Mark schemes

Q1.

(a) Similarities:

- same number of protons

or

same atomic number

allow both atoms / nuclei contain 6 protons

1

- same number of electrons

1

Difference:

- different number of neutrons

or

different mass number

*allow carbon-12 has 6 neutrons **and** carbon-14 has 8 neutrons*

1

(b) the time it takes for the number of nuclei (in a radioactive sample) to halve (is 5700 years)

allow atoms for nuclei

or

the time it takes for the activity (of a radioactive sample) to halve (is 5700 years)

ignore radioactivity

or

the time it takes for the radiation emitted (by a radioactive sample) to halve (is 5700 years)

or

the time it takes for the count rate (of a radioactive sample) to halve (is 5700 years)

or

the time it takes for the mass of carbon-14 (in a sample) to halve (is 5700 years)

1

(c) 2 half-lives

1

128.74 (s)

allow 129 (s)

1

(d) nitrogen-18

1

greatest activity

MP2 and MP3 dependent on scoring MP1

allow emits most radiation per second

allow emits most radiation in a given time period

ignore shortest half-life

1

(so) greatest dose of radiation absorbed (per second)

1

(e) irradiation is the exposure of an object / person to radiation

allow 'absorption of radiation' for 'exposure'

allow specific examples of ionising radiation

1

(while) contamination is the (unwanted) presence of radioactive material / atoms on an object / person

allow 'inside a person' for 'on an object / person'

1

(f) any **one** from:

- cancer / tumours
- DNA / genetic mutation

  ignore mutates cells
- damages / kills cells
- radiation poisoning / sickness / burns

  ignore death

1

(g) some radioactive materials emit alpha radiation

1

which has a (very) short range (in air)

MP2 dependent on scoring MP1 allow weakly penetrating for short range (in air)

1

(h) pilot's dose in 24 hours = 0.072 (mSv)

1

$$\text{number of days} = \frac{0.072}{0.00050}$$

1

number of days = 144

OR

nuclear power worker hourly dose = 0.0000208... (mSv) (1)

$$\text{number of days} = \frac{0.0030}{0.0000208} \text{ (1)}$$

number of days = 144 (1)

OR

$$\frac{\text{hourly dose}}{\text{daily dose}} = \frac{0.0030}{0.00050} = 6 \text{ (1)}$$

number of days = 6 × 24 (1)

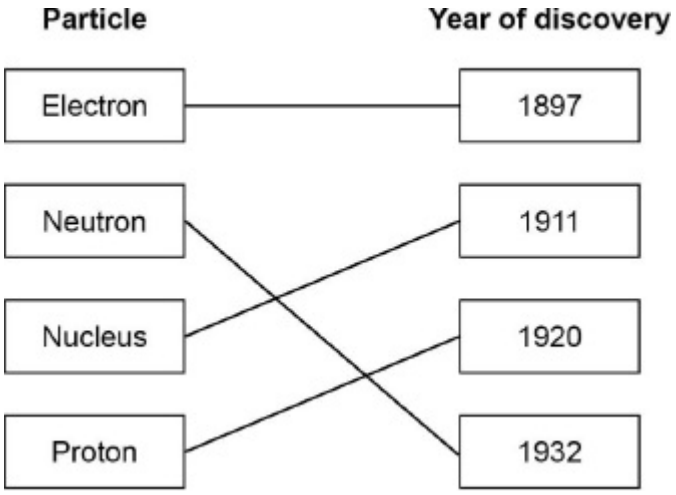
number of days = 144 (1)

1

[17]

Q2.

(a)



4 correct for 2 marks

2 or 3 correct for 1 mark

additional line from a box on the left negates the mark for that box

2

(b) both the alpha particles and the (gold) nucleus have positive / same charge

*'it' is alpha particle **A***

allow alpha particles and protons have positive / same charge

1

so the alpha particle and the gold nucleus repel each other

allow like charges repel

ignore deflection (this refers to the path taken not the force)

1

(c) particle **B** passes closer to the nucleus

*'it' is particle **B***

1

so experiences a stronger (repulsive) force
or
so experiences a stronger electric field

*any mention of particle **B** colliding with the nucleus scores zero*

1

(d) the atom is mostly empty space

1

(e) in the Bohr model the electrons orbit (the nucleus) at specific distances
(whereas in the nuclear model the electrons can orbit at a continuous range of distances)

allow energy levels or shells for specific distances

1

(f) to move to a higher energy level an electron absorbs energy from electromagnetic radiation

allow absorbs energy by collision with another electron allow EM radiation for electromagnetic radiation

1

to move to a lower energy level an electron emits energy in the form of electromagnetic radiation

1

if no other mark scored allow 1 mark for an electron changes energy level by emitting or absorbing electromagnetic radiation

[10]