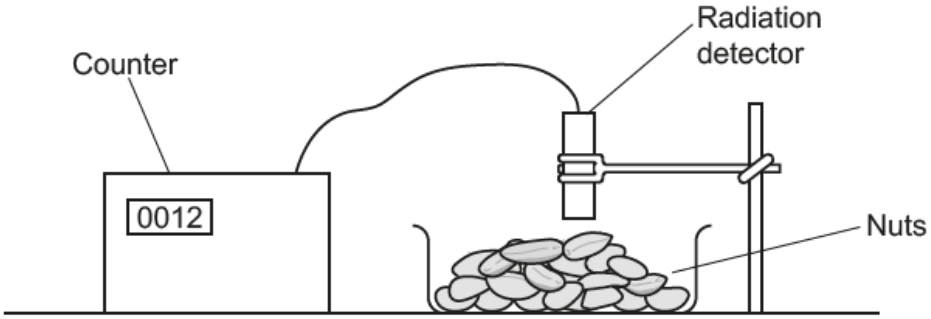
Radioactive materials – 2021/20 GCSE 21st Physics B

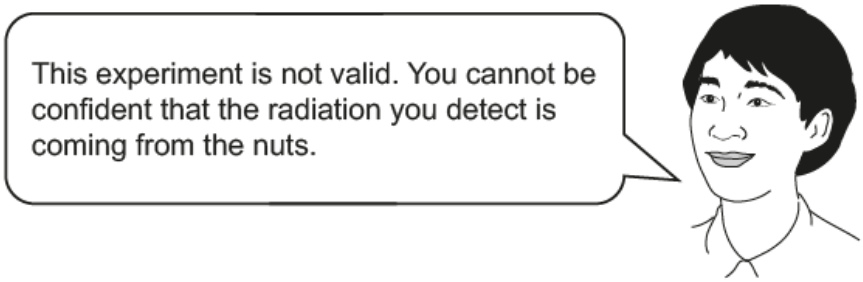
1. Nov 2021/Paper_J259/01/No.11

Some types of nut are slightly radioactive. They emit alpha radiation.

Amaya uses a radiation detector to measure the radiation given out by some nuts.



(a) Li comments that there is a problem with Amaya's experiment.



Suggest how to solve this problem.

.....

..... **[1]**

(b) Explain how Amaya could find out if the radiation that she detects is alpha radiation.

.....

.....

.....

..... **[2]**

2. Nov 2021/Paper_J259/02/No.7

The properties of some radioactive isotopes are shown in the table.

Radioactive isotope	Type of radiation emitted	Half-life
Americium-214	Alpha	432 years
Bismuth-213	Alpha	46 minutes
Cobalt-60	Gamma	5.3 years
Technetium-99m	Gamma	6 hours

(a) A patient is injected with a medical tracer.
A medical tracer contains a radioactive isotope that emits radiation. This radiation is detected from outside the body to produce an image.

Explain why technetium-99m is suitable for use as a medical tracer.

Use data from the table in your answer.

.....

.....

.....

..... **[2]**

(b) The radioactive medical tracer, technetium-99m, is prepared in the same room as the patient.

Identify **one** precaution when preparing this medical tracer in the same room as the patient, and explain how this reduces the risk to the patient.

Precaution .....

.....

Explanation .....

.....

[2]

(c) Radiotherapy is a treatment to kill cancerous cells carried out over several weeks. The radioactive isotope needs to produce a consistent beam of radiation over several weeks.

Which radioactive isotope from the table is suitable to use for radiotherapy?

Give **one** reason for your answer.

Radioactive isotope .....

Reason .....

[2]

3. Nov 2020/Paper_J259/01/No.2

Kareem researches nuclear fission and nuclear fusion.

(a) (i) Complete the sentence to explain what is meant by nuclear fission.

Put a (ring) around the correct answer.

Fission is when nuclei **fuse / grow / shrink / split** to form smaller nuclei. **[1]**

(ii) Complete the sentence to explain what causes nuclear fission.

Put a (ring) around the correct answer.

Fission happens because some nuclei are **negative / positive / unstable / stable**. **[1]**

(b) During nuclear **fission**, energy is released in two main forms.

How is the energy released?

Tick (✓) **two** boxes.

Elastic potential energy of the new particles	☐
Gamma radiation	☐
Gravitational potential energy of the new particles	☐
Kinetic energy of the new particles	☐
Radio waves	☐
Sound waves	☐

[2]

(c) (i) Describe what happens during nuclear **fusion**.

.....

.....

.....

..... **[2]**

(ii) During nuclear **fusion** some of the mass is lost.

What is this mass converted into?

..... **[1]**

4. Nov 2020/Paper_J259/02/No.5

Nuclear Physicists use atomic numbers and mass numbers to identify isotopes.

The table shows data on three atoms, **Atom A**, **Atom B**, and **Atom C**.

	Atom A	**Atom B**	**Atom C**
Atomic number	6	6	.....
Mass number	12	14	14
Number of neutrons	.....	8	7
Stable	Yes	No	Yes

(a) Complete the **two** missing values in the table. **[1]**

(b) Isotopes of an element are atoms with the same number of protons but a different number of neutrons.

Which **two** atoms are isotopes of the same element?

Put a (ring) around the **two** correct answers.

Atom A **Atom B** **Atom C**

[1]

(c) Carbon-14 is an unstable isotope which decays to nitrogen-14.

$$^{14}_{6}C \rightarrow {}^{14}_{7}N + \text{Decay particle}$$

What is the decay particle emitted when carbon-14 decays?

Put a (ring) around the correct answer.

Alpha particle **Beta particle** **Gamma ray** **Neutron**

[1]

5. Nov 2020/Paper_J259/03/No.9

Nuclear Physicists use atomic numbers and mass numbers to identify isotopes.

The table shows data on three atoms, **Atom A**, **Atom B**, and **Atom C**.

	Atom A	**Atom B**	**Atom C**
Atomic number	6	6	.....
Mass number	12	14	14
Number of neutrons	.....	8	7
Stable	Yes	No	Yes

(a) Complete the **two** missing values in the table. **[1]**

(b) Isotopes of an element are atoms with the same number of protons but a different number of neutrons.

Which **two** atoms are isotopes of the same element?

Put a (ring) around the **two** correct answers.

Atom A **Atom B** **Atom C**

[1]

(c) Carbon-14 is an unstable isotope which decays to nitrogen-14.

$$^{14}_{6}C \rightarrow {}^{14}_{7}N + \text{Decay particle}$$

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Put a (ring) around the correct answer.

Alpha particle **Beta particle** **Gamma ray** **Neutron**

[1]