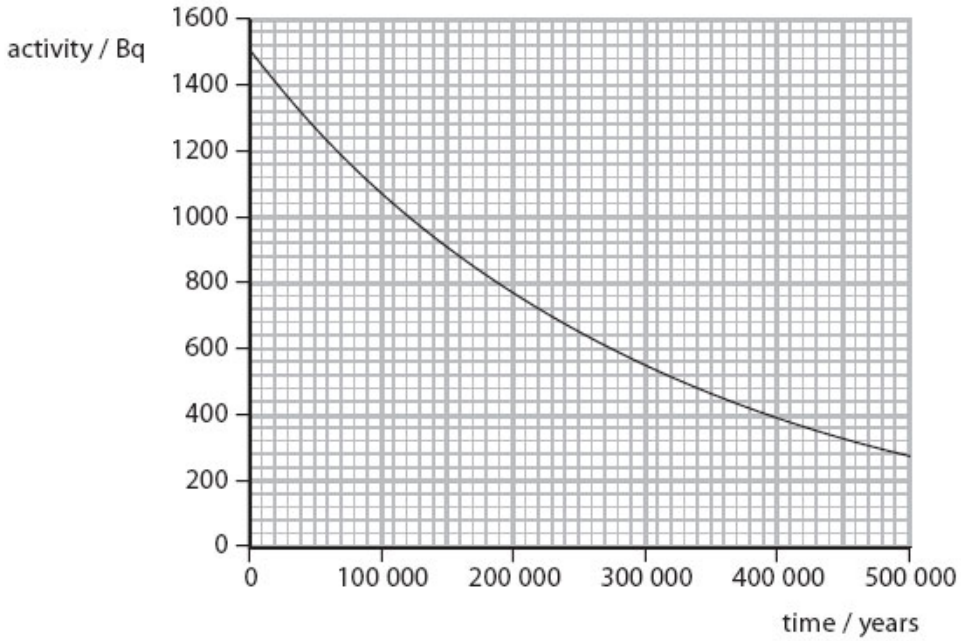
(Total for question = 3 marks)

Q4.

Everyone is exposed to background radiation. Some of this radiation comes from natural sources.

Technetium-99 is one of the radioactive isotopes in nuclear waste.

The graph shows the decay curve for technetium-99.



(i) Use the graph to show that the half-life of technetium-99 is about 200 000 years.

(2)

(ii) Technetium-99 emits beta particles.

Give **one** reason that beta particles can cause harm to people.

(1)

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Q5.

Lead-214 is a radioactive isotope.

(i) State **one** way in which radioactive isotopes can be harmful to people.

(1)

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(ii) Lead-214 emits β^- particles.

Describe what happens to the nucleus of a lead-214 atom when it emits a β^- particle.

(2)

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(Total for question = 3 marks)

Q6.

Radioactivity is used in PET scanners in hospitals.

(i) Describe **one** use of PET scanners in hospitals.

(2)

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(ii) State **two** precautions that hospital staff should take when working with radioactivity.

(2)

1 .....

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2 .....

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(Total for question = 4 marks)

Q7.

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)

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

(2)

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Q8.

* Describe how radioactive materials can be used in the diagnosis and treatment of some illnesses.

(6)

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Q9.

Every hospital radiographer who works with radiation wears a radiation badge.

The badge is used to monitor the amount of radiation the radiographer absorbs each month.

(i) Explain why it is important to monitor the amount of radiation a radiographer absorbs each month.

(2)

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(ii) Radiographers are restricted to a smaller annual dose of radiation nowadays compared to 50 years ago.

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

This is because nowadays,

(1)

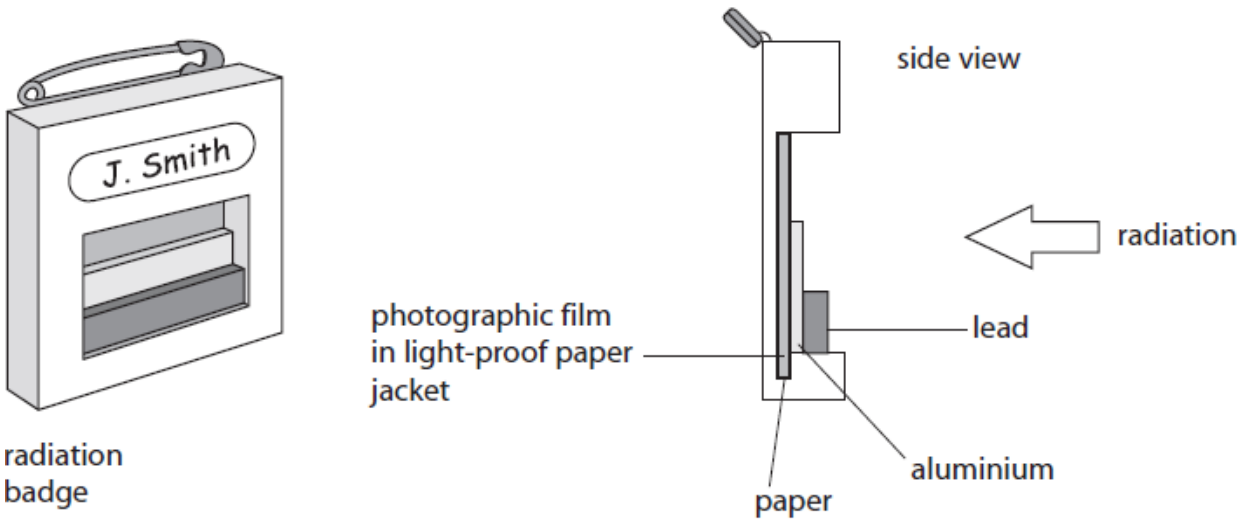
☒ **A** the radioactive sources have decayed

☒ **B** we can measure radiation more accurately

☒ **C** we have a better understanding of the risks from radiation

☒ **D** we have more effective ways of shielding against radiation

*(iii) The radiation badge contains a photographic film which is sensitive to radiation.



The radiation badge is sent to a laboratory after a month and the film is checked.

Explain how the badge shows the amount of different types of radiation that the radiographer has been exposed to.

(6)

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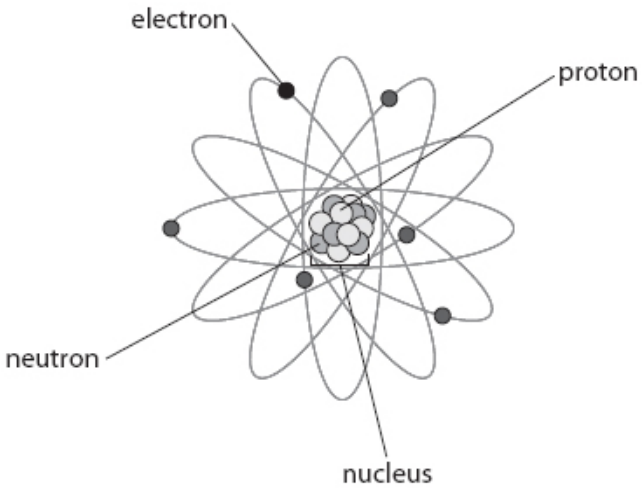
Q10.

The diagram shows the structure of an atom.



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

The size of the charge on each electron is

(1)

☒ **A** a third of the charge on the proton

☒

B half the charge on the proton

☒ **C** the same as the charge on the proton

☒ **D** twice the charge on the proton

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

The atomic number of a neutral atom is always the same as the number of

(1)

☒ **A** electrons

☒ **B** electrons and neutrons

☒ **C** protons and neutrons

☒ **D** neutrons

(b) The element radium has a radioactive isotope, radium-226.

This can be written as

82	84	86	90	222	224	228	230

This radioactive isotope emits alpha particles.

The alpha particle has a mass number of 4 and contains two protons.

Using the numbers in the box complete the following sentences.

82	84	86	90	222	224	228	230

(i) When an alpha particle is emitted by

82	84	86	90	222	224	228	230

the mass number becomes .....

(1)

(ii) When an alpha particle is emitted by

82	84	86	90	222	224	228	230

the atomic number becomes .....

(1)

(c) Describe how the emissions from radioactive substances can be dangerous to living things.

(2)

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(d) Explain **one** precaution that is taken in hospitals to limit the risks of exposure to radiation.

(2)

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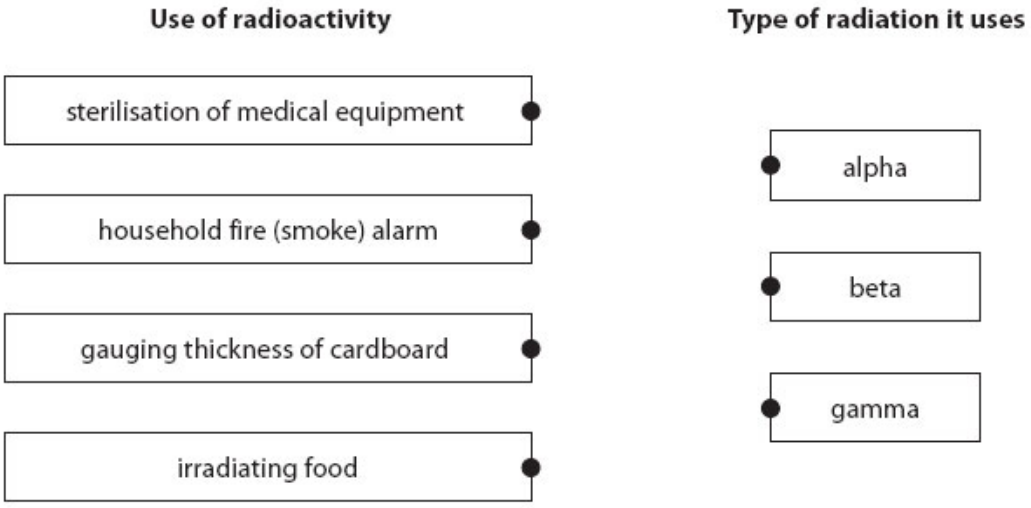
(Total for Question = 8 marks)

Q11.

(a) Here are four uses of radioactivity.
Draw a line from each one of them to the type of radiation it uses.

Each type of radiation may be chosen once, more than once or not at all.

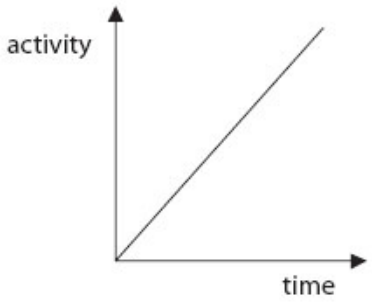
(4)



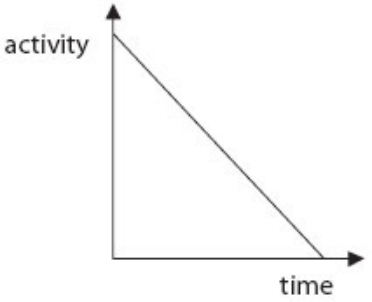
(b) Which graph best shows how the activity of a radioactive isotope changes with time?

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

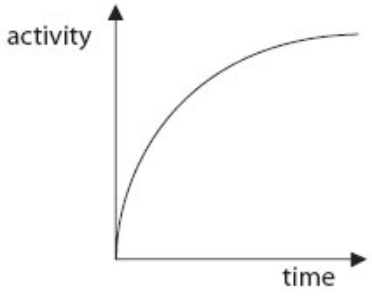
(1)



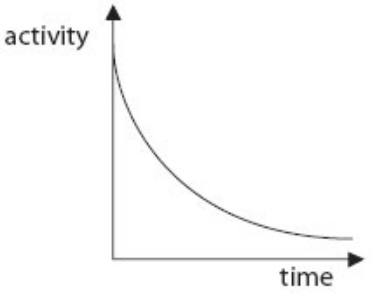
☐ **A**



☐ **B**



☐ **C**



☐ **D**

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

The unit of activity of a radioactive isotope is the

(1)

☒ **A** americium

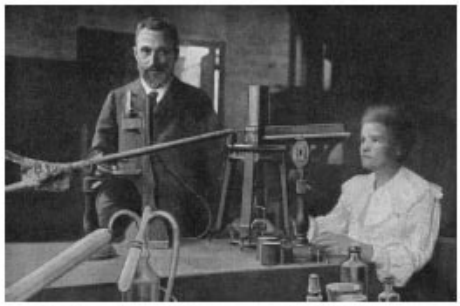
☒ **B** becquerel

☒ **C** einstein

☒ **D** radium

(d)

Marie Curie investigated radioactivity over 100 years ago.



She often carried radioactive materials in her pocket.
She stored them in her desk drawer.
She liked the coloured light they gave off.
Marie probably died from exposure to their radiation.

Describe **two** precautions that scientists now take when they use radioactive materials.

(2)

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(Total for Question = 8 marks)

Q12.

(a) Cobalt-60 is a radioactive substance.
A nucleus of cobalt-60 contains 27 protons and 33 neutrons.

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

The number of electrons in a neutral atom of cobalt-60 is

(1)

☒ **A** 87

☒ **B** 60

☒ **C** 33

☒ **D** 27

(ii) Cobalt-60 decays by emitting gamma radiation.

Explain what happens to the mass of a cobalt-60 atom when a gamma ray is emitted.

(2)

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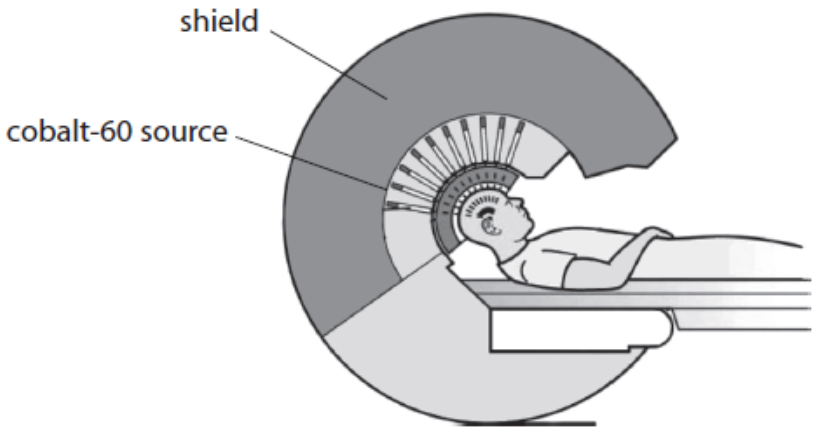
(b) Gamma radiation from cobalt-60 can be used to destroy tumours.
The diagram shows how gamma radiation is used to destroy a brain tumour.



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

Gamma radiation is used because

(1)

☒ **A** gamma can penetrate further than alpha or beta

☒ **B** gamma is more ionising than alpha or beta

☒ **C** gamma is always safer than alpha or beta

☒ **D** gamma has a shorter half-life than alpha or beta

(ii) Describe what the shield is used for.

(2)

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(iii) Suggest **two** advantages that this kind of treatment has over other forms of treatment for tumours.

(2)

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(iv) Explain why several beams of gamma radiation are used instead of just one.

(2)

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(Total for Question = 10 marks)

Q13.

Everyone is exposed to background radiation. Some of this radiation comes from natural sources.

(a) (i) One example of a source of background radiation that does not occur naturally is radiotherapy.

State **one** other source of background radiation that does not occur naturally.

(1)

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(ii) Radon gas is a natural source of background radiation.

In some parts of the country, a lot of the background radiation comes from radon gas.

Explain why there is no radon gas in some other parts of the country.

(2)

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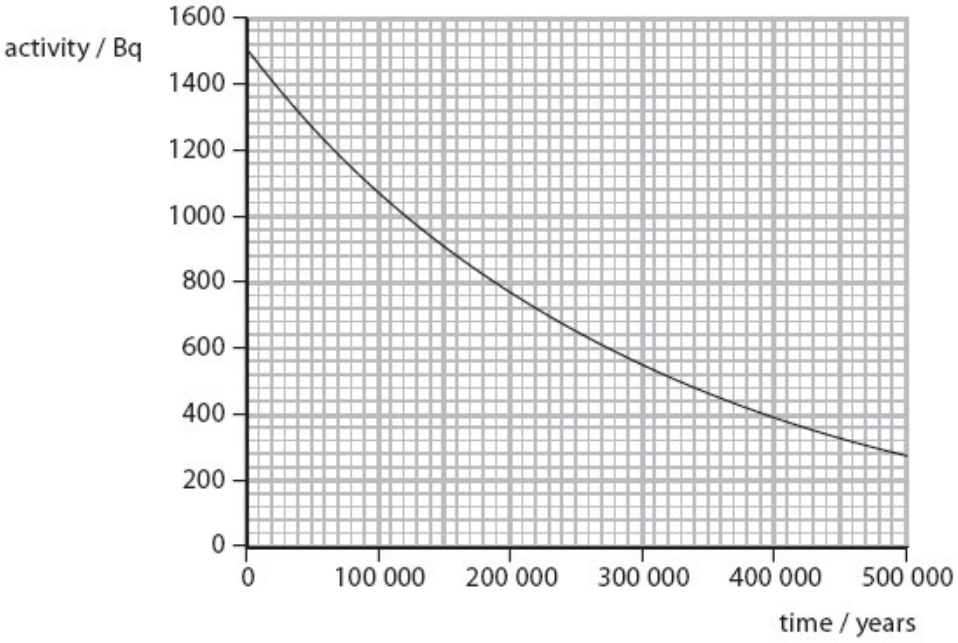
(b) Technetium-99 is one of the radioactive isotopes in nuclear waste.

The graph shows the decay curve for technetium-99.



(i) Use the graph to show that the half-life of technetium-99 is about 200 000 years.

(2)

(ii) Technetium-99 emits beta particles.

Give **one** reason that beta particles can cause harm to people.

(1)

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*(c) There are many radioactive isotopes in nuclear waste.

Technetium-99 is just one of these isotopes.

People are worried about how we should deal with nuclear waste.

Explain why it is difficult to deal with nuclear waste safely.

(6)

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(Total for Question is 12 marks)