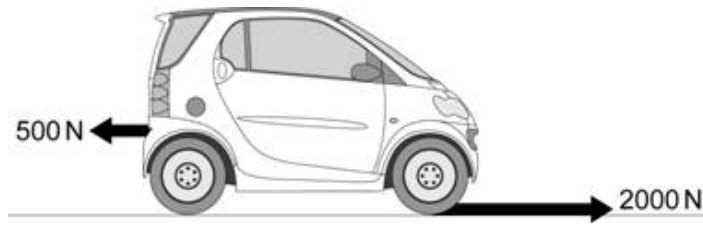


- Q1.** (a) The diagram shows the horizontal forces acting on a car travelling along a straight road.



- (i) Calculate the size of the resultant force acting on the car.  
Show clearly how you work out your answer.

.....  
.....

Resultant force = ..... N

(2)

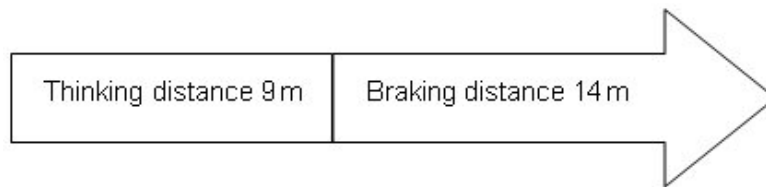
- (ii) Describe the motion of the car when the forces shown in the diagram act on it.

.....  
.....  
.....  
.....

(2)

- (b) A car driver makes an emergency stop.

The chart shows the 'thinking distance' and the 'braking distance' needed to stop the car.



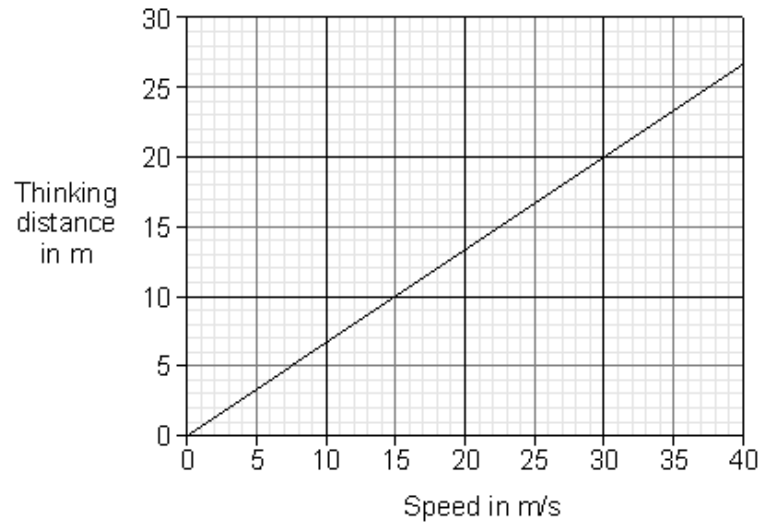
- (i) Calculate the total stopping distance of the car.

.....

Stopping distance = ..... m

(1)

(ii) The graph shows that speed affects thinking distance.



Use the graph to find the thinking distance for a car driven at 30 m/s.

Thinking distance = ..... m

(1)

(iii) Give **one** further factor that will affect the thinking distance.

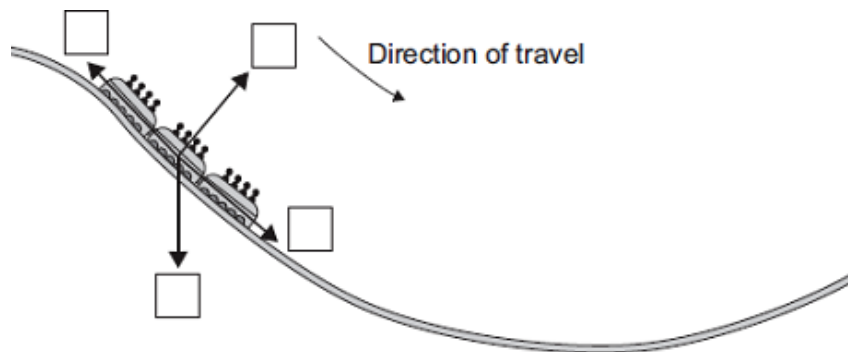
.....

(1)

(Total 7 marks)

**Q2.** The diagram shows the passenger train on part of a rollercoaster ride.

(a) Which arrow shows the direction of the resultant force acting on the passenger train?  
Put a tick (✓) in the box next to your choice.



(1)

- (b) For part of the ride, the maximum gravitational field strength acting on the passengers seems 3 times bigger than normal.

Normal gravitational field strength = 10 N/kg

- (i) Calculate the maximum gravitational field strength that seems to act on the passengers during the ride.

.....  
 .....

Maximum gravitational field strength = ..... N/kg

(1)

- (ii) One of the passengers has a mass of 75 kg.

Use the equation in the box to calculate the maximum weight this passenger seems to have during the ride.

$\text{weight} = \text{mass} \times \text{gravitational field strength}$
--

Show clearly how you work out your answer.

.....  
 .....

Maximum weight = ..... N

(2)

(Total 4 marks)

- Q3.** (a) Two skydivers jump from a plane. Each holds a different position in the air.



**A**



**B**

*Adapted from Progress with Physics by Nick England, reproduced by permission of Hodder Arnold*

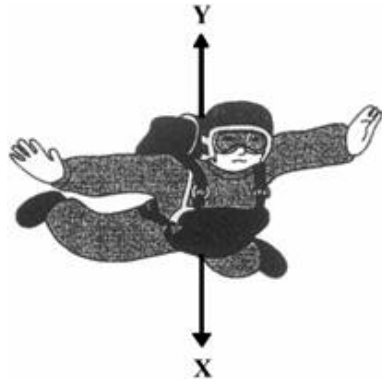
Complete the following sentence.

Skydiver ..... will fall faster because.....

.....  
 .....

(2)

The diagram shows the direction of the forces acting on one of the skydivers.



Adapted from *Progress with Physics* by Nick England, reproduced by permission of Hodder Arnold

(b) In the following sentences, cross out in each box the **two** lines that are wrong.

(i) Force **X** is caused by 

air resistance
friction
gravity

 (1)

(ii) Force **Y** is caused by 

air resistance
gravity
weight

 (1)

(iii) When force **X** is bigger than force **Y**, the speed of the

skydiver will 

go up
stay the same
go down

 (1)

(iv) After the parachute opens, force **X**

goes up
stays the same
goes down

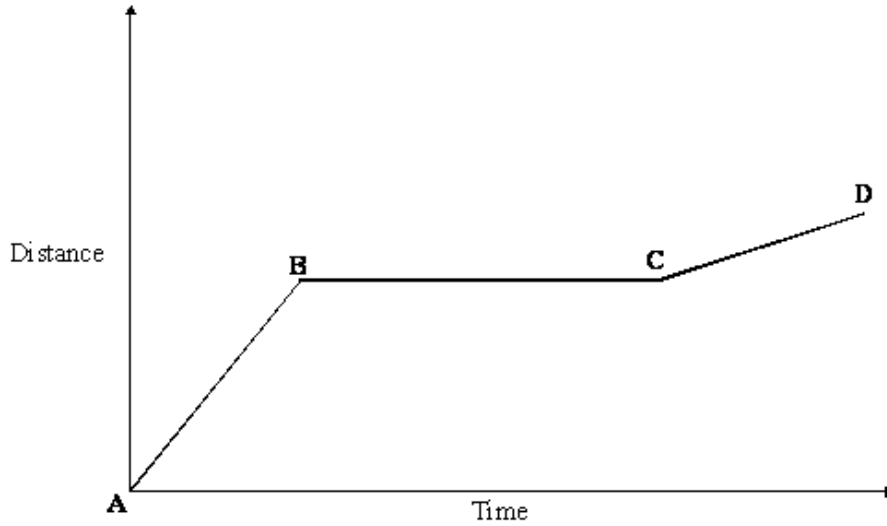
 (1)

(c) How does the area of an opened parachute affect the size of force **Y**?

.....  
.....

(1)  
(Total 7 marks)

**Q4.** The graph shows the distance a person walked on a short journey.



(a) Choose from the phrases listed to complete the statements which follow. You may use each statement once, more than once or not at all.

- standing still
- walking at constant speed
- walking with an increasing speed
- walking with a decreasing speed

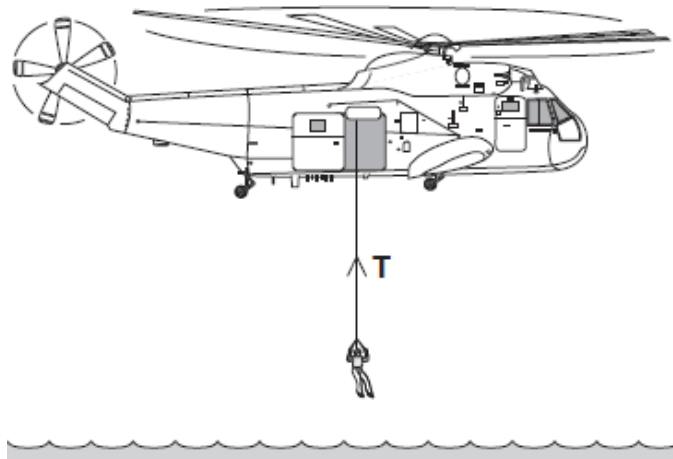
(i) Between points **A** and **B** the person is  
 ..... (1)

(ii) Between points **B** and **C** the person is  
 ..... (1)

(b) Complete the sentence.  
 You can tell that the speed of the person between points **A** and **B** is .....  
 than the speed between points **C** and **D** because .....  
 ..... (2)

(c) Write the equation which relates distance, speed and time.  
 ..... (1)  
**(Total 5 marks)**

**Q5.** The diagram shows a helicopter being used to rescue a person from the sea.



(a) (i) The mass of the rescued person is 72 kg.

Use the equation in the box to calculate the weight of the rescued person.

$\text{weight} = \text{mass} \times \text{gravitational field strength}$
--

gravitational field strength = 10 N/kg

Show clearly how you work out your answer.

.....  
 .....

Weight = ..... N

(2)

(ii) An electric motor is used to lift the person up to the helicopter.  
 The motor lifts the person at a constant speed.

State the size of the force, **T**, in the cable.

Force **T** = ..... N

(1)

(b) To lift the person up to the helicopter, the electric motor transformed 21 600 joules of energy usefully.

(i) Use a form of energy from the box to complete the following sentence.

gravitational potential      heat      sound
--

The electric motor transforms electrical energy to kinetic energy. The kinetic energy is then transformed into useful ..... energy.

(1)

- (ii) It takes 50 seconds for the electric motor to lift the person up to the helicopter.

Use the equation in the box to calculate the power of the electric motor.

$$\text{power} = \frac{\text{energy transformed}}{\text{time}}$$

Show clearly how you work out your answer and give the unit.

Choose the unit from the list below.

coulomb (C)

hertz (Hz)

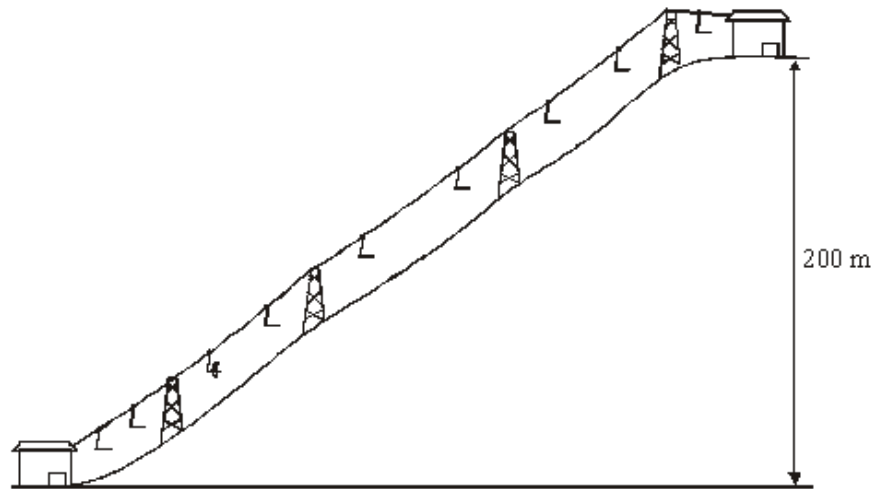
watt (W)

.....  
.....

Power = .....

(3)  
(Total 7 marks)

- Q6.** (a) A chair lift carries two skiers, Greg and Jill, to the top of a ski slope. Greg weighs 700 N and Jill weighs 500 N.



- (i) Write down the equation that links distance moved, force applied and work done.

.....

(1)

- (ii) Calculate the work done to lift Greg and Jill through a vertical height of 200 m. Show clearly how you work out your answer and give the unit.

.....  
.....  
.....

work done = .....

(3)

- (b) The chair takes 5 minutes to move from the bottom to the top of the ski slope.

Use the following equation to calculate the power required to lift Greg and Jill to the top of the ski slope. Show clearly how you work out your answer.

$$\text{power} = \frac{\text{work done}}{\text{time taken}}$$

.....  
.....

power = ..... watts

(2)

- (c) The chair lift is driven by an electric motor.

- (i) Why would the power output of the electric motor need to be larger than your answer to part (b)?

.....  
.....

(1)

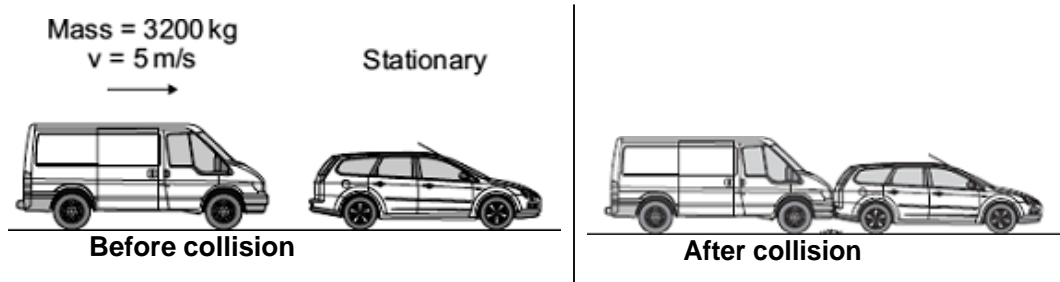
- (ii) Complete the following sentence.

When the ski lift is working ..... energy supplied to the motor  
is usefully transferred as gravitational ..... energy.

(1)

**(Total 8 marks)**

- Q7.** (a) A van has a mass of 3200 kg. The diagram shows the van just before and just after it collides with the back of a car.



Just before the collision, the van was moving at 5 m/s and the car was stationary.

- (i) Use the equation in the box to calculate the momentum of the van just before the collision.

$\text{momentum} = \text{mass} \times \text{velocity}$
--

Show clearly how you work out your answer.

.....  
 .....

Momentum = ..... kg m/s

(2)

- (ii) The collision makes the van and car join together.

What is the total momentum of the van and the car just after the collision?

Momentum = ..... kg m/s

(1)

- (iii) Complete the following sentence by drawing a ring around the correct line in the box.

The momentum of the car before the collision is 

more than
the same as
less than

 the

momentum of the car after the collision.

(1)

- (b) A seat belt is one of the safety features of a car.



In a collision, wearing a seat belt reduces the risk of injury.

Use words or phrases from the box to complete the following sentences.

decreases      stays the same      increases

In a collision, the seat belt stretches. The time it takes for the person held by the seat belt to lose momentum compared to a person not wearing a seat belt,

.....

The force on the person's body ..... and so reduces the risk of injury.

(2)  
(Total 6 marks)

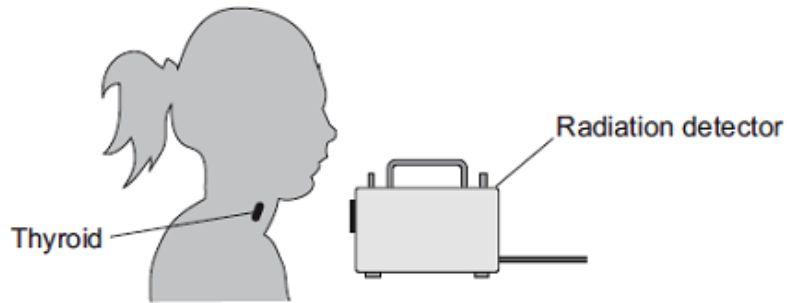
- Q8.** (a) The names of three types of radiation are given in **List A**. Some properties of these three types of radiation are given in **List B**.

Draw **one** line from each type of radiation in **List A** to its correct property in **List B**.

<b>List A</b> Type of radiation	<b>List B</b> Property of radiation
alpha	will pass through paper but is stopped by thin metal
beta	has the shortest range in air
gamma	will not harm human cells
	is very weakly ionising

(3)

- (b) The radioactive isotope iodine-123 can be used by a doctor to examine the thyroid gland of a patient. The iodine, taken as a tablet, is absorbed by the thyroid gland. The gamma radiation emitted as the iodine atoms decay is detected outside the body.



The doctor uses an isotope emitting gamma radiation to examine the thyroid gland rather than an isotope emitting alpha or beta radiation.

Which **one** of the following gives a reason why gamma radiation is used?

Tick (✓) **one** box.

- Gamma radiation will pass through the body.
- Gamma radiation is not deflected by a magnet.
- Gamma radiation has a long range in air.

(1)

- (c) Iodine-123 has a half-life of 13 hours.

Use a word from the box to complete the sentence.

<b>all</b>	<b>half</b>	<b>most</b>
------------	-------------	-------------

After 13 hours ..... of the iodine-123 atoms the thyroid absorbed have decayed.

(1)

(d) Iodine-123 and iodine-131 are two of the isotopes of iodine.

Draw a ring around the correct answer to complete the sentence.

The nucleus of an iodine-123 atom has the same number of

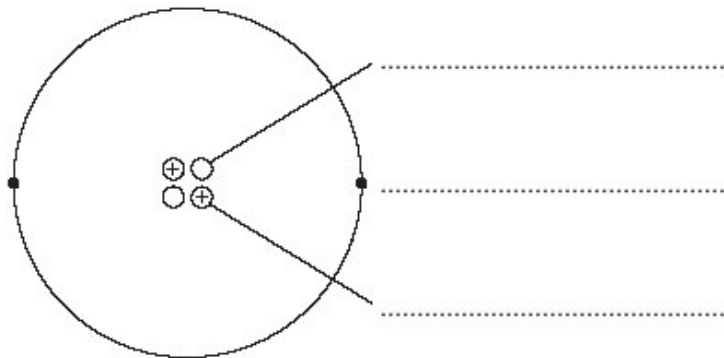
- |           |
|-----------|
| electrons |
| neutrons  |
| protons   |

as the

nucleus of an iodine-131 atom.

(1)  
(Total 6 marks)

**Q9.** The diagram shows a helium atom.



(a) (i) Use the words in the box to label the diagram.

- |                 |                |               |
|-----------------|----------------|---------------|
| <b>electron</b> | <b>neutron</b> | <b>proton</b> |
|-----------------|----------------|---------------|

(2)

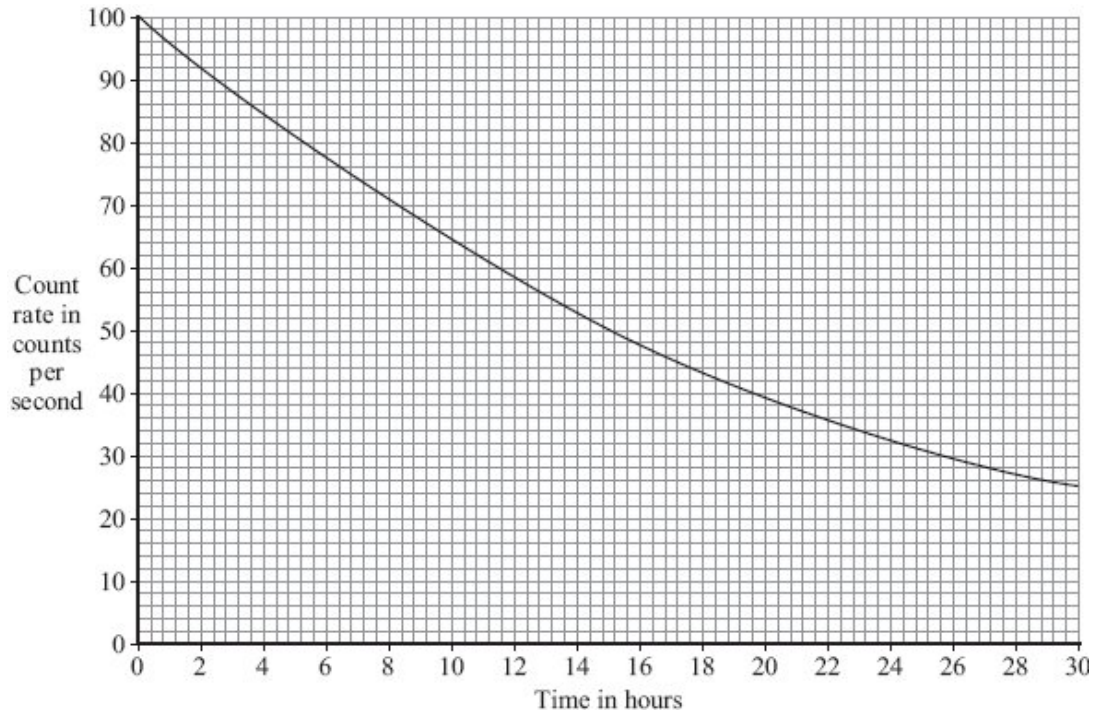
(ii) An alpha particle is the same as the nucleus of a helium atom.

How is an alpha particle different from a helium atom?

.....  
.....

(1)

- (b) The graph shows how the count rate from a sample of radioactive sodium-24 changes with time.



- (i) How many hours does it take for the count rate to fall from 100 counts per second to 50 counts per second?

Time = ..... hours

(1)

- (ii) What is the half-life of sodium-24?

Half-life = ..... hours

(1)

- (c) A smoke detector contains a small amount of americium-241.

Americium-241 is a radioactive substance which emits alpha particles. It has a half-life of 432 years.

- (i) Which **one** of the following statements gives a reason why the americium-241 inside the smoke detector will **not** need replacing?

Put a tick (✓) in the box next to your answer.

The alpha particles have a low energy.

People replace smoke detectors every few years.

Americium-241 has a long half-life.

(1)

(ii) The diagram shows the label on the back of the smoke detector.



Why do people need to know that the smoke detector contains a radioactive material?

.....  
.....

(1)  
(Total 7 marks)

**Q10.** Four different processes are described in **List A**. The names of these processes are given in **List B**.

Draw a line to link each description in **List A** to its correct name in **List B**.  
Draw only **four** lines.

**List A**

the nuclei of two atoms  
joining together

the nucleus of an atom  
splitting into several pieces

an atom losing an electron

an electric charge moving  
through a metal

**List B**

gamma emission

electric current

ionisation

nuclear fission

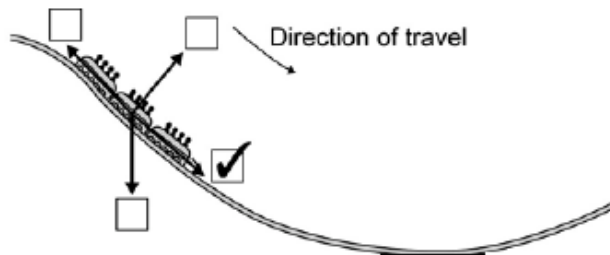
nuclear fusion

(Total 4 marks)

- M1.** (a) (i) 1500  
*allow 1 mark for subtraction shown ie 2000 – 500* 2
- (ii) it accelerates 1  
 in a forward direction  
*accept gains speed/velocity* 1
- (b) (i) 23 (m) 1
- (ii) 20 (m)  
*only this answer* 1
- (iii) any **one** from:  
 • drinking alcohol  
 • taking drugs  
 • tired  
*accept (a specific) distraction*  
*accept any factor that affects the drivers reactions* 1

[7]

- M2.** (a) correct box ticked



- (b) (i) 30  
*ignore added units* 1

- (ii) 2250 **or** their (b)(i)  $\times$  75 correctly calculated  
*allow 1 mark for correct substitution ie  $75 \times 30$  **or** their (b)(i)  $\times$  75  
 provided no subsequent step shown  
 an answer of 750 gains 1 mark only if answer to (b)(i) is 10*

2

[4]

**M3.** (a) B

more aerodynamic **or** most streamlined shape **or**  
 smaller (surface) area

*accept less air/wind resistance **or** less drag **or** less friction clothing  
 traps less air **or** rolled up into ball **or** arms, legs drawn in  
 accept converse*

2

(b) (i) gravity

1

(ii) air resistance

1

(iii) go up

1

(iv) stays the same

1

(c) bigger the area, the bigger force Y

*accept the converse*

**or** bigger the area more drag

*accept when the parachute opens then force Y bigger*

**or** bigger the area more air resistance

*need the relation of area to force*

1

[7]

**M4.** (a) (i) walking at constant speed

1

(ii) standing still

1

(b) is higher **or** faster

*accept less time to walk more distance (both time and distance  
 must be mentioned)*

1

the slope of graph is steeper

*accept slope is more*

1

(c)  $\text{speed} = \frac{\text{distance}}{\text{time}}$

*accept suitable symbols used in correct formula  
do not accept a triangle*

1

[5]

**M5.** (a) (i) 720

*allow 1 mark for correct substitution,  
ie  $72 \times 10$  provided no subsequent step shown*

2

(ii) 720  
**or**  
their (a)(i)

1

(b) (i) gravitational potential  
*allow gravitational  
allow potential*

1

(ii) 432

*allow 1 mark for correct substitution, ie  $\frac{21600}{50}$  provided no  
subsequent step shown*


2

watt / W

1

[7]

**M6.** (a) (i) work (done) = force (applied)  $\times$  distance (moved)  
*accept  $W = F \times s$  or  $W = F \times d$*

*accept*  *provided subsequent method is correct*

1

(ii) 240 000

*allow 1 mark for correct substitution **or** correct use of 1200 (N)*

2

joules

*accept J  
do **not** accept  $j / Nm$*

1

(b) 800 (watts)

*accept 0.8 kW*

*accept their (a)(ii) ÷ 300 correctly evaluated for 2 marks*

*allow 1 mark for correct substitution*

*(a)(ii) ÷ 5 correctly evaluated for 1 mark*

2

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

- needs to raise the chair / lift

- lifting more than one chair

*allow lifting more than 2 people*

*implication of a heavier weight*

- energy transfer to the surroundings

*correctly qualified*

*accept loss for transfer*

*do **not** accept motor inefficient*

*do **not** accept motor gets hot*

*do **not** accept friction unless the location is specified as external to the motor*

1

(ii) electrical

*accept electric*

potential

***both** answers required for the mark*

1

[8]

**M7.** (a) (i) 16 000

*allow 1 mark for correct substitution ie 3200 × 5*

2

(ii) 16 000 or their (a)(i)

1

(iii) less than

1

(b) increases

1

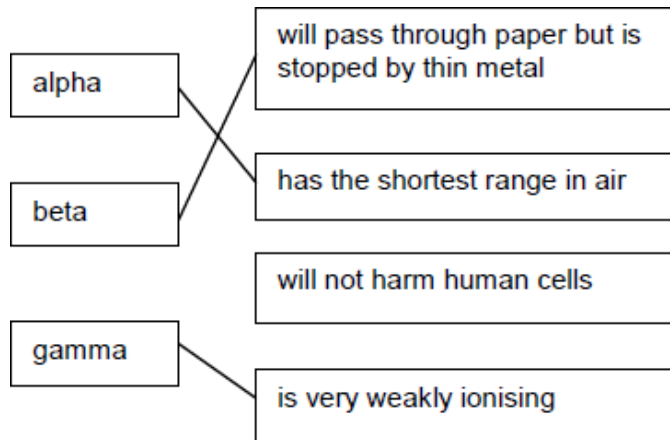
decreases

*correct order only*

1

[6]

M8. (a) 3 lines correct



allow 1 mark for each correct line  
if more than one line is drawn from any type of radiation box then all of those lines are wrong

3

(b) Gamma radiation will pass through the body

1

(c) half

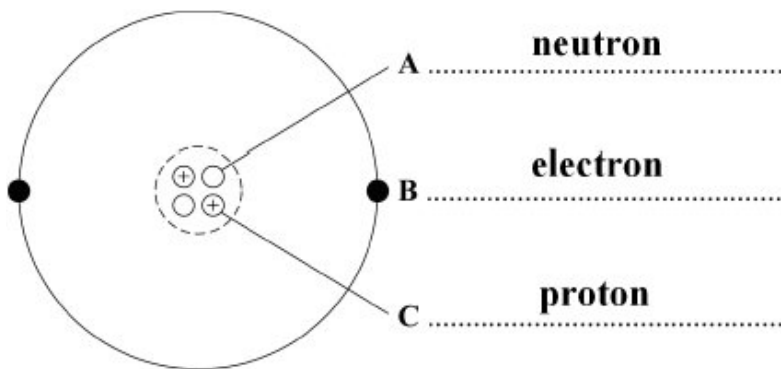
1

(d) protons

1

[6]

M9. (a) (i)



all 3 labels correct  
allow 1 mark for 1 correct label

2

- (ii) has no electrons  
*it = alpha*  
*allow alpha has a positive(charge)*  
*allow a helium (atom) has no (charge)*  
*do **not** accept general properties of alpha*  
*do **not** accept general answers in terms of size / density / mass*  
*etc* 1
- (b) (i) 15 (hours)  
*accept any answer between 14.8 and 15.2 inclusive* 1
- (ii) 15 (hours) or their (b) (i) 1
- (c) (i) americium-241 has a long half life 1
- (ii) any **one** from:
- alpha (particles) are harmful to ...  
*accept radiation / radioactive material is harmful to ...*  
*accept specific example of harm*  
*eg can cause cancer*  
*accept radiation is poisonous if ingested / inhaled*  
*do **not** accept it is poisonous / in case of leakage*
  - so they dispose of it safely / appropriately
  - so they don't break it open / open it  
*accept do **not** touch the radioactive source*
  - so they can make a choice about having a radioactive source (in the house)  
*it = radioactive material* 1

[7]

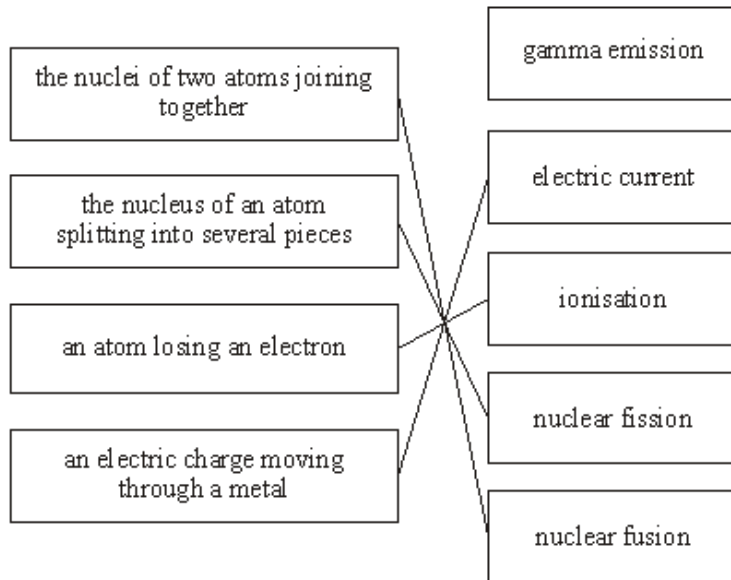
**M10.** four lines correct

*allow 1 mark for each correct line*

*if more than 1 line is drawn from a box in List A, mark each line incorrect*

**List A**

**List B**



[4]

