M1. (a) (i) cannot penetrate aluminium

allow can only pass through air / paper too weak is neutral

1

(ii) gamma rays not affected (by aluminium)

allow all / most (gamma rays) to pass through

too strong is neutral
danger is neutral

1

(b) (i) (nuclei) unstable

1

(ii) causes harm / damage to body / cells

allow radiation sickness

1

detail e.g., causes mutations / causes cancer / damages DNA / damages chromosomes

allow two effects for 2 marks

1

[5]

M2.   2 weeks

if answer is incorrect 2 gains two marks weeks gains one mark
half of 68 or 34 gains one mark / allow working shown on graph

[3]

M3. (a) (i) **K** and **L**

both answers required either order

1

(ii) (1) same number of protons

accept same number of electrons
accept same atomic number

1

(2) different numbers of neutrons

1

(b) (i) 90

1

(ii) 140

1

(c) alpha (particle)

reason may score even if beta or gamma is chosen

1

mass number goes down by 4 **or**
number of protons and neutrons goes down by 4
or
number of neutrons goes down by 2

*candidates that answer correctly in terms of why gamma **and** beta decay are not possible gain full credit*

1

atomic / proton number goes down by 2 **or**
number of protons goes down by 2

accept an alpha particle consists of 2 neutrons and 2 protons

Page 3

*for **1** mark*

*accept alpha equals ^4_2He or $^4_2\alpha$ for **1** mark*

an alpha particle is a helium nucleus is insufficient for this mark

1

[8]

M4. beta

1

alpha absorbed by paper

allow beta and alpha
second mark is linked to first

1

or beta absorbed by aluminium allow beta can penetrate paper
or gamma would affect all of film

i.e. cannot obtain second mark unless first mark is correct

[2]

M5. (a)   two half lives

gains 1 mark

but
20 minutes

gains 2 marks

2

(b)   alphas will be stopped by skin / air **or** do not penetrate betas and gammas
can reach / damage organs / cells

for 1 mark each

2

[4]

M6. (a)   suitable arrangement of source and GM tube ie <u>fixed distance apart</u>
               accept 'detector' for GM tube and counter

               1

        suitable test
               *eg introduce absorbing material **or** increase distance*
               between source and GM tube

               1

        suitable conclusion
               alpha that which gives a greatly reduced count with a paper
               *absorber **or** alpha if count decreases rapidly when distance*
               between source and GM tube exceeds 5 cm (approx)
               the first two marks could be scored from a <u>labelled</u> diagram

               1

    (b)   (i)   (changes to) background radiation
                  *do **not** accept the source is decaying if it is their only answer*

           or

           (beta) decay is random
                  accept decay is not constant

               1

           (ii)   thickness decreasing
                   accept it is thin

               1

           increased count rate

               1

           (means) less (beta) radiation absorbed
                   accept more (beta) radiation passes through

               1

           (iii)   changing thickness will not change count rate (significantly)
                    accept insufficient absorption of gamma radiation
                    irrespective of thickness
                    *do **not** accept gamma rays too penetrating*
                    *do **not** accept answers in terms of speed*

               1

                                                                                    [8]

M7. *answers must be comparative*
accept converse answers throughout

alpha: the count rate is (greatly) reduced
by the card **or** the card absorbs alphas <u>but not betas</u>
accept paper for the card

1

beta: the count rate is (greatly) reduced by the metal **or** the thin metal absorbs
alphas <u>and</u> betas **or** the thin metal absorbs all of the radiation (from the source)
accept aluminium for the metal

1

gamma: would pass through the thin
accept aluminium for the metal

metal but count rate is background **or** no radiation passing through **or** a higher
reading would be recorded **or** to reduce the count to 2 would require <u>much
more</u> than 3 mm of metal
accept lead / aluminium for the metal

1
[3]

M8. (i) 50 ± 5

1

(ii) 50 ± 5
accept their (b)(i)
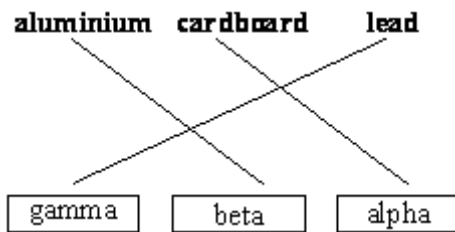
1

(iii) less
accept any way of indicating the correct answer

1
[3]

M9. (a) (i) **P**

1

(ii) **Q**

1

(b) 3 lines correct

aluminium   cardboard   lead

gamma   beta   alpha

*allow **1** mark for 1 correct line*
two lines drawn from any source or box – both incorrect

2

(c) (i) **K**

1

(ii) 56
accept 50 – 60 inclusive

1

(iii) **K**

1

(iv) to inject... tracer

1

**[8]**

M10. (a) (i) nuclear reactor

1

star

1

(ii) nuclei are joined (not split)

accept converse in reference to nuclear fission

*do **not** accept atoms are joined*

1

(b) (i) any **four** from:

- neutron
- (neutron) absorbed by U (nucleus)

  ignore atom

  *do **not** accept reacts*

  *do **not** accept added to*
- forms a larger nucleus
- (this larger nucleus is) unstable
- (larger nucleus) splits into two (smaller) <u>nuclei</u> / into Ba and Kr
- releasing <u>three</u> neutrons and energy

  accept fast-moving for energy

4

(ii) 56 (Ba)

1

57 (La)

*if proton number of Ba is incorrect allow **1** mark if that of La is 1 greater*

1

$_{-1}^{0}\beta$

accept e for β

$$_{56}^{139}\text{Ba} \longrightarrow {}_{57}^{139}\text{La} + {}_{-1}^{0}\beta$$
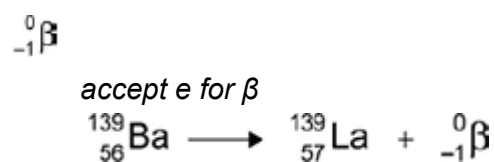
*scores **3** marks*

1

[10]

M11.   (a)   (i)   200 to 50

accept either order

1

(ii)   5.3

accept values between 5.2 and 5.4 inclusive

1

(iii)   5.3

accept values between 5.2 and 5.4 inclusive
or their (a)(ii)

1

(b)   (i)   Make the conveyor belt move more slowly

1

(ii)   lead

1

(c)   Exposure increased the content of some types of vitamin.

1

[6]