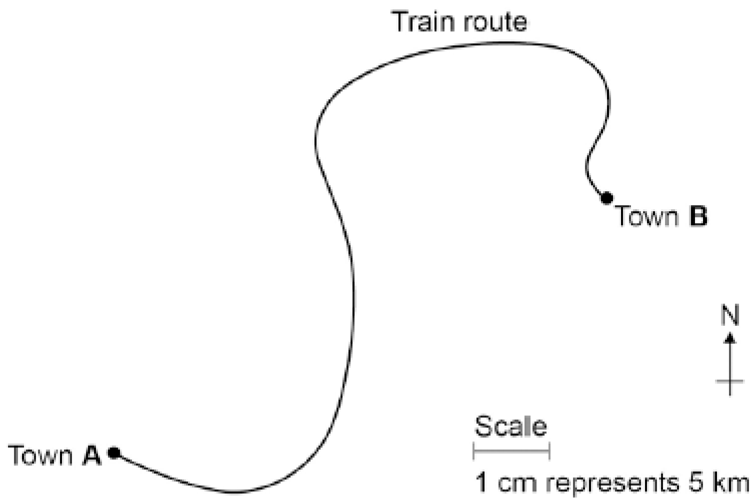
VELOCITY

Q1.

A train travels from town **A** to town **B**.

Figure 1 shows the route taken by the train.
Figure 1 has been drawn to scale.

Figure 1



(a) The distance the train travels between **A** and **B** is not the same as the displacement of the train.

What is the difference between distance and displacement?

___

___

___

(1)

(b) Use **Figure 1** to determine the displacement of the train in travelling from **A** to **B**.

Show how you obtain your answer.

___

___

Displacement = ____________________ km

Direction = ____________________

(2)

(c) There are places on the journey where the train accelerates without changing speed.

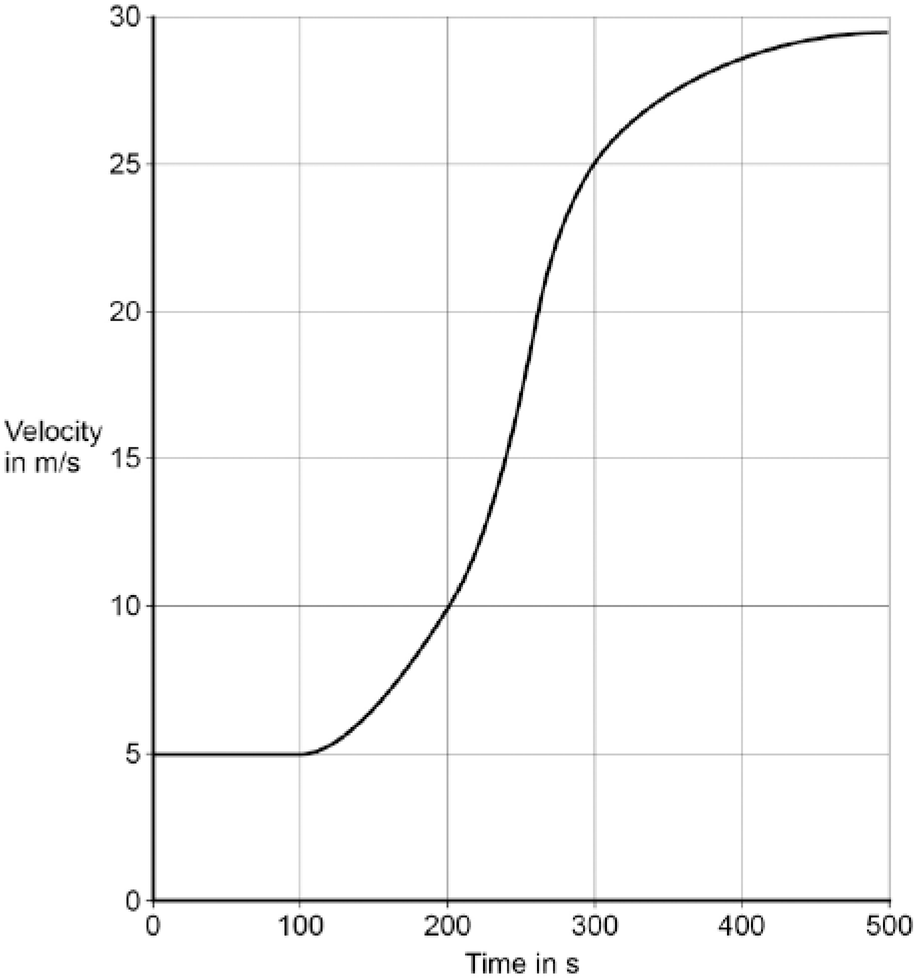
Explain how this can happen.

___

(2)

(d) **Figure 2** shows how the velocity of the train changes with time as the train travels along a straight section of the journey.

Figure 2



Estimate the distance travelled by the train along the section of the journey shown in **Figure 2**.

To gain full marks you must show how you worked out your answer.

Distance = ___________________________ m

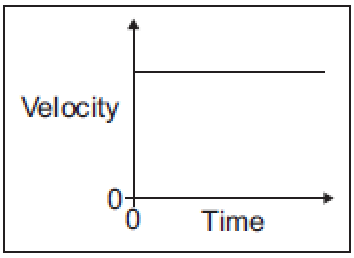
(3)

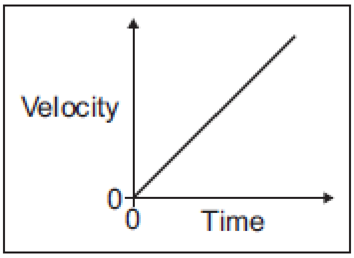
(Total 8 marks)

Q2.

(a) Draw **one** line from each velocity−time graph to the statement describing the motion shown by the graph.

Velocity–time graph





Motion shown by graph

Constant acceleration

Not moving

Constant deceleration

Constant velocity

(2)

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

energy	**momentum**	**speed**

The velocity of an object includes both the ____________________________ of the object
and the direction the object is moving.

(1)

(c) At the start of a race, a horse accelerates from a velocity of 0 m / s to a velocity of 9 m / s in 4 seconds.

(i) Calculate the acceleration of the horse.

____

____

Acceleration = ________________________ m / s^2

(2)

(ii) When the horse accelerates, what, if anything, happens to the air resistance acting against the horse?

Tick (✓) **one** box.

The air resistance decreases ☐

The air resistance is constant ☐

The air resistance increases ☐

(1)

(d) A horse and a pony walk across a field at the same constant speed.

The horse has 4000 joules of kinetic energy.

The pony is **half** the mass of the horse.

What is the kinetic energy of the pony?

Draw a ring around the correct answer

2000 J **4000 J** **8000 J**

Give a reason for your answer.

____

____

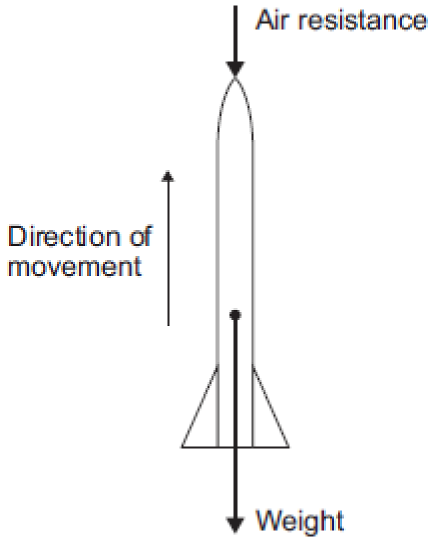
(2)

(Total 8 marks)

Q3.

(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.

____

____

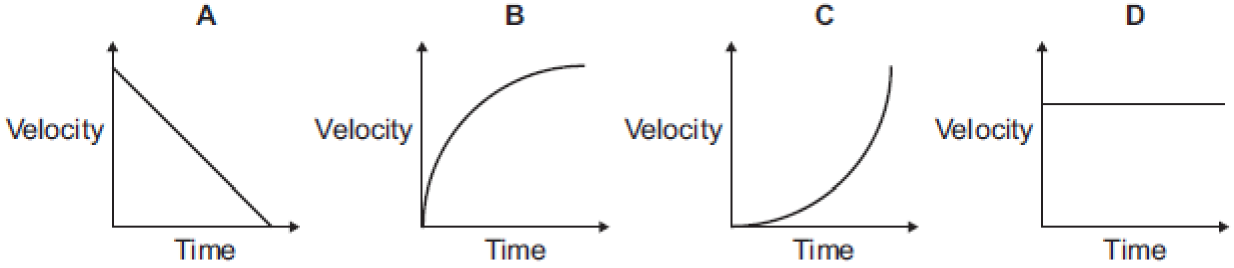
____

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?

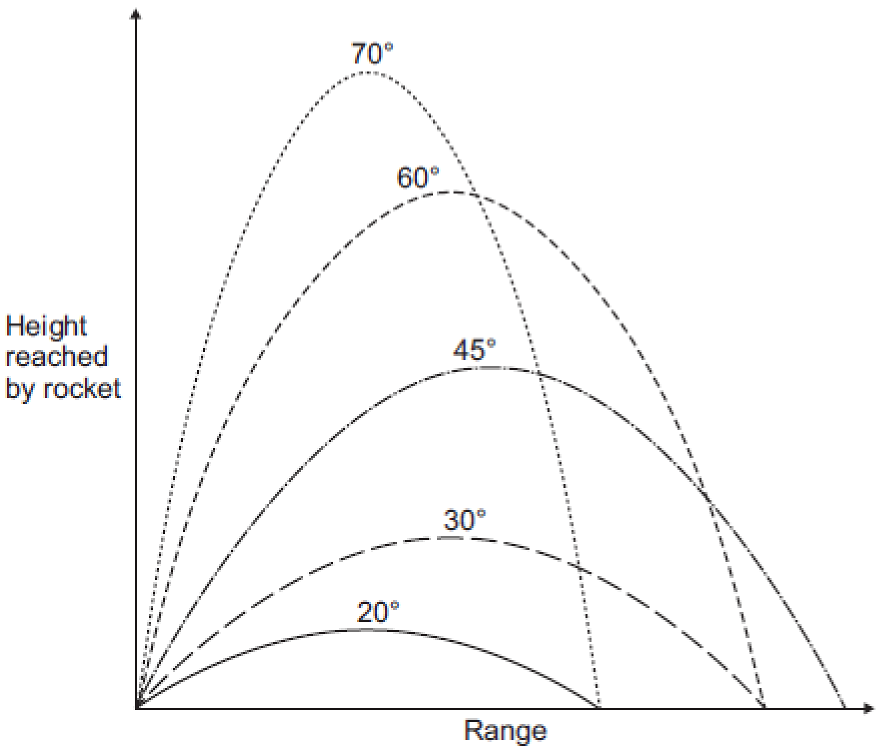
Write the correct answer in the box. ☐

(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?

____

____

____

____

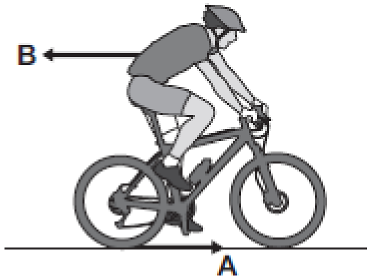
(2)

(Total 11 marks)

Q4.

(a) **Figure 1** shows the horizontal forces acting on a moving bicycle and cyclist.

Figure 1



(i) What causes force **A**?

Draw a ring around the correct answer.

friction **gravity** **weight**

(1)

(ii) What causes force **B**?

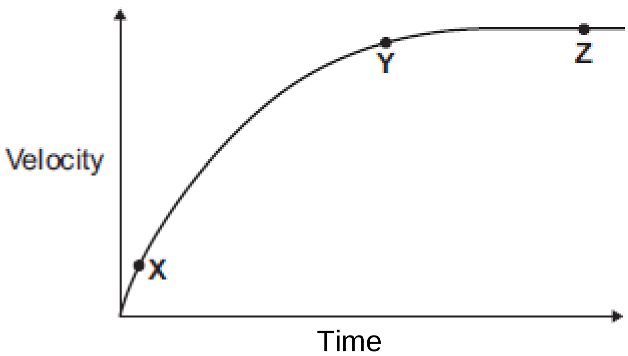
____

(1)

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

Figure 2 shows how the velocity of the cyclist changes during the first part of a journey along a straight and level road. During this part of the journey the force applied by the cyclist to the bicycle pedals is constant.

Figure 2



Describe how **and** explain, in terms of the forces **A** and **B**, why the velocity of the cyclist changes:

- between the points **X** and **Y**
- and between the points **Y** and **Z**, marked on the graph in **Figure 2**.

Extra space

(6)

(b) (i) The cyclist used the brakes to slow down and stop the bicycle.

A constant braking force of 140 N stopped the bicycle in a distance of 24 m.

Calculate the work done by the braking force to stop the bicycle. Give the unit.

Work done = ______________________________

(3)

(ii) Complete the following sentences.

When the brakes are used, the bicycle slows down. The kinetic energy of the bicycle ______________________________ .

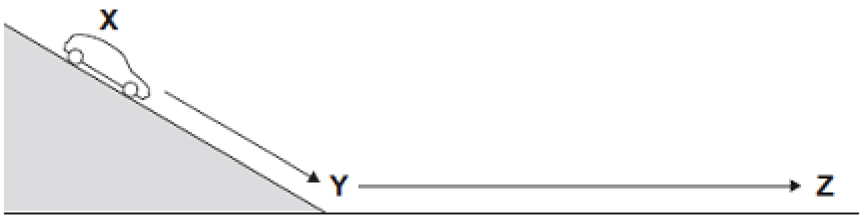
At the same time, the ______________________________ of the brakes increases.

(2)

(Total 13 marks)

Q5.

(a) The diagram shows a car at position **X**.



The handbrake is released and the car rolls down the slope to **Y**.
The car continues to roll along a horizontal surface before stopping at **Z**.
The brakes have **not** been used during this time.

(i) What type of energy does the car have at **X**?

____

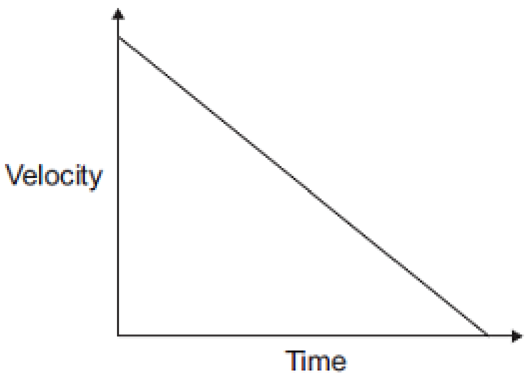
(1)

(ii) What type of energy does the car have at **Y**?

____

(1)

(b) The graph shows how the velocity of the car changes with time between **Y** and **Z**.



(i) Which feature of the graph represents the negative acceleration between

Y and **Z**?

____ **(1)**

(ii) Which feature of the graph represents the distance travelled between **Y** and **Z**?

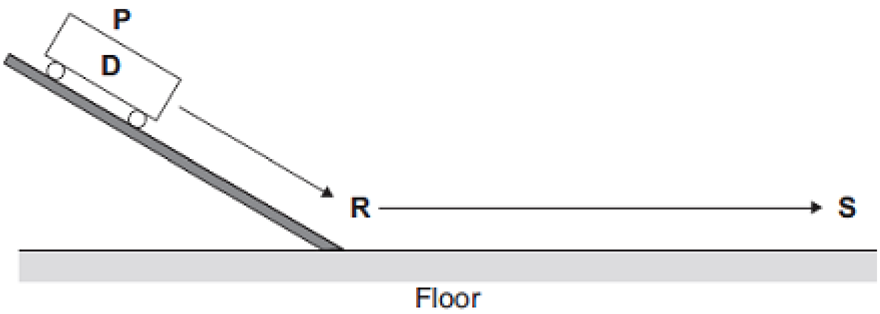
____ **(1)**

(iii) The car starts again at position **X** and rolls down the slope as before. This time the brakes are applied lightly at **Y** until the car stops.

Draw on the graph another straight line to show the motion of the car between **Y** and **Z**.

(2)

(c) Three students carry out an investigation. The students put trolley **D** at position **P** on a slope. They release the trolley. The trolley rolls down the slope and along the floor as shown in the diagram.



The students measure the distance from **R** at the bottom of the slope to **S** where the trolley stops. They also measure the time taken for the trolley to travel the distance **RS**.
They repeat the investigation with another trolley, **E**.

Their results are shown in the table.

Trolley	Distance RS in centimetres	Time taken in seconds	Average velocity in centimetres per second
D	65	2.1	
E	80	2.6	

(i) Calculate the average velocity, in centimetres per second, between **R** and **S** for trolleys **D** and **E**. Write your answers in the table.

____

____

____ **(3)**

(ii) Before the investigation, each student made a prediction.

- Student **1** predicted that the two trolleys would travel the same distance.
- Student **2** predicted that the average velocity of the two trolleys would be the same.
- Student **3** predicted that the negative acceleration of the two trolleys would be the same.

Is each prediction correct?

Justify your answers.

____

____

____

____

____

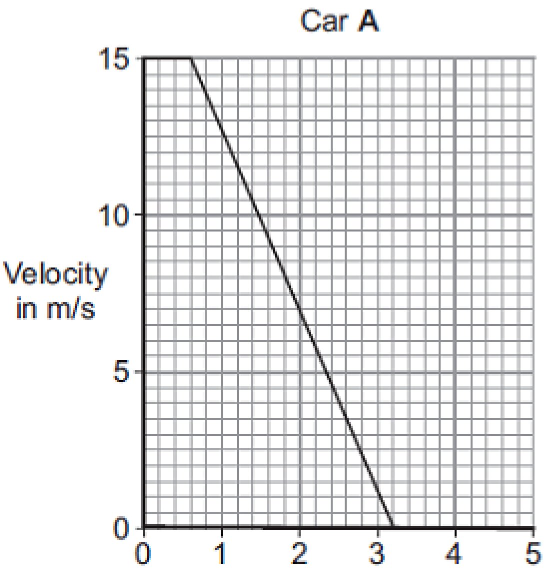
____

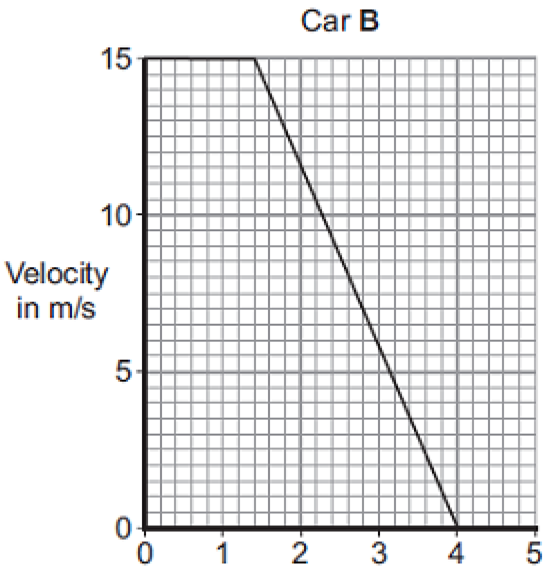
(3)

(Total 12 marks)

Q6.

(a) The graphs show how the velocity of two cars, **A** and **B**, change from the moment the car drivers see an obstacle blocking the road.





Time in secondsTime in seconds

One of the car drivers has been drinking alcohol. The other driver is wide awake and alert.

(i) How does a comparison of the two graphs suggest that the driver of car **B** is the one who has been drinking alcohol?

____

(1)

(ii) How do the graphs show that the two cars have the same deceleration?

(1)

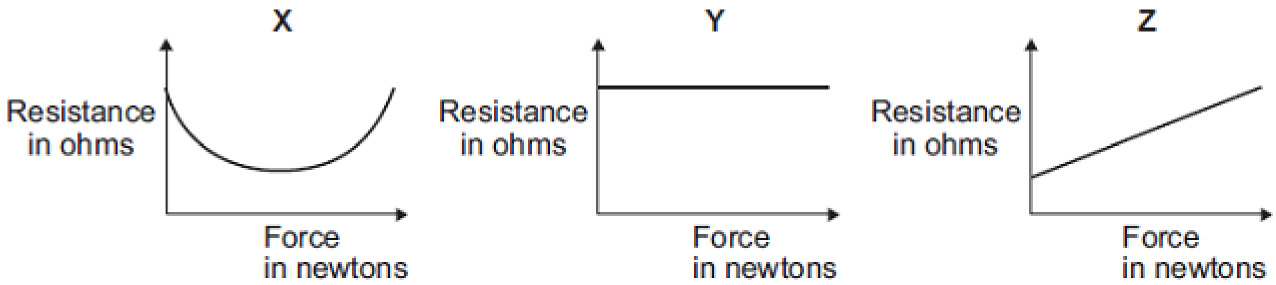
(iii) Use the graphs to calculate how much further car **B** travels before stopping compared to car **A**.

Show clearly how you work out your answer.

Additional stopping distance = ______________________ m

(3)

(b) In a crash-test laboratory, scientists use sensors to measure the forces exerted in collisions. The graphs show how the electrical resistance of 3 experimental types of sensor, **X**, **Y**, and **Z**, change with the force applied to the sensor.



Which of the sensors, **X**, **Y** or **Z**, would be the best one to use as a force sensor?

Give a reason for your answer.

(2)
(Total 7 marks)

Q7.

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.

___

___

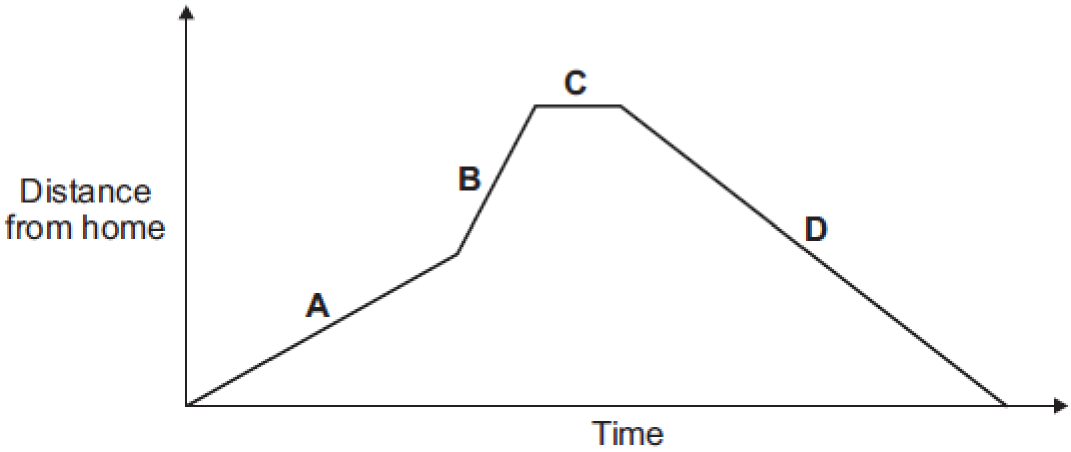
(1)

(Total 4 marks)

Q8.

(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)

Q9.

A cyclist travelling along a straight level road accelerates at 1.2 m/s^2 for 5 seconds.
The mass of the cyclist and the bicycle is 80 kg.

(a) Calculate the resultant force needed to produce this acceleration.

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

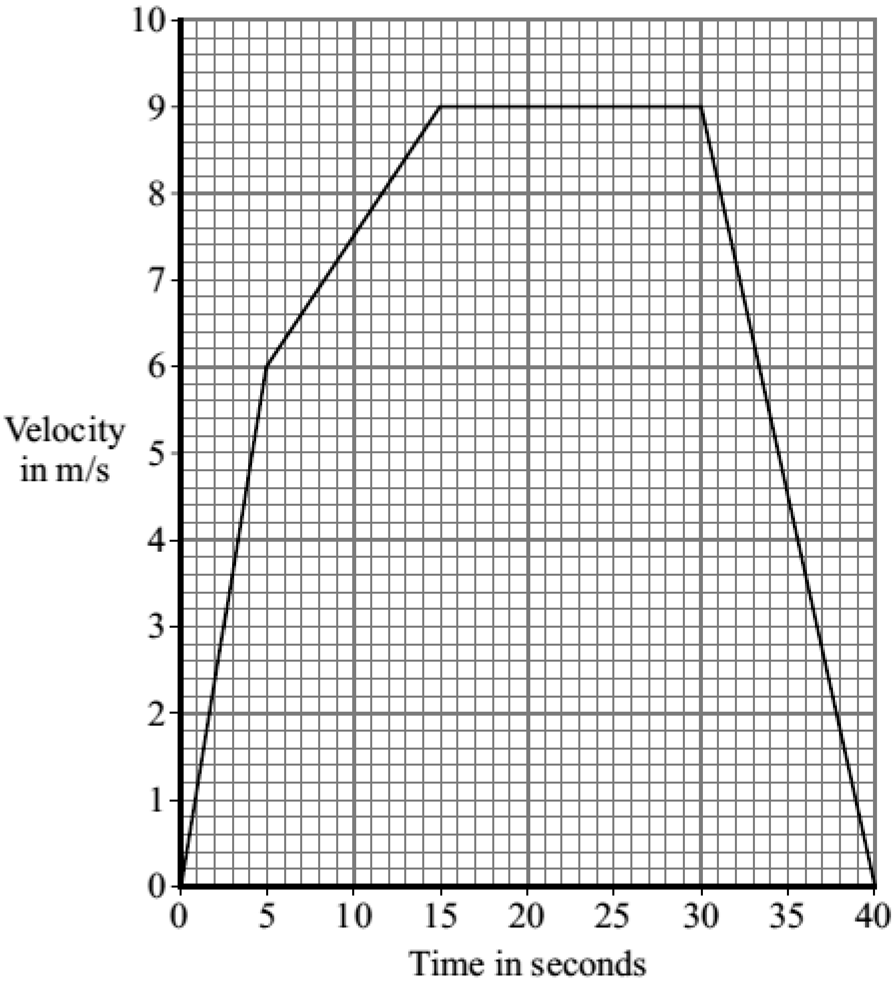
___

___

Resultant force = ___

(3)

(b) The graph shows how the velocity of the cyclist changes with time.



(i) Complete the following sentence.

The velocity includes both the speed and the _____________ of the cyclist.

(1)

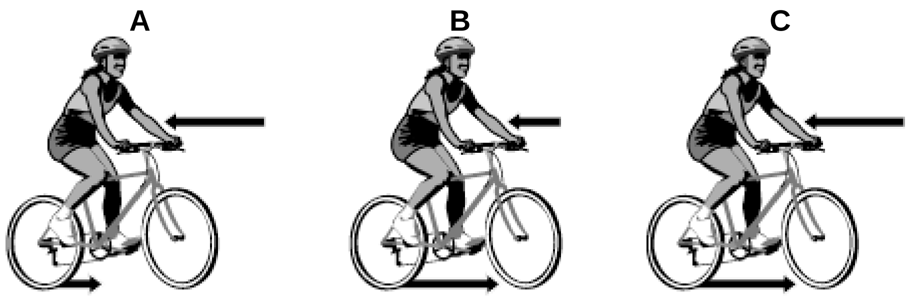
(ii) Why has the data for the cyclist been shown as a line graph instead of a bar chart?

____

____

(1)

(iii) The diagrams show the horizontal forces acting on the cyclist at three different speeds. The length of an arrow represents the size of the force.



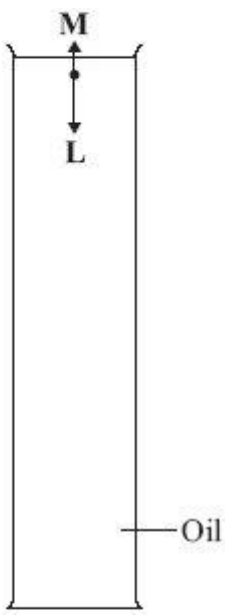
Which **one** of the diagrams, **A**, **B** or **C**, represents the forces acting when the cyclist is travelling at a constant 9 m/s?

Explain the reason for your choice.

(3)
(Total 8 marks)

Q10.

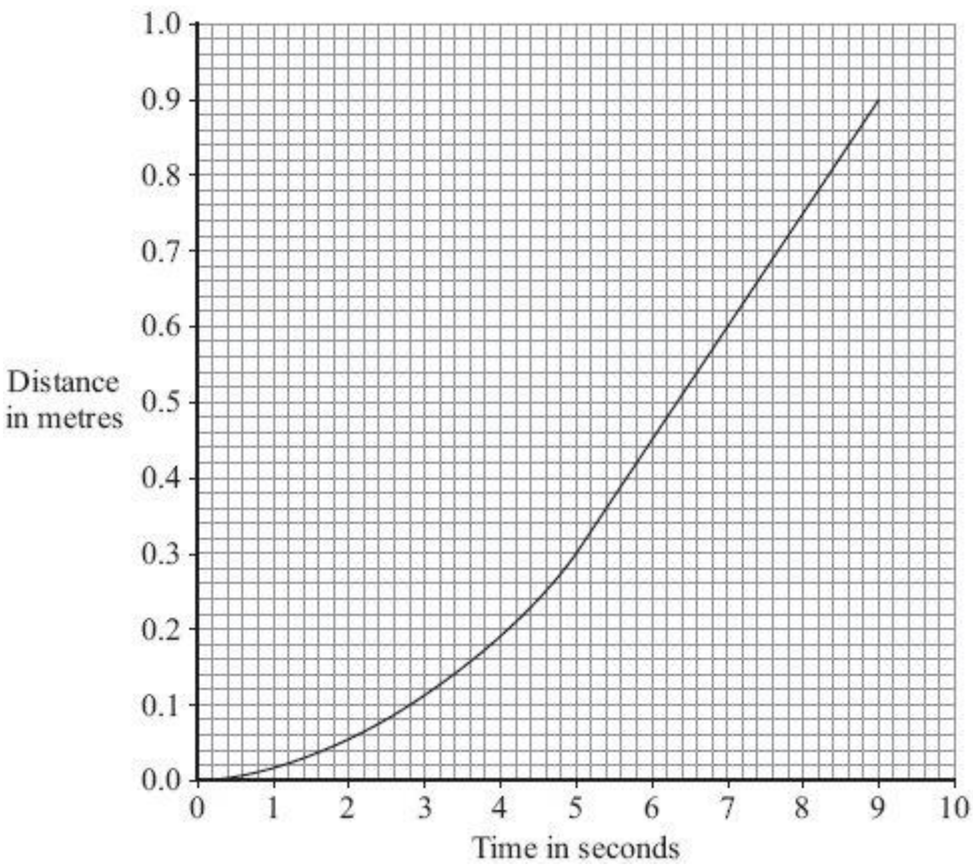
(a) The diagram shows a steel ball-bearing falling through a tube of oil.
The forces, **L** and **M**, act on the ball-bearing.



What causes force **L**?

(1)

(b) The distance – time graph represents the motion of the ball-bearing as it falls through the oil.



(i) Explain, in terms of the forces, **L** and **M**, why the ball-bearing accelerates at first but then falls at constant speed.

____

____

____

____

____

____

(3)

(ii) What name is given to the constant speed reached by the falling ball-bearing?

____

(1)

(iii) Calculate the constant speed reached by the ball-bearing.

Show clearly how you use the graph to work out your answer.

____

____

____

Speed = ______________________________ m/s

(2)

(Total 7 marks)

Q11.

(a) A car driver makes an emergency stop.

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

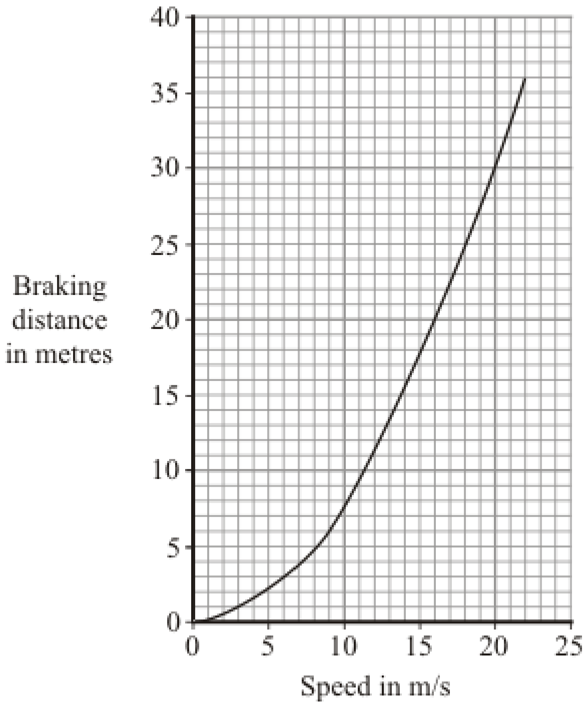
Calculate the total stopping distance of the car.

____

Stopping distance = ___________________________ m

(1)

(b) The graph shows how the braking distance of a car driven on a dry road changes with the car's speed.



The braking distance of the car on an icy road is longer than the braking distance of the car on a dry road.

(i) Draw a new line on the graph to show how the braking distance of the car on an icy road changes with speed.

(2)

(ii) Which **two** of the following would also increase the braking distance of the car?

Put a tick (✓) next to each of your answers.

rain on the road ☐

the driver having drunk alcohol ☐

car brakes in bad condition ☐

the driver having taken drugs ☐

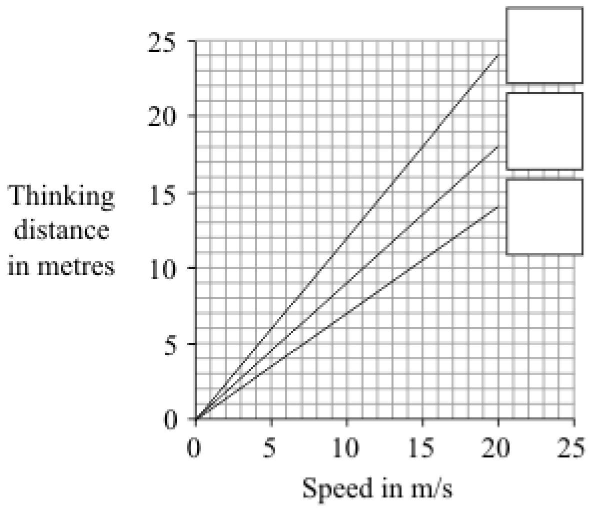
(2)

(c) The thinking distance depends on the driver's reaction time.

The table shows the reaction times of three people driving under different conditions.

Car driver	**Condition**	**Reaction time in seconds**
A	Wide awake with no distractions	0.7
B	Using a hands-free mobile phone	0.9
C	Very tired and listening to music	1.2

The graph lines show how the thinking distance for the three drivers, **A**, **B** and **C**, depends on how fast they are driving the car.



(i) Match each graph line to the correct driver by writing **A**, **B** or **C** in the box next to the correct line.

(2)

(ii) The information in the table cannot be used to tell if driver **C**'s reaction time is increased by being tired or by listening to music.

Explain why.

____

____

____

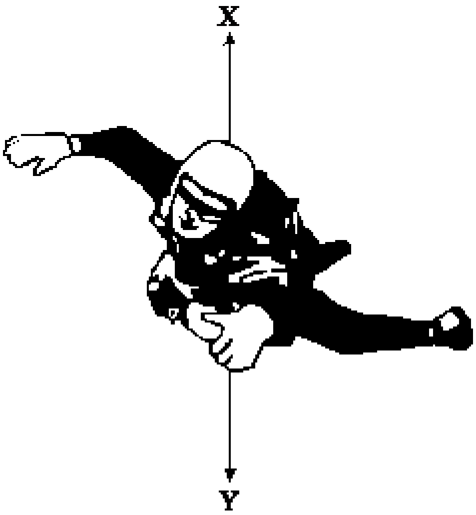
____

(2)

(Total 9 marks)

Q12.

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)

Q13.

(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.

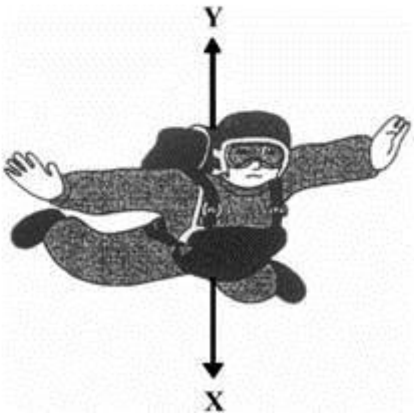
Skydiver ____________ will fall faster because_____________________________

____

____

(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

go up
stay the same
go down

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**?

____

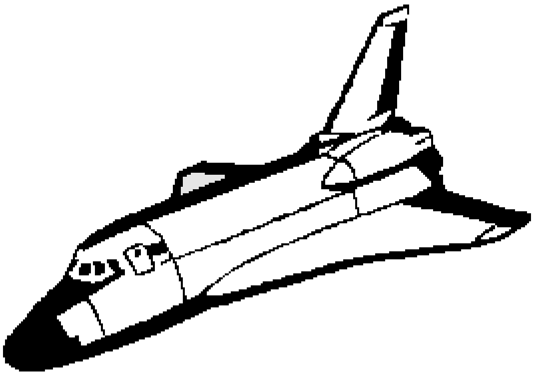
____

(1)

(Total 7 marks)

Q14.

The diagram shows an orbiter, the reusable part of a space shuttle. The data refers to a typical flight.



Orbiter data	
Mass	78 000 kg
Orbital speed	7.5 km/s
Orbital altitude	200 km
Landing speed	100 m/s
Flight time	7 days

(a) (i) What name is given to the force which keeps the orbiter in orbit around the Earth?

____

(1)

(ii) Use the following equation to calculate the kinetic energy, in joules, of the orbiter while it is in orbit.

kinetic energy = ½ mv^2

____

____

Kinetic energy = _______________ joules

(2)

(iii) What happens to most of this kinetic energy as the orbiter re-enters the Earth's atmosphere?

____

____

(1)

(b) After touchdown the orbiter decelerates uniformly coming to a halt in 50 s.

(i) Give the equation that links acceleration, time and velocity.

____

(1)

(ii) Calculate the deceleration of the orbiter. Show clearly how you work out your answer and give the unit.

____

____

Deceleration = ________________

(2)

(c) (i) Give the equation that links acceleration, force and mass.

____

(1)

(ii) Calculate, in newtons, the force needed to bring the orbiter to a halt. Show clearly how you work out your answer.

____

____

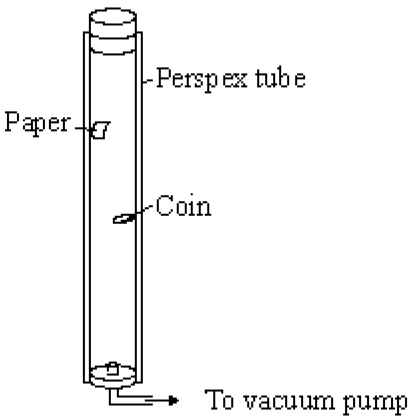
Force = ______________ newtons

(1)

(Total 9 marks)

Q15.

The apparatus shown is used to compare the motion of a coin with the motion of a piece of paper as they both fall.



(a) When the tube is filled with air the coin falls faster than the piece of paper. Why?

____

____

(1)

(b) The air in the tube is removed by the vacuum pump. The tube is turned upside down.
State **two** ways in which the motion of the coin and piece of paper will change compared to when there was air in the tube.

1. ____

____

____

2. ____

____

____

(2)
(Total 3 marks)

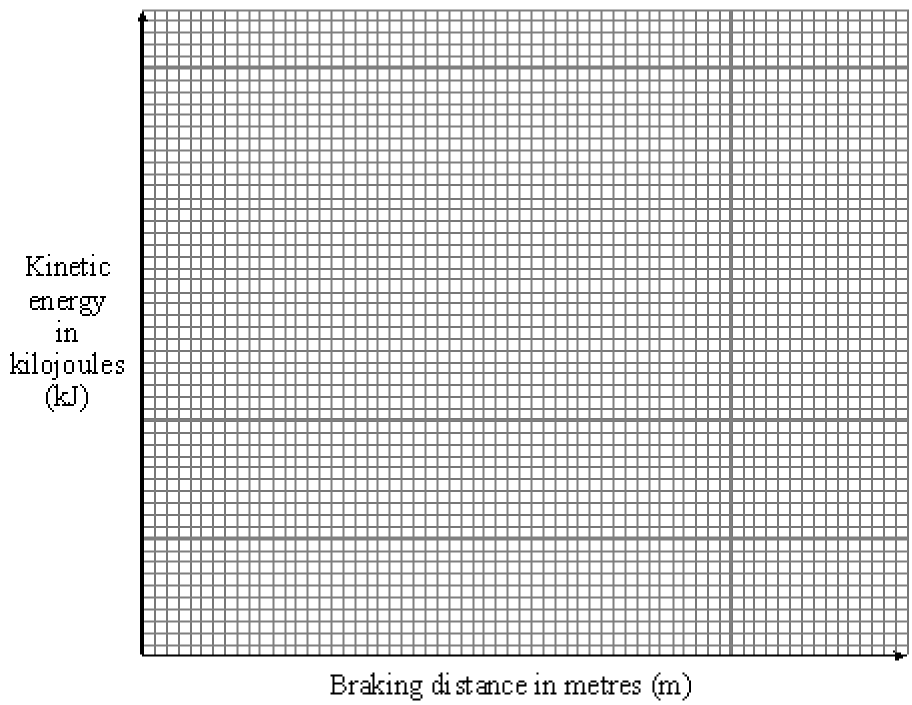
Q16.

The table shows the braking distances for a car at different speeds and kinetic energy.
The braking distance is how far the car travels once the brakes have been applied.

Braking distance in m	**Speed of car in m/s**	**Kinetic energy of car in kJ**
5	10	40
12	15	90
20	20	160
33	25	250
45	30	360

(a) A student suggests, "*the braking distance is directly proportional to the kinetic energy*."

(i) Draw a line graph to test this suggestion.



(3)

(ii) Does the graph show that the student's suggestion was correct or incorrect? Give a reason for your answer.

____

____

(1)

(iii) Use your graph and the equation for kinetic energy to predict a braking distance for a speed of 35 metres per second (m/s). The mass of the car is 800 kilograms (kg). Show clearly how you obtain your answer.

____

____

Braking distance = ____________________ m

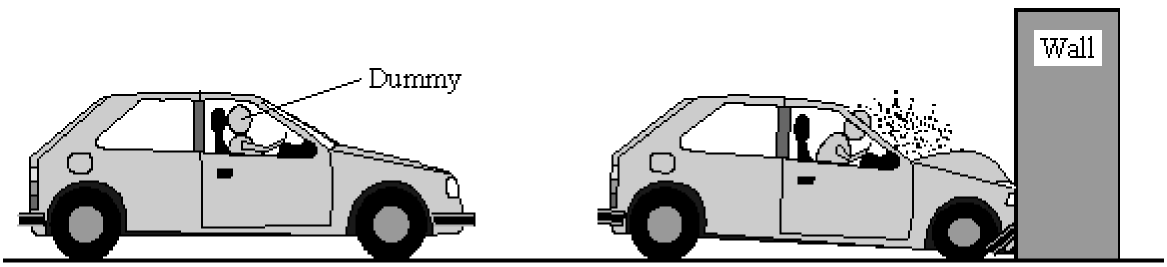
(2)

(iv) State **one** factor, apart from speed, which would increase the car's braking distance.

____

(1)

(b) The diagram shows a car before and during a crash test. The car hits the wall at 14 metres per second (m/s) and takes 0.25 seconds (s) to stop.



(i) Write down the equation which links acceleration, change in velocity and time taken.

____

(1)

(ii) Calculate the deceleration of the car.

____

Deceleration = ____________________ m/s^2

(1)

(iii) In an accident the crumple zone at the front of a car collapses progressively. This increases the time it takes the car to stop. In a front end collision the injury to the car passengers should be reduced. Explain why. The answer has been started for you.

By increasing the time it takes for the car to stop, the ___________________

____

____

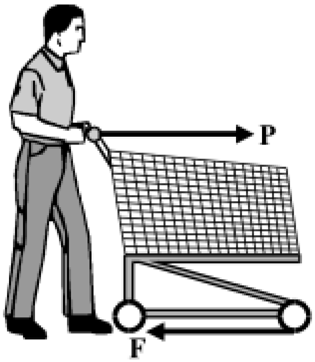
____

(2)

(Total 11 marks)

Q17.

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

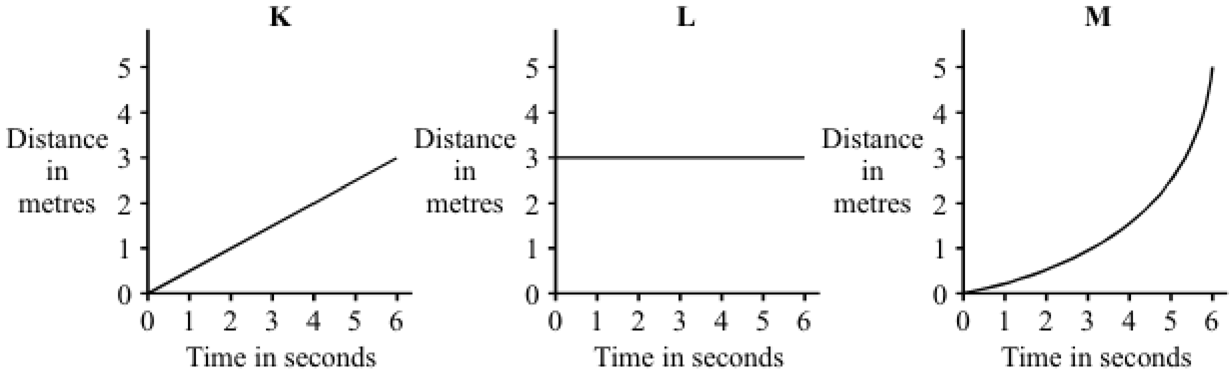


(i) How big is force **P** compared to force **F**?

____

(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)

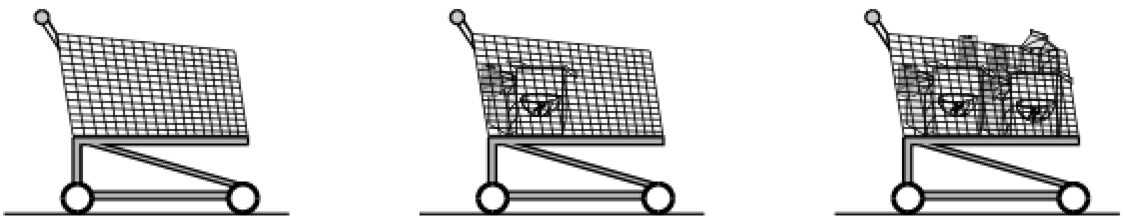
(b) Complete the sentence by crossing out the **two** words in the box that are wrong.

Acceleration is the rate of change of

energy. speed. velocity.

(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.

____

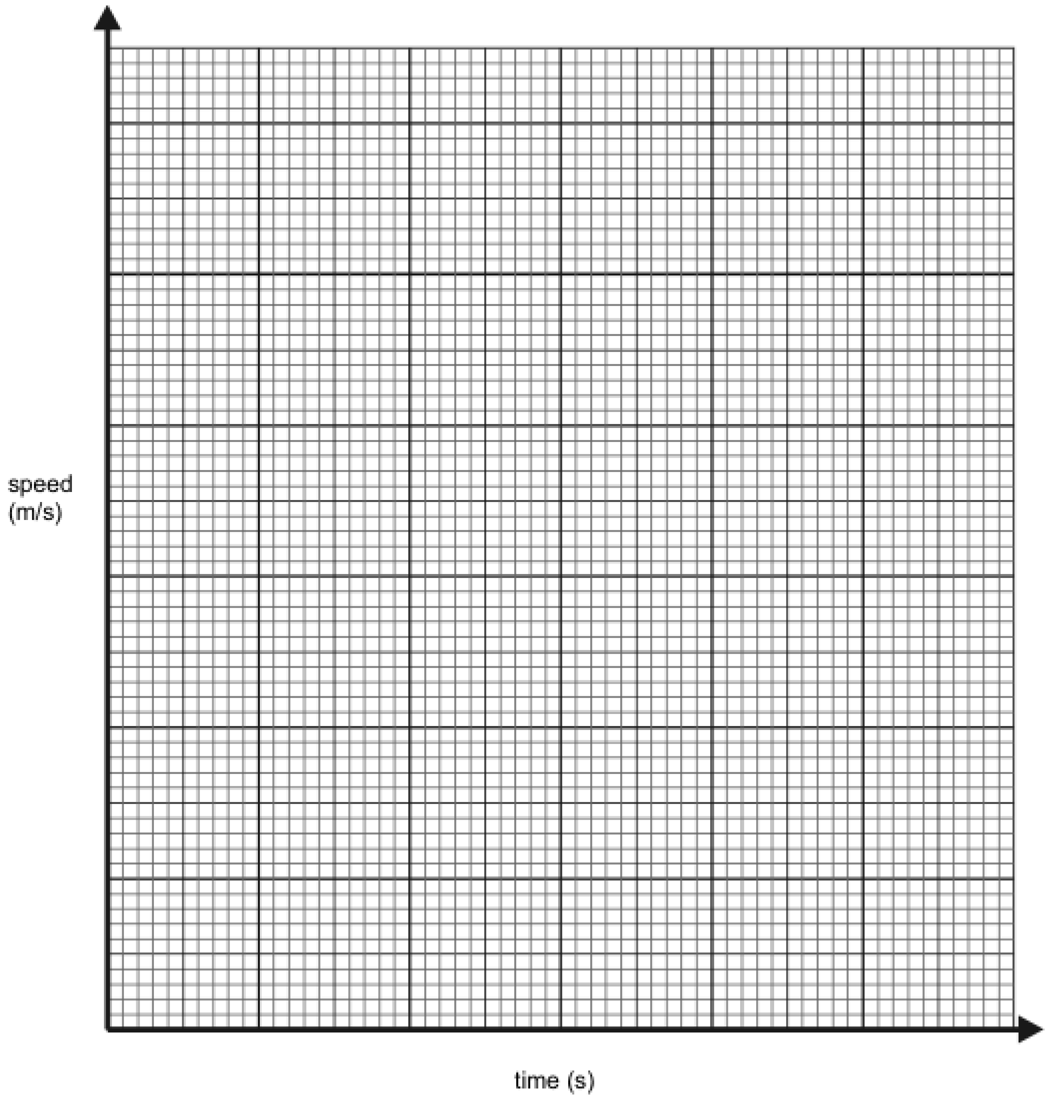
(2)

(Total 5 marks)

Q18.

A driver is driving along a road at 30 m/s. The driver suddenly sees a large truck parked across the road and reacts to the situation by applying the brakes so that a constant braking force stops the car. The reaction time of the driver is 0.67 seconds, it then takes another 5 seconds for the brakes to bring the car to rest.

(a) Using the data above, draw a speed-time graph to show the speed of the car from the instant the truck was seen by the driver until the car stopped.



(5)

(b) Calculate the acceleration of the car whilst the brakes are applied.

____

____

____

Answer = ____________________ m/s^2

(3)

(c) The mass of the car is 1500 kg. Calculate the braking force applied to the car.

____

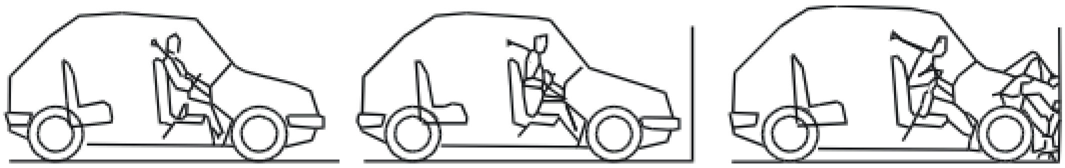
____

____

Answer = ____________________ N

(3)

(d) The diagrams below show what would happen to a driver in a car crash.



(i) Explain why the driver tends to be thrown towards the windscreen.

____

____

____

____

____

____

(ii) The car was travelling at 30 m/s immediately before the crash. Calculate the energy which has to be dissipated as the front of the car crumples.

____

____

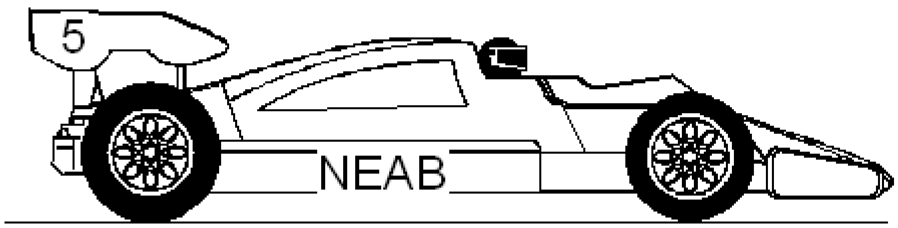
____

____

(8)
(Total 17 marks)

Q19.

A racing driver is driving his car along a **straight** and **level** road as shown in the diagram below.



(a) The driver pushes the accelerator pedal as far down as possible. The car does not accelerate above a certain maximum speed. Explain the reasons for this in terms of the forces acting on the car.

____

____

____

____

____

(4)

(b) The racing car has a mass of 1250 kg. When the brake pedal is pushed down a constant braking force of 10 000 N is exerted on the car.

(i) Calculate the acceleration of the car.

(ii) Calculate the kinetic energy of the car when it is travelling at a speed of 48 m/s.

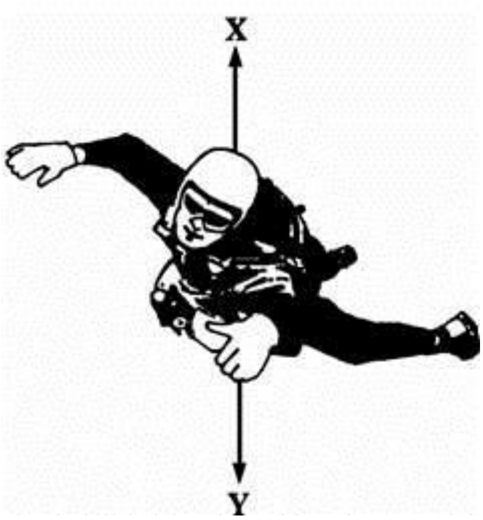
(iii) When the brakes are applied with a constant force of 10 000 N the car travels a distance of 144 m before it stops. Calculate the work done in stopping the car.

(12)
(Total 16 marks)

Q20.

A sky-diver jumps from a plane.

The sky-diver is shown in the diagram below.



(a) Arrows **X** and **Y** show two forces acting on the sky-diver as he falls.

(i) Name the forces **X** and **Y**.

X ______________________________

Y ______________________________

(2)

(ii) Explain why force **X** acts in an upward direction.

____

____

(1)

(iii) At first forces **X** and **Y** are unbalanced.

Which of the forces will be bigger? ____________________

(1)

(iv) How does this unbalanced force affect the sky-diver?

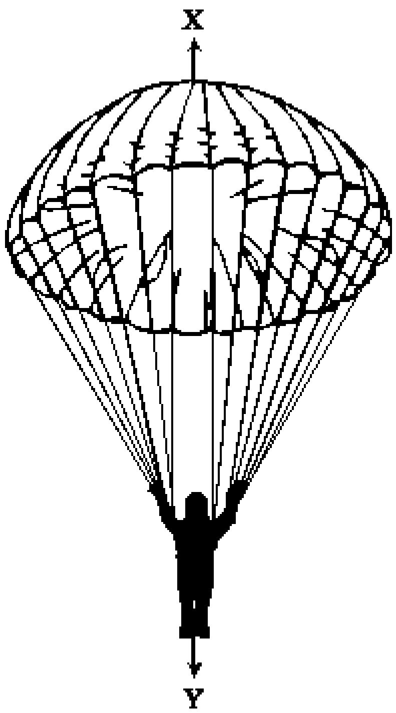
____

____

(2)

(b) After some time the sky-diver pulls the rip cord and the parachute opens.

The sky-diver and parachute are shown in the diagram below.



After a while forces **X** and **Y** are balanced.

Underline the correct answer in each line below.

Force **X** has

increased / stayed the same / decreased.

Force **Y** has

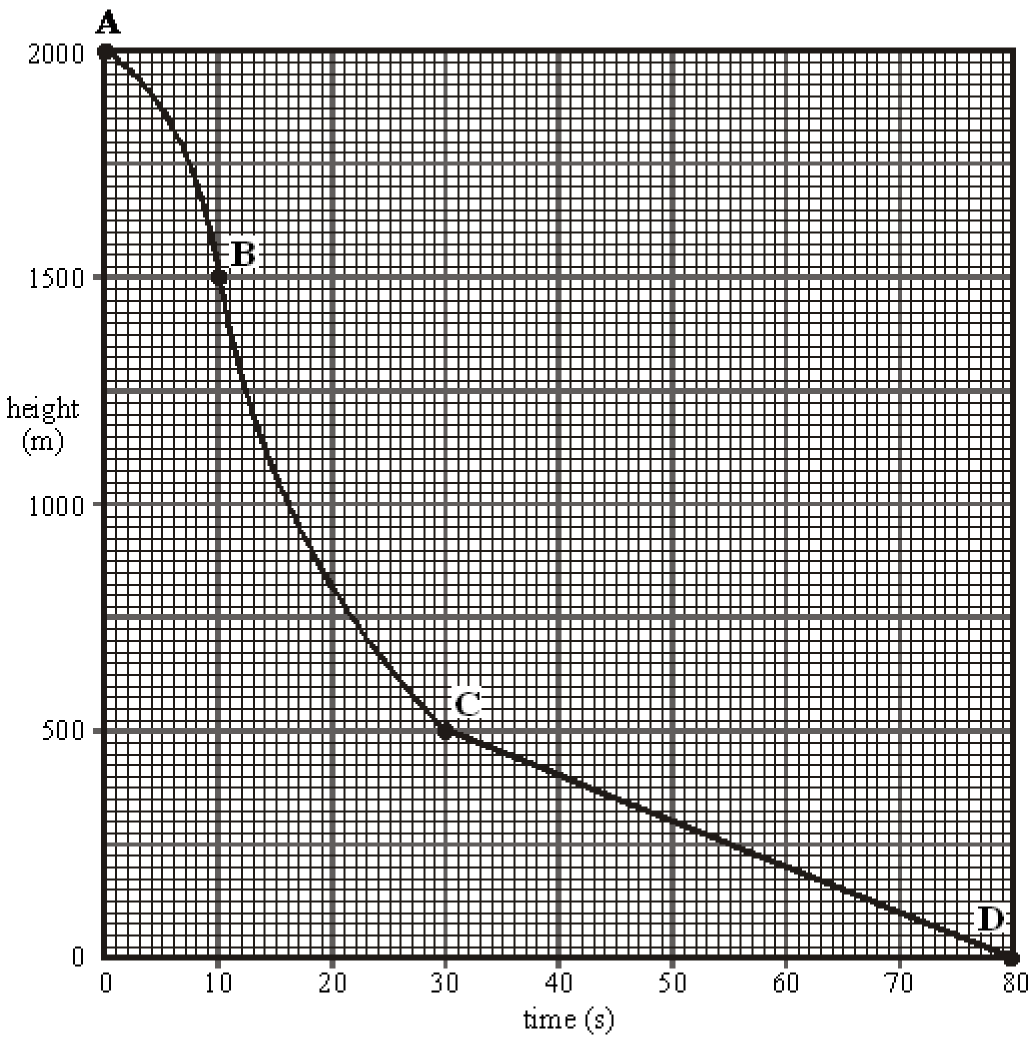
increased / stayed the same / decreased.

The speed of the sky-diver will

increase / stay the same / decrease.

(3)

(c) The graph below shows how the height of the sky-diver changes with time.



(i) Which part of the graph, **AB**, **BC** or **CD** shows the sky-diver falling at a constant speed?

____

(1)

(ii) What distance does the sky-diver fall at a constant speed?

Distance ________________ m

(1)

(iii) How long does he fall at this speed?

Time ____________________ s

(1)

(iv) Calculate this speed.

____

____

____

Speed ________________ m/s

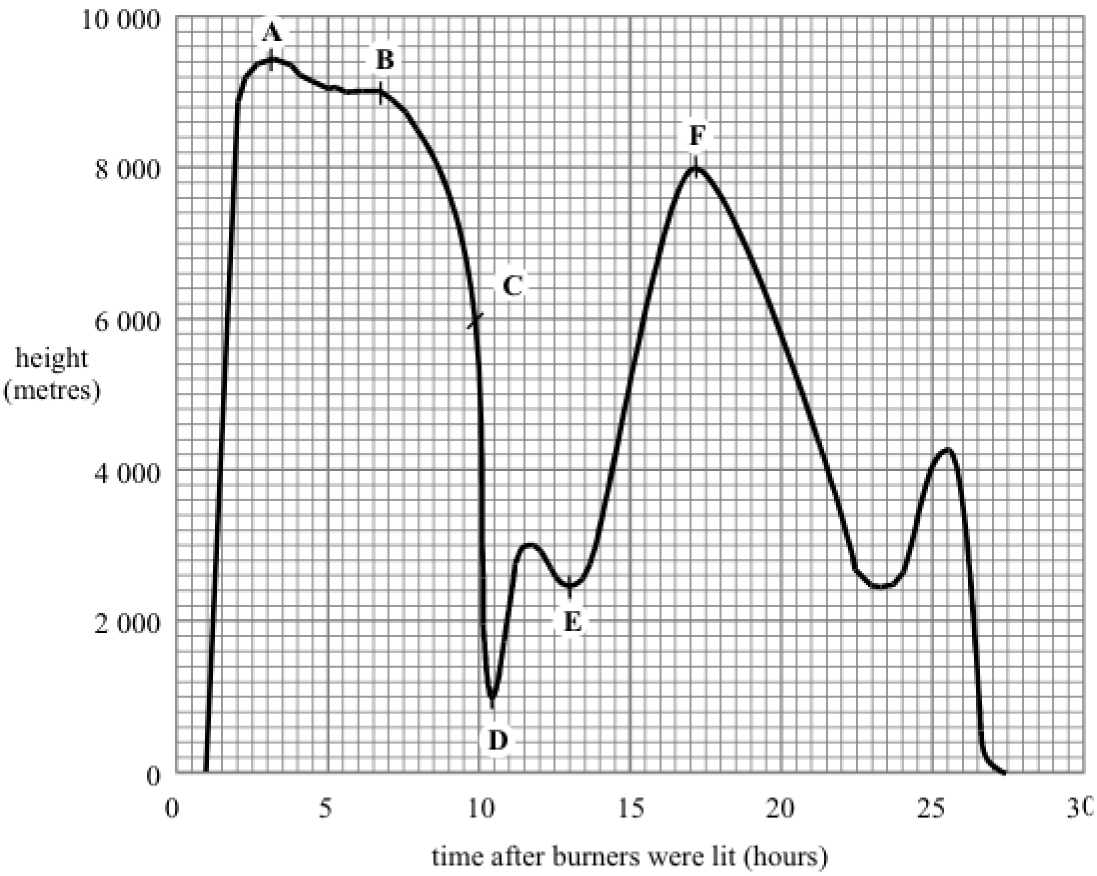
(2)

(Total 14 marks)

Q21.

A hot air balloon called Global Challenger was used to try to break the record for travelling round the world.

The graph shows how the height of the balloon changed during the flight.



The balloon took off from Marrakesh one hour after the burners were lit and climbed rapidly.

(a) Use the graph to find:

(i) the maximum height reached.

Maximum height _______________ metres.

(ii) the total time of the flight.

Total time ______________________ hours.

(2)

(b) Several important moments during the flight are labelled on the graph with the letters **A**, **B**, **C**, **D**, **E** and **F**.
At which of these moments did the following happen?

(i) The balloon began a slow controlled descent to 2500 metres.

____

(ii) The crew threw out all the cargo on board in order to stop a very rapid descent.

____

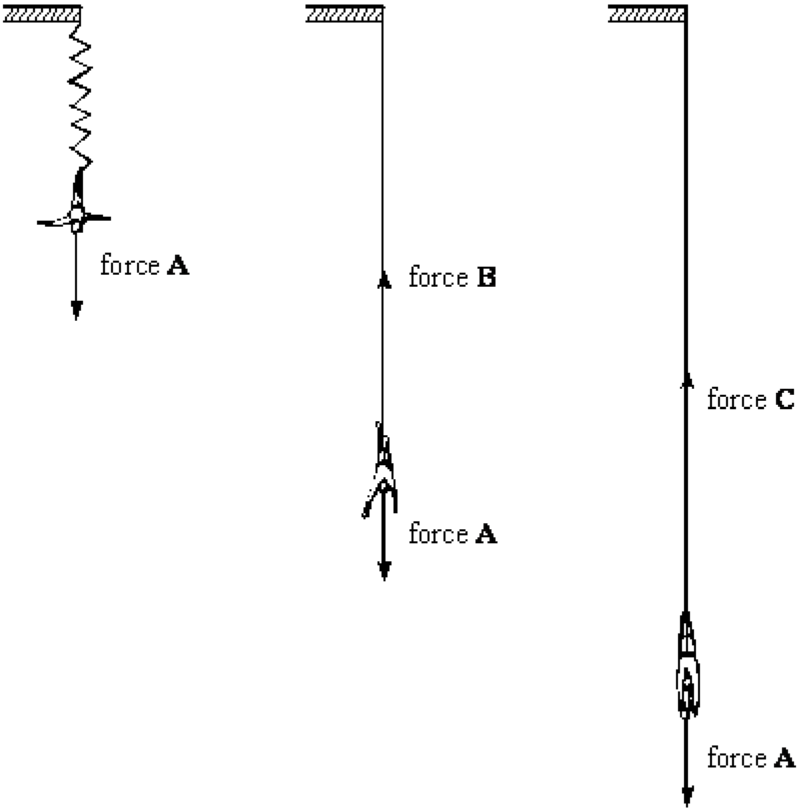
(iii) The balloon started to descend from 9000 metres.

____

(3)
(Total 5 marks)

Q22.

When a bungee-jump is made the jumper steps off a high platform. An elastic cord from the platform is tied to the jumper.
The diagram below shows different stages in a bungee-jump.
Forces **A**, **B** and **C** are forces acting on the jumper at each stage.



moving down large acceleration	moving down small acceleration	moving down slowing acceleration
diagram **X**	diagram **Y**	diagram **Z**

(a) Name force **A**.

____

(1)

(b) The motion of the jumper is shown in the diagrams.
By comparing forces **A**, **B** and **C**, state how the motion is caused in:

(i) diagram **X**;

____

(ii) diagram **Y**;

____

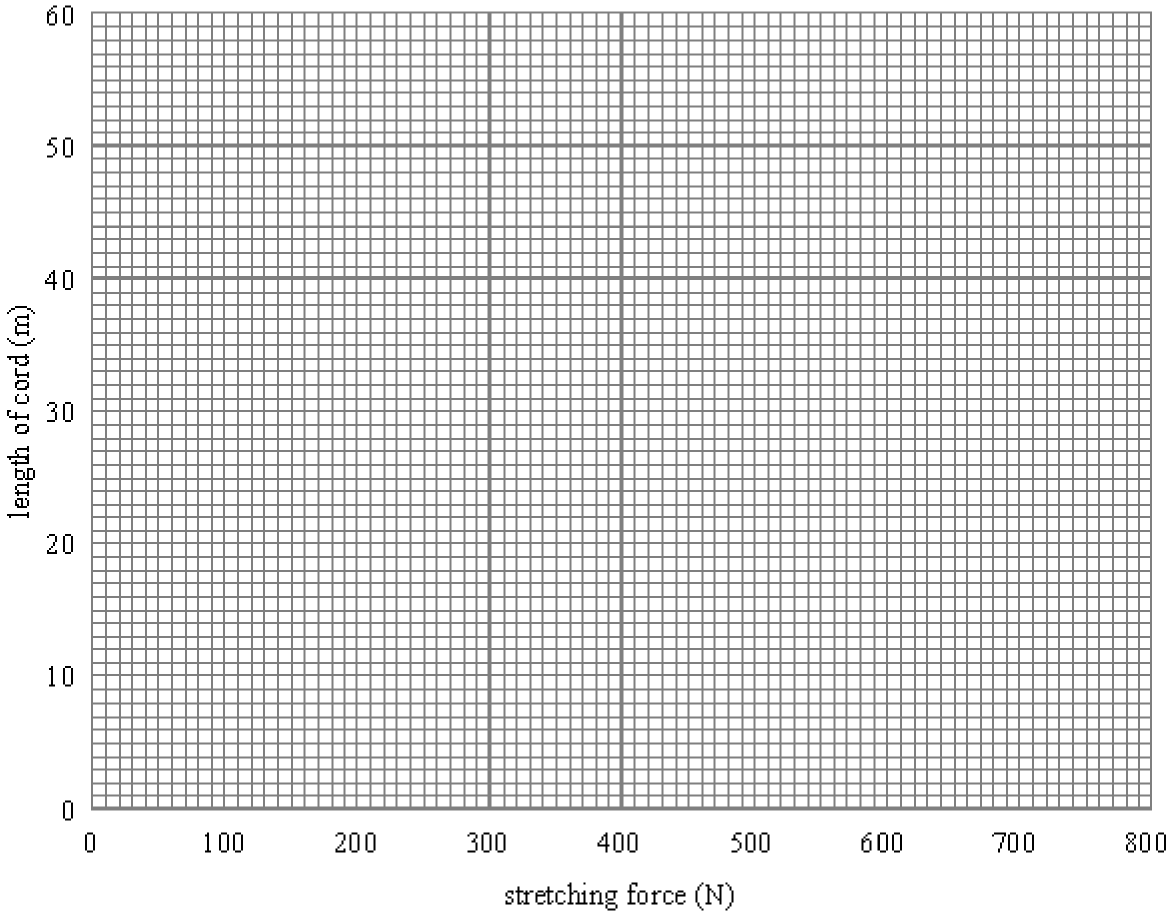
(iii) diagram **Z**.

(3)

(c) The table gives results for a bungee cord when it is being stretched.

STRETCHING FORCE (N)	100	200	400	600	800
LENGTH OF CORD (m)	20	24	32	40	48

(i) Plot a graph of these results on the graph paper.



(3)

(ii) Use the graph to find the length of the cord before it was stretched.

Length ___________ m

(1)

(Total 8 marks)

Q23.

When you transfer *energy* to a shopping trolley, the amount of *work done* depends on the *force* used and the *distance moved*.

Complete the table by using the correct units from the box.

joule (J)	**metre (m)**	**newton (N)**

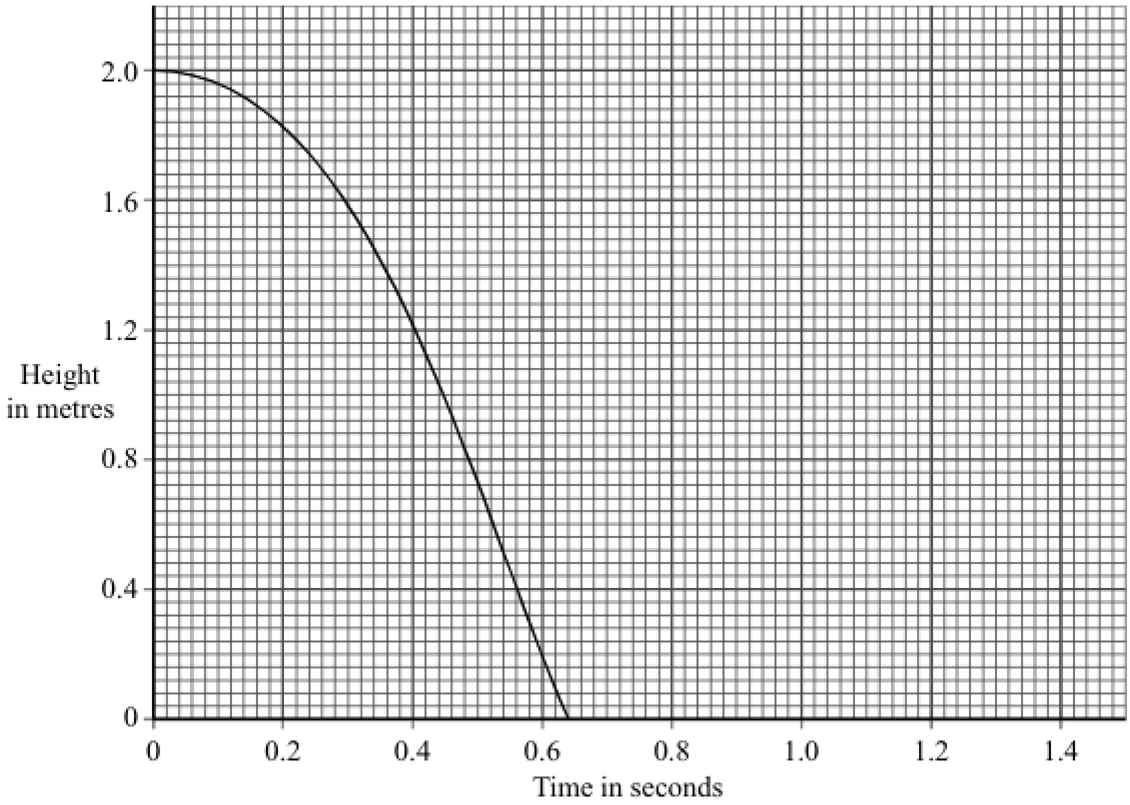
The first one has been done for you.

Quantity	**Unit**
energy (transferred)	joule
force	
distance (moved)	
work done	

(Total 2 marks)

Q24.

A bouncy ball is dropped vertically from a height of 2.00 m onto the floor. The graph shows the height of the ball above the floor at different times during its fall until it hits the floor after 0.64 s.



(a) What is the average speed of the ball over the first 0.64 s? Show clearly how you work out your answer.

____

____

Average speed = ____________________ m/s

(1)

(b) After it hits the floor the ball bounces back to a height of 1.25 m. It reaches this height 1. 16 s after it was dropped. Plot this point on the grid above and sketch a graph to show the height of the ball above the floor between 0. 64 s and 1.16 s.

(3)

(c) (i) The ball bounces on the floor 0.64 s after being dropped. How long after being dropped will it be before it bounces a second time?

____

____

(1)

(ii) What distance will the ball travel between its first and second bounce?

____

____

(1)

(d) The ball was held stationary before being dropped. On the graph and your sketch mark **two** other points X_1 and X_2, where the ball is stationary, and in each case explain why the ball is not moving.

X_1 ____

X_2 ______________________________

____

(2)

(Total 8 marks)

Q25.

When a gun is fired, a very large force acts on the bullet for a very short time.

The change in momentum of the bullet is given by the following relationship:

force (N) × time(s) = change in momentum (kg m/s)

(a) An average force of 4000 newton acts for 0.01 seconds on a bullet of mass 50g.

Calculate the speed of the bullet. (*Show your working*.)

____

____

____

Answer ______________________ m/s

(4)

(b) The bullet is fired horizontally. In the short time it takes for the bullet to reach its target, its horizontal speed has fallen to 80% of its initial speed.

(i) Explain why the speed of the bullet decreases so quickly.

____

____

(2)

(ii) Calculate the percentage of its original kinetic energy the bullet still has when it reaches its target.

(Show your working.)

____

____

____

____

(4)

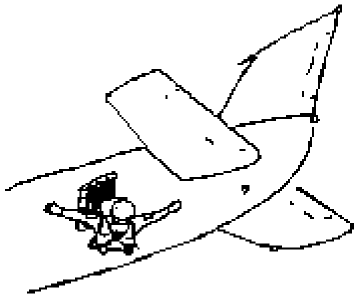
(Total 10 marks)

Q26.

A sky-diver steps out of an aeroplane.

After 10 seconds she is falling at a steady speed of 50m/s.

She then opens her parachute.



After another 5 seconds she is once again falling at a steady speed.

This speed is now only 10m/s.

(a) Calculate the sky-diver's average acceleration during the time from when she opens her parachute until she reaches her slower steady speed. (Show your working.)

____

____

____

(3)

(b) Explain, as fully as you can:

(i) why the sky-diver eventually reaches a steady speed (with or without her parachute).

____

____

____

____

(3)

(ii) why the sky-diver's steady speed is lower when her parachute is open.

____

(1)

(c) The sky- diver and her equipment have a total mass of 75kg. Calculate the gravitational force acting on this mass. (Show your working.)

____

____

Answer ____________________ N

(1)

(Total 8 marks)

Q27.

A man's car will not start, so two friends help him by pushing it.

Mass of car = 800 kg

By pushing as hard as they can for 12 seconds they make the car reach a speed of 3 metres per second.

(a) Calculate the acceleration they give to the car.

____

____

____ Answer __________ m/s^2

(2)

(b) Whilst pushing the car the two friends together do a total of 2400 joules of work. Calculate their total power.

____

____

____ Answer __________ watts

(2)

(c) Another motorist has the same problem. The two friends push his car along the same stretch of road with the same force as before.

It takes them 18 seconds to get the second car up to a speed of 3 metres per second.

What does this tell you about the mass of the second car?
(You can ignore forces of friction.)

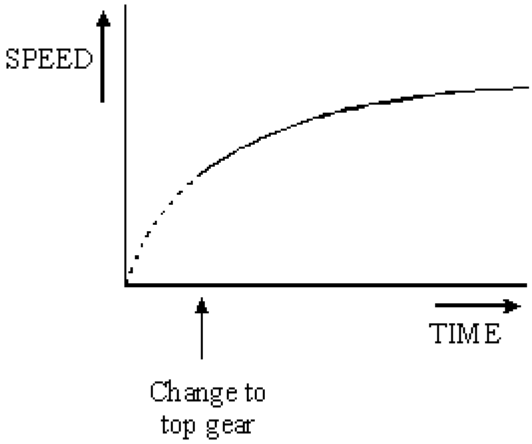
____

____

(2)

(d) On a flat stretch of a motorway a lorry driver changes into top gear. He then makes the lorry go as fast as he can.

The graph shows what happens to the speed of the lorry.



Explain why the speed of the lorry increases at first but then levels out.

____

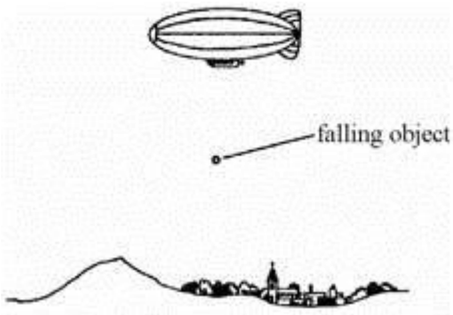
____

(3)

(Total 9 marks)

Q28.

A small object falls out of a balloon.



Choose words from the list to complete the sentences below.

friction	**gravity**	**air pressure**
accelerates	**falls at a steady speed**	**slows down**

- The weight of an object is the force of ______________________ which acts on it.
- When you drop something, first of all it ________________________ .
- The faster it falls, the bigger the force of _____________________ which acts on it.
- Eventually the object _______________________ .

(Total 4 marks)

Q29.

The diagram shows a shuttlecock that is used for playing badminton.

The shuttlecock weighs very little.
When you drop it from a height of a few metres, it accelerates at first but soon reaches a steady speed.

Explain, as fully as you can:

(a) why the shuttlecock accelerates at first,

____

____

____

(2)

(b) why the shuttlecock reaches a steady speed.

____

____

____

____

(3)
(Total 5 marks)