Q1. (a) Two skydivers jump from a plane. Each holds a different position in the air.



A



B

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Complete the following sentence.

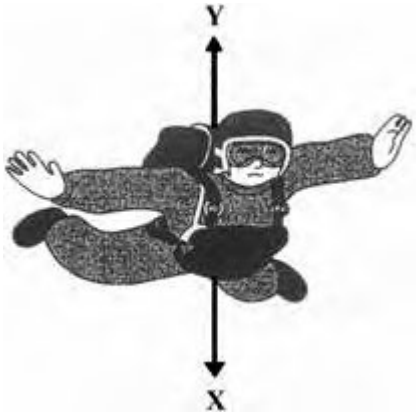
Skydiver ..... will fall faster because.....

.....

.....

(2)

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



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(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**?

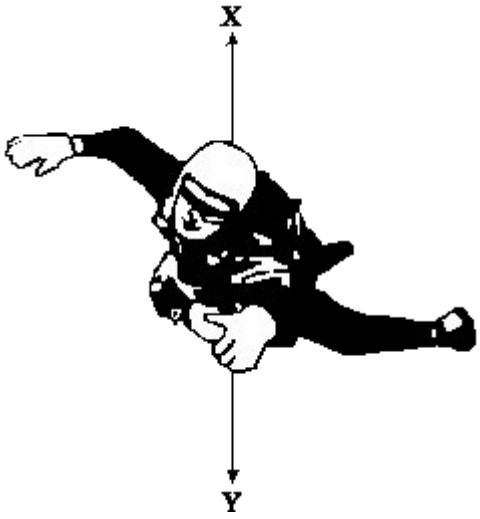
.....

.....

(1)

(Total 7 marks)

Q2. The diagram shows a sky-diver in free fall. Two forces, **X** and **Y**, act on the sky-diver.



(a) Complete these sentences by crossing out the **two** lines in each box that are wrong.

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

friction
gravity
weight

. **(1)**

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

air resistance
friction
gravity

. **(1)**

(b) The size of force **X** changes as the sky-diver falls. Describe the motion of the sky-diver when:

(i) force **X** is smaller than force **Y**,

.....

..... **(2)**

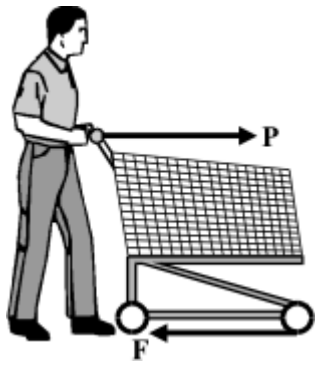
(ii) force **X** is equal to force **Y**.

.....

.....

(1)
(Total 5 marks)

Q3. (a) A shopping trolley is being pushed at a constant speed. The arrows represent the horizontal forces on the trolley.

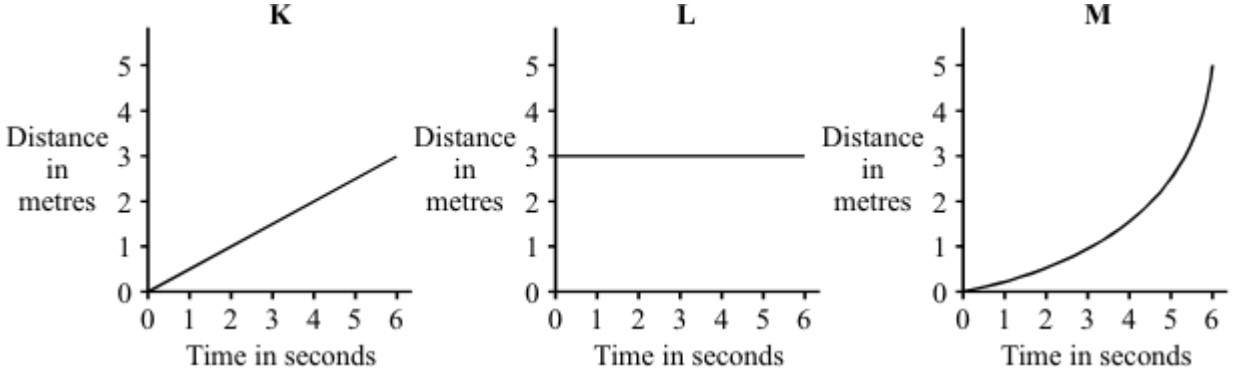


(i) How big is force **P** compared to force **F**?

.....

(1)

(ii) Which **one** of the distance-time graphs, **K**, **L** or **M**, shows the motion of the trolley? Draw a circle around your answer.



(1)

(b) Complete the sentence by crossing out the **two** words in the box that are wrong.

energy.
speed.
velocity.

Acceleration is the rate of change of

(1)

(c) Three trolleys, **A**, **B** and **C**, are pushed using the same size force. The force causes each trolley to accelerate.



A



B



C

Which trolley will have the smallest acceleration?

.....

Give a reason for your answer.

.....

(2)
(Total 5 marks)

Q4.(a) The diagrams, **A**, **B** and **C**, show the horizontal forces acting on a **moving** car.

Draw a line to link each diagram to the description of the car's motion at the moment when the forces act.

Draw only **three** lines.



A



B

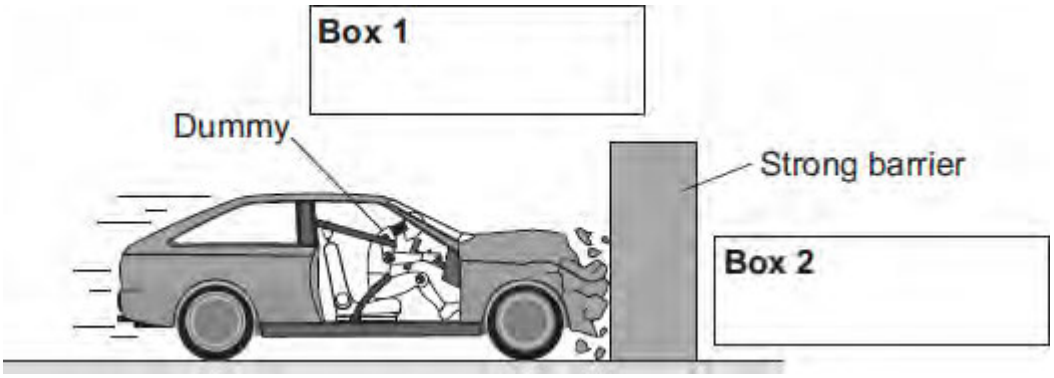


C

stationary
constant speed
slowing down
accelerating forwards

(3)

(b) The front crumple zone of a car is tested at a road traffic laboratory. This is done by using a remote control device to drive the car into a strong barrier. Electronic sensors are attached to a dummy inside the car.



(i) Draw an arrow in **Box 1** to show the direction of the force that the car exerts on the barrier.

(1)

(ii) Draw an arrow in **Box 2** to show the direction of the force that the barrier exerts on the car.

(1)

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

The car exerts a force of 5000 N on the barrier. The barrier does not move. The force

exerted by the barrier on the car will be | more than / equal to / less than | 5000 N.

(1)

(iv) Which **one** of the following gives the most likely reason for attaching electronic sensors to the dummy?

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

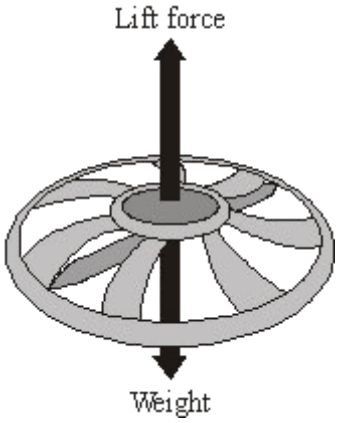
To measure the speed of the car just before the impact. ☐

To measure the forces exerted on the dummy during the impact. ☐

To measure the distance the car travels during the impact. ☐

(1)
(Total 7 marks)

Q5. The diagram shows the forces on a small, radio-controlled, flying toy.



(a) (i) The mass of the toy is 0.06 kg.
Gravitational field strength = 10 N/kg

Calculate the weight of the toy.

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

.....

.....

Weight = ...

(3)

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

When the toy is hovering stationary in mid-air, the lift force is

bigger than	
the same as	the weight of the toy.
smaller than	

(1)

(b) When the motor inside the toy is switched off, the toy starts to *accelerate* downwards.

(i) What does the word *accelerate* mean?

.....

(1)

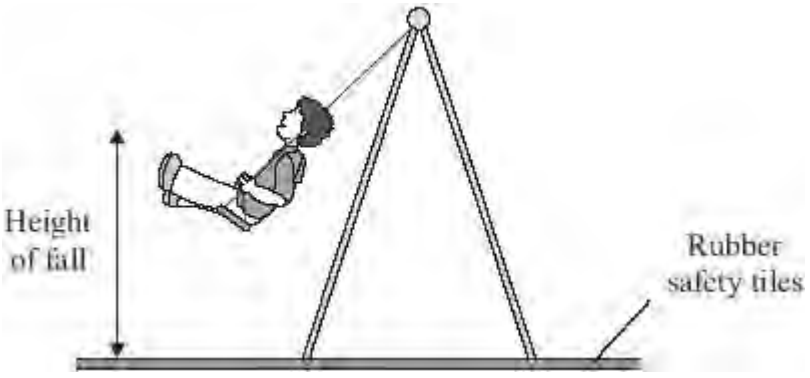
(ii) What is the direction of the resultant force on the falling toy?

.....

(1)

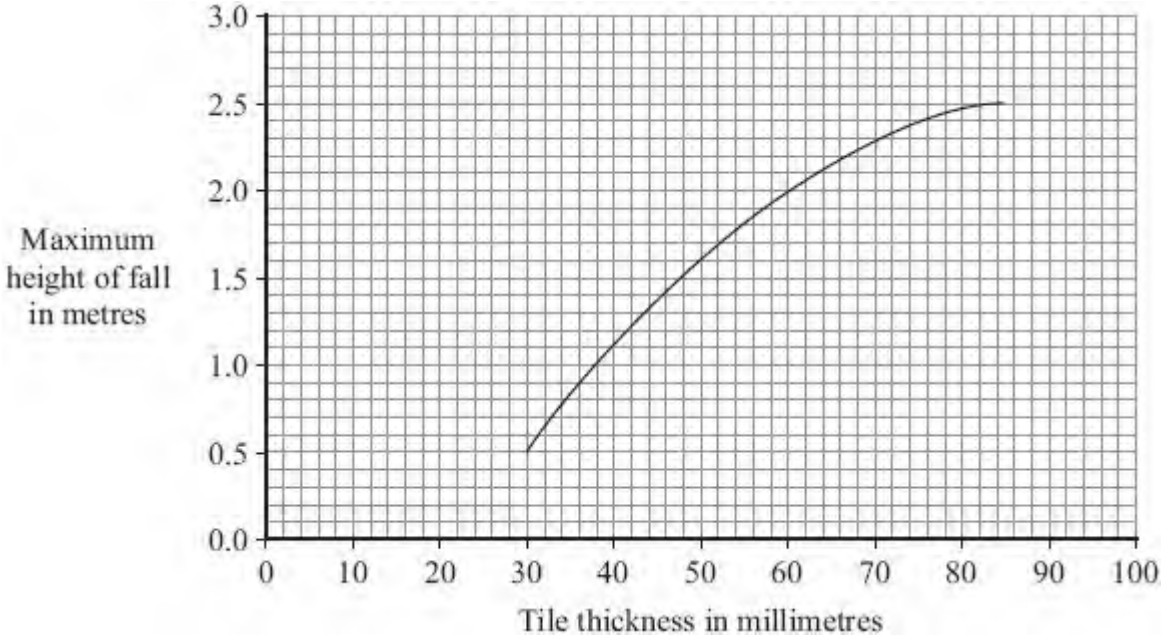
(Total 6 marks)

Q6. The diagram shows a child on a playground swing.



The playground surface is covered in rubber safety tiles. The tiles reduce the risk of serious injury to children who fall off the swing.

The graph gives the maximum height that a child can fall onto rubber safety tiles of different thicknesses and be unlikely to get a serious head injury.



(i) Describe how the maximum height of fall relates to the thickness of the rubber safety tile.

.....

.....

(1)

(ii) The maximum height of any of the playground rides is 2 metres.

What tile thickness should be used in the playground?

.....

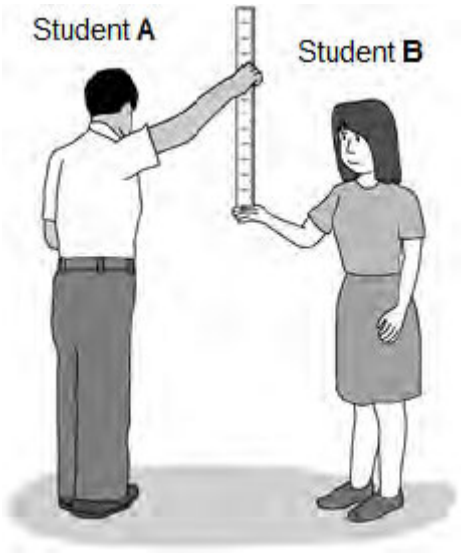
Give a reason for your answer.

.....

.....

(2)
(Total 3 marks)

Q7.(a) The figure below shows two students investigating reaction time.



Student **A** lets the ruler go.

Student **B** closes her hand the moment she sees the ruler fall.

This investigation can be used to find out if listening to music changes the reaction times of a student.

Explain how.

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4)

(b) A second group of students used a stop clock and computer simulation test to measure their reaction times.

The table below shows their results.

Student	Reaction time in seconds		
	Test 1	Test 2	Test 3
X	0.44	0.40	0.34
Y	0.28	0.24	0.22
Z	0.36	0.33	0.47

Give **one** conclusion that can be made from the results for student **X** and student **Y**.

.....

.....

(1)

(c) Test **3** for student **Z** gave an anomalous result.

Suggest **two** possible reasons why this anomalous result occurred.

1 .....

.....

2 .....

.....

(2)

(Total 7 marks)

Q8. Some students designed and built an electric-powered go-kart.
The go-kart is shown below.



(a) Suggest **two** changes that could be made to the design of the go-kart to increase its top speed.

1 .....

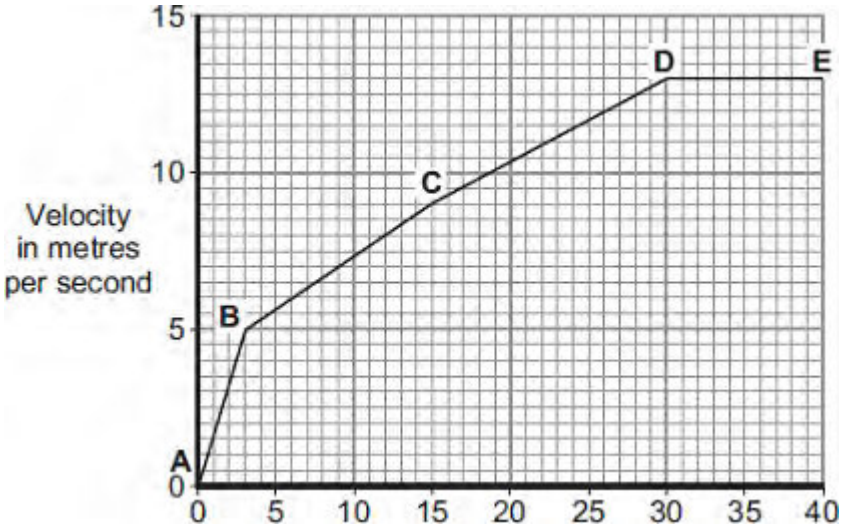
.....

2 .....

.....

(2)

(b) A go-kart with a new design is entered into a race.
The velocity-time graph for the go-kart, during the first 40 seconds of the race, is shown below.



(i) Between which **two** points did the go-kart have the greatest acceleration?

Tick (✓) **one** box.

A–B ☐

B–C ☐

C–D ☐

Give a reason for your answer.

.....

.....

(2)

(ii) The go-kart travels at a speed of 13 m/s between points **D** and **E**.
The total mass of the go-kart and driver is 140 kg.

Calculate the momentum of the go-kart and driver between points **D** and **E**.

.....

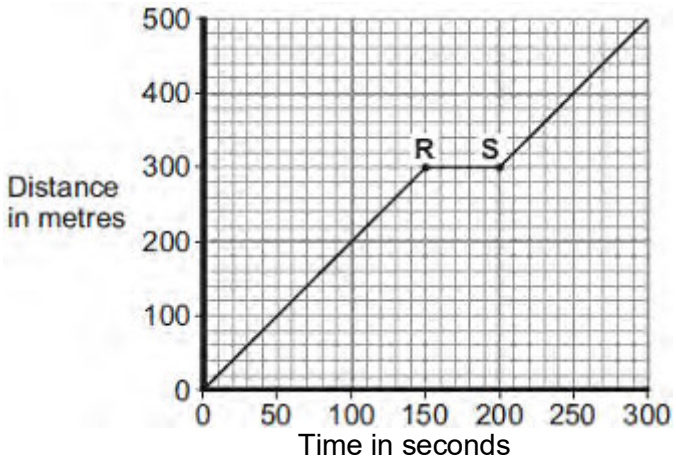
.....

Momentum = ... kg m/s

(2)
(Total 6 marks)

Q9.(a) **Figure 1** shows the distance–time graph for a person walking to a bus stop.

Figure 1



(i) Which **one** of the following statements describes the motion of the person between points **R** and **S** on the graph?

Tick (✓) **one** box.

Not moving ☐

Moving at constant speed ☐

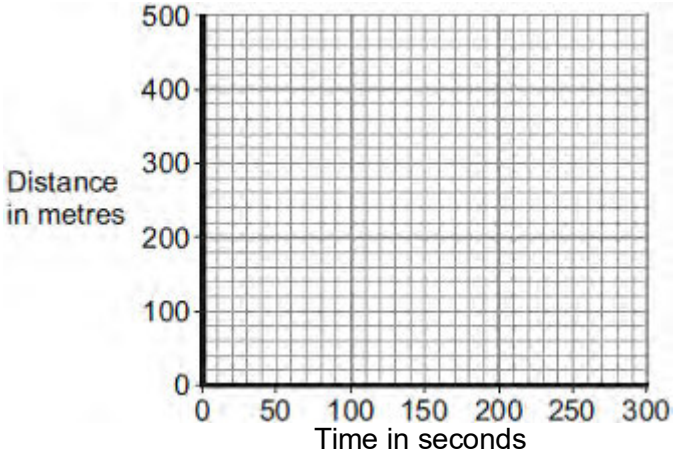
Moving with increasing speed ☐

(1)

(ii) Another person, walking at constant speed, travels the same distance to the bus stop in 200 seconds.

Complete **Figure 2** to show a distance–time graph for this person.

Figure 2



(1)

(b) A bus accelerates away from the bus stop at 2.5 m/s^2.

The total mass of the bus and passengers is 14 000 kg.

Calculate the resultant force needed to accelerate the bus and passengers.

.....

.....

.....

Resultant force = ... N

(2)
(Total 4 marks)