

- 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

for 1 mark

accept alpha equals ${}^4_2\text{He}$ 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 fixed distance apart
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 labelled 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 but not betas
accept paper for the card

1

beta: the count rate is (greatly) reduced by the metal **or** the thin metal absorbs
alphas and 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 much
more 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

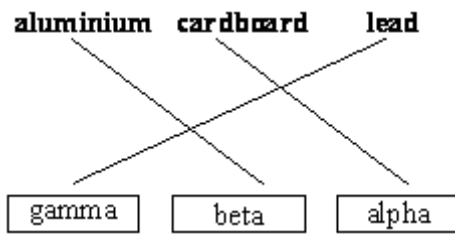
(iii) less
accept any way of indicating the correct answer

1

[3]

- M9. (a) (i) P 1
- (ii) Q 1

(b) 3 lines correct



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

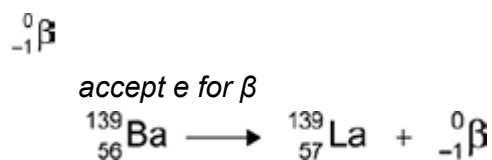
(ii) nuclei are joined (not split) 1
accept converse in reference to nuclear fission
do not accept atoms are joined

(b) (i) any **four** from: 4

- 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) nuclei / into Ba and Kr
- releasing three neutrons and energy
accept fast-moving for energy

(ii) 56 (Ba) 1

57 (La) 1
if proton number of Ba is incorrect allow 1 mark if that of La is 1 greater



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]