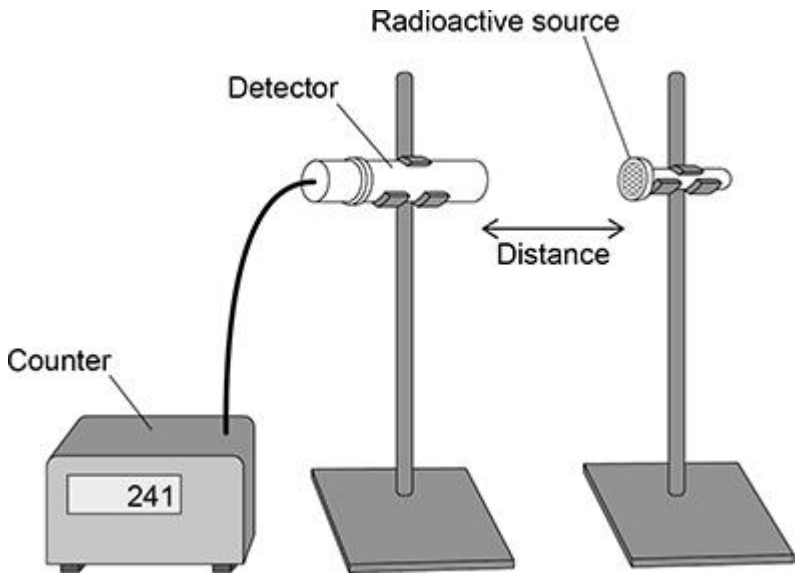
Questions are for both separate science and combined science students unless indicated in the question

Q1.

A teacher investigated the radiation emitted by two different radioactive sources, **A** and **B**.

Figure 1 shows a radiation detector positioned near one of the radioactive sources.

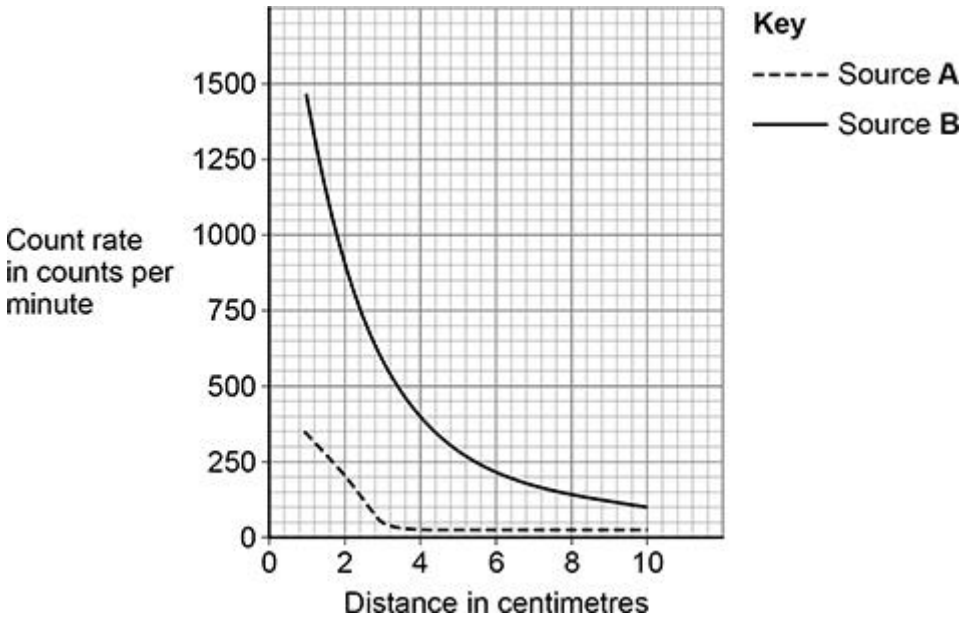
Figure 1



The teacher measured the count rate at different distances for each radioactive source.

Figure 2 shows the results.

Figure 2



(a) Explain how **Figure 2** shows that Source **A** only emits alpha radiation.

(3)

(b) **Figure 2** can **not** be used to determine if Source **B** emits beta radiation or gamma radiation.

Explain how an absorbing material could be used to show which type of radiation is emitted by Source **B**.

(2)

The teacher took safety precautions during the experiment.

(c) Suggest **one** safety precaution the teacher would have taken to reduce the radiation dose the teacher received.

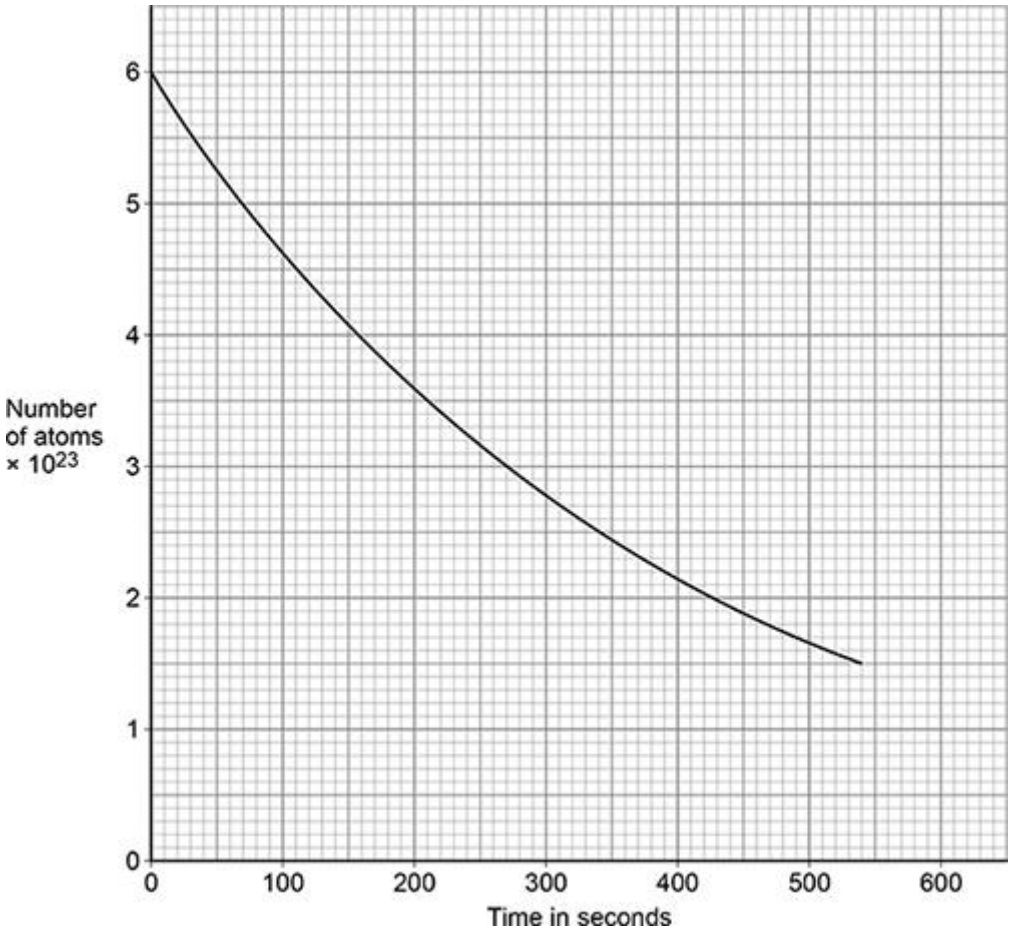
(1)

(d) Suggest **one** safety precaution that the teacher would have taken to avoid becoming contaminated.

(1)

(e) **Figure 3** shows how the number of atoms of a radioactive element in a sample varied with time. **(HT only)**

Figure 3



Activity is the rate at which a source of unstable nuclei decays.

Determine the activity of the radioactive sample at 300 seconds.

Give the unit.

_____

_____

_____

_____

Activity = _____ Unit _____

(4)

(Total 11 marks)

Q2.

Some isotopes emit nuclear radiation.

(a) Carbon-14 and carbon-12 are isotopes of carbon.

Compare the structure of an atom of carbon-14 with the structure of an atom of carbon-12.

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(3)

(b) Carbon-14 is a radioactive isotope.

Carbon-14 has a half-life of 5700 years.

What does ‘a half-life of 5700 years’ mean?

_____

_____

_____

(1)

The table below gives the half-life of some other radioactive isotopes.

Isotope	Half-life in seconds
Nitrogen-18	0.62
Nitrogen-17	4.17
Fluorine-17	64.37
Fluorine-18	6584.34

(c) A sample of fluorine-17 has an activity that is one quarter of its original activity.

Calculate the age of the sample of fluorine-17.

Age = _____ s

(2)

(d) All of the isotopes in the table above emit beta radiation.

Explain which isotope would cause the biggest risk to a person's health based only on the half-life of each isotope. **(Physics only)**

(3)

(e) People who work in the nuclear power industry need to be aware of irradiation and contamination.

Describe the difference between irradiation and contamination.

(2)

(f) Give **one** health risk to a person working close to a source of nuclear radiation.

(1)

(g) Workers in nuclear power stations are monitored to check the radiation they emit.

A worker stands 1 cm away from a radiation detector.

The amount of radiation the worker emits is recorded. **(HT only) (Physics only)**

Explain why the worker needs to stand close to the radiation detector.

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(2)

(h) Workers in the nuclear power industry are exposed to nuclear radiation.

Pilots on aircraft are exposed to cosmic radiation from space.

daily dose caused by working in a nuclear power station = 0.00050 mSv

hourly dose from cosmic rays to a pilot while flying = 0.0030 mSv

Calculate the number of days it takes for a nuclear power station worker to receive the same dose as a pilot flying for 24 hours. **(HT only) (Physics only)**

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_____

_____

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_____

Number of days = _____

(3)

(Total 17 marks)

Q3.

Alpha particles, beta particles and gamma rays are types of nuclear radiation.

(a) What does an alpha particle consist of?

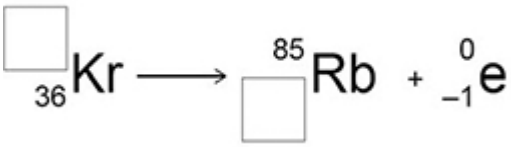
_____

_____

(1)

(b) A krypton (Kr) nucleus decays into a rubidium (Rb) nucleus by emitting a beta particle.

Complete the nuclear equation for this decay by writing the missing number in each box.



(2)

(c) Internal contamination of the human body means radioactive material is inside the human body.

Explain how the risk from internal contamination is different to the risk from external irradiation by a source of alpha radiation. **(HT only)**

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(5)

(Total 8 marks)