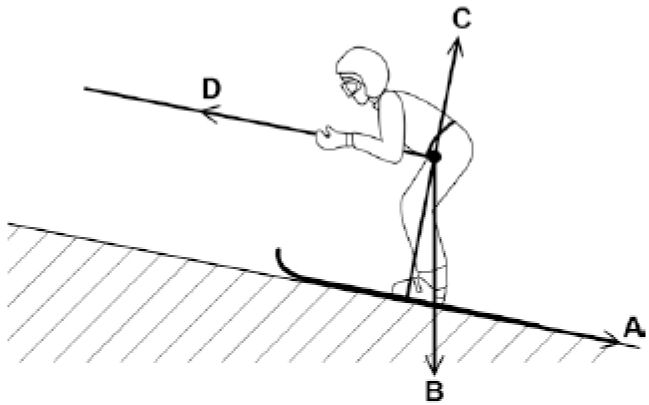
1 **Figure 1** shows a skier using a drag lift.

The drag lift pulls the skier from the bottom to the top of a ski slope.

The arrows, **A**, **B**, **C** and **D** represent the forces acting on the skier and her skis.

Figure 1



(a) Which arrow represents the force pulling the skier up the slope?

Tick **one** box.

A ☐

B ☐

C ☐

D ☐

(1)

(b) Which arrow represents the normal contact force?

Tick **one** box.

A ☐

B ☐

C ☐

D ☐

(1)

(c) The drag lift pulls the skier with a constant resultant force of 300N for a distance of 45 m.

Use the following equation to calculate the work done to pull the skier up the slope.

work done = force × distance

____

____

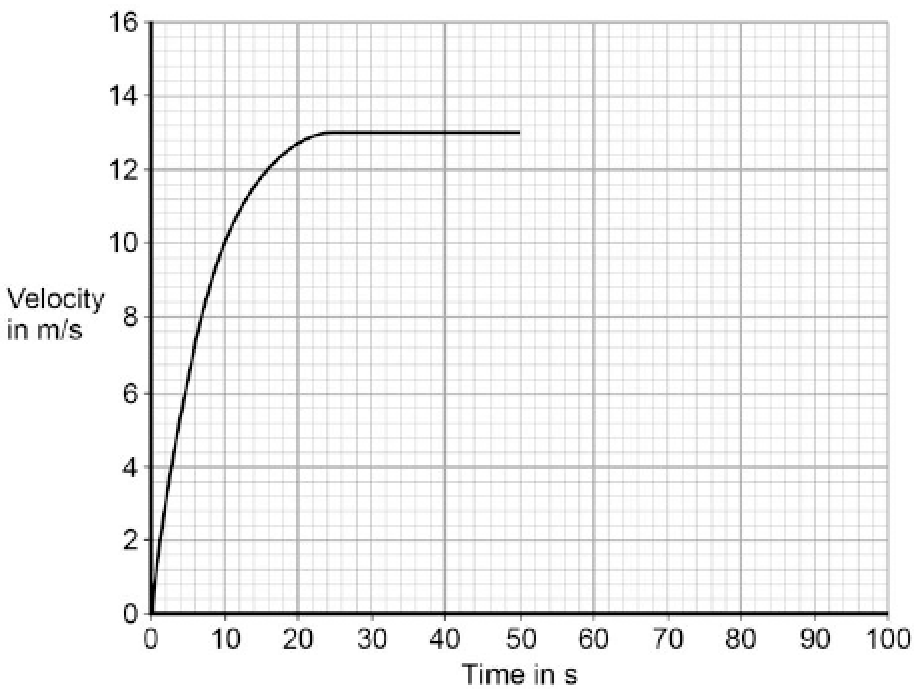
Work done = ___________________________ J

(2)

(d) At the top of the slope the skier leaves the drag lift and skis back to the bottom of the slope.

Figure 2 shows how the velocity of the skier changes with time as the skier moves down the slope.

Figure 2



After 50 seconds the skier starts to slow down.

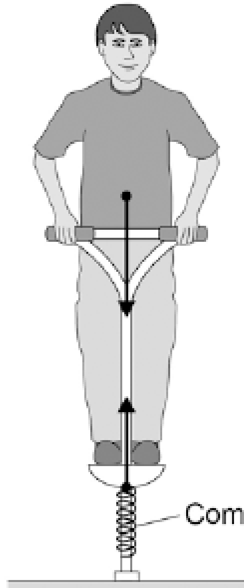
The skier decelerates at a constant rate coming to a stop in 15 seconds.

Draw a line on **Figure 2** to show the change in velocity of the skier as she slows down and comes to a stop.

(2)
(Total 6 marks)

2 The figure below shows the forces acting on a child who is balancing on a pogo stick.

The child and pogo stick are not moving.



(a) The downward force of the child on the spring is equal to the upward force of the spring on the child.

This is an example of which one of Newton's Laws of motion?

Tick **one** box.

First Law ☐

Second Law ☐

Third Law ☐

(1)

(b) Complete the sentence.

Use an answer from the box.

elastic potential	**gravitational potential**	**kinetic**

The compressed spring stores ______________________ energy.

(1)

(c) The child has a weight of 343 N.

Gravitational field strength = 9.8 N / kg

Write down the equation which links gravitational field strength, mass and weight.

____

(1)

(d) Calculate the mass of the child.

____

____

____

Mass = ___________________________ kg

(3)

(e) The weight of the child causes the spring to compress elastically from a length of 30cm to a new length of 23cm.

Write down the equation which links compression, force and spring constant.

____

(1)

(f) Calculate the spring constant of the spring.

Give your answer in newtons per metre.

____

____

____

Spring constant = ___________________________ N / m

(4)

(Total 11 marks)

3 The stopping distance of a car is the sum of the thinking distance and the braking distance.

The table below shows how the thinking distance and braking distance vary with speed.

Speed in m / s	**Thinking distance in m**	**Braking distance in m**
10	6	6.0
15	9	13.5
20	12	24.0
25	15	37.5
30	18	54.0

(a) What is meant by the braking distance of a vehicle?

____

____

(1)

(b) The data in the table above refers to a car in good mechanical condition driven by an alert driver.

Explain why the stopping distance of the car increases if the driver is very tired.

____

____

____

____

(2)

(c) A student looks at the data in the table above and writes the following:

thinking distance ∝ speed

thinking distance ∝ speed

Explain whether the student is correct.

____

____

____

____

(2)

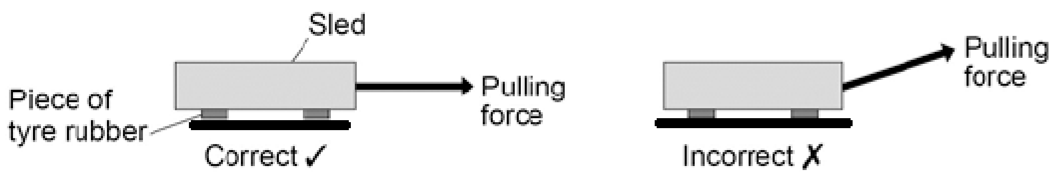
(d) Applying the brakes with too much force can cause a car to skid.

The distance a car skids before stopping depends on the friction between the road surface and the car tyres and also the speed of the car.

Friction can be investigated by pulling a device called a ‘sled’ across a surface at constant speed.

The figure below shows a sled being pulled correctly and incorrectly across a surface.

The constant of friction for the surface is calculated from the value of the force pulling the sled and the weight of the sled.



Why is it important that the sled is pulled at a constant speed?

Tick **one** box.

If the sled accelerates it will be difficult to control. ☐

If the sled accelerates the value for the constant of friction will be wrong. ☐

If the sled accelerates the normal contact force will change. ☐

(1)

(e) If the sled is pulled at an angle to the surface the value calculated for the constant of friction would not be appropriate.

Explain why.

___

___

___

___

(2)

(f) By measuring the length of the skid marks, an accident investigator determines that the distance a car travelled between the brakes being applied and stopping was 22 m.

The investigator used a sled to determine the friction. The investigator then calculated that the car decelerated at 7.2 m / s^2.

Calculate the speed of the car just before the brakes were applied.

Give your answer to two significant figures.

Use the correct equation from the Physics Equation Sheet.

___

___

___

___

Speed = ___________________________ m / s

(3)

(Total 11 marks)

4 Alpha particles, beta particles and gamma rays are types of nuclear radiation.

(a) Describe the structure of an alpha particle.

___

___

(1)

(b) Nuclear radiation can change atoms into ions by the process of ionisation.

(i) Which type of nuclear radiation is the least ionising?

Tick (✓) **one** box.

alpha particles	☐
beta particles	☐
gamma rays	☐

(1)

(ii) What happens to the structure of an atom when the atom is ionised?

____

____

(1)

(c) People working with sources of nuclear radiation risk damaging their health.

State **one** precaution these people should take to reduce the risk to their health.

____

____

(1)

(d) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

The type of radiation emitted from a radioactive source can be identified by comparing the properties of the radiation to the properties of alpha, beta and gamma radiation.

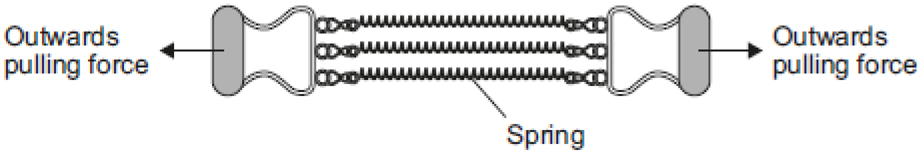
Describe the properties of alpha, beta and gamma radiation in terms of their:

- penetration through materials
- range in air
- deflection in a magnetic field.

(6)
(Total 10 marks)

5 **Figure 1** shows an exercise device called a chest expander. The three springs are identical.

Figure 1



A person pulls outwards on the handles and does work to stretch the springs.

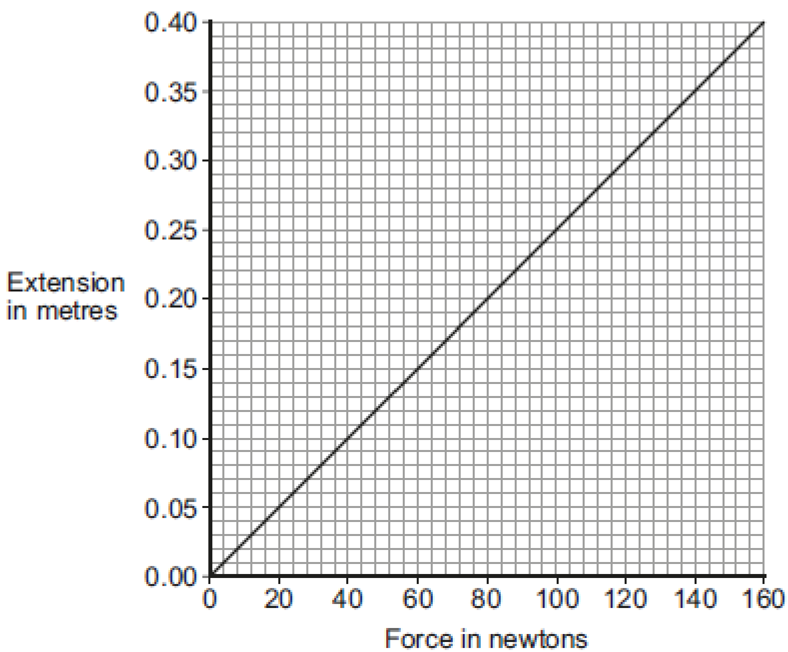
(a) Complete the following sentence.

When the springs are stretched ____________ ____________ energy is stored in the springs.

(1)

(b) **Figure 2** shows how the extension of a single spring from the chest expander depends on the force acting on the spring.

Figure 2



(i) How can you tell, from **Figure 2**, that the limit of proportionality of the spring has not been exceeded?

____

____

(1)

(ii) Use data from **Figure 2** to calculate the spring constant of the spring.
Give the unit.

___

___

___

Spring constant = ____________ Unit ____________

(3)

(iii) Three identical resistors joined in parallel in an electrical circuit share the total current in the circuit.

In a similar way, the three springs in the chest expander share the total force exerted.

By considering this similarity, use **Figure 2** to determine the total force exerted on the chest expander when each spring is stretched by 0.25 m.

___

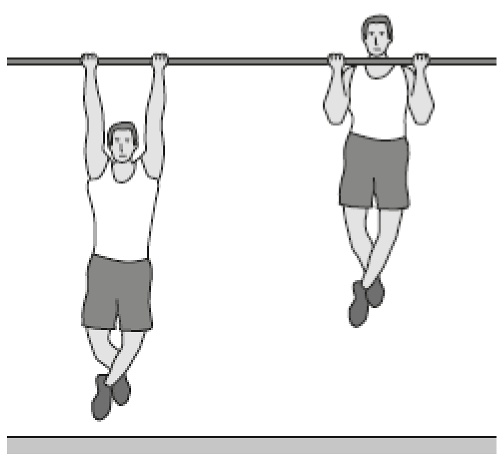
___

Total force = ____________ N

(2)

(c) The student in **Figure 3** is doing an exercise called a chin-up.

Figure 3



Each time the student does one chin-up he lifts his body 0.40 m vertically upwards.
The mass of the student is 65 kg.
The student is able to do 12 chin-ups in 60 seconds.

Calculate the power developed by the student.

Gravitational field strength = 10 N/kg

____

____

____

____

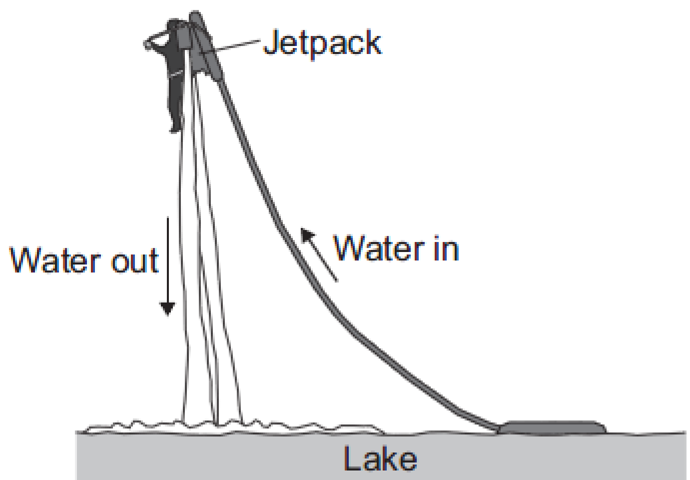
____

Power = ___________ W

(3)

(Total 10 marks)

6 The diagram below shows a person using a device called a jetpack. Water is forced downwards from the jetpack and produces an upward force on the person.



(a) State the condition necessary for the person to be able to remain stationary in mid-air.

____

____

(1)

(b) The person weighs 700 N and the jetpack weighs 140 N.

(i) Calculate the combined mass of the person and the jetpack.

Gravitational field strength = 10 N/kg

____

____

____

Combined mass = ____________ kg

(2)

(ii) Increasing the upward force to 1850 N causes the person to accelerate upwards.

Calculate the acceleration of the person and the jetpack. Give the unit.

____

____

____

____

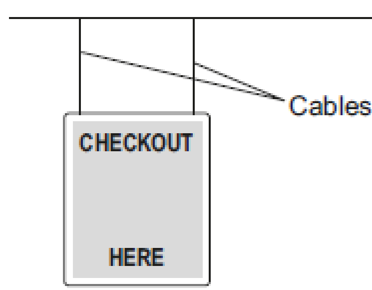
Acceleration = ____________ Unit ____________

(3)

(Total 6 marks)

7 A sign hangs from the ceiling using two cables, as shown in **Figure 1**.

Figure 1



(a) On **Figure 1**, mark the centre of mass of the sign using an X.

(1)

(b) Use the correct answer from the box to complete the sentence.

concentrated	**greatest**	**pivoted**

The centre of mass of an object is the point where the mass appears

to be ____________________ .

(1)

(c) A breeze made the sign swing forwards and backwards like a pendulum.
The frequency of oscillations of the sign was 2 hertz.

Calculate the periodic time for the sign.

____

____

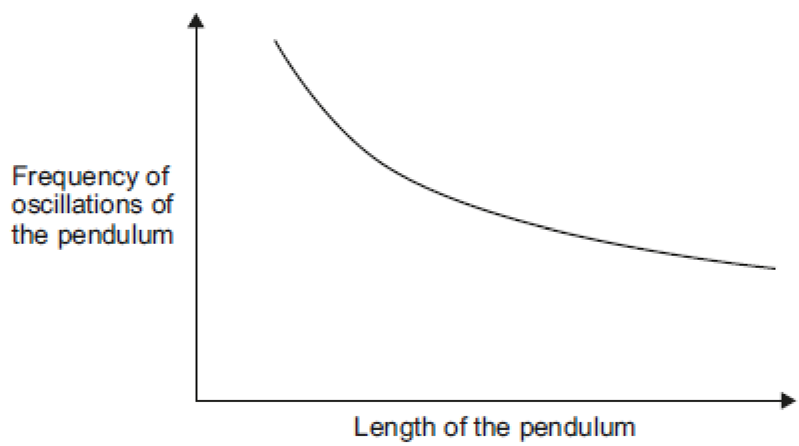
____

Periodic time = _______ seconds

(2)

(d) **Figure 2** is a sketch graph showing how the frequency of the oscillations of a pendulum changes as the length of the pendulum is increased.

Figure 2



Give **one** way the sign could be made to swing with a lower frequency.

Use **only** the information in the sketch graph.

____

____

(1)

(Total 5 marks)

8 Quantities in physics are either scalars or vectors.

(a) Use the correct answers from the box to complete the sentence.

acceleration	**direction**	**distance**	**speed**	**time**

Velocity is ____________________________ in a given _________________ .

(2)

(b) Complete the table to show which quantities are scalars and which quantities are vectors.

Put **one** tick (✓) in each row.

The first row has been completed for you.

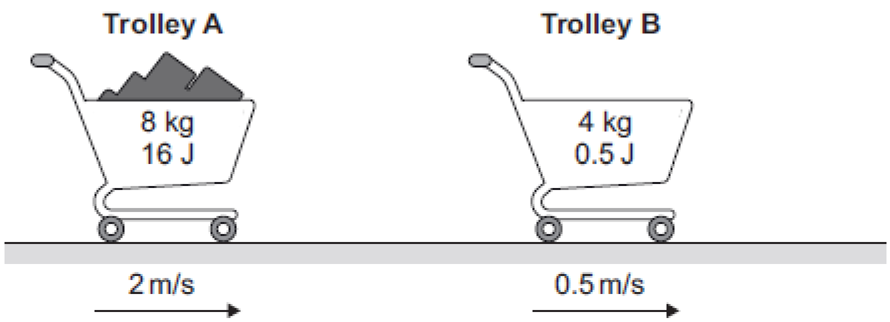
Quantity	**Scalar**	**Vector**
Momentum		✓
Acceleration		
Distance		
Force		
Time		

(3)

(c) The diagram shows two supermarket trolleys moving in the same direction.

Trolley **A** is full of shopping, has a total mass of 8 kg and is moving at a velocity of 2 m / s with a kinetic energy of 16 J.

Trolley **B** is empty, has a mass of 4 kg and is moving at a velocity of 0.5 m / s with a kinetic energy of 0.5 J.



(i) Calculate the momentum of both trolley **A** and trolley **B**.

Give the unit.

____

____

Momentum of trolley **A** = ________________

Momentum of trolley **B** = ________________

Unit ___________

(4)

(ii) The trolleys in the diagram collide and join together. They move off together.

Calculate the velocity with which they move off together.

____

____

____

____

Velocity = ________________ m / s

(3)

(iii) In a different situation, the trolleys in the digram move at the same speeds as before but now move towards each other.

Calculate the total momentum and the total kinetic energy of the two trolleys before they collide.

____

____

Total momentum = ___________________

____

____

Total kinetic energy = _________________ J

(2)

(Total 14 marks)

9 (a) When a force is applied to a spring, the spring extends by 0.12 m.
The spring has a spring constant of 25 N / m.

Calculate the force applied to the spring.

____

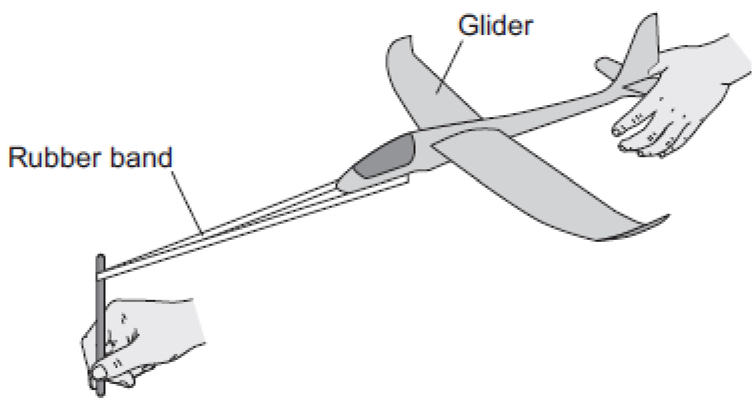
____

Force = ________________________ N

(2)

(b) **Figure 1** shows a toy glider. To launch the glider into the air, the rubber band and glider are pulled back and then the glider is released.

Figure 1



(i) Use the correct answers from the box to complete the sentence.

chemical	**elastic potential**	**kinetic**	**thermal**

When the glider is released, the _________________________ energy

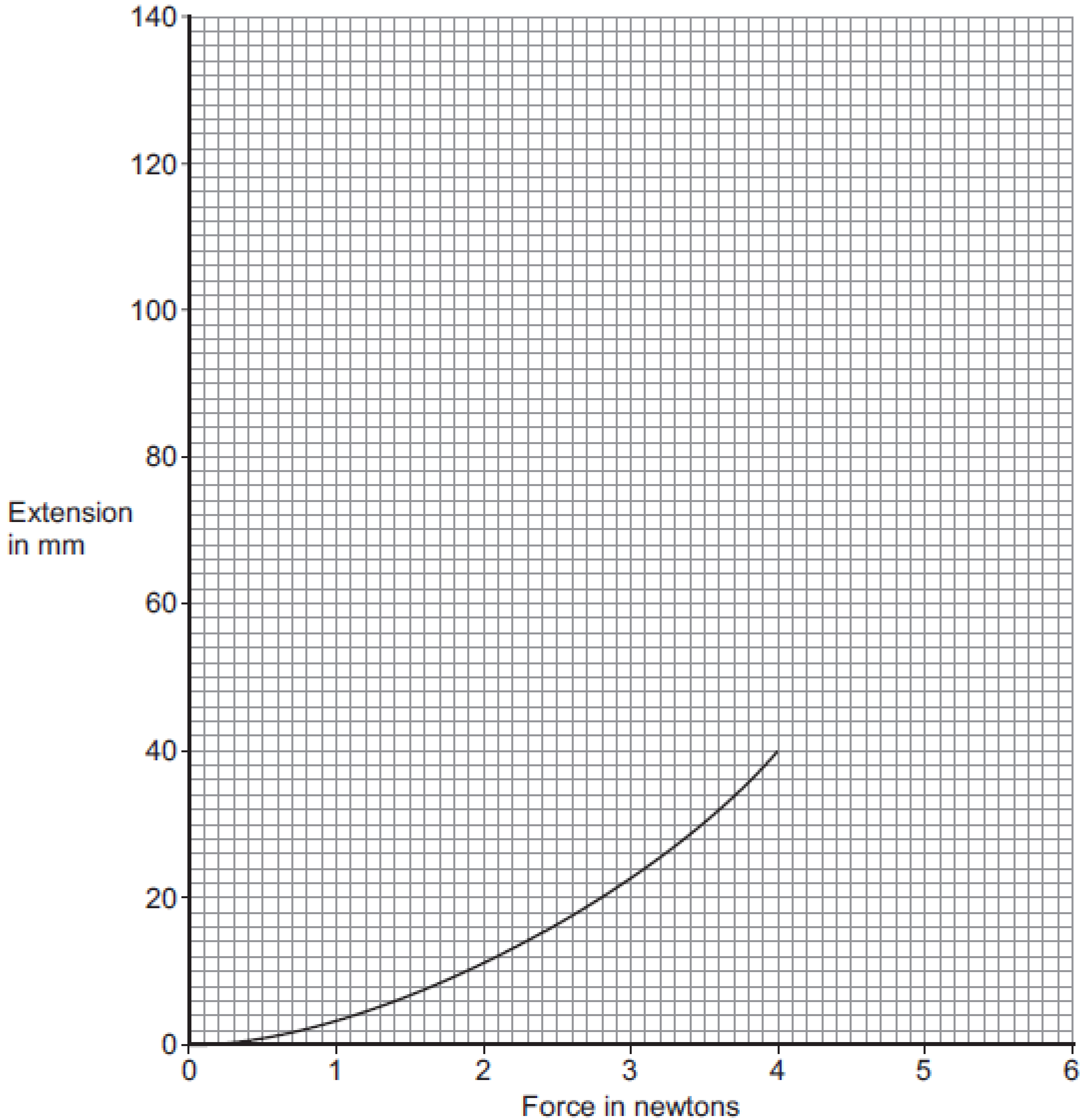
stored in the rubber band decreases and the glider gains

_________________________ energy.

(2)

(ii) **Figure 2** shows how the extension of the rubber band varies with the force applied to the rubber band.

Figure 2



What can you conclude, from **Figure 2**, would happen to the extension of the rubber band if the force applied to the rubber band was increased to 6 N?

The rubber band does **not** break.

____

____

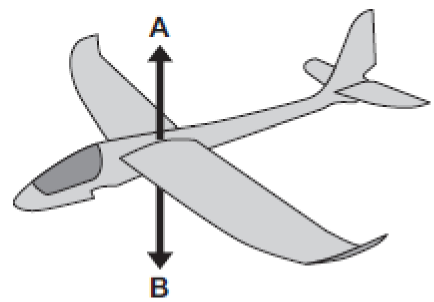
____

____

(2)

(c) **Figure 3** shows the vertical forces, **A** and **B**, acting on the glider when it is flying.

Figure 3



(i) What name is given to the force labelled **B**?

Draw a ring around the correct answer.

drag **friction** **weight**

(1)

(ii) Which **one** of the following describes the downward speed of the glider when force **B** is greater than force **A**?

Tick (✓) **one** box.

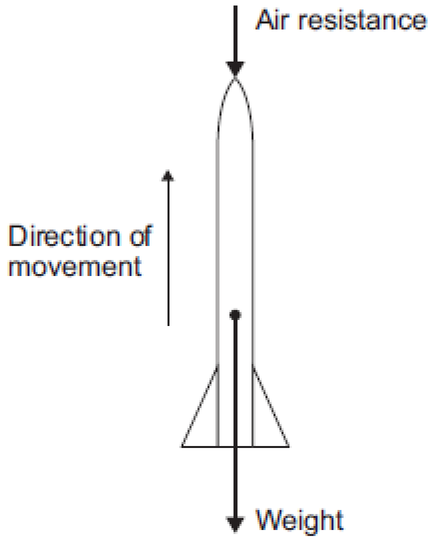
Downward speed increases	☐
Downward speed is constant	☐
Downward speed decreases	☐

(1)

(Total 8 marks)

10 (a) **Figure 1** shows the forces acting on a model air-powered rocket just after it has been launched vertically upwards.

Figure 1



(i) How does the velocity of the rocket change as the rocket moves **upwards**?

____

Give a reason for your answer.

____

____

(2)

(ii) The velocity of the rocket is not the same as the speed of the rocket.

What is the difference between the velocity of an object and the speed of an object?

____

____

____

(1)

(b) The speed of the rocket just after being launched is 12 m / s.
The mass of the rocket is 0.05 kg.

(i) Calculate the kinetic energy of the rocket just after being launched.

____

____

____

Kinetic energy = ______________________ J

(2)

(ii) As the rocket moves upwards, it gains gravitational potential energy.

State the maximum gravitational potential energy gained by the rocket.

Ignore the effect of air resistance.

Maximum gravitational potential energy = ______________________ J

(1)

(iii) Calculate the maximum height the rocket will reach.

Ignore the effect of air resistance.

Gravitational field strength = 10 N / kg.

____

____

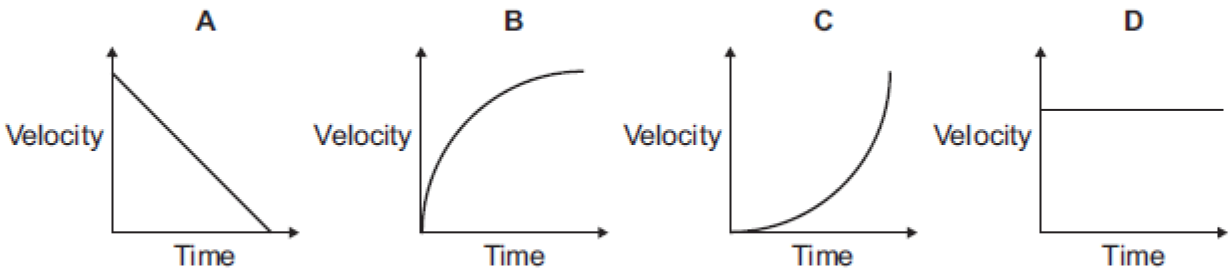
____

Maximum height = ______________________ m

(2)

(iv) **Figure 2** shows four velocity−time graphs.

Figure 2



Taking air resistance into account, which graph, **A**, **B**, **C** or **D**, shows how the velocity of the rocket changes as it **falls** from the maximum height it reached until it just hits the ground?

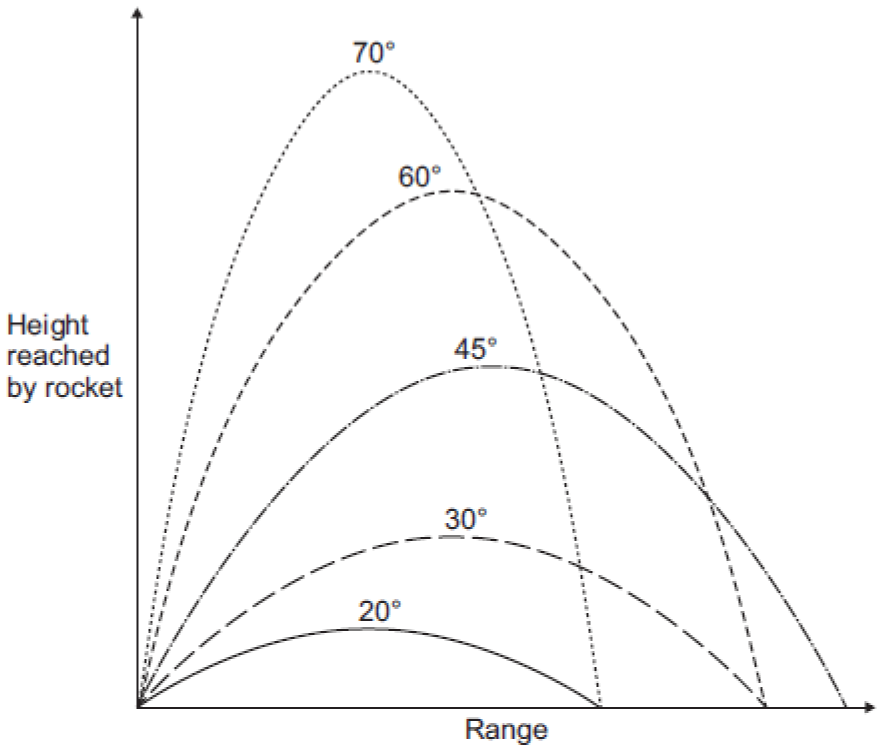
Write the correct answer in the box. ☐

(1)

(c) The rocket can be launched at different angles to the horizontal.
The horizontal distance the rocket travels is called the range.

Figure 3 shows the paths taken by the rocket when launched at different angles.
Air resistance has been ignored.

Figure 3



What pattern links the angle at which the rocket is launched and the range of the rocket?

____

____

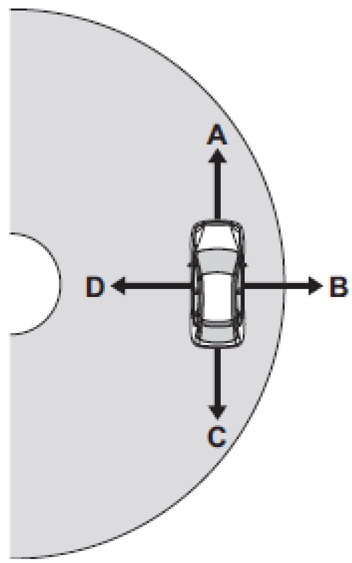
____

____

(2)
(Total 11 marks)

11 (a) **Figure 1** shows a car travelling around a bend in the road. The car is travelling at a constant speed.

Figure 1



There is a resultant force acting on the car. This resultant force is called the centripetal force.

(i) In which direction, **A**, **B**, **C** or **D**, does the centripetal force act on the car?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(ii) State the name of the force that provides the centripetal force.

____

(1)

(iii) State **two** factors that affect the size of the centripetal force acting on the car.

1. ____

2. ____

(2)

(b) **Figure 2** shows a racing car.

Figure 2

© braverabbit/iStock/Thinkstock

The racing car should not roll over when racing.

State **two** features of the car that make it difficult for the car to roll over.

1. ____

____

2. ____

____

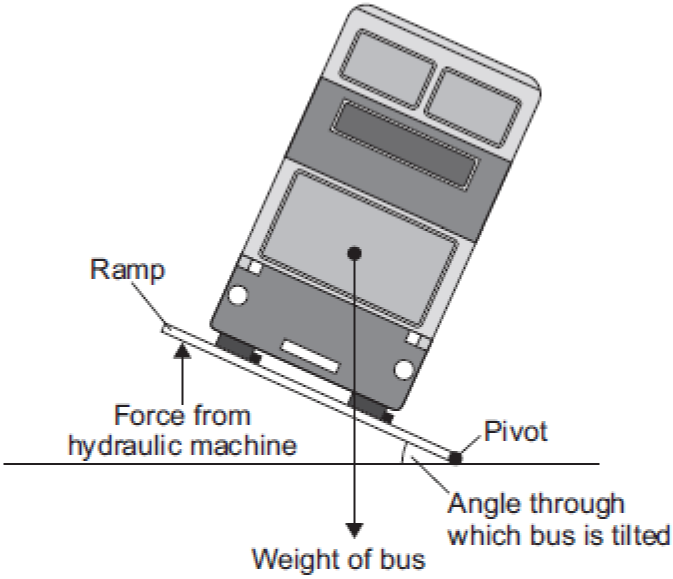
(2)

(Total 6 marks)

12 Before a new bus can be used on the roads, it must pass a stability test.
Figure 1 shows how the bus is tested.

Figure 1

Front view



(a) (i) The bus will topple over if the ramp is tilted at too great an angle.

Explain why.

____

____

____

____

(2)

(ii) The bus is tested to angles of tilt far greater than it would experience in normal use.

Suggest **two** reasons why.

1. ____

____

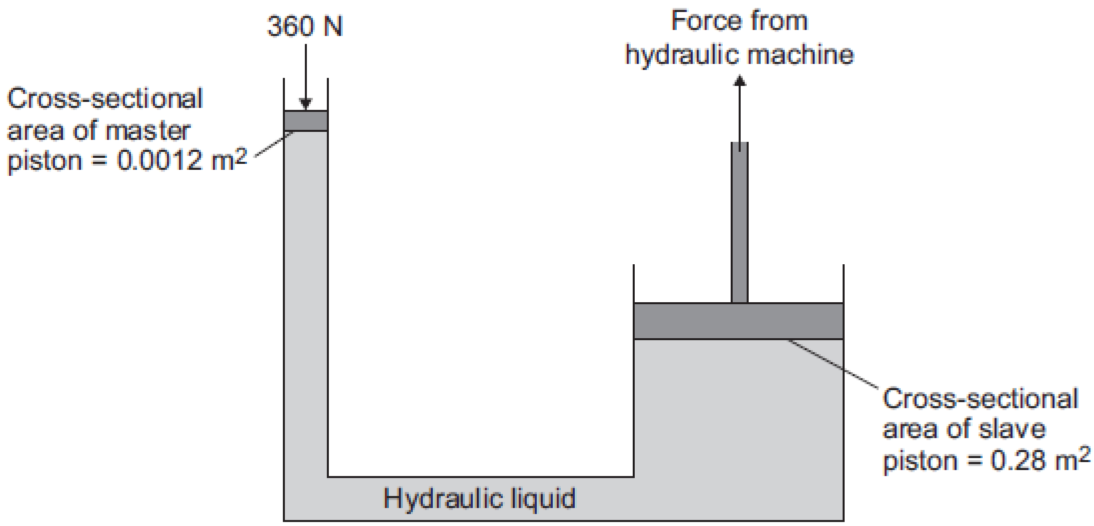
2. ____

____

(2)

(b) **Figure 2** shows the hydraulic machine that is used to make the ramp tilt.

Figure 2



The pressure applied to the hydraulic liquid at the master piston is the same as the pressure applied by the hydraulic liquid to the slave piston.

(i) State the property of the liquid that keeps the pressure at both pistons the same.

____

(1)

(ii) A 360 N force acts on the master piston.

Use information from **Figure 2** to calculate the force applied by the hydraulic liquid to the slave piston.

____

____

____

____

Force = ____________________ N

(3)

(Total 8 marks)

13 When two objects interact, they exert forces on each other.

(a) Which statement about the forces is correct?

Tick (✓) **one** box.

	Tick (✓)
The forces are equal in size and act in the same direction.	
The forces are unequal in size and act in the same direction.	
The forces are equal in size and act in opposite directions.	
The forces are unequal in size and act in opposite directions.	

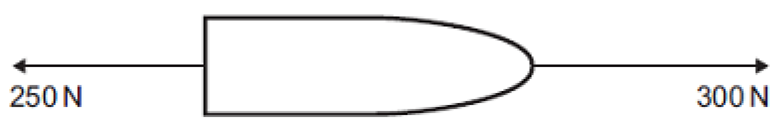
(1)

(b) A fisherman pulls a boat towards land.

The forces acting on the boat are shown in **Diagram 1**.

The fisherman exerts a force of 300 N on the boat.
The sea exerts a resistive force of 250 N on the boat.

Diagram 1



(i) Describe the motion of the boat.

____

____

____

____

(2)

(ii) When the boat reaches land, the resistive force increases to 300 N. The fisherman continues to exert a force of 300 N.

Describe the motion of the boat.

Tick (✓) **one** box.

Accelerating to the right ☐

Constant velocity to the right ☐

Stationary ☐

(1)

(iii) Explain your answer to part **(b)(ii)**.

____

____

____

____

(2)

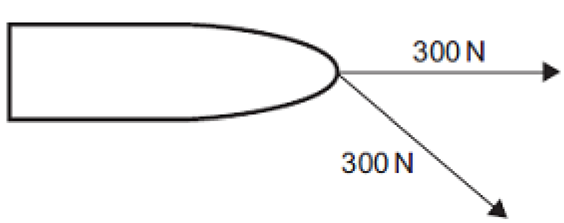
(iv) Another fisherman comes to help pull the boat. Each fisherman pulls with a force of 300 N, as shown in **Diagram 2**.

Diagram 2 is drawn to scale.

Add to **Diagram 2** to show the single force that has the same effect as the two 300 N forces.

Determine the value of this resultant force.

Diagram 2



Resultant force = ____________________ N

(4)

(Total 10 marks)

14 On 14 October 2012, a skydiver set a world record for the highest free fall from an aircraft.

After falling from the aircraft, he reached a maximum steady velocity of 373 m / s after 632 seconds.

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

This maximum steady velocity is called the [frictional / initial / terminal] velocity.

frictional
initial
terminal

(1)

(b) The skydiver wore a chest pack containing monitoring and tracking equipment.
The weight of the chest pack was 54 N.

The gravitational field strength is 10 N / kg.

Calculate the mass of the chest pack.

____

____

Mass of chest pack = ____________________ kg

(2)

(c) During his fall, the skydiver's acceleration was not uniform.

Immediately after leaving the aircraft, the skydiver's acceleration was 10 m / s ^{2}.

(i) Without any calculation, estimate his acceleration a few seconds after leaving the aircraft.

Explain your value of acceleration in terms of forces.

Estimate ____

Explanation ____

____

____

____

____

____

(3)

(ii) Without any calculation, estimate his acceleration 632 seconds after leaving the aircraft.

Explain your value of acceleration in terms of forces.

Estimate ____

Explanation ____

____

____

____

____

____

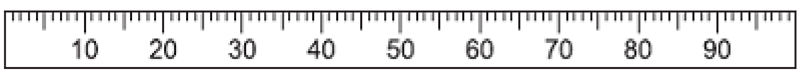
(3)

(Total 9 marks)

15 A student carries out an investigation using a metre rule as a pendulum.

(a) **Diagram 1** shows a metre rule.

Diagram 1



(i) Draw, on **Diagram 1**, an **X** to show the position of the centre of mass of the rule.

(1)

(ii) State what is meant by the 'centre of mass of an object'.

____

____

(1)

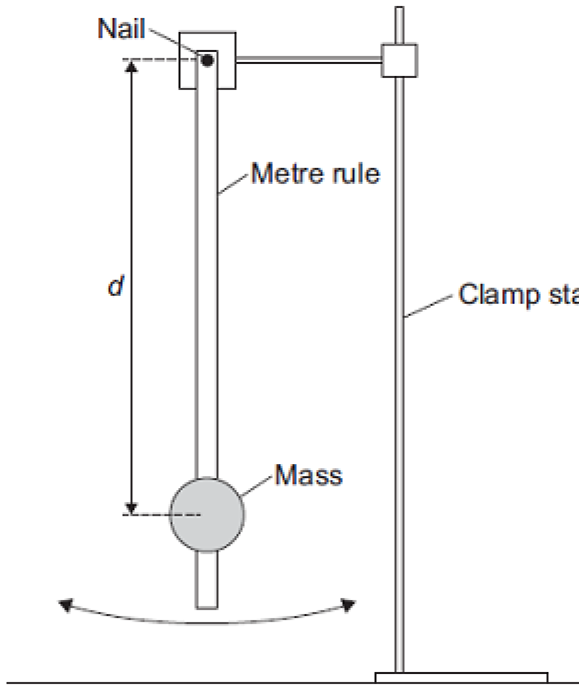
(b) The student taped a 100 g mass to a metre rule.

She set up the apparatus as shown in **Diagram 2**.

She suspended the metre rule from a nail through a hole close to one end, so she could use the metre rule as a pendulum.

The distance d is the distance between the nail and the 100 g mass.

Diagram 2



(i) Draw, on **Diagram 2**, a **Y** to show a possible position of the centre of mass of the pendulum.

(1)

(ii) The student carried out an investigation to find out how the time period of the pendulum varies with *d*.

Some of her results are shown in the table.

	Time for 10 swings in seconds				
***d* in cm**	**First test**	**Second test**	**Third test**	**Mean value**	**Mean time for 1 swing in seconds**
10.0	15.3	15.4	15.5	15.4	1.54
30.0	14.7	14.6	14.7	14.7	1.47
50.0	15.3	15.6	15.4	15.4	1.54
70.0	16.5	16.6	16.5		

Complete the table.

You may use the space below to show your working.

____

____

(3)

(iii) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

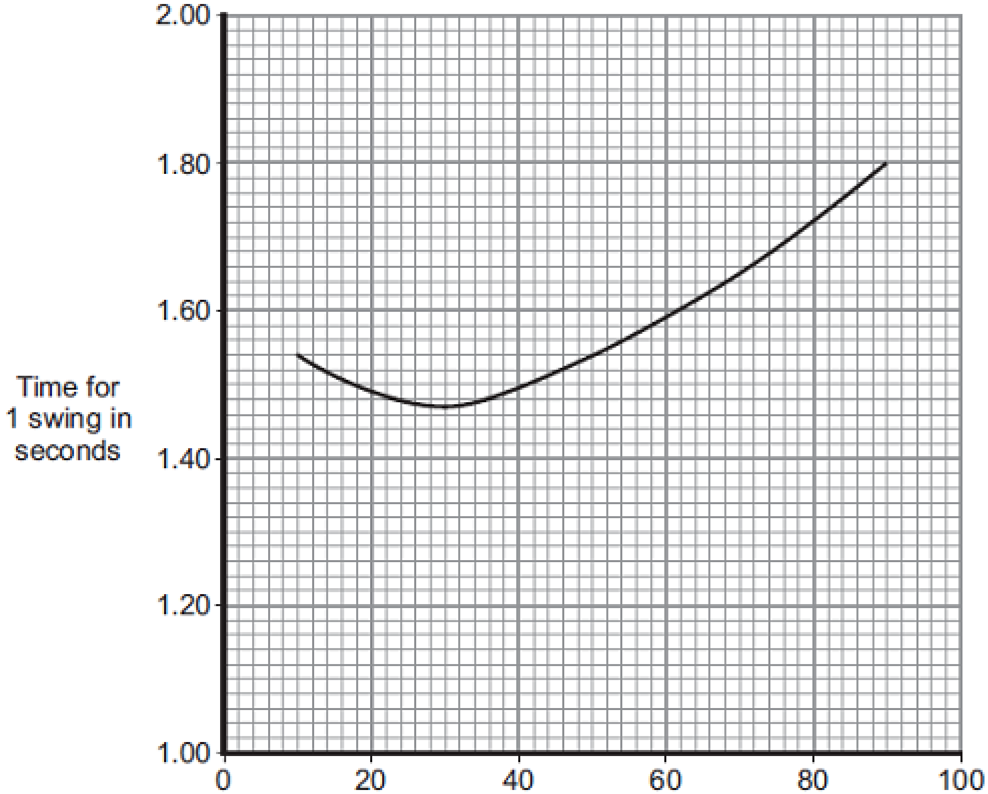
Describe how the student would carry out the investigation to get the results in the table in part (ii).

You should include:

- any other apparatus required
- how she should use the apparatus
- how she could make it a fair test
- a risk assessment
- how she could make her results as accurate as possible.

(6)

(c) A graph of the student's results is shown below.



Distance *d* in cm

(i) Describe the pattern shown by the graph.

___

___

___

___

(2)

(ii) The student thinks that the measurements of time for *d* = 10 cm might be anomalous, so she takes a fourth measurement.

Her four measurements are shown below.

15.3 s **15.4 s** **15.5 s** **15.3 s**

State whether you consider any of these measurements to be anomalous.

Justify your answer.

___

___

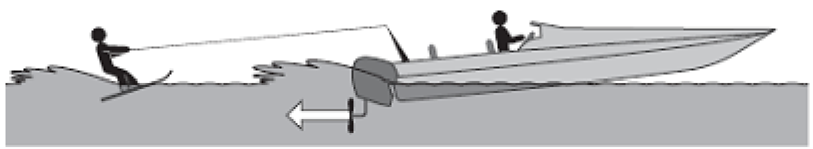
___

___

(2)

(Total 16 marks)

16 The diagram shows a boat pulling a water skier.



(a) The arrow represents the force on the water produced by the engine propeller. This force causes the boat to move.

Explain why.

___

___

___

___

(2)

(b) The boat accelerates at a constant rate in a straight line. This causes the velocity of the water skier to increase from 4.0 m/s to 16.0 m/s in 8.0 seconds.

(i) Calculate the acceleration of the water skier and give the unit.

____

____

____

Acceleration = ___________________________

(3)

(ii) The water skier has a mass of 68 kg.

Calculate the resultant force acting on the water skier while accelerating.

____

____

____

Resultant force = ___________________________ N

(2)

(iii) Draw a ring around the correct answer to complete the sentence.

The force from the boat pulling the water skier forwards

	less than	
will be	the same as	the answer to part **(b)(ii)**.
	greater than	

Give the reason for your answer.

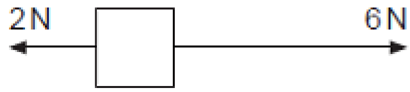
____

____

(2)

(Total 9 marks)

17 (a) The diagram shows two forces acting on an object.



What is the resultant force acting on the object?

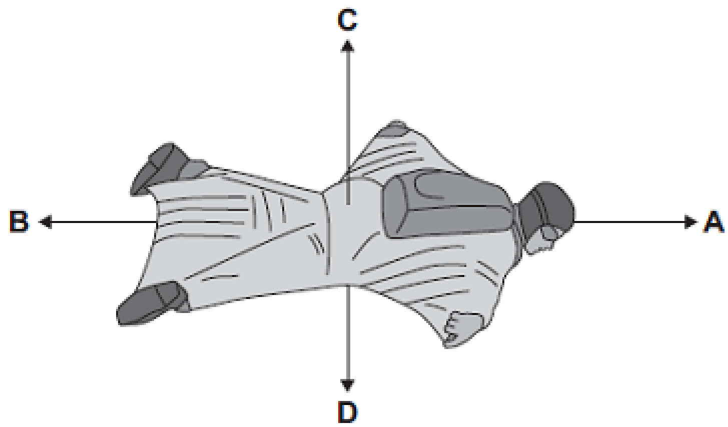
Tick (✓) **one** box.

8 N to the right	☐
8 N to the left	☐
4 N to the right	☐
4 N to the left	☐

(1)

(b) BASE jumpers jump from very high buildings and mountains for sport.

The diagram shows the forces acting on a BASE jumper in flight.
The BASE jumper is wearing a wingsuit.



(i) Draw a ring around the correct answer in the box to complete each sentence.

The BASE jumper accelerates forwards when force **A**

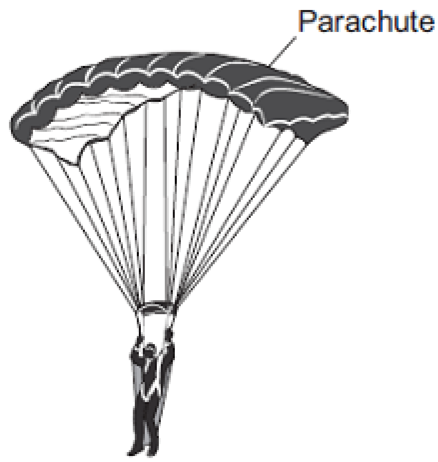
is	smaller than equal to bigger than	force **B**.

The BASE jumper falls with a constant speed when force **C**

is	smaller than equal to bigger than	force **D**.

(2)

(ii) To land safely the BASE jumper opens a parachute.



What effect does opening the parachute have on the speed of the falling BASE jumper?

____

Give a reason for your answer.

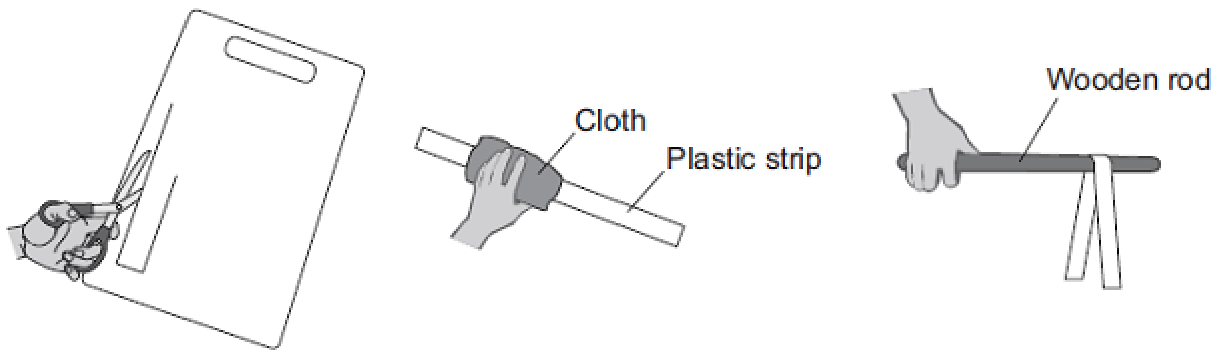
____

____

(2)

(Total 5 marks)

18 (a) A student uses some everyday items to investigate static electricity.



1 A strip of plastic is cut from a plastic carrier bag

2 The plastic strip is rubbed with a cloth

3 The plastic strip is hung over a wooden rod

(i) Draw a ring around the correct answer in the box to complete each sentence.

Rubbing the plastic strip with a cloth causes the strip to become negatively charged.

This happens because	electrons neutrons protons	move from the cloth onto the plastic strip.

The cloth is left with	a negative a positive zero	charge.

(2)

(ii) When the plastic strip is hung over the wooden rod, the two halves of the strip move equally away from each other.

What **two** conclusions should the student make about the forces acting on the two halves of the plastic strip?

1. ____

____

2. ____

____

(2)

(b) Electrical charges move more easily through some materials than through other materials.

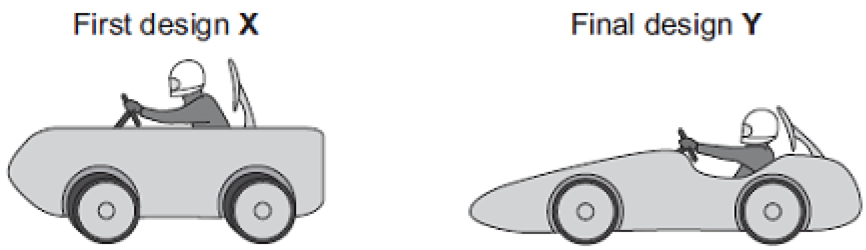
Through which **one** of the following materials would an electrical charge move most easily?

Draw a ring around your answer.

aluminium **glass** **rubber**

(1)
(Total 5 marks)

19 (a) Some students have designed and built an electric-powered go-kart. After testing, the students decided to make changes to the design of their go-kart.



The go-kart always had the same mass and used the same motor.

The change in shape from the first design (**X**) to the final design (**Y**) will affect the top speed of the go-kart.

Explain why.

___

___

___

___

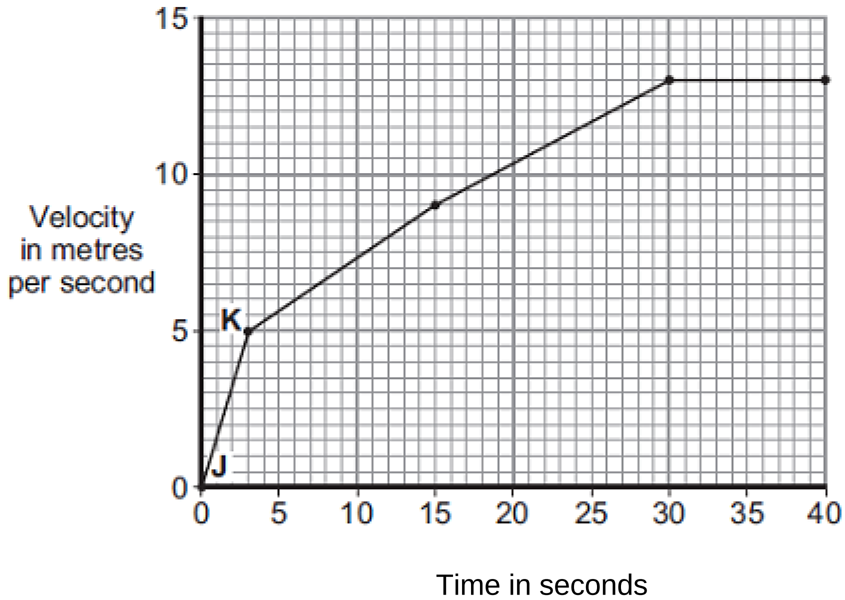
___

___

(3)

(b) The final design go-kart, **Y**, is entered into a race.

The graph shows how the velocity of the go-kart changes during the first 40 seconds of the race.



(i) Use the graph to calculate the acceleration of the go-kart between points **J** and **K**.

Give your answer to **two** significant figures.

____

____

____

Acceleration = ____________________ m/s^2

(2)

(ii) Use the graph to calculate the distance the go-kart travels between points **J** and **K**.

____

____

____

Distance = ____________________ m

(2)

(iii) What causes most of the resistive forces acting on the go-kart?

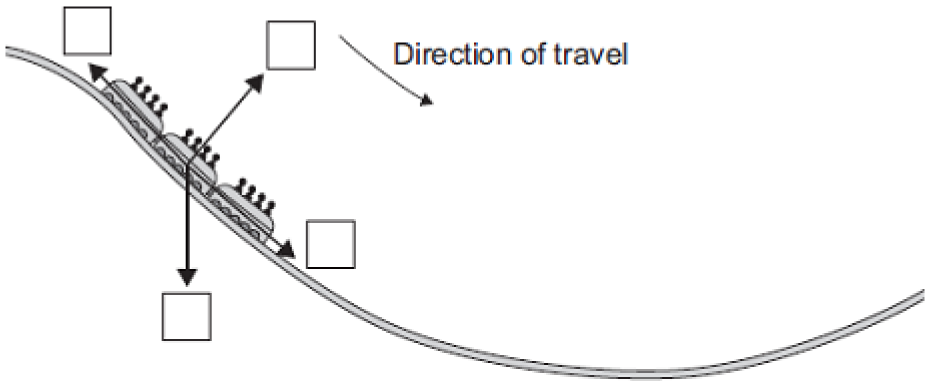
____

(1)

(Total 8 marks)

20 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.

Calculate the maximum weight this passenger seems to have during the ride.

Show clearly how you work out your answer.

____

____

Maximum weight = _______________ N

(2)

(Total 4 marks)

21 The London Eye is one of the largest observation wheels in the world.

© Angelo Ferraris/Shutterstock

The passengers ride in capsules. Each capsule moves in a circular path and accelerates.

(a) Explain how the wheel can move at a steady speed and the capsules accelerate at the same time.

___

___

___

(2)

(b) In which direction is the resultant force on each capsule?

___

(1)

(c) The designers of the London Eye had to consider **three** factors which affect the resultant force described in part (b).

Two factors that increase the resultant force are:

- an increase in the speed of rotation
- an increase in the total mass of the wheel, the capsules and the passengers.

Name the other factor that affects the resultant force and state what effect it has on the resultant force.

____

____

(1)

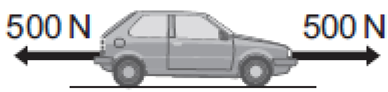
(Total 4 marks)

22 (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.

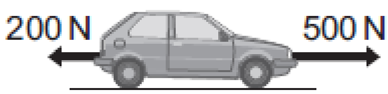
Draw only **three** lines.

stationary



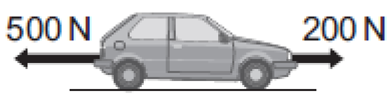
A

constant speed



B

slowing down

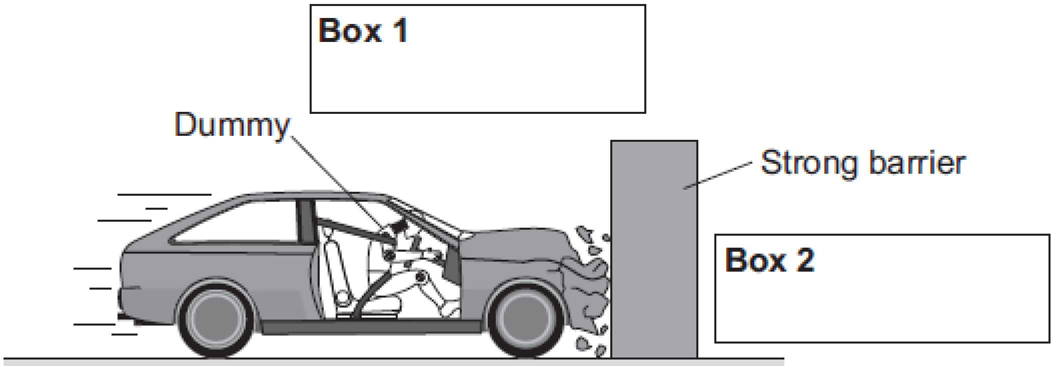


C

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

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

(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)

23 (a) A car is being driven along a straight road. The diagrams, **A**, **B** and **C**, show the horizontal forces acting on the moving car at three different points along the road.

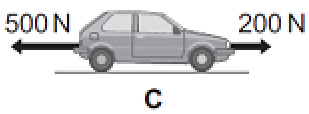
Describe the motion of the car at each of the points, **A**, **B** and **C**.

____

____

____

____



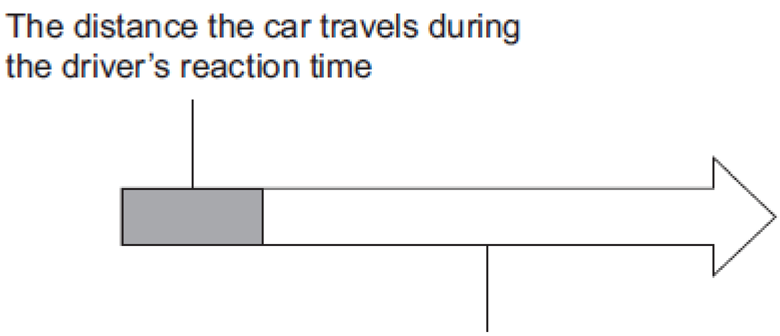
____

____

(3)

(b) The diagram below shows the stopping distance for a family car, in good condition, driven at 22 m/s on a dry road. The stopping distance has two parts.

(i) Complete the diagram below by adding an appropriate label to the second part of the stopping distance.



____

____

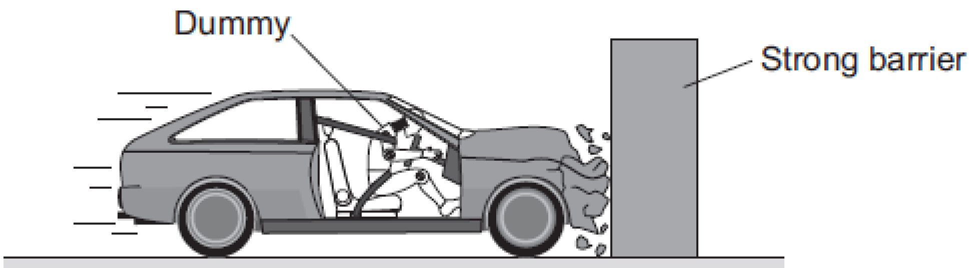
(1)

(ii) State **one** factor that changes both the first part **and** the second part of the stopping distance.

____

(1)

(c) 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 the dummy inside the car.



(i) At the point of collision, the car exerts a force of 5000 N on the barrier.

State the size and direction of the force exerted by the barrier on the car.

____

____

(1)

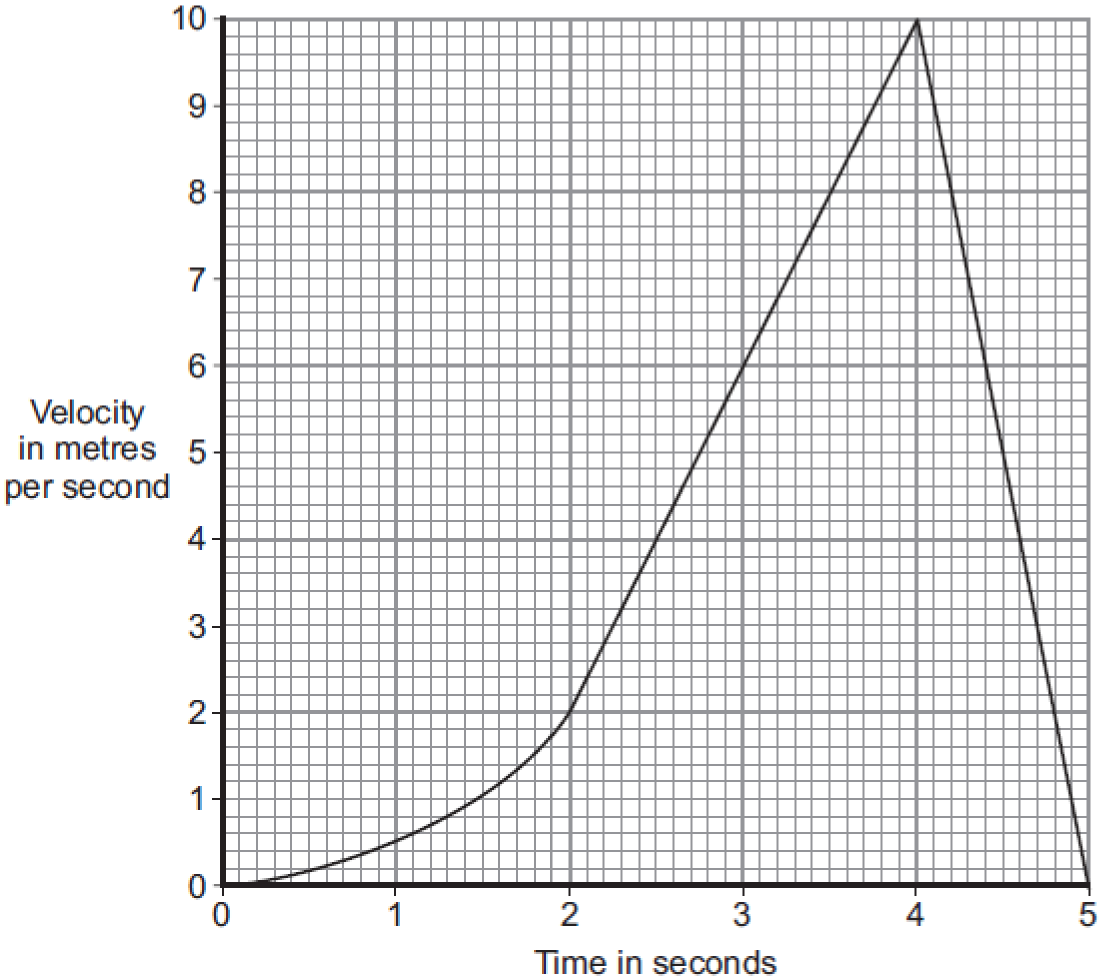
(ii) Suggest why the dummy is fitted with electronic sensors.

____

____

(1)

(iii) The graph shows how the velocity of the car changes during the test.



Use the graph to calculate the acceleration of the car just before the collision with the barrier.

Show clearly how you work out your answer, including how you use the graph, and give the unit.

___

___

___

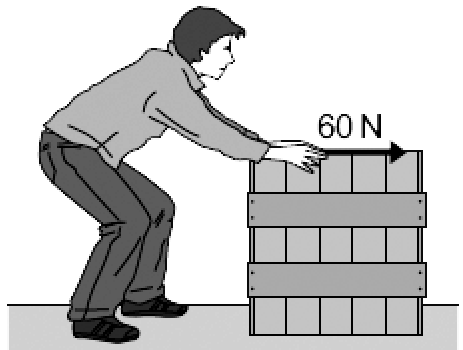
___

Acceleration = ___

(3)

(Total 10 marks)

24 The diagram shows a worker using a constant force of 60 N to push a crate across the floor.



My Revision Notes AQA GCSE Physics for A* – C,
Steve Witney, © Philip Allan UK

(a) The crate moves at a constant speed in a straight line

(i) Draw an arrow on the diagram to show the direction of the friction force acting on the moving crate.

(1)

(ii) State the size of the friction force acting on the moving crate.

___________________________ N

Give the reason for your answer.

____

____

(2)

(b) Calculate the work done by the worker to push the crate 28 metres.

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

Choose the unit from the list below.

joule **newton** **watt**

____

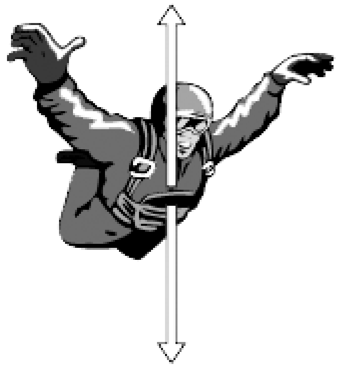
____

Work done = ___________________________

(3)

(Total 6 marks)

25 (a) The diagram shows the forces acting on a parachutist in free fall.



The parachutist has a mass of 75 kg.

Calculate the weight of the parachutist.

gravitational field strength = 10 N/kg

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

____

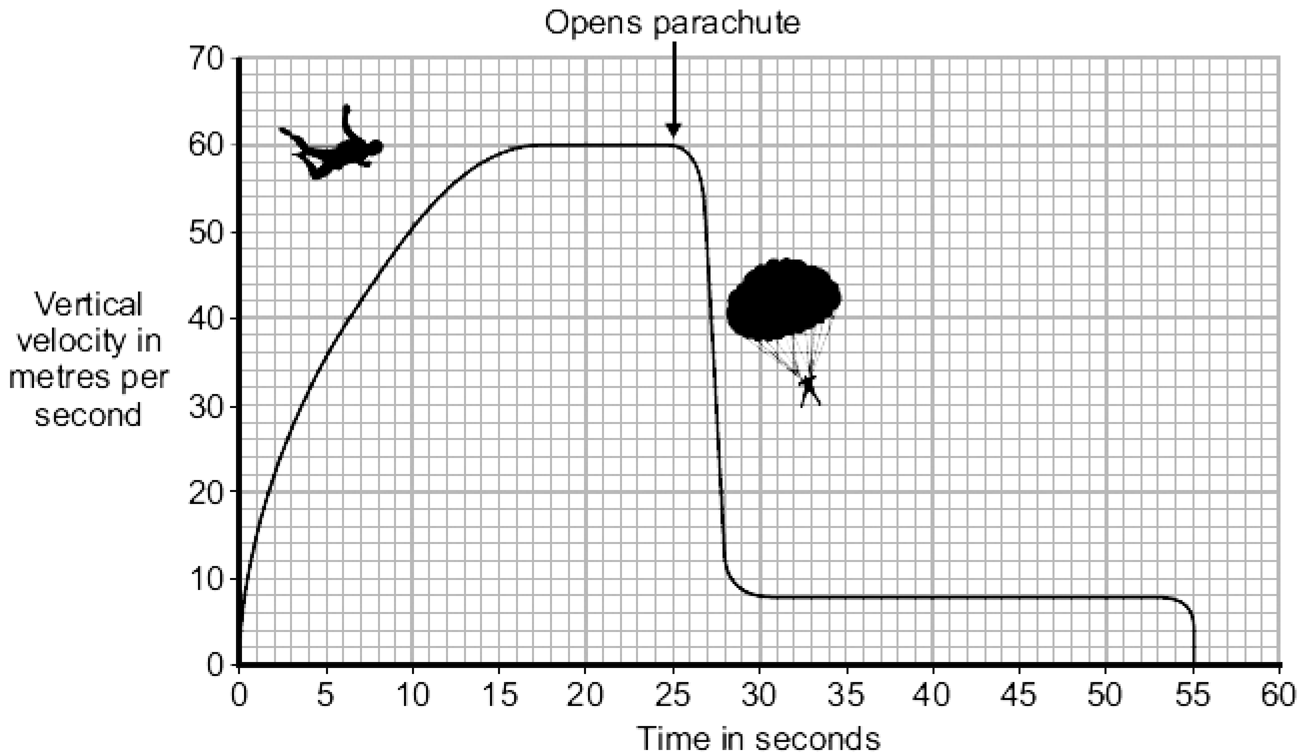
____

Weight = ____________________

(3)

(b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The graph shows how the vertical velocity of a parachutist changes from the moment the parachutist jumps from the aircraft until landing on the ground.



Using the idea of forces, explain why the parachutist reaches a terminal velocity and why opening the parachute reduces the terminal velocity.

___

___

___

___

___

___

___

___

___

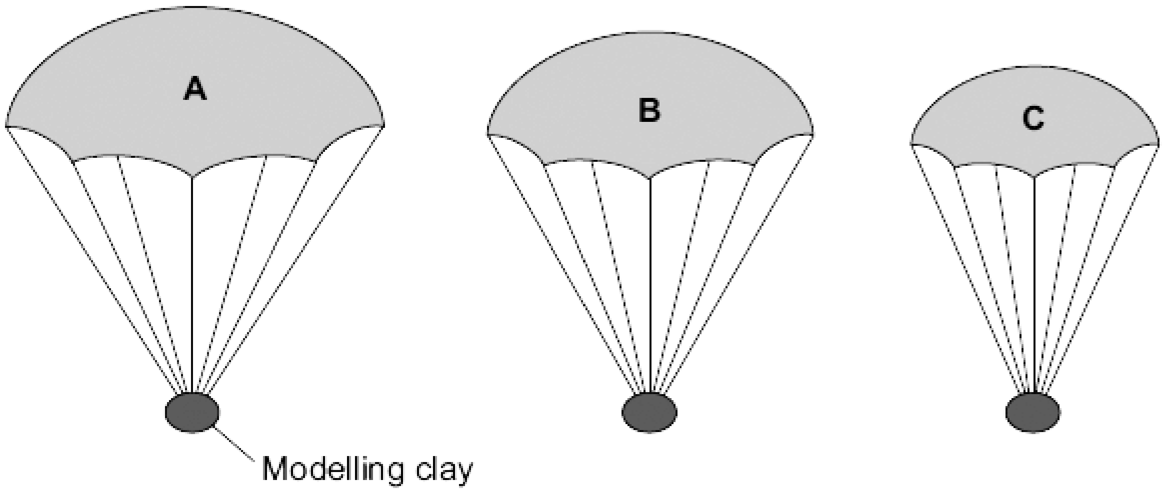
___

(6)

(c) A student wrote the following hypothesis.

'*The larger the area of a parachute, the slower a parachutist falls.*'

To test this hypothesis the student made three model parachutes, **A**, **B** and **C**, from one large plastic bag. The student dropped each parachute from the same height and timed how long each parachute took to fall to the ground.



(i) The height that the student dropped the parachute from was a control variable.

Name **one** other control variable in this experiment.

____

(1)

(ii) Use the student's hypothesis to predict which parachute, **A**, **B** or **C**, will hit the ground first.

Write your answer in the box. ☐

Give a reason for your answer.

____

____

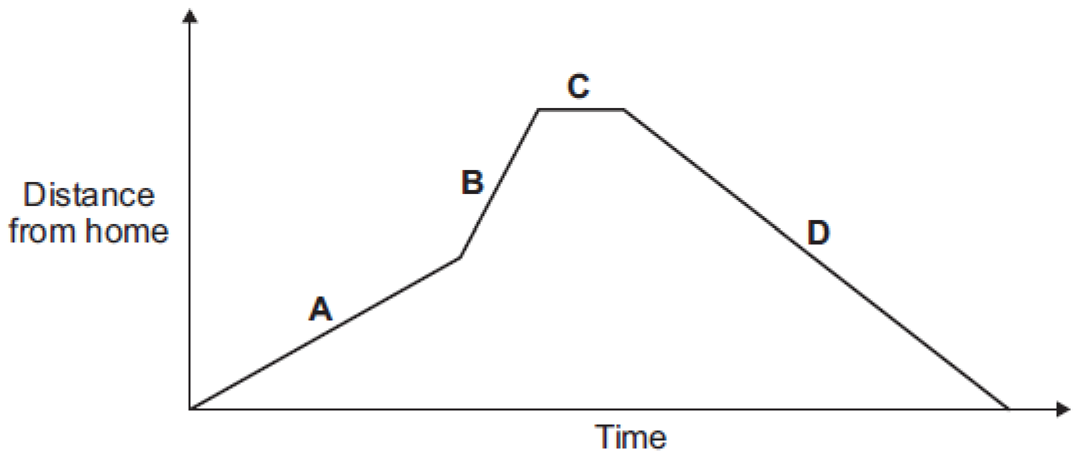
____

(2)

(Total 12 marks)

26 (a) A person takes their dog for a walk.

The graph shows how the distance from their home changes with time.



Which part of the graph, **A**, **B**, **C** or **D**, shows them walking the fastest?

Write your answer in the box. [ ]

Give the reason for your answer.

____

____

(2)

(b) During the walk, both the speed and the velocity of the person and the dog change.

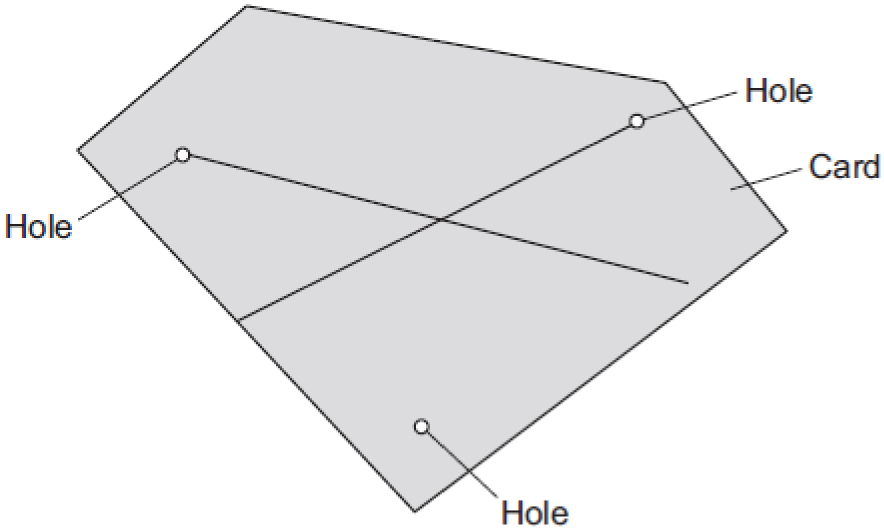
How is *velocity* different from *speed*?

____

____

(1)
(Total 3 marks)

27 A student was asked to find the centre of mass of a thin sheet of card. The diagram shows the result of the student's experiment. The student drew two lines onto the card. The centre of mass is where the two lines cross.



(a) Describe how the student found the correct positions to draw the **two** lines.

You may include a labelled diagram in your answer.

____

____

____

____

____

____

____

____

(3)

(b) Explain how the student can check that the position found for the centre of mass is accurate.

___

___

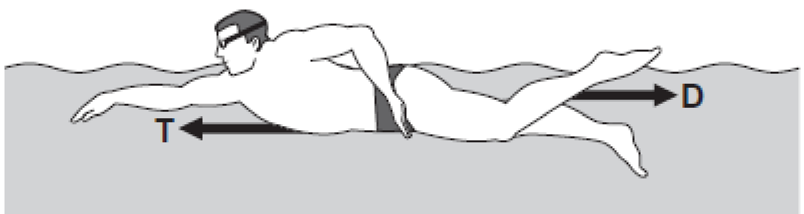
___

___

(2)

(Total 5 marks)

28 (a) The diagram shows the horizontal forces acting on a swimmer.



(i) The swimmer is moving at constant speed.
Force **T** is 120 N.

What is the size of force **D**?

___ N

(1)

(ii) By increasing force **T** to 140 N, the swimmer accelerates to a higher speed.

Calculate the size of the initial resultant force acting on the swimmer.

___

___

Initial resultant force = ___ N

(1)

(iii) Even though the swimmer keeps the force **T** constant at 140 N, the resultant force on the swimmer decreases to zero.

Explain why.

____

____

____

____

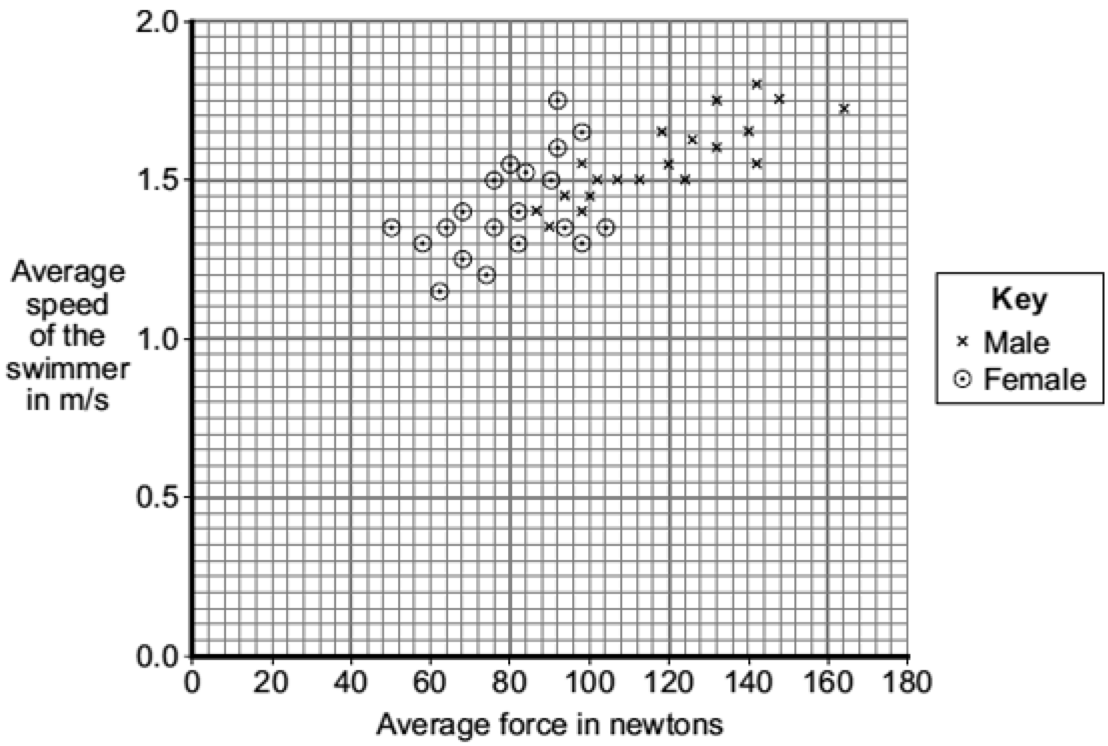
____

____

(3)

(b) A sports scientist investigated how the force exerted by a swimmer's hands against the water affects the swimmer's speed.
The investigation involved 20 males and 20 females swimming a fixed distance.
Sensors placed on each swimmer's hands measured the force 85 times every second over the last 10 metres of the swim.
The measurements were used to calculate an average force.
The average speed of each swimmer over the last 10 metres of the swim was also measured.

The data from the investigation is displayed in the graph.



(i) What was the dependent variable in this investigation?

____

(1)

(ii) Explain **one** advantage of measuring the force 85 times every second rather than just once or twice every second.

____

____

____

____

(2)

(iii) Give **one** way in which the data for the male swimmers is different from the data for the female swimmers.

____

____

(1)

(iv) Considering only the data from this investigation, what advice should a swimming coach give to swimmers who want to increase their average speed?

____

____

(1)

(Total 10 marks)

29 The drawing shows a plastic toy which can stand on its feet.

(a) (i) Draw an **X** on the diagram so that the centre of the **X** marks the likely position of the centre of mass of the toy.

Photograph supplied by Hemera/Thinkstock

(1)

(ii) Explain the reason for your choice in part (a)(i).

____

____

(1)

(b) Suggest **two** ways in which the design of the toy could be altered to make the toy more stable.

1. ____

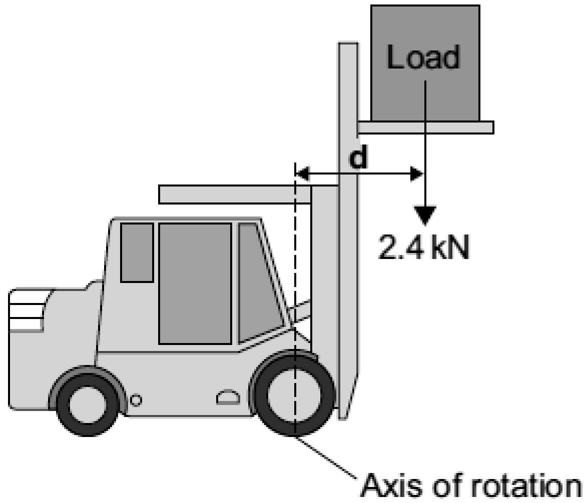
____

2. ____

____

(2)
(Total 4 marks)

30 The diagram shows a fork-lift truck with a load of 2.4 kN. The clockwise moment caused by this load is 2880 Nm.



(a) Use the equation in the box to calculate the distance **d**.

moment	=	force	×	perpendicular distance from the line of action of the force to the axis of rotation

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

___

___

___

Distance **d** = ______________________________

(3)

(b) This warning notice is in the driver's cab.

Warning
Maximum load 10.0 kN
This load must not be exceeded

Explain in terms of moments why the maximum load must not be exceeded.

____

____

____

____

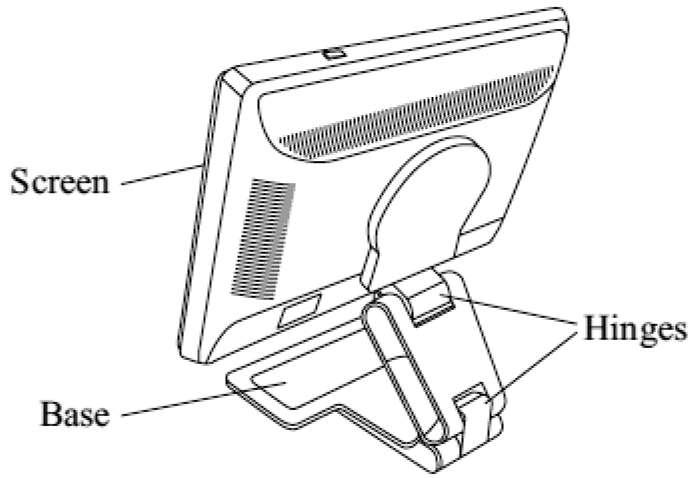
____

____

(2)

(Total 5 marks)

31 The diagram shows a back view of a computer monitor.



(a) In normal use, the monitor is *stable*.

(i) Explain the meaning, in the above sentence, of the word *stable*.

____

____

____

____

(2)

(ii) State the relationship between the total clockwise moment and the total anticlockwise moment about any axis of the monitor when it is stable.

____

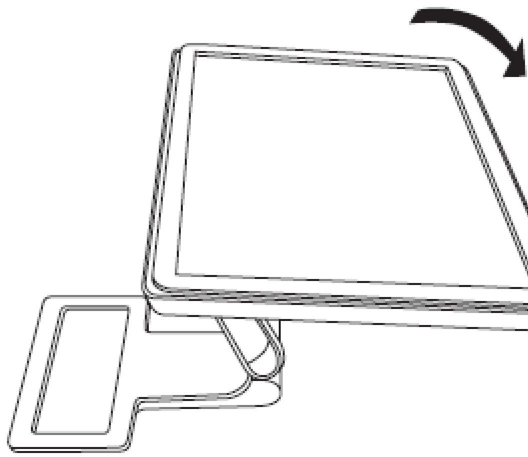
____

(1)

(b) The instruction booklet explains that the screen can be tilted.
It also includes a warning.

Caution

The monitor can tip over if the screen is tilted too far back.



Explain why the monitor will tip over if the screen is tilted too far back.

Include the words *centre of mass, weight* and *moment* in your explanation.

____

____

____

____

____

____

(3)

(Total 6 marks)