# Hazards and Uses of Radiation

Mark Scheme

Name: _____

Class: _____

Date: _____

Time: **92 minutes**

Marks: **92 marks**

Comments:

Mark schemes

**1** (i) photographic film / paper

*accept X-ray film*

1

(ii) (when developed) the film is darker

*must have a comparison*

1

(iii) to prevent them receiving / being exposed to too much radiation **or**
so they know how much radiation they have been exposed to

*accept if he gets too much radiation there may be something wrong with the plant*

*any statement making reference to a need for preventive or corrective action gains **1** mark*

*an isolated statement of fact of the effect of radiation gains **0** marks*

1

**[3]**

**2** (i) (strontium-90)
beta rays partly absorbed by aluminium

*accept gamma rays not absorbed **and** alpha all absorbed*

*if phosphorus -32 then one mark max for beta ray explanation*

1

long half life means it can be used for a long time

1

(ii) (technetium-99)
(gamma) rays will pass out of body / less likely to be absorbed

*accept (gamma) less damaging or alpha / beta will damage cells if cobalt -60 then one mark max for gamma ray explanation*

1

short half life means it will not affect body over a long period

1

**[4]**

**3** (a) (i) alpha

1

(ii) damages them / changes DNA

*accept kills them / destroys*

*accept causes cancer*

*accept causes cell mutations*

*do **not** accept they ionise cells on its own*

1

(b) count is (roughly) the same

**1**

gamma is not affected by magnetic field

*accept magnet for magnetic field*

**1**

**or**

alpha and beta are deflected by a magnetic field (1)
count would go down significantly (1)

(c) time taken for number of nuclei to halve

*do **not** accept time for radioactivity to halve*

**or**

time taken for count rate to fall to half
(its initial value)

*do **not** accept time for nuclei to halve*

**1**

(d) not enough time to take measurements / make observations

**1**

before level of radiation became insignificant

**1**

**[7]**

**4**

(a) (i) any **one** from:

- nuclear power (stations)

  *accept nuclear waste*
  *accept coal power stations*

- nuclear weapons (testing)

  *accept nuclear bombs / fallout*

- nuclear accidents

  *accept named accident, eg Chernobyl or Fukushima*

  *accept named medical procedure which involves a radioactive source*
  *accept radiotherapy*
  *accept X-rays*
  *accept specific industrial examples that involve a radioactive source*

  *nuclear activity / radiation is insufficient*

  *smoke detectors is insufficient*

**1**

(ii) (radioactive decay) is a random process

*accept an answer in terms of background / radiation varies (from one point in time to another)*

**1**

(b) any **one** from:

- (maybe) other factors involved

  *accept a named 'sensible' factor, eg smoking*

- evidence may not be valid

  *accept not enough data*

- may not have (a complete) understanding of the process (involved)

**1**

(c) (i) 2

**1**

2

**1**

(ii) 218

*correct order only*

**1**

84

**1**

(d) 3.8 (days)

*allow **1** mark for showing correct method using the graph provided no subsequent steps*

*correct answers obtained using numbers other than 800 and 400 gain **2** marks provided the method is shown*

**2**

**[9]**

**5** (a) evidence of $\frac{7350}{15}$

*gains 1 mark*

**but**

490

*gains 2 marks*

**but**

4900

*gains 3 marks*

units $cm^3$

*for 1 further mark*

**4**

(b) some of radioactive solution gets into cells/body organs
some of radioactive solution gets into urine (in the kidney)
the radioactive solution becomes less radioactive during the test
variability in readings
*in any order for 1 mark each*

**3**

(c) *ideas that*

- won't lose (too) much radioactivity during the test
- won't stay radioactive/harm cells for too long after test is over

*for 1 mark each*

**2**

**[9]**

**6** (a) cobalt-(60)

**1**

gamma (radiation) will pass through food / packaging
*this can score if technetium chosen*

**1**

long half-life so level of radiation (fairly) constant for (a number) of years
*this can score if strontium / caesium is chosen*
*accept long half-life so source does not need frequent replacement*
*accept answers in terms of why alpha and beta cannot be used*
*gamma kills bacteria is insufficient*

**1**

(b) (i) people may link the use of radiation with illness / cancer
*accept (they think) food becomes radioactive*
*accept (they think) it is harmful to them*
*'it' refers to irradiated food*

**1**

(ii) not biased / influenced (by government views)

**1**

(iii) any **two** from:

- data refers only to (cooked) chicken
- data may not generalise to other foods
- the content of some vitamins increases when food / chicken is irradiated
- no vitamins are (completely) destroyed
- (only) two vitamins decrease (but not significantly)

*accept irradiated chicken / food contains a higher level of vitamins*
*marks are for the explanation only*

**2**

(iv) so can choose to eat / not eat that (particular) food

*accept irradiated food may cause health problems (for some people)*

*accept people may have ethical issues (over eating irradiated food)*

**1**

(c) (i) electron
from nucleus / neutron

***both** parts required*

**1**

(ii) 90 years

*allow **1** mark for showing 3 half-lives*

**2**

**[11]**

**7** (a) (i) 3 fewer neutrons

*accept fewer neutrons*

*accept different number of neutrons*
*do **not** accept different number of electrons*

**1**

(ii) electron from the nucleus

*both points needed*

**1**

(iii) 32 (days)

*allow **1** mark for clearly obtaining 4 half-lives*

**2**

(iv) has a **<u>much</u>** longer half-life

*accept converse answers in terms of iodine-131*

*accept it has not reached one half-life yet*

**1**

little decay happened / still in the atmosphere

*accept it is still decaying*

**1**

(b) any **two** from:

*marks are for reasons*

- some children developed TC before 1986
- some children (after 1986) that developed TC did not live in highly contaminated areas
- the (large) increase can (only) be explained by (a large increase in) radiation as caused by Chernobyl
- all areas would be contaminated (and raise the risk of TC)
- no evidence (of effect) of other variables

**2**

(c) People not exposed (to the radiation but who were otherwise similar)

*accept people not affected (by the radiation)*

**1**

(d) any **two** from:

*answers should be in terms of nuclear power and **not** why we should not use other fuels*

- produce no pollutant / harmful gases

  *accept named gas or greenhouse gases*
  *do **not** accept no pollution*

- produces a lot of energy for a small mass (of fuel) **or** is a concentrated energy source

  *accept amount for mass*

  *accept high energy density*

- it is reliable **or** it can generate all of the time
- produces only a small volume of (solid) waste

  *accept amount for volume*

**2**

**[11]**

**8** (a) (i) 18

**1**

(ii) the count rate for the source

**1**

(iii) the alpha radiation would not cover such a distance

**1**

(iv) plots correct to within ½ small square

*allow **1** mark for 4 correct points plotted*

**2**

correct curve through points as judged by eye

1

(v) two attempts at finding 'half-distance' using the table

*20 to 10 cpm d = 0.4 m*
*125 to 56 cpm d = 0.2 m*
*31 to 14 cpm d = 0.4 m*

*allow **1** mark for one attempted comparison*

2

obeyed or not obeyed

*dependent on previous two marks*

1

(b) (i) there is no effect on the count rate in experiment 1 because the field is parallel **or** beta particles are not deflected **or** there is no force

1

count rate is reduced in experiment 2 because field is perpendicular **or** beta particles are deflected **or** there is a force

1

(ii) only background radiation (as beta do not travel as far)

1

slightly different values show the random nature of radioactive decay

1

**[13]**

**9**

(a) (i) electron
neutron
proton
nucleus

*1 mark for each correct label*

4

(ii) H-1 has no neutrons
H-3 has 2 neutrons

*more neutrons gets 1 mark*

2

(iii) nucleus unstable

2

(b) lead/concrete
lead/concrete needed to stop gamma rays

2

**[10]**

**10** (a) two from:
internal/bodies
thoron
building materials
soil
food
rocks
radon
gamma rays
cosmic rays/outer space

*any 2 for 1 mark each*

**2**

(b) only a very small amount of the background
radioactivity comes from nuclear power owtte.

*accept any sensible response for 1 mark*

**1**

(c) use G.M. tube/meter/counter or film
'count' higher than or compare with background/normal/control or film is blacker

*for 1 mark each*

**2**

(d) more neutrons/different number

*gains 1 mark*

**but** I-131 has 4 extra neutrons = 2
**or** I-131 has 78 neutrons I-127 has 74 (2)

*gains 2 marks*

**2**

(e) (i) emits radiation
ionises
molecules
in cells
radiation damages cells/mutation/kills cells
may cause cancer
β /☼/radiation is penetrating
half-life is long enough for damage to be caused

*any 4 for 1 mark each (4 from above)*

**4**

(ii) e.g. replace I-127 in body/body cannot tell the difference/causes thyroid cancer/causes cancer (but not if already given in (i))

*for 1 mark*

**1**

(iii) **Either** No
half-life = 8 days many half lives have passed/attempts to calculate number of half-lives **or** explains meaning of half-life so very little left/become harmless

*for 1 mark each*

**or** Yes half-life = 8 days such a large quantity was released although little left it is still harmful

*for 1 mark each*

**3**

**[15]**