2021 ASSESSMENT MATERIALS

GCSE
PHYSICS

Physics Test 3: Particle model of matter and Atom Structure (Foundation)

Total number of marks: 36

0 5 Radioactive waste from nuclear power stations is a man-made source of background radiation.

0 5 . 1 Which of the following is also a man-made source of background radiation?

[1 mark]

Tick (✓) **one** box.

cosmic rays	☐
radiotherapy	☑
rocks	☐
stars	☐

0 5 . 2 Nuclear power stations use the process of nuclear fission.

Complete the sentences to describe the process of nuclear fission.

Choose answers from the box.

[3 marks]

a neutron	**a proton**		**an electron**
cosmic rays	**energy**	**gamma rays**	**x-rays**

An unstable nucleus absorbs a neutron and splits into two parts.

Two or three neutrons are released, as well as energy

and gamma rays .

0 5 . 3 Plutonium-239 is one type of radioactive waste from nuclear power stations.

The following nuclear equation represents the decay of plutonium-239 (Pu-239).

$$^{239}_{94}Pu \rightarrow \, ^{235}_{92}U + \, ^{4}_{2}He$$

How does the nuclear equation show that alpha radiation is emitted when plutonium-239 decays?

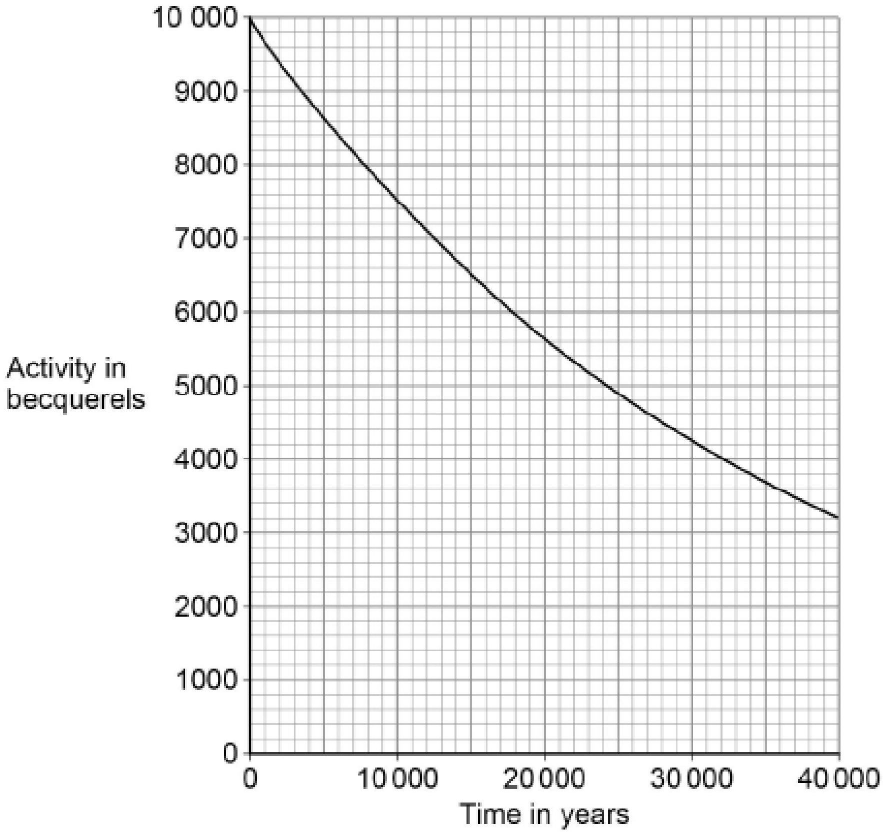
[1 mark]

Tick (✓) **one** box.

An alpha particle contains 92 protons.	☐
An alpha particle has a mass number of 235.	☐
An alpha particle is the same as a helium nucleus.	✓

Figure 8 shows how the activity of a sample of plutonium-239 varies with time.

Figure 8



0 5 . 4 How much time will it take for the activity of the sample of plutonium-239 to fall to half of its initial activity?

[1 mark]

activity → 5000

Time = 24000 years

0 5 . 5 What is the half-life of plutonium-239?

[1 mark]

Half-life = 24000 years

0 5 . 6 The radioactive waste from a nuclear power station is buried underground.

People are warned to stay away from places where radioactive waste is buried.

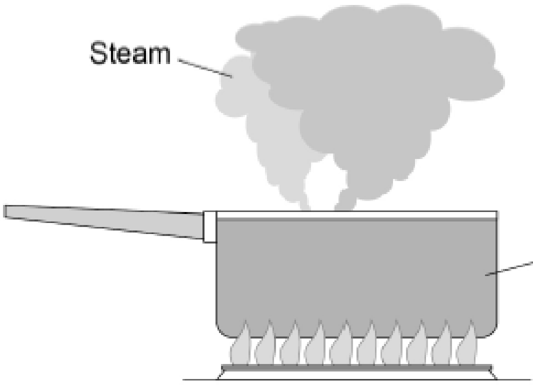
Suggest **one** risk of going near the place where radioactive waste is buried.

[1 mark]

DNA Mutations

0 1 **Figure 1** shows water being heated. Eventually the water changed into steam.

Figure 1



0 1 . 1 Complete the sentences.

Choose answers from the box.

Each answer may be used once, more than once or not at all.

[2 marks]

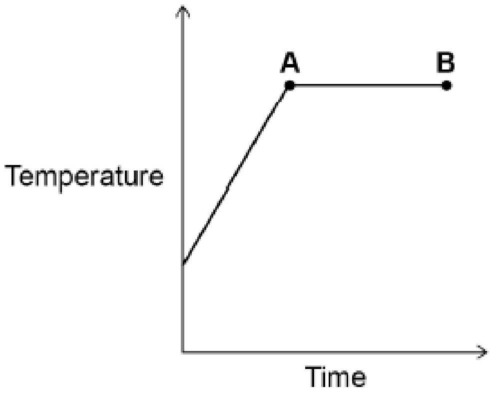
greater than	**less than**	**the same as**

The distance between the particles in steam is greater than the distance between the particles in liquid water.

The density of steam is less than the density of liquid water.

Figure 2 shows how the temperature of the water varied with time.

Figure 2



0 1 . 2 What is the name of the process that is taking place between points **A** and **B**?

Give a reason for your answer.

[2 marks]

Process Boiling

Reason Because there is no temperature change according to the graph and a liquid is heated here.

0 1 . 3 A mass of 0.063 kg of water was turned into steam.

The specific latent heat of vaporisation of water is 2 260 000 J/kg

Calculate the thermal energy transferred to the water to turn it into steam.

Use the equation:

thermal energy for a change of state = mass × specific latent heat

[2 marks]

$= 0.063 \times 2260000$

Energy = 142380 J

0 1 . 4 The mass of the steam was 0.063 kg

The volume of the steam was 0.105 m^3

Calculate the density of steam.

Use the equation:

$$\text{density} = \frac{\text{mass}}{\text{volume}} = \frac{0.063}{0.105}$$

Choose the unit from the box.

[3 marks]

kg	**m^3 / kg**	**kg / m^3**

Density = 0.6 Unit Kg/m^3

0 4 A student wanted to determine the density of a small piece of rock.

0 4 . 1 Describe how the student could measure the volume of the piece of rock.

[4 marks]

See below

0 4 . 2 The volume of the piece of rock was 18.0 cm^3.

The student measured the mass of the piece of rock as 48.6 g.

Calculate the density of the rock in g/cm^3.

Use the equation:

$$\text{density} = \frac{\text{mass}}{\text{volume}} = \frac{48.6}{18}$$

[2 marks]

Density = 2.7 g/cm^3

4.1 Answer

Fill a measuring cylinder to a known volume (v1) with water.
Add the rock into the cylinder and measure the volume (V2)
Substract the two readings (V2-V1) to obtain the volume of the rock.

11 A teacher used a Geiger-Muller tube and counter to measure the number of counts in 60 seconds for a radioactive rock.

11.1 The counter recorded 819 counts in 60 seconds. The background radiation count rate was 0.30 counts per second.

Calculate the count rate for the rock.

Total count rate : $\frac{\text{counts}}{\text{time}} = \frac{819}{60} = 13.65$

[3 marks]

13.65 - 0.30

Count rate = 13.35 per second

11.2 A householder is worried about the radiation emitted by the granite worktop in his kitchen.

1 kg of granite has an activity of 1250 Bq. The kitchen worktop has a mass of 180 kg.

Calculate the activity of the kitchen worktop in Bq.

[2 marks]

1250×180

Activity = 225000 Bq

11.3 The average total radiation dose per year in the UK is 2.0 millisieverts.

Table 2 shows the effects of radiation dose on the human body.

Table 2

Radiation dose in millisieverts	**Effects**
10 000	Immediate illness; death within a few weeks
1000	Radiation sickness; unlikely to cause death
100	Lowest dose with evidence of causing cancer

The average radiation dose from the granite worktop is 0.003 millisieverts per day.

Explain why the householder should **not** be concerned about his yearly radiation dose from the granite worktop.

One year is 365 days.

[2 marks]

Radiation dose over a year : $0.003 \times 365 = 1.095$

$1.095 < $ uk average (2)

11.4 Bananas are a source of background radiation. Some people think that the unit of radiation dose should be changed from sieverts to Banana Equivalent Dose.

Suggest **one** reason why the Banana Equivalent Dose may help the public be more aware of radiation risks.

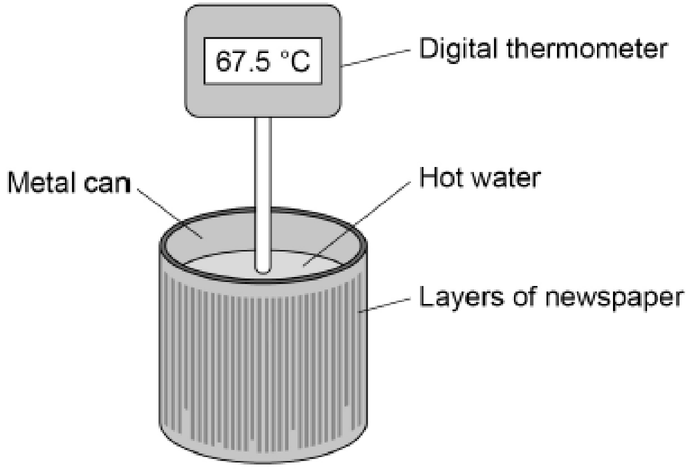
[1 mark]

Because bananas are used frequently and ordinary people will understand something they use in day-today life

1 0 A student investigated the insulating properties of newspaper.

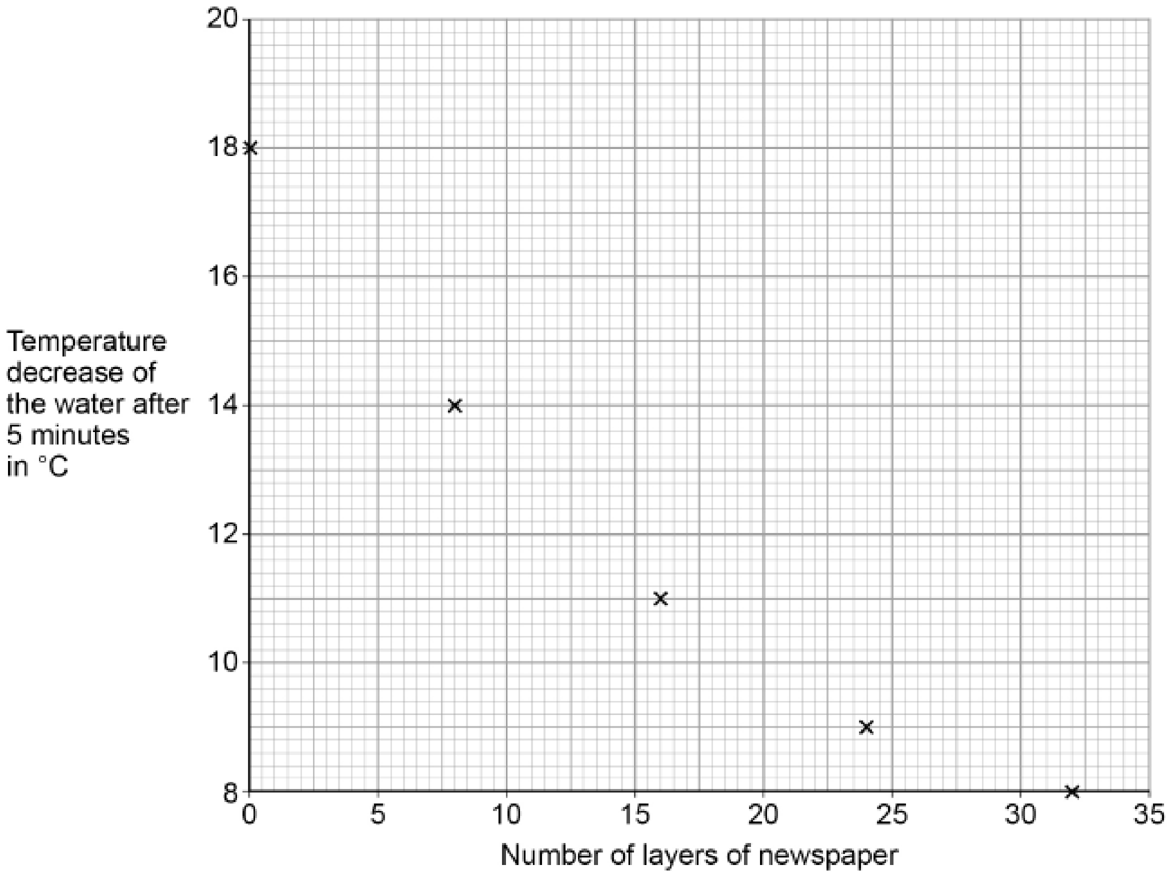
Figure 15 shows the apparatus the student used.

Figure 15



The student's results are shown in **Figure 16**.

Figure 16



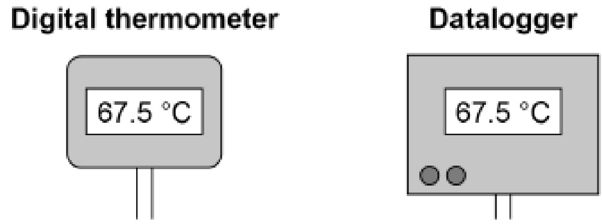
1 0 . 1 Describe a method the student could have used to obtain the results shown in **Figure 16**.

[6 marks]

1 0 . 2 The student could have used a datalogger with a temperature probe instead of the digital thermometer.

Figure 17 shows the readings on the digital thermometer and the datalogger.

Figure 17



The datalogger records 10 readings every second.

The student considered using a temperature probe and datalogger.

Explain why it was **not** necessary to use a temperature probe and datalogger for this investigation.

[2 marks]

The temperature does not change very fast and the readings are approximately the same.

1.01 Answer

The student set up the apparatus as above and added hot water to the metal can. He begins the experiment with zero layers of newspapers. Measures the initial reading at time of pouring and measures the temperature again after five minutes. He substracts the second reading from the first to find the temperature change.

The student repeats the experiment with 8,16,24 and 32 layers of newspapers. The student can mark the readings on a table and use it to plot a temperature change vs number of newspaper layers graph.