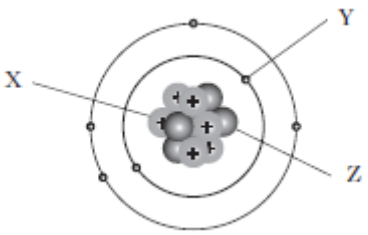
# Radioactivity Questions – NAT 5

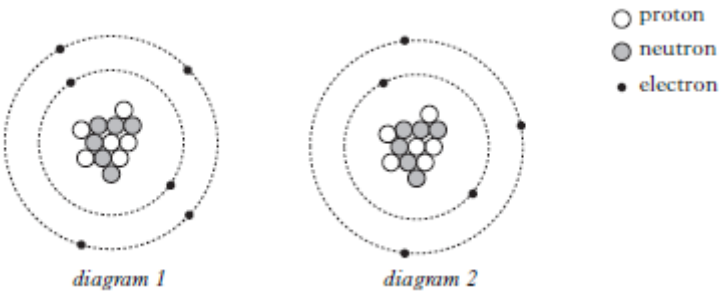
**1)** Label the particles X, Y and Z from the diagram of the model of the atom below.




**2)** A Physics teacher demonstrates alpha, beta and gamma radiation during a lesson. She then explains that these radiations are absorbed and can cause ionisation in the absorbing material.

a) What is meant by the term 'ionisation'?

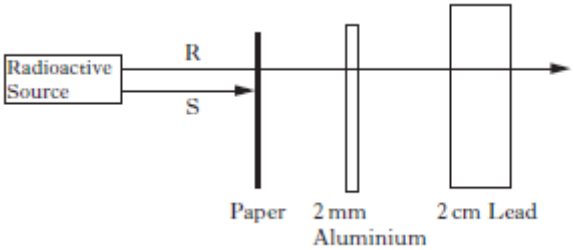
b) i) From the diagrams below, which one represents an ionised atom?
ii) Explain your answer using the word electrons.




c) i) Which type of radiation causes the greatest ionisation?

ii) Describe **one** medical use of radiation used to destroy cells.

**3)** A radioactive source emits two types of radiation R and S as shown in the diagram below.

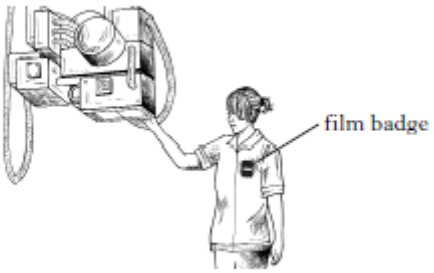



a) Identify radiation R.

b) Identify Radiation S.

c) State the name of a detector of radiation.

**4)** Radiographers in hospitals wear film badges when using X-Ray machines.

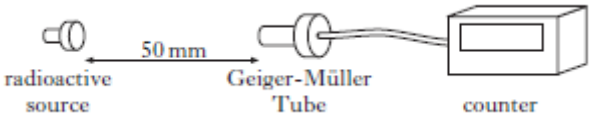



A film badge contains photographic film in a plastic folder which stops light entering.

a) What effect does X-Ray radiation have on the film badge?

b) Suggest a reason why radiographers wear film badges.

**5)** A Physics student sets up the experiment shown below.




The student places a 3mm aluminium sheet between the radioactive source and the Geiger-Muller Tube .The activity of the radioactive source is observed to decrease. The student concludes that the radioactive material is emitting beta radiation.

a) Suggest a reason why her conclusion **may** be incorrect.

b) State **two** safety precautions that the student must observe when handling radioactive sources.

**6)** a) What is an alpha particle?

b) What does an alpha particle consist of?

c) What type of charge does an alpha particle have?

**7)** a) What is a beta particle?

b) What type of charge does a beta particle have?

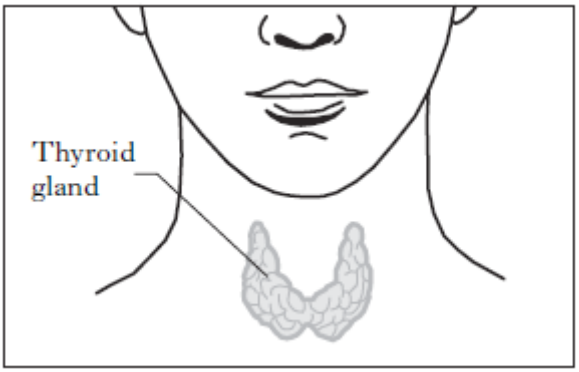
**8)** a) What is a gamma ray?

b) What charge and mass does a gamma ray have?

**9)** Calculate the activity of a radioactive source if 1800 atoms decay in 4 minutes.

**10)** The activity of a radioactive source is 32kBq. Calculate how long it will take for 512,000 atoms to disintegrate.

**11)** The thyroid gland, located in the neck, is essential for maintaining good health.




A radioactive source, which is a gamma emitter, is used as a radioactive tracer for the diagnosis of thyroid gland disorders.

a) A small quantity of this tracer, with an activity of 20MBq is injected into the patient's body. After 52 hours, the activity of the tracer is measured at 1.25MBq.

Calculate the half - life of the tracer.

b) Another radioactive tracer is used to **treat** cancer of the thyroid gland. This source emits only beta radiation.

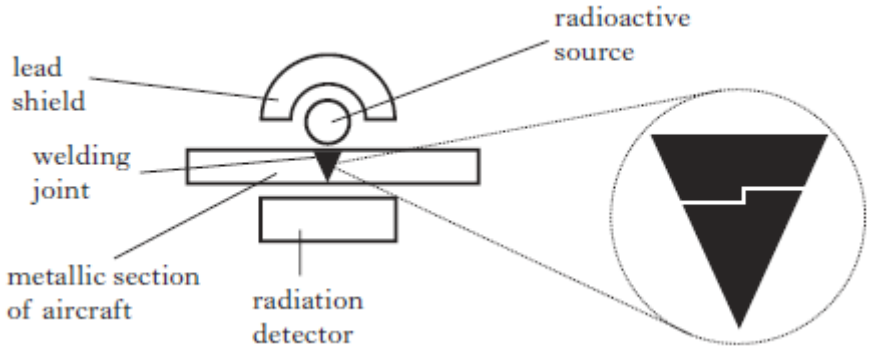
Why is this source unsuitable as a **tracer**?

c) The equivalent dose is much higher for the beta emitter than the gamma emitter.

Why is this higher dose necessary?

d) What are the units of equivalent dose?

**12)** Aircraft welding joints must be checked regularly for cracks and other faults. A radioactive source can be used to carry out these checks.




The radiation detector monitors the amount of radiation passing through the section of the aircraft being checked.

a) Explain how the crack in the section of the aircraft would be detected.

b) The aircraft has to be checked regularly and take 24 hours to complete.

The following radioactive sources are available.

| *Source* | *Half-Life* | *Radiation Emitted* |
|---|---|---|
| W | 20 years | Alpha |
| X | 15 hours | Beta |
| Y | 30 years | Gamma |
| Z | 3 hours | Gamma |

i) State what is meant by the term ‘half - life’.

ii) Explain which source is most suitable for the purpose of detecting cracks in the aircraft.

c) The lead shield is used as a safety precaution to prevent workers being exposed to large doses of radiation.

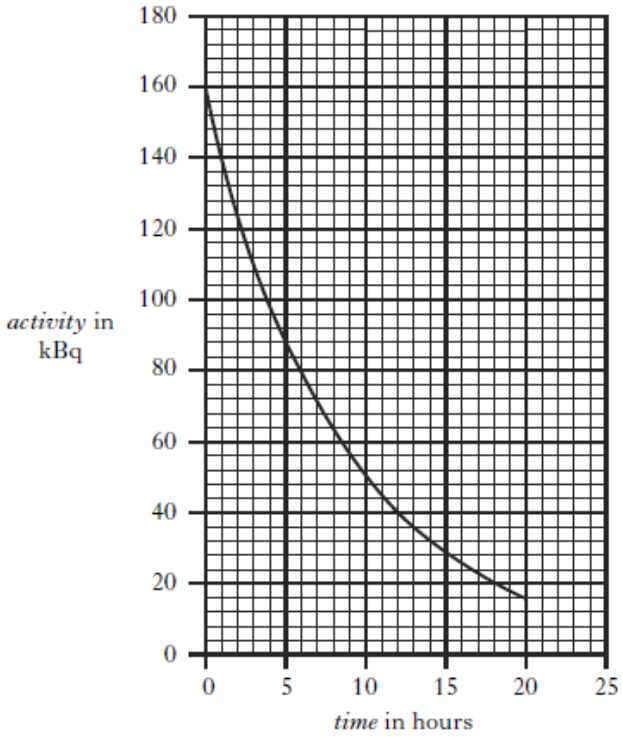
State **one** other safety precaution that is necessary when working with radioactive sources.

d) A different radioactive source has a half – life of 12 hours.

The source has an initial activity of 128MBq.

Calculate the activity of the source after 3 days.

**13)** A hospital technician is working with a radioactive source. The graph below shows the activity of the source over a period of time.

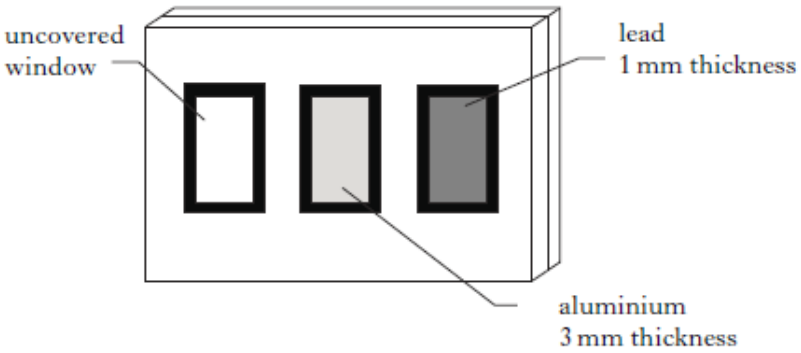



a) Use the graph to find the half – life of the radioactive source.

b) The initial activity of the radioactive source is 160kBq.

Calculate the activity of the radioactive source after **four** half – lives.

c) As a safety precaution the technician wears a film badge when working with radioactive sources. The film badge contains photographic film which light cannot enter.




Describe how the film badge indicates the **type** and the **amount** of radiation received.

**14)** A sample of tissue has a mass of 0.05kg.If the tissue is exposed to radiation and absorbs 0.015J of energy in 2 minutes.

Calculate the absorbed dose.

**15)** Information about a radioactive source is given in the table below.

| *Activity* | *Energy absorbed per kilogram of tissue* | *Radiation weighting factor* |
|---|---|---|
| 500 MBq | 0·2 μJ | 10 |

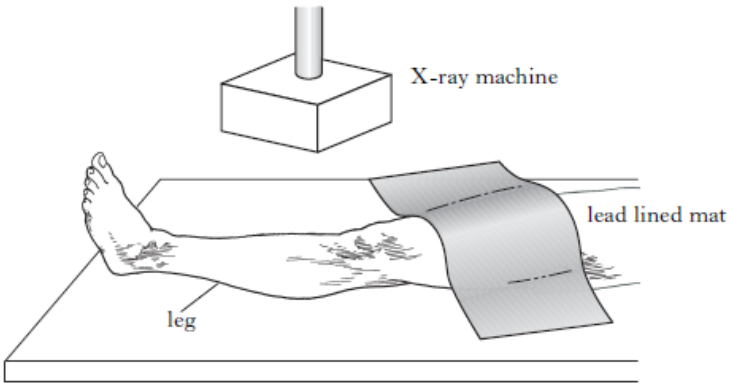
Calculate:

a) Absorbed Dose

b) Equivalent Dose

c) The activity of the source after 21 days if it has a half – life of 7 days.

**16)** A footballer injures his leg while playing in a match.



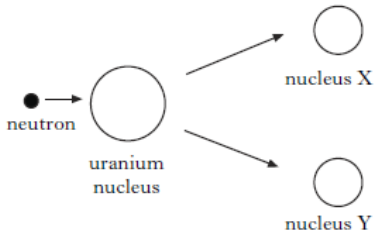

In hospital the player has **three** X-Rays, each producing an absorbed dose of 50μGy.

a) The mass of the players' leg is 6kg. Calculate the energy absorbed by the leg from the X – Rays.

b) Why is the rest of the players leg covered with a lead lined mat?

c) Apart from the absorbed dose, state **two** other factors that contribute to the biological harm caused by radiation.

**17)** a) Which type of nuclear reaction is shown below?




b) For a chain reaction to occur what must also be released?

**18)** Disposal of some types of nuclear waste from nuclear reactors is particularly difficult.

Give a reason for this difficulty.

**19)** Electrical energy can be generated using fossil fuels or nuclear fuels.

State one advantage of using nuclear fuels.

**20)** Energy is released from stars as a result of nuclear reactions.

One of these reactions is represented by the statement given below.

$$^{14}_{7}\mathrm{N} + {}^{4}_{2}\mathrm{He} \longrightarrow {}^{18}_{9}\mathrm{F} + \text{gamma radiation}$$

a) What type of nuclear reaction is described by this statement?

b) What is released in this nuclear reaction?