Questions are for both separate science and combined science students

Q1.

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?

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(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.

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_____

_____

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.

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(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.

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(2)

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

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(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.

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.

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Number of days = _____

(3)

(Total 17 marks)

Q2.

Scientists developed new models of the atom as new particles were discovered.

(a) Draw **one** line from each particle to the year it was discovered.

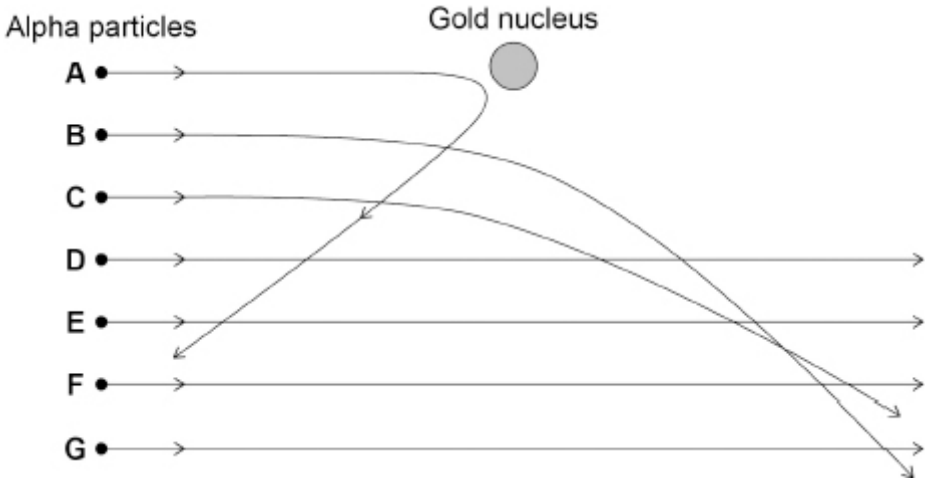
Particle	Year of discovery
Electron	1897
Neutron	1911
Nucleus	1920
Proton	1932

(2)

The nucleus was discovered using an alpha particle scattering experiment.

Alpha particles were directed at a sheet of gold foil.

The figure below shows the paths taken by seven alpha particles, **A**, **B**, **C**, **D**, **E**, **F** and **G**.



(b) Explain why alpha particle **A** takes the path shown in the figure above.

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(2)

(c) Explain why the path of alpha particle **B** is more tightly curved than the path of alpha particle **C**.

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(2)

(d) What can be deduced about the atom from the paths taken by alpha particles **D**, **E**, **F** and **G** in the figure above?

Tick (✓) **one** box.

The atom contains a nucleus. ☐

The atom contains protons, neutrons and electrons. ☐

The atom is mostly empty space. ☐

(1)

(e) How is the Bohr model of the atom different from the nuclear model of the atom?

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(1)

(f) Explain how an electron can move up and down between energy levels in an atom.

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(2)

(Total 10 marks)