Forces Questions 3

35 Questions

Name: _____

Class: _____

Date: _____

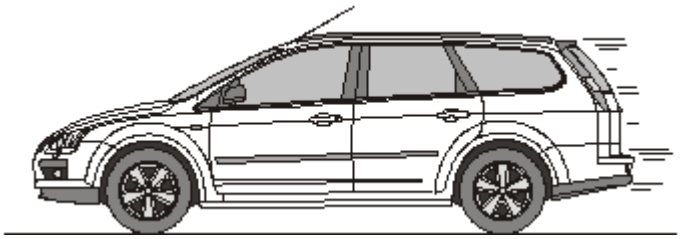
Time:

Marks:

Comments:

Q1.

(a) The diagram shows a car travelling at a speed of 12 m/s along a straight road.



(i) Calculate the momentum of the car.

Mass of the car = 900 kg

Show clearly how you work out your answer.

_____

_____

_____

_____

Momentum = _____ kg m/s

(2)

(ii) Momentum has direction.

Draw an arrow on the diagram to show the direction of the car's momentum.

(1)

(b) The car stops at a set of traffic lights.

How much momentum does the car have when it is stopped at the traffic lights?

_____

Give a reason for your answer.

_____

_____

_____

_____

(2)

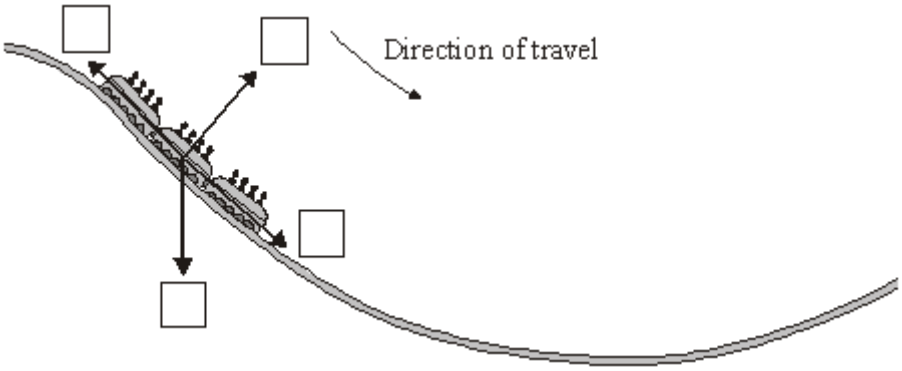
(Total 5 marks)

Q2.

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

(a) Which arrow shows the direction of the resultant force acting on the passenger train?

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



(1)

(b) At the bottom of the slope, the passengers in the train all have the same speed but they each have a different kinetic energy.

Why is the kinetic energy of each passenger different?

_____

_____

(1)

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

Normal gravitational field strength = 9.8 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 80 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 5 marks)

Q3.

(a) The diagram shows an athlete at the start of a race. The race is along a straight track.

In the first 2 seconds, the athlete accelerates constantly and reaches a speed of 9 m/s.

(i) Calculate the acceleration of the athlete.

Show clearly how you work out your answer.

_____

_____

_____

Acceleration = _____

(2)

(ii) Which **one** of the following is the unit for acceleration?

Draw a ring around your answer.

J/s **m/s** **m/s^2** **Nm**

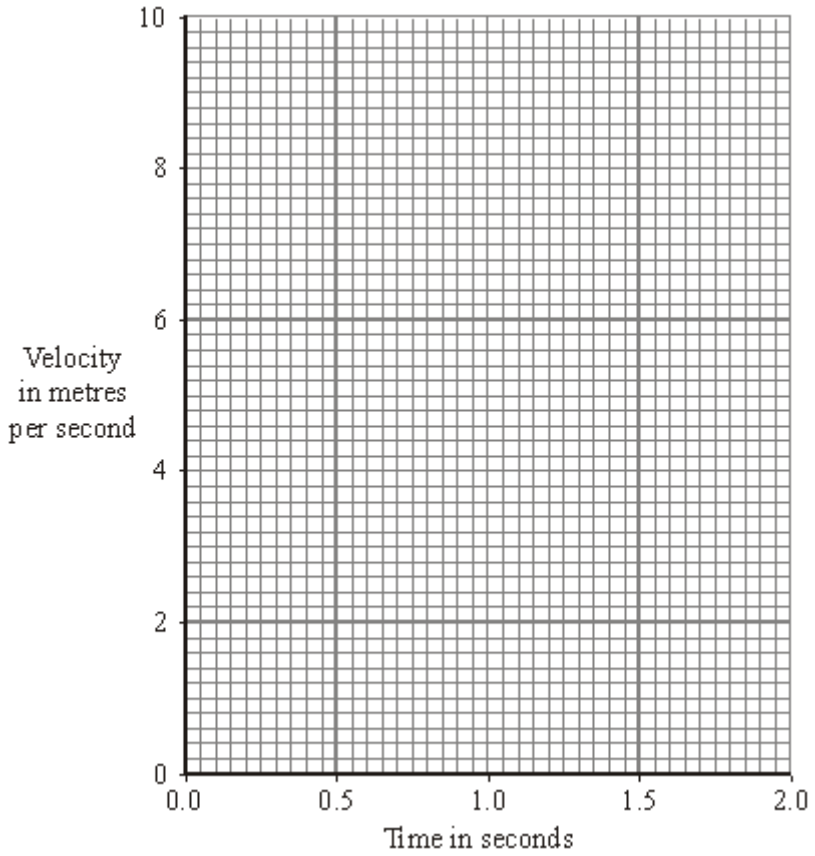
(1)

(iii) Complete the following sentence.

The velocity of the athlete is the _____ of the athlete in a given direction.

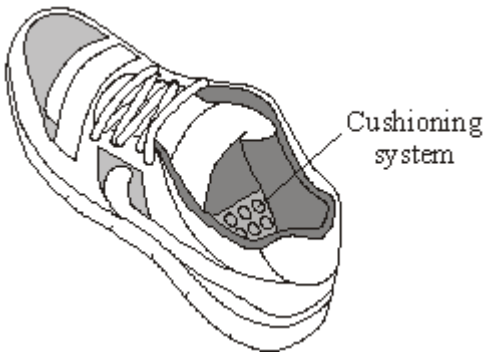
(1)

(iv) Complete the graph to show how the velocity of the athlete changes during the first 2 seconds of the race.

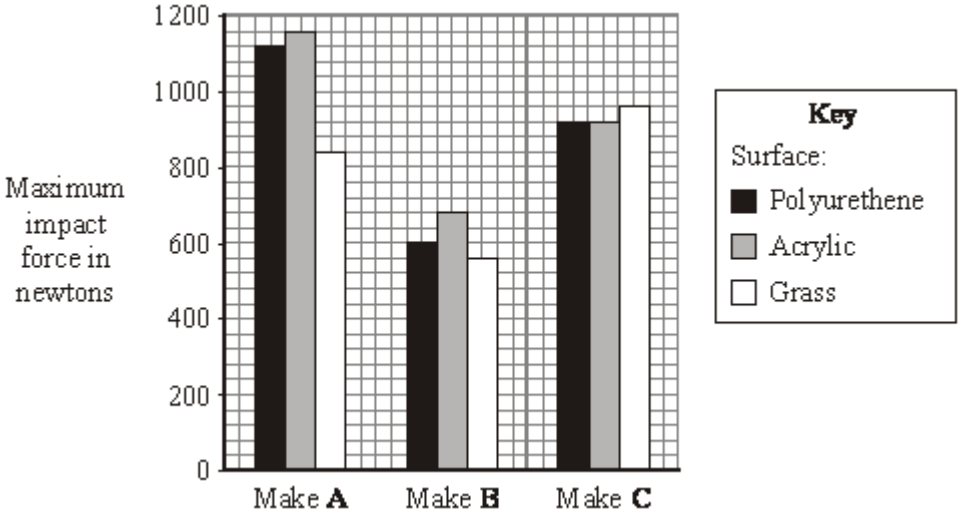


(2)

(b) Many running shoes have a cushioning system. This reduces the impact force on the athlete as the heel of the running shoe hits the ground.



The bar chart shows the maximum impact force for three different makes of running shoe used on three different types of surface.



(i) Which **one** of the three makes of running shoe, **A**, **B** or **C**, has the best cushioning system?

_____

Explain the reason for your answer.

_____

_____

_____

_____

(3)

(ii) The data needed to draw the bar chart was obtained using a robotic athlete fitted with electronic sensors.

Why is this data likely to be more reliable than data obtained using human athletes?

_____

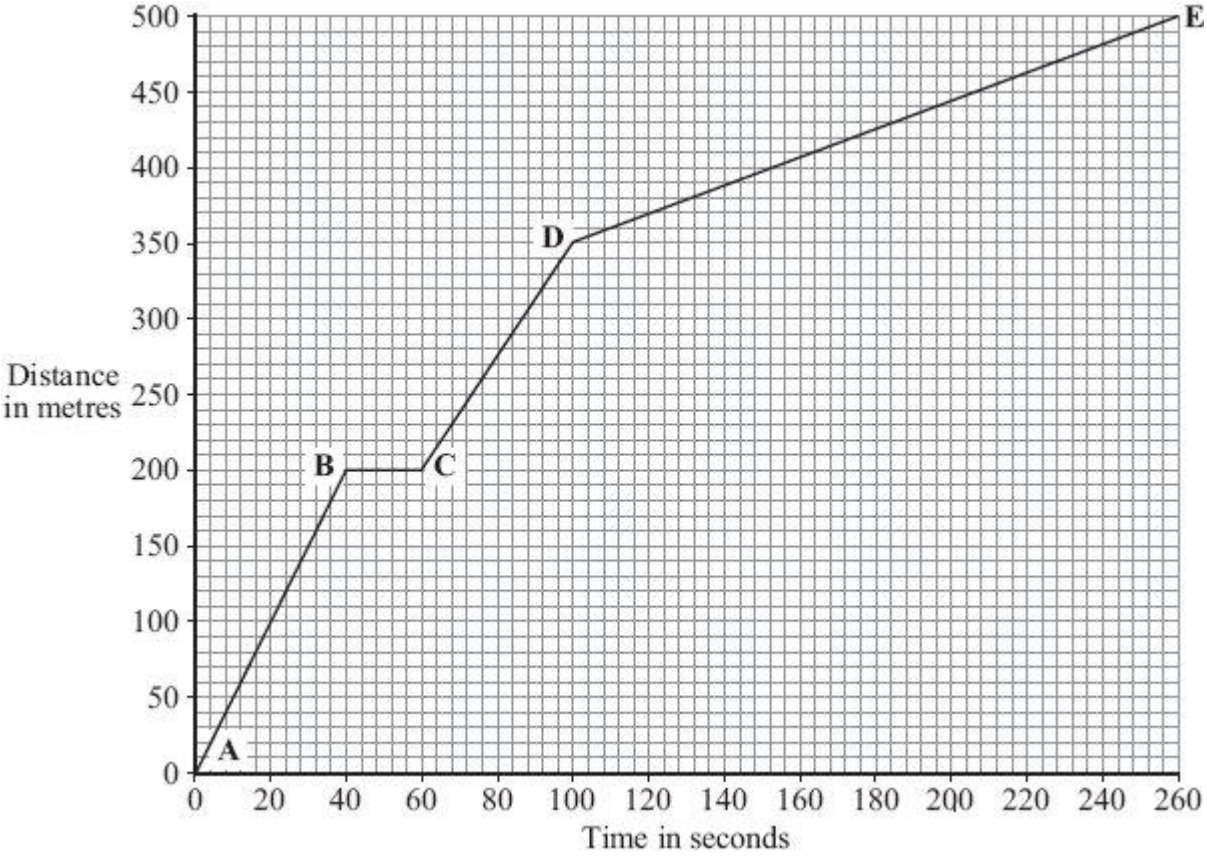
_____

(1)

(Total 10 marks)

Q4.

Part of a bus route is along a high street.
The distance – time graph shows how far the bus travelled along the high street and how long it took.



(a) The bus travels the **slowest** between points **D** and **E**.

How can you tell this from the graph?

_____

_____

(1)

(b) Between which two points was the bus travelling the **fastest**?

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

Points	
A – B	
B – C	
C – D	

(1)

(c) There is a bus stop in the high street.
This is marked as point **B** on the graph.

(i) What is the distance between point **A** on the graph and the bus stop?

Distance _____ metres

(1)

(ii) How long did the bus stop at the bus stop?

Show clearly how you work out your answer.

_____

Time = _____ seconds

(2)

(d) A cyclist made the same journey along the high street.
The cyclist started at the same time as the bus and completed the journey in 200 seconds. The cyclist travelled the whole distance at a constant speed.

(i) Draw a line on the graph to show the cyclist's journey.

(2)

(ii) After how many seconds did the cyclist overtake the bus?

The cyclist overtook the bus after _____ seconds.

(1)

(Total 8 marks)

Q5.

The diagram shows an adult and a child pushing a loaded shopping trolley.

(a) (i) What is the *total force* on the trolley due to the adult and child?

_____

(1)

(ii) Which **one** of the terms in the box means the same as *total force*?

Draw a ring around your answer.

answer force	**mean force**	**resultant force**

(1)

(iii) The trolley is pushed at a constant speed for 80 metres.

Calculate the work done to push the trolley 80 metres.

Show clearly how you work out your answer.

_____

_____

Work done = _____

(2)

(b) Complete the following sentences by drawing a ring around the correct word in each of the boxes.

(i) The unit of work done is the

joule
newton
watt

.

(1)

(ii) Most of the work done to push the trolley is transformed into

heat
light
sound

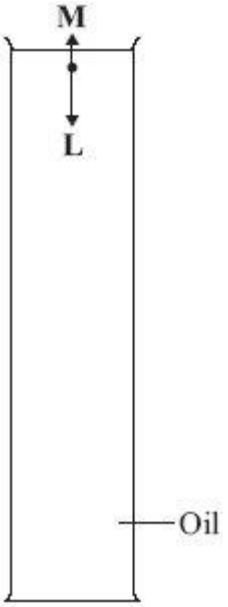
.

(1)

(Total 6 marks)

Q6.

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

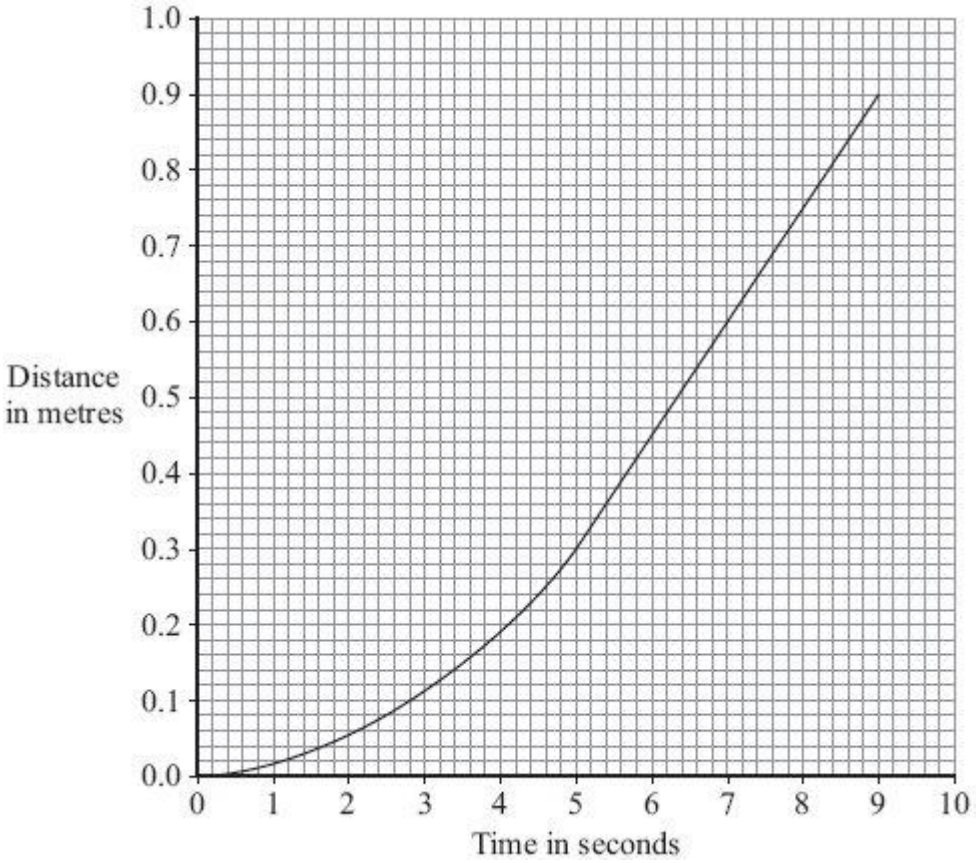


What causes force **L**?

_____

(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.

_____

_____

_____

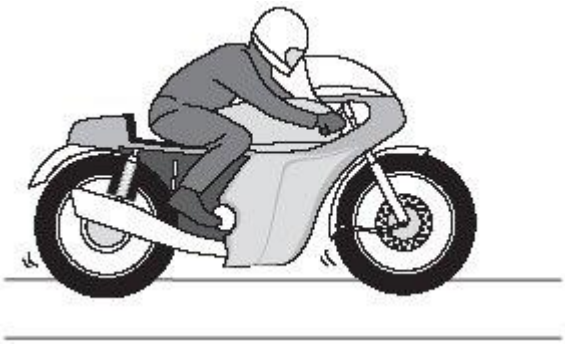
Speed = _____ m/s

(2)

(Total 7 marks)

Q7.

The diagram shows a motorbike of mass 300 kg being ridden along a straight road.



The rider sees a traffic queue ahead. He applies the brakes and reduces the speed of the motorbike from 18 m/s to 3 m/s.

(a) Calculate the kinetic energy lost by the motorbike.

Show clearly how you work out your answer.

_____

_____

_____

_____

Kinetic energy lost = _____ J

(2)

(b) (i) How much work is done on the motorbike by the braking force?

_____

(1)

(ii) What happens to the kinetic energy lost by the motorbike?

_____

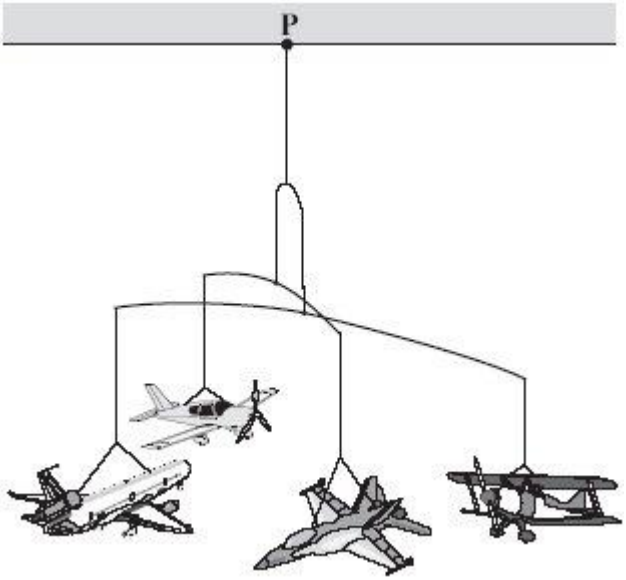
(1)

(Total 4 marks)

Q8.

(a) The diagram shows a child's mobile. The mobile hangs from point **P** on the ceiling of the child's bedroom.

(i) Mark the position of the centre of mass of the mobile by drawing a letter **X** on the diagram. Do this so that the centre of the **X** marks the centre of mass of the mobile.



(1)

(ii) Explain why you have chosen this position for your letter **X**.

_____

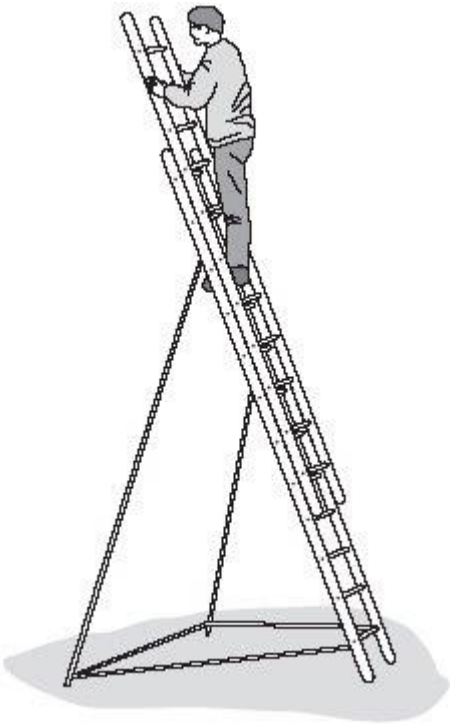
_____

_____

_____

(2)

(b) The diagram shows a device which helps to prevent a ladder from falling over.

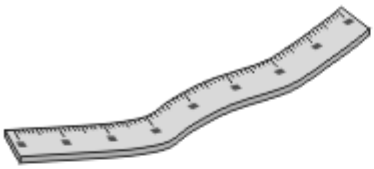


Use the term *centre of mass* to explain why the ladder, in the situation shown, is unlikely to topple over.
You may add to the diagram to illustrate your explanation.

(3)
(Total 6 marks)

Q9.

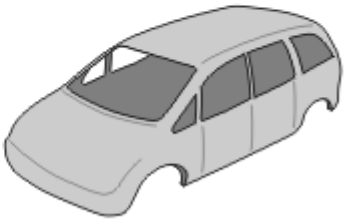
(a) The pictures show four objects. Each object has had its shape changed.



Bent metal ruler
A

Stretched bungee cords
B

Springs on a playground ride
C



Moulded plastic model car body
D

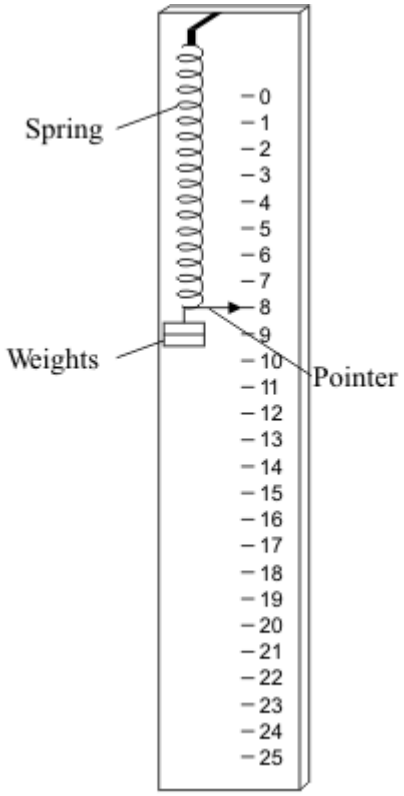
Which of the objects are storing elastic potential energy?

Explain the reason for your choice or choices.

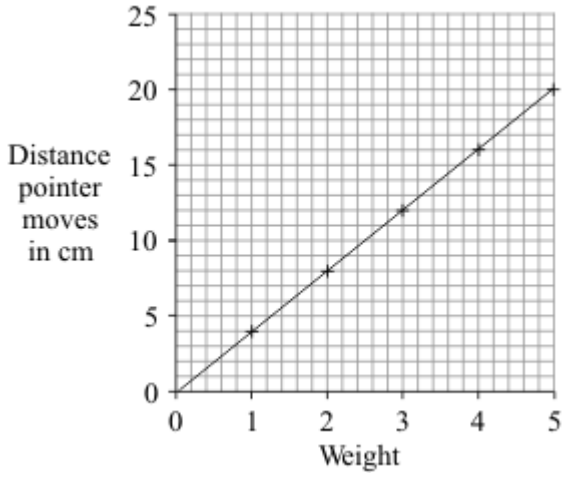
(3)

(b) A student makes a simple spring balance. To make a scale, the student uses a range of weights. Each weight is put onto the spring and the position of the pointer

marked



The graph below shows how increasing the weight made the pointer move further.



(i) Which **one** of the following is the unit of weight?.

Draw a ring around your answer.

joule **kilogram** **newton** **watt**

(1)

(ii) What range of weights did the student use?

_____

(1)

(iii) How far does the pointer move when 4 units of weight are on the spring?

_____

(1)

(iv) The student ties a stone to the spring. The spring stretches 10 cm.

What is the weight of the stone?

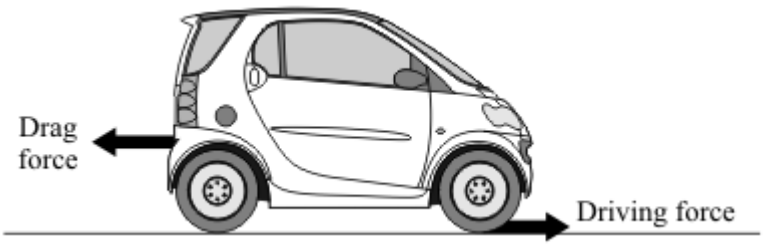
_____

(1)

(Total 7 marks)

Q10.

The diagram shows the horizontal forces acting on a car travelling along a straight road.



(a) Complete the following sentences by drawing a ring around the correct word in each box.

(i) When the driving force equals the drag force, the speed ofthe car is

decreasing
constant
increasing

(1)

(ii) Putting the brakes on transforms the car's kinetic energy mainly into

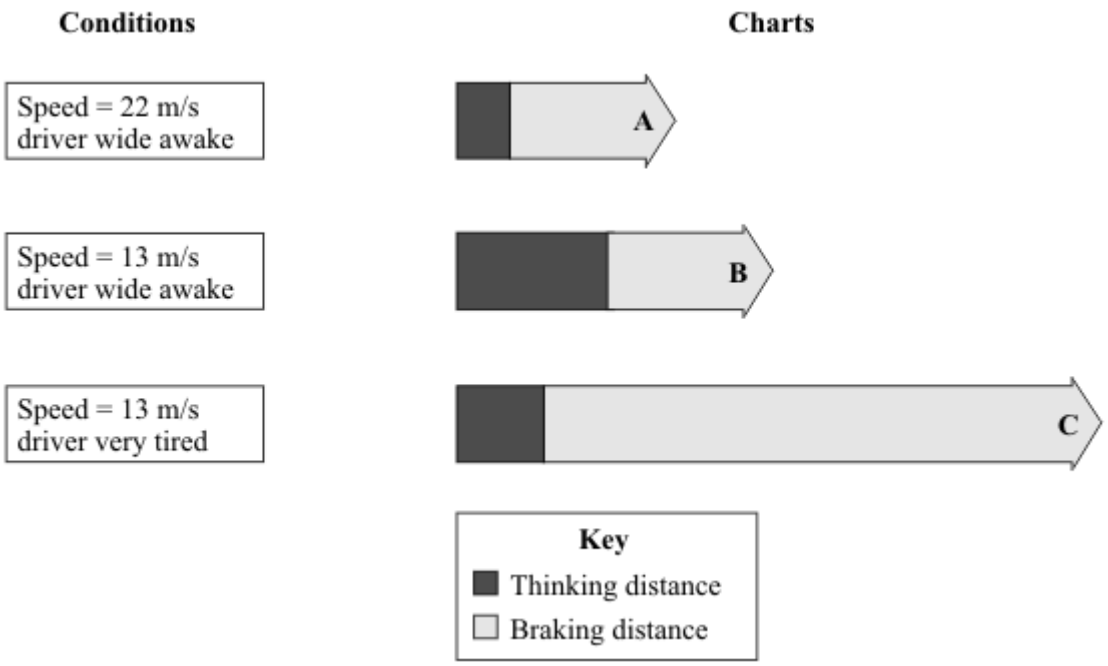
heat
light
sound

(1)

(b) The charts, **A**, **B** and **C** give the thinking distance and the braking distance for a car driven under different conditions.

(i) Draw straight lines to match each chart to the correct conditions.

Draw only **three** lines.



(2)

(ii) The three charts above all apply to dry road conditions.

How would the braking distances be different if the road were wet?

_____

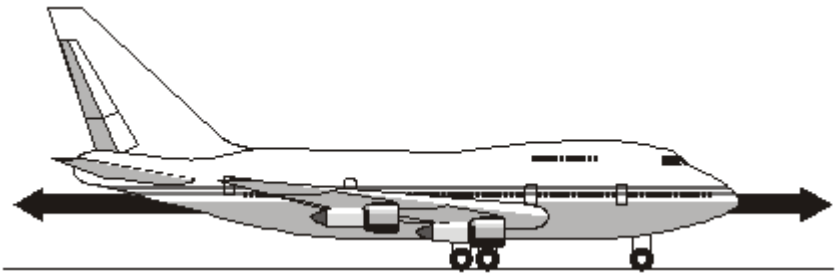
_____

(1)

(Total 5 marks)

Q11.

(a) The diagram shows an aircraft and the horizontal forces acting on it as it moves along a runway. The *resultant force* on the aircraft is zero.



(i) What is meant by the term *resultant force*?

_____

_____

(1)

(ii) Describe the movement of the aircraft when the resultant force is zero.

_____

_____

(1)

(b) The aircraft has a take-off mass of 320 000 kg. Each of the 4 engines can produce a maximum force of 240 kN.

Calculate the maximum acceleration of the aircraft.

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

_____

_____

_____

Acceleration = _____

(3)

(c) As the aircraft moves along the runway to take off, its acceleration decreases even though the force from the engines is constant.

Explain why.

_____

_____

_____

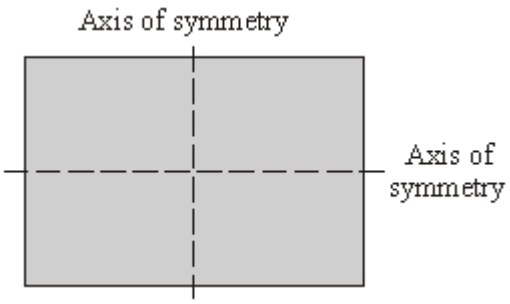
_____

(2)

(Total 7 marks)

Q12.

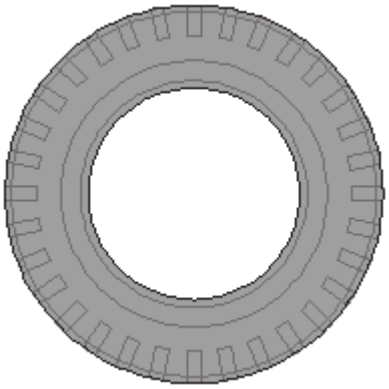
(a) The diagram shows a rectangle made out of a sheet of cardboard.



Draw an **X** on the diagram so that the centre of the **X** is at the centre of mass of the rectangle.

(1)

(b) The drawing shows a car tyre.



(i) Where is the centre of mass of the tyre?

_____

(1)

(ii) Explain your answer to (b)(i).

_____

_____

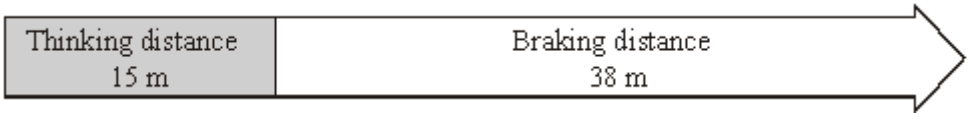
(1)

(Total 3 marks)

Q13.

(a) A car driver makes an emergency stop.

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



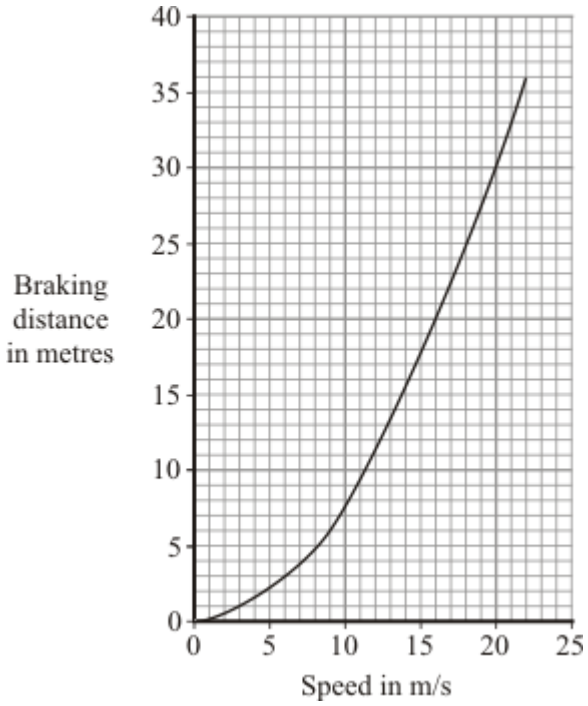
Calculate the total stopping distance of the car.

_____

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)

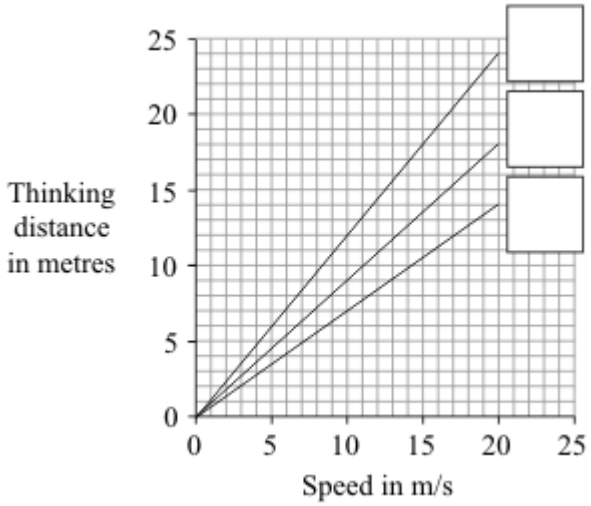
(c) The thinking distance depends on the driver's reaction time.

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	0.9

	phone	
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.

_____

_____

_____

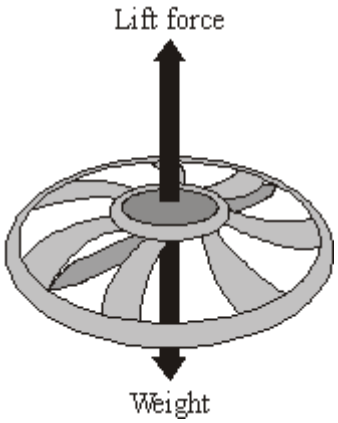
_____

(2)

(Total 9 marks)

Q14.

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
smaller than

the weight of the toy.

(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?

_____

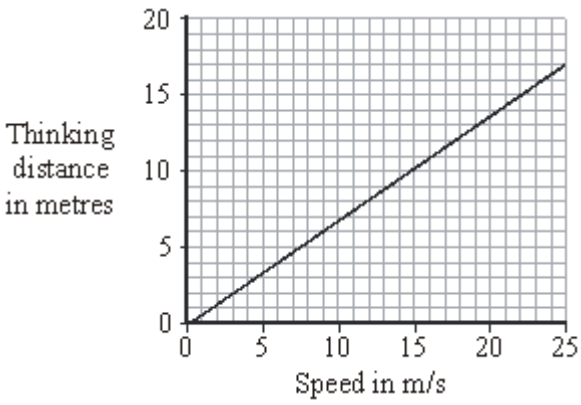
(1)

(Total 6 marks)

Q15.

(a) A car driver takes a short time to react to an emergency before applying the brakes. The distance the car will travel during this time is called the 'thinking distance'.

The graph shows how the thinking distance of a driver depends on the speed of the car.



(i) What is the connection between thinking distance and speed?

_____

(1)

(ii) Many people drive while they are tired.

Draw a new line on the graph to show how thinking distance changes with speed for a tired driver.

(1)

(iii) The graph was drawn using data given in the Highway Code.

Do you think that the data given in the Highway Code is likely to be reliable?

Draw a ring around your answer.

Yes **No** **Maybe**

Give a reason for your answer.

_____

_____

(1)

(b) The distance a car travels once the brakes are applied is called the 'braking distance'.

(i) What is the relationship between thinking distance, braking distance and stopping distance?

_____

(1)

(ii) State **two** factors that could increase the braking distance of a car at a speed of 15 m/s.

1. _____

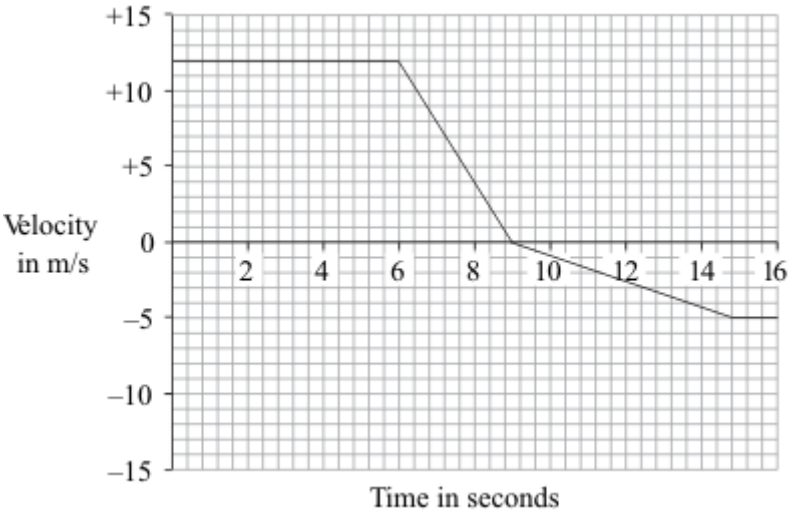
2. _____

(2)

(Total 6 marks)

Q16.

A car is driven along a straight road. The graph shows how the velocity of the car changes during part of the journey.



(a) Use the graph to calculate the deceleration of the car between 6 and 9 seconds.

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

_____

_____

_____

Deceleration = _____

(3)

(b) At what time did the car change direction?

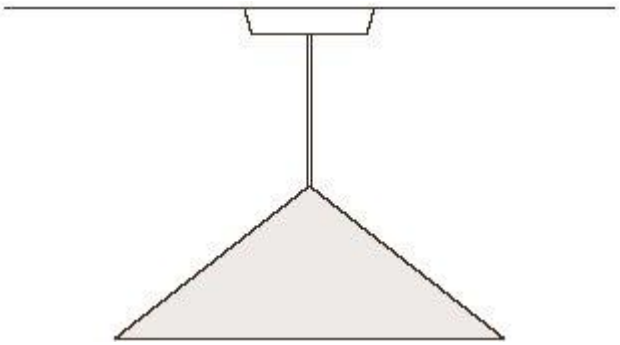
_____ seconds

(1)

(Total 4 marks)

Q17.

(a) The diagram shows a lampshade hanging from the ceiling. Draw an **X** on the diagram so that the centre of the **X** marks the centre of the mass of the lampshade.



(1)

(b) Complete the sentence using the correct word or phrase from the box.

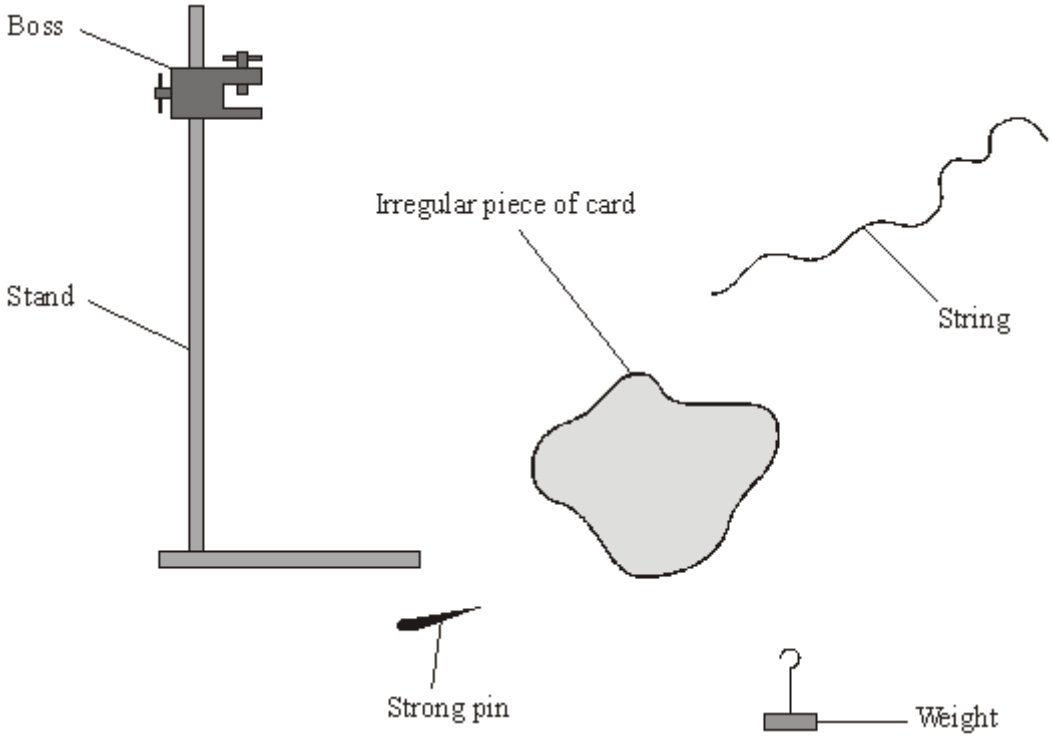
above	**below**	**to the left of**	**to the right of**

A suspended object will come to rest with its centre of mass directly

_____ the point of suspension.

(1)

(c) The diagrams show equipment that a student uses to find the centre of mass of a thin sheet of card.



Arrange these sentences in the correct order to describe how the student can find the centre of mass of the card.

The sequence starts with sentence **D** and finishes with sentence **E**.

A A line is drawn on the card marking the position of the string.

B The pin is put through one of the holes in the card and held in the boss.

C This is repeated using the other hole.

D Two holes are made in the card with each hole near to the edge of the card.

E The centre of mass is where the lines cross on the card.

F The weight is tied to the string and then the string is hung from the pin.

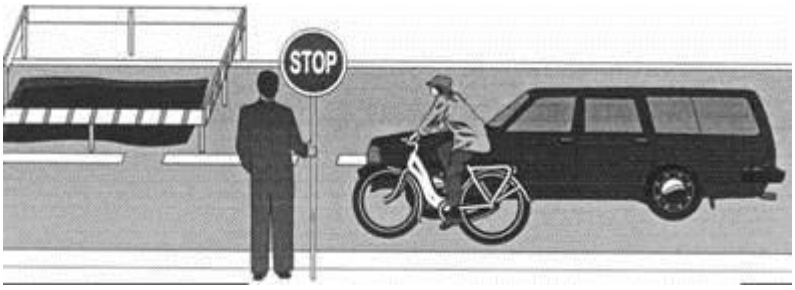
D					**E**

(3)

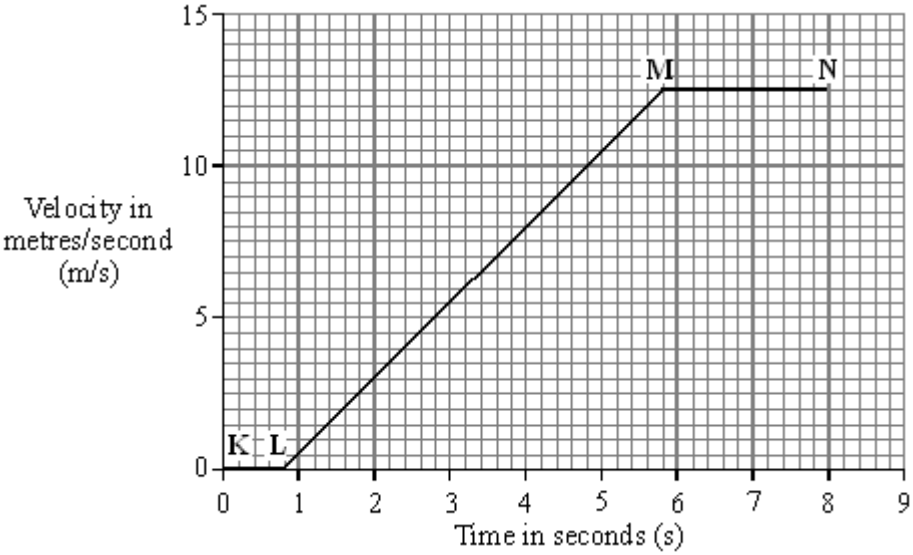
(Total 5 marks)

Q18.

A car and a bicycle are travelling along a straight road. They have stopped at road works.



The graph shows how the velocity of the car changes after the sign is changed to GO.



(a) Between which two points on the graph is the car moving at constant velocity?

_____

(1)

(b) Between which two points on the graph is the car accelerating?

_____

(1)

(c) Between the sign changing to GO and the car starting to move, there is a time delay. This is called the reaction time.

(i) What is the reaction time of the car driver?

Reaction time = _____ seconds

(1)

(ii) Which **one** of the following could increase the reaction time of a car driver? Tick the box next to your choice.

Drinking alcohol ☐

Wet roads ☐

Worn car brakes ☐

(1)

(d) The cyclist starts to move at the same time as the car. For the first 2 seconds the cyclist's acceleration is constant and is greater than that of the car.

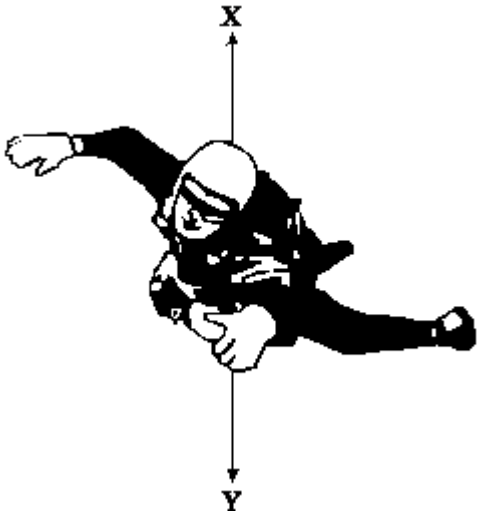
Draw a line on the graph to show how the velocity of the cyclist might change during the first 2 seconds of its motion.

(2)

(Total 6 marks)

Q19.

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**.

_____

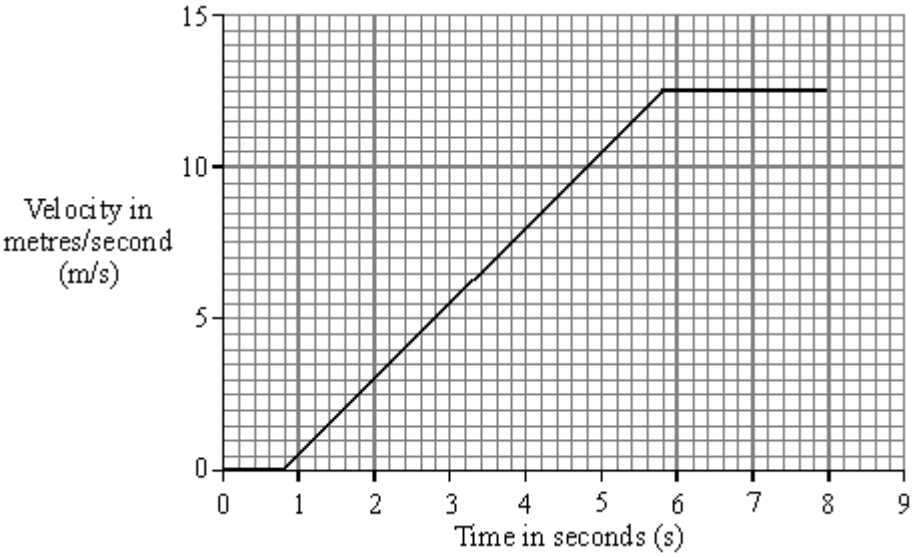
_____

(1)

(Total 5 marks)

Q20.

A car travelling along a straight road has to stop and wait at red traffic lights. The graph shows how the velocity of the car changes after the traffic lights turn green.



(a) Between the traffic lights changing to green and the car starting to move there is a time delay. This is called the reaction time. Write down **one** factor that could affect the driver's reaction time.

_____

(1)

(b) Calculate the distance the car travels while accelerating. Show clearly how you work out your answer.

_____

_____

Distance = _____metres

(3)

(c) Calculate the acceleration of the car. Show clearly how you work out your final answer and give the units.

_____

_____

_____

Acceleration = _____

(4)

(d) The mass of the car is 900 kg.

(i) Write down the equation that links acceleration, force and mass.

_____

(1)

(ii) Calculate the force used to accelerate the car. Show clearly how you work out your final answer.

_____

_____

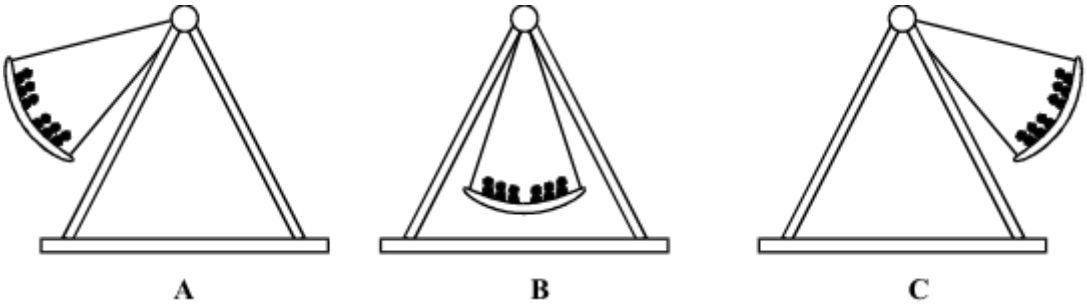
Force = _____ newtons

(2)

(Total 11 marks)

Q21.

The Boat is a theme park ride. The Boat swings backwards and forwards. The diagrams show the Boat at the top and bottom of its swing.



(a) As the Boat swings from its position in **A** to its position in **B**, a child on the ride gains 5070 joules of kinetic energy. The child has a mass of 60 kg and is sitting at the centre.

(i) Write down the equation which links kinetic energy, mass and speed.

_____

_____

(1)

(ii) Calculate the speed of the child as the Boat passes through **B**. Show clearly how you work out your final answer.

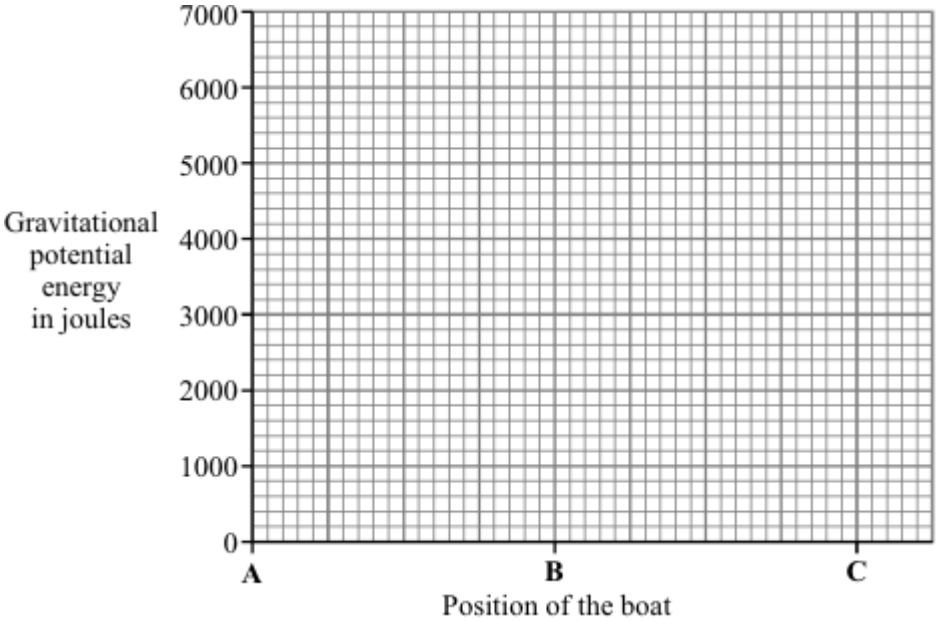
_____

_____

Speed = _____ m/s

(2)

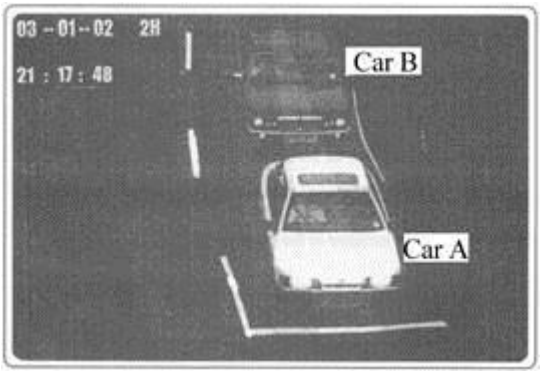
(b) Sketch a graph to show how the gravitational potential energy of the child changes as the Boat swings from **A** to **B** to **C**. The axes have been drawn for you.



(2)
(Total 5 marks)

Q22.

The roads were very icy. An accident was recorded by a security camera.



Car **A** was waiting at a road junction. Car **B**, travelling at 10 m/s, went into the back of car **A**. This reduced car **B**'s speed to 4 m/s and caused car **A** to move forward.

The total mass of car **A** was 1200 kg and the total mass of car **B** was 1500 kg.

(i) Write down the equation, in words, which you need to use to calculate momentum.

_____

(1)

(ii) Calculate the change in momentum of car **B** in this accident.

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

_____

_____

Change in momentum = _____

(3)

(iii) Use your knowledge of the conservation of momentum to calculate the speed, in

m/s, of car **A** when it was moved forward in this accident.

Show clearly how you work out your final answer.

_____

_____

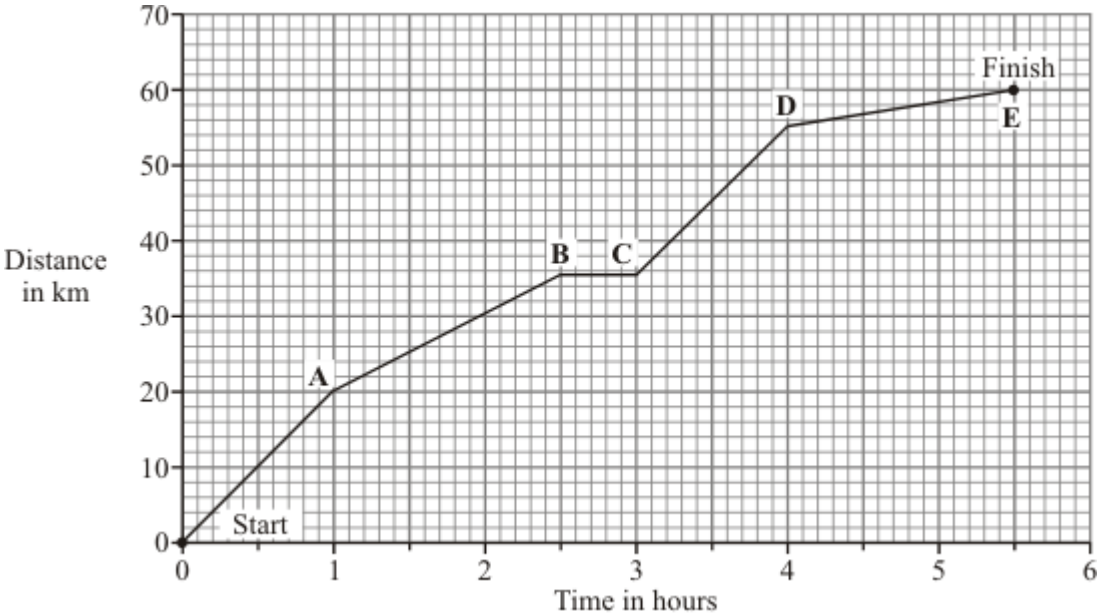
Speed = _____ m/s

(3)

(Total 7 marks)

Q23.

A horse and rider take part in a long distance race. The graph shows how far the horse and rider travel during the race.



(a) What was the distance of the race?

distance = _____ km

(1)

(b) How long did it take the horse and rider to complete the race?

_____

(1)

(c) What distance did the horse and rider travel in the first 2 hours of the race?

distance = _____ km

(1)

(d) How long did the horse and rider stop and rest during the race?

_____

(1)

(e) Not counting the time it was resting, between which two points was the horse moving the slowest?

_____ and _____

Give a reason for your answer.

_____

_____

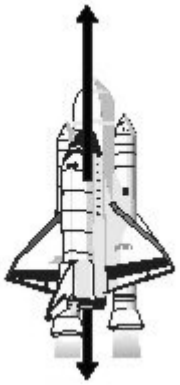
(2)

(Total 6 marks)

Q24.

(a) The arrows in the diagram represent the size and direction of the forces on a space shuttle, fuel tank and booster rockets one second after launch. The longer the arrow the bigger the force.

Thrust force



Weight of shuttle, fuel tanks and
booster rockets plus air resistance

(i) Describe the upward motion of the space shuttle one second after launch.

_____

(1)

(ii) By the time it moves out of the Earth's atmosphere, the total weight of the space shuttle, fuel tank and booster rockets has decreased and so has the air resistance.

How does this change the motion of the space shuttle? (Assume the thrust force does not change).

_____

(1)

(b) The space shuttle takes 9 minutes to reach its orbital velocity of 8100 m/s.

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

_____

(1)

(ii) Calculate, in m/s^2, the average acceleration of the space shuttle during the first 9 minutes of its flight. Show clearly how you work out your answer.

_____

_____

average acceleration = _____ m/s^2

(2)

(iii) How is the velocity of an object different from the speed of an object?

_____

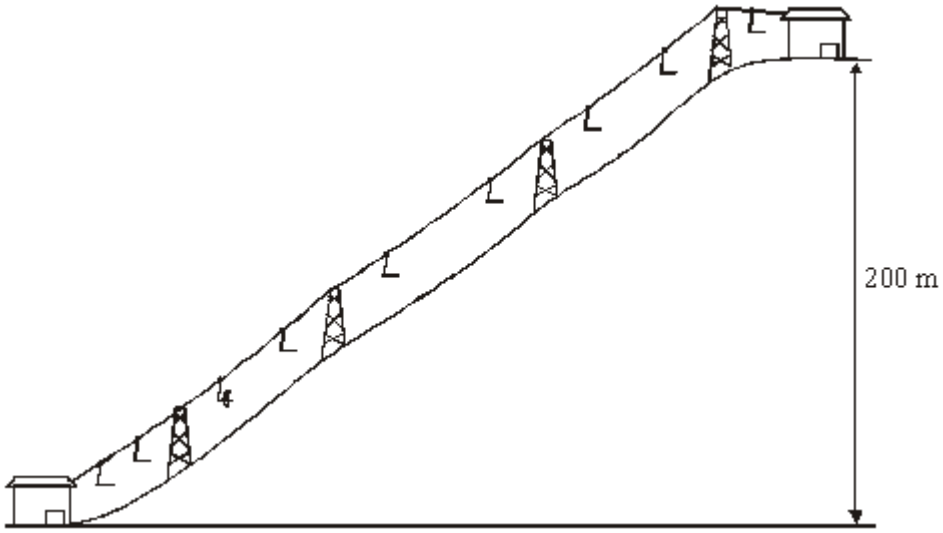
_____

(1)

(Total 6 marks)

Q25.

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



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

_____

(1)

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

_____

_____

_____

work done = _____

(3)

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

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

_____

_____

power = _____ watts

(2)

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

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

_____

_____

(1)

(ii) Complete the following sentence.

When the ski lift is working _____ energy supplied to the motor

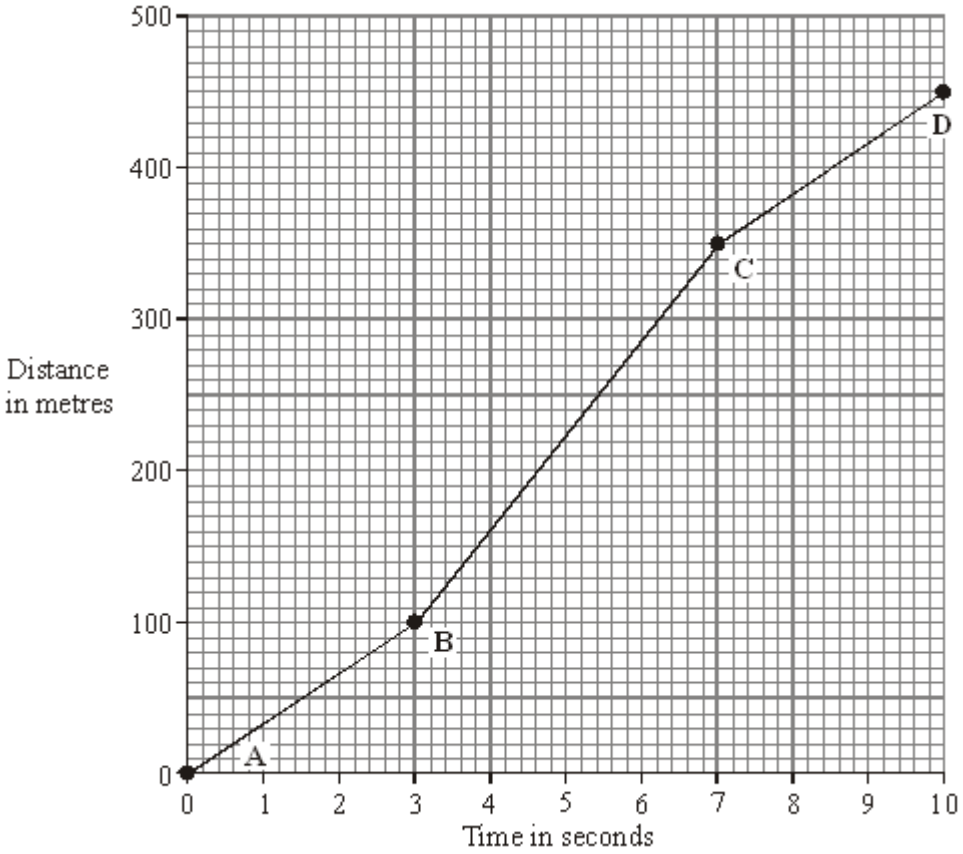
is usefully transferred as gravitational _____ energy.

(1)

(Total 8 marks)

Q26.

The distance-time graph represents the motion of a car during a race.



(a) Describe the motion of the car between point **A** and point **D**. You should not carry out any calculations.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

_____

_____

_____

_____

_____

(3)

(b) Calculate the gradient of the graph between point **B** and point **C**. Show clearly how you get your answer.

_____

_____

_____

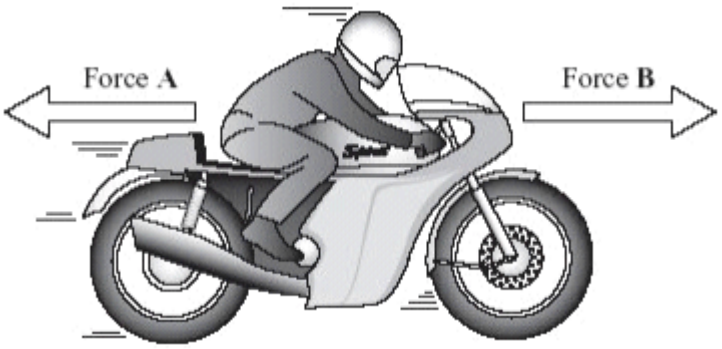
gradient = _____

(3)

(Total 6 marks)

Q27.

(a) The diagram shows the horizontal forces that act on a **moving** motorbike.



(i) Describe the movement of the motorbike when force **A** equals force **B**.

_____

_____

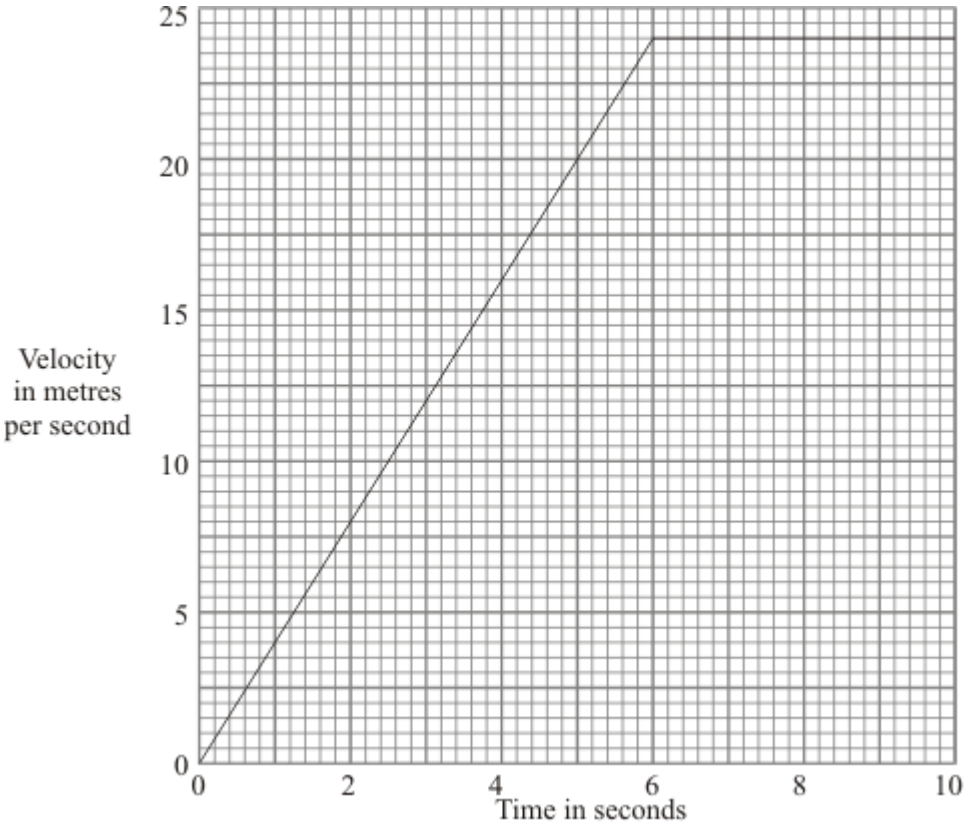
(2)

(ii) What happens to the speed of the motorbike if force **B** becomes smaller than force **A**?

_____

(1)

(b) The graph shows how the velocity of a motorbike changes when it is travelling along a straight road.



(i) What was the change in velocity of the motorbike in the first 5 seconds?

_____

(1)

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

_____

(1)

(iii) Calculate the acceleration of the motorbike during the first 5 seconds. Show clearly how you work out your answer and give the unit.

_____

_____

Acceleration = _____

(3)

(c) A car is travelling on an icy road.

Describe and explain what might happen to the car when the brakes are applied.

_____

_____

_____

_____

(2)

(d) Name **three** factors, other than weather conditions, which would increase the overall stopping distance of a vehicle.

1. _____

_____

2. _____

_____

3. _____

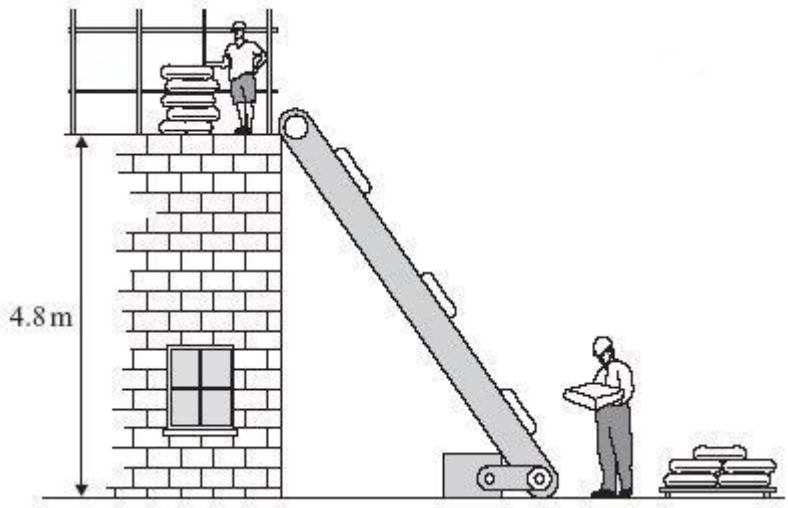
_____

(3)

(Total 13 marks)

Q28.

A machine is used to lift materials on a building site.



(a) (i) Write down the equation that links change in gravitational potential energy, change in vertical height and weight.

_____

(1)

(ii) A 25 kg bag of cement is lifted from the ground to the top of the building. Calculate the gain in the gravitational potential energy of the bag of cement.

(On Earth a 1 kg mass has a weight of 10 N.)

_____

_____

Change in gravitational potential energy = _____ joules

(2)

(b) The conveyor belt delivers six bags of cement each minute to the top of the building.

(i) Calculate the useful energy transferred by the machine each second.

_____

_____

_____

Useful energy transfer each second = _____ J

(1)

(ii) The machine is 40% efficient.
Use the following equation to calculate the total energy supplied to the machine each second. Show how you work out your answer.

$$\text{Efficiency} = \frac{\text{useful energy transferred by device}}{\text{total energy supplied to device}}$$

_____

_____

Total energy supplied each second = _____ J

(2)

(Total 6 marks)

Q29.

(a) When two objects collide, and no other forces act, then *conservation of momentum* applies.

(i) What does the term conservation of momentum mean?

_____

_____

_____

(2)

(ii) Apart from collisions and similar events, give another type of event in which *conservation of momentum* applies.

_____

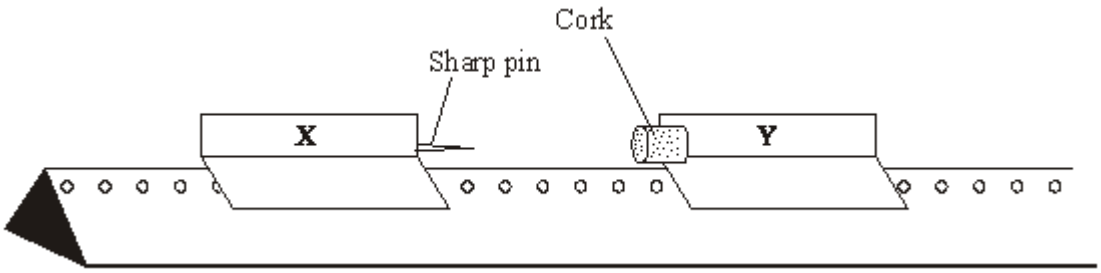
(1)

(iii) Write, in words, the equation which you need to use to calculate momentum.

_____

(1)

(iv) The diagram shows a straight and horizontal runway and two trolleys, **X** and **Y**, which can move on the runway.



X has a mass of 0.2 kg and its velocity is 1.2 m/s to the right. **Y** has a mass of 0.1 kg and is stationary. When **X** collides with **Y** they stick together.

Calculate the velocity of the trolleys after the collision.

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

_____

_____

_____

_____

Velocity of the trolleys = _____

(5)

(v) What assumption did you make in order to calculate your answer to part (a)(iv)?

_____

_____

(1)

(b) Just before it hits a target, a bullet has a momentum of 5 kg m/s. It takes 0.00125 s for the target to stop the bullet.

Calculate the force, in newtons, needed to do this.

Write, in words, the equation that you will need to use and show clearly how you work out your answer.

Force = _____ newtons

(3)

(Total 13 marks)

Q30.

The molten rock flowing from an erupting volcano can reach a speed of 8 m/s.

(i) Write down the equation that links kinetic energy, mass and speed.

_____

(1)

(ii) Calculate the kinetic energy of 1 tonne of molten rock flowing at 8 m/s.
(1 tonne = 1000 kg)

_____

_____

Kinetic energy = _____ joules

(1)

(Total 2 marks)

Q31.

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

A

B

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

Complete the following sentence.

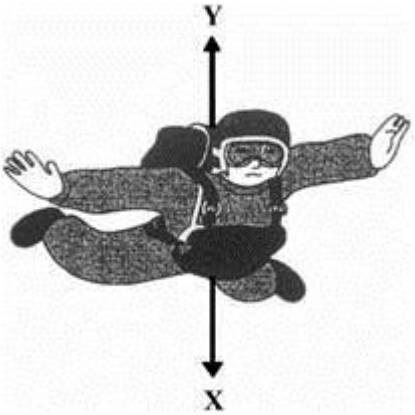
Skydiver _____ will fall faster because_____

_____

_____

(2)

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



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

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

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

air resistance
friction
gravity

(1)

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

air resistance gravity weight

(1)

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

go up stay the same go down

(1)

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

goes up stays the same goes down

(1)

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

_____

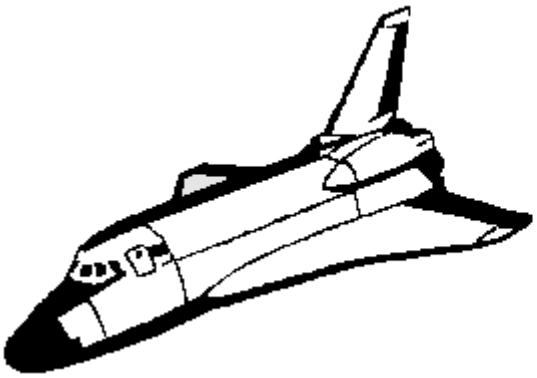
_____

(1)

(Total 7 marks)

Q32.

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.

$$\text{kinetic energy} = \tfrac{1}{2}\, mv^2$$

_____

_____

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)

Q33.

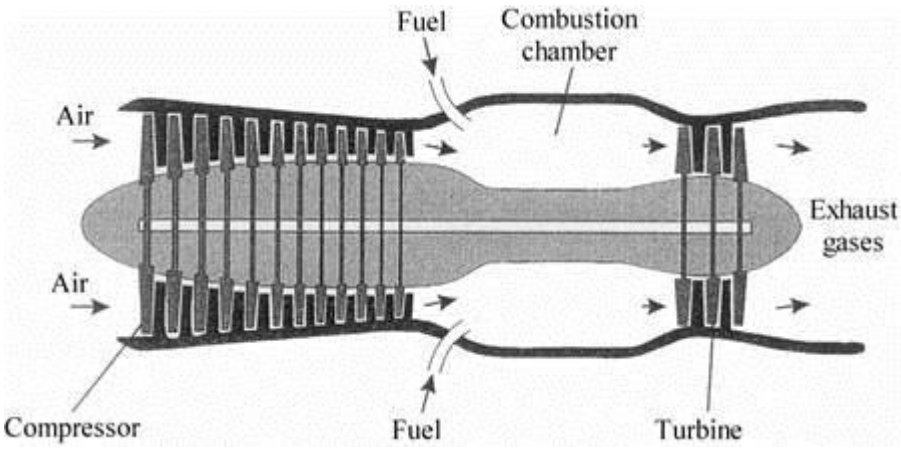
(a) What is the principle of conservation of momentum?

_____

_____

(2)

(b) The diagram shows a simplified aircraft jet engine.



Adapted from GCSE Physics by Tom Duncan. John Murray (Publishers) Ltd.

(i) What is the function of the turbine?

_____

_____

(1)

(ii) Explain how the engine produces a forward thrust.

_____

_____

_____

_____

_____

_____

_____

(4)

(c) During flight, air enters the engine at 175 m/s and leaves at 475 m/s. A forward thrust of 105 kN is produced.

Use the following equation to calculate the mass of air passing through the engine every second. (Ignore the mass of the burned fuel.)

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

_____

_____

_____

Mass of air = _____ kg

(2)

(Total 9 marks)

Q34.

(a) The weightlifter in the picture has lifted a weight of 2250 newtons above his head. The weight is held still.

(i) In the box are the names of three forms of energy.

gravitational potential	kinetic	sound

Which **one** of these forms of energy does the weight have?

_____

(1)

(ii) What force is used by the weightlifter to hold the weight still?

Size of force = _____ N

Give a reason for your answer _____

_____

_____

(2)

(b) To lift the weight, the weightlifter does 4500 joules of work in 3.0 seconds.

Calculate the power developed by the weightlifter. Show clearly how you work out your answer.

_____

_____

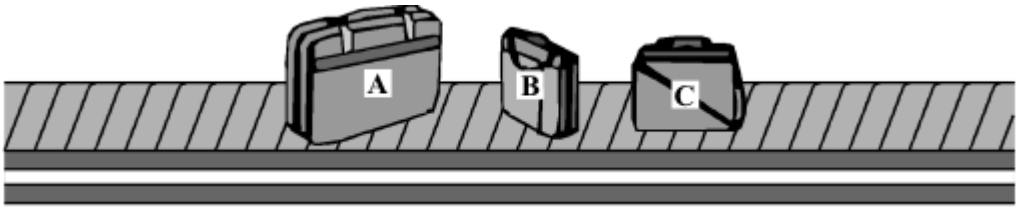
Power = _____ watts

(2)

(Total 5 marks)

Q35.

The picture shows luggage which has been loaded onto a conveyor belt.



Each piece of luggage has a different mass.

Mass of **A** = 22 kg mass of **B** = l2 kg mass of **C** = 15 kg

(a) (i) What is the momentum of the luggage before the conveyor belt starts to move?

_____

Give a reason for your answer.

_____

_____

(2)

(ii) When the conveyor belt is switched on the luggage moves with a constant speed. Which piece of luggage **A**, **B** or **C** has the most momentum?

_____

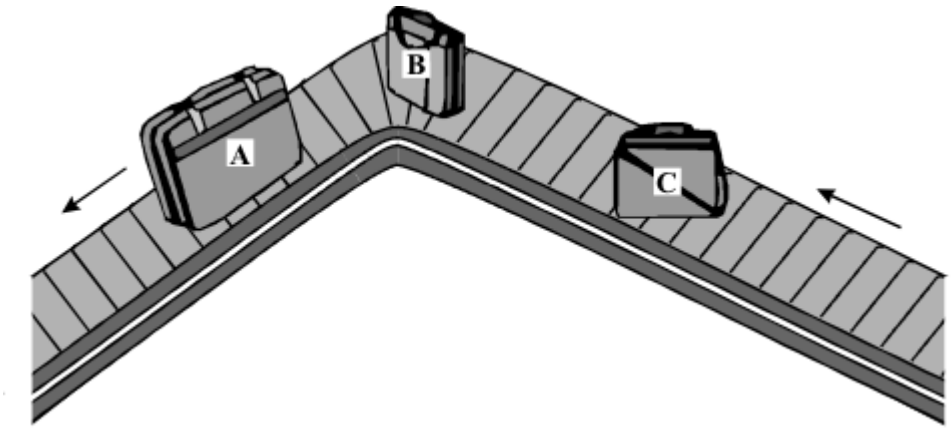
Give a reason for your answer.

_____

_____

(2)

(iii) At one point the conveyor belt turns left. The luggage on the belt continues to move at a constant speed.



Does the momentum of the luggage change as it turns left with the conveyor belt?

_____

Give a reason for your answer.

_____

_____

(2)

(b) Draw a circle around the unit which can be used to measure momentum.

J/s kg m/s Nm

(1)
(Total 7 marks)

Mark schemes

Q1.

(a) (i) 10800

allow 1 mark for correct substitution i.e. 900 × 12

2

(ii) arrow pointing towards the left

allow anywhere on the diagram or at bottom of the page

1

(b) zero

accept 0 / none / nothing

1

velocity is zero

accept speed for velocity

accept stopped / not moving

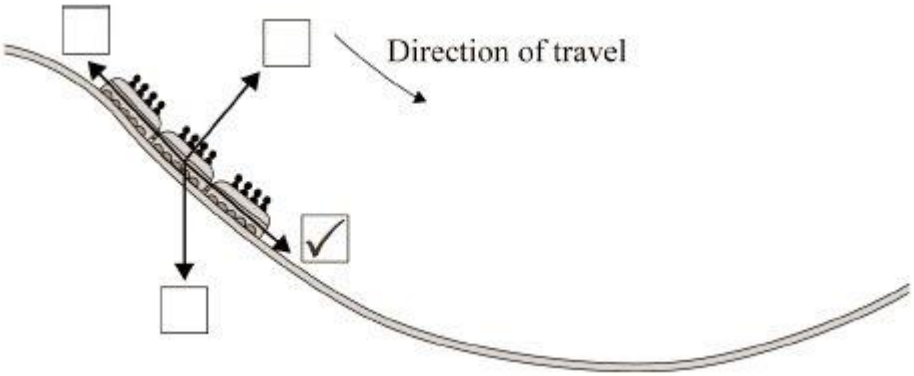
accept a calculation i.e. 900 × 0 = 0

1

[5]

Q2.

(a) correct box ticked



1

(b) each passenger has a different mass

accept weight for mass

ignore other irrelevant factors about the person e.g. mass and height

do not accept a list with incorrect factors e.g. mass and position

accept passengers started with different (gravitational) potential energy

1

(c) (i) 29.4

ignore added units

1

(ii) 2400

accept their (c)(i) × 80 correctly calculated for both marks

allow 1 mark for correct substitution of their (c)(i) and 80

an answer of 800 gains 1 mark only if answer to (c)(i) is not 10

2

[5]

Q3.

(a) (i) 4.5

*allow **1** mark for correct substitution i.e. 9 ÷ 2*

2

(ii) m/s^2

accept answer given in (a)(i) if not contradicted here

1

(iii) speed

1

(iv) straight line from the origin passing through (2s, 9m/s)

*allow **1** mark for straight line from the origin passing through to t = 2 seconds*

*allow **1** mark for an attempt to draw a straight line from the origin passing through (2,9)*

*allow **1** mark for a minimum of 3 points plotted with no line provided if joined up would give correct answer. Points must include(0,0) and (2,9)*

2

(b) (i) **B**

*if **A** or **C** given scores **0** marks in total*

1

smallest (impact) force

1

on all/ every/ any surfaces

these marks are awarded for comparative answers

1

(ii) (conditions) can be repeated

or

difficult to measure forces with human athletes

accept answers in terms of variations in human athletes e.g.

athletes may have different weights area / size of feet may be different difficult to measure forces athletes run at different speeds

accept any answer that states or implies that with humans the conditions needed to repeat tests may not be constant

e.g.

athletes unable to maintain constant speed during tests (or during repeat tests)

*do **not** accept the robots are more accurate*

removes human error is insufficient

fair test is insufficient

1

[10]

Q4.

(a) shallowest slope/ gradient

accept smallest distance in biggest time
accept longest time to travel the same distance
accept the line is not as steep
accept it is a less steep line
*do **not** accept the line is not steep*

1

(b) **A – B**

If 2 or 3 boxes are ticked no mark

1

(c) (i) 200 m

1

(ii) 20 s

*allow **1** mark for correctly identifying 60 s or 40 s from the graph*

2

(d) (i) <u>straight</u> line starting at origin

accept within one small square of the origin

1

passing through t = 200 and d = 500

1

(ii) 166

accept any value between 162 and 168
accept where their line intersects
given graph line correctly read ± 3 s

1

[8]

Q5.

(a) (i) 50 (N)

ignore any units

1

(ii) resultant force

1

(iii) 4000

*accept their (a)(i) × 80 correctly calculated for **2** marks*
*allow **1** mark for correct substitution i.e. 50 × 80 or their (a)(i) × 80*
ignore any units

2

(b) (i) joule

1

(ii) heat

1

[6]

Q6.

(a) gravity

accept weight
*do **not** accept mass*
accept gravitational pull

1

(b) (i) Initially force L greater than force M

accept there is a resultant force downwards

1

(as speed increases) force M increases

accept the resultant force decreases

1

when M = L, (speed is constant)

accept resultant force is 0
accept gravity/weighty for L
accept drag/ upthrust/resistance/friction for M
*do **not** accept air resistance for M but penalise only once*

1

(ii) terminal <u>velocity</u>

1

(iii) 0.15

accept an answer between 0.14 – 0.16
an answer of 0.1 gains no credit
*allow **1** mark for showing correct use of the graph*

2

[7]

Q7.

(a) 47250

*answers of 1350/ 33750/ 48600 gain **1** mark*
*allow **1** mark for correct substitution using both 18 and 3*

2

(b) (i) 47250 or their (a)

accept statement 'same as the KE (lost)'
ignore any units

1

(ii) transformed into heat/ thermal energy

sound on its own is insufficient
accept transferred/ lost/ for transformed
*do **not** accept any other form of energy included as a list*

1

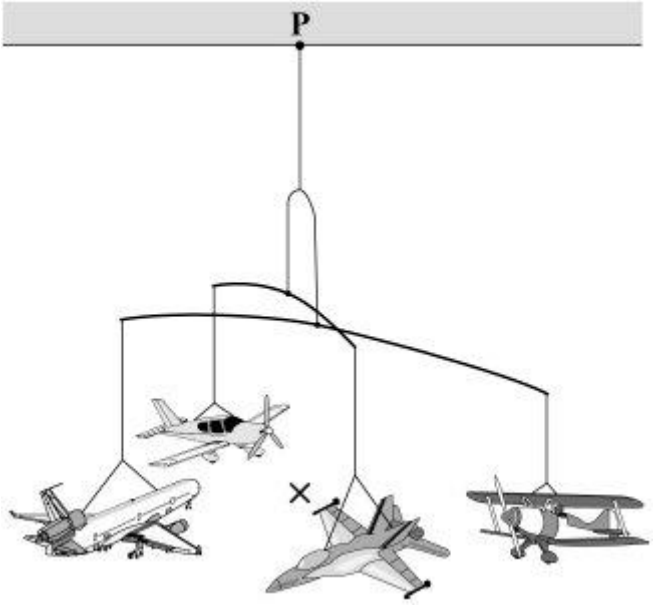
[4]

Q8.

(a) (i) centre of **X** directly below **P** <u>and</u> between the model aeroplanes

as judged by eye but between centre of propeller of top aeroplane and canopy of bottom aeroplane

example



1

(ii) the centre of mass is (vertically) below the point of suspension / P

1

the centre of mass is in the middle of the aeroplanes

accept the centre of mass is level with the aeroplanes

1

(b) centre of mass of the worker and the ladder (and device)

1

line of action of the weight is inside the base

accept the centre of mass is above / within / inside the base (of the ladder and device)

1

so there will not be a (resultant) moment

accept so he / it / the ladder will not topple even if he leans over

or it will (only) topple over if the line of action of the weight / the centre of mass is outside the base

*accept each point, either on the diagram or in the written explanation, but do **not** accept the point if there is any contradiction between them*

1

[6]

Q9.

(a) **B** or bungee cords

1

C or springs or playground ride

*each additional answer loses **1** mark minimum mark zero*

1

will go back to original shape/size

1

(b) (i) newton

1

(ii) 0 – 5 (N) or 5

accept1 – 5 (N)
*do **not** accept 4*

1

(iii) 16 (cm)

1

(iv) 2.5 (N)

accept answer between 2.4 and 2.6 inclusive

1

[7]

Q10.

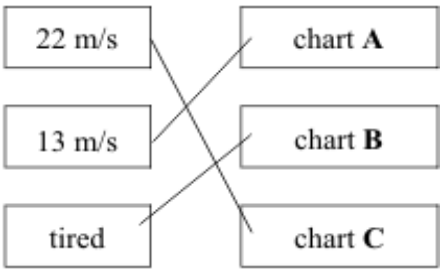
(a) (i) constant

1

(ii) heat

1

(b) (i) 3 links correct



*allow **1** mark for 1 correct link*
if more than one line is drawn from a condition mark all lines from that condition incorrect

2

(ii) increased

1

[5]

Q11.

(a) (i) a single force that has the same effect as all the forces combined

accept all the forces added / the sum of the forces / overall force

1

(ii) constant speed (in a straight line)

*do **not** accept stationary*

or constant velocity

1

(b) 3

*allow **1** mark for correct substitution into transformed equation*

*accept answer 0.003 gains **1** mark*
*answer = 0.75 gains **1** mark*

2

m/s^2

1

(c) as speed increases air resistance increases

accept drag / friction for air resistance

1

reducing the resultant force

1

[7]

Q12.

(a) centre of X at the point where the axes cross

to within 1 mm in any direction

1

(b) (i) (at / in the) centre (of the tyre)

***or** unambiguously shown on the diagram*

1

(ii) (this is) where axes of symmetry (of the tyre) cross / intersect / meet

***or** point at which the mass of the tyre seems to be (concentrated)*

1

[3]

Q13.

(a) 53 (m)

1

(b) (i) Similar shape curve drawn <u>above</u> existing line going <u>through (0, 0)</u>

*allow **1** mark for any upward smooth curve or straight upward line above existing line going through (0, 0)*

2

(ii) rain on road

1

car brakes in bad condition

1

(c) (i) all three lines correctly labelled

*allow **1** mark for one correctly labelled*

top line – C

accept 1.2

middle line – B

accept 0.9

bottom line – A

accept 0.7

2

(ii) any **two** from:

- (table has) both variables are together
  accept tired and music as named variables
- both (variables) could/ would affect the reaction time
- cannot tell original contribution
  accept cannot tell which variable is affecting the drive (the most)
- need to measure one (variable) on its own
  accept need to test each separately
- need to control one of the variables

2

[9]

Q14.

(a) (i) 0.6

*allow **1** mark for correct substitution*

2

newtons

accept N
*do **not** accept n*
accept Newtons

1

(ii) the same as

1

(b) (i) changed velocity

accept increased/ decreased for change
accept speed for velocity
accept <u>change</u> direction
accept getting faster/ slower
accept start/ stop moving
accept correct equation in terms of change in speed or change in velocity

1

(ii) down(wards)

accept towards the ground
accept ↓
*do **not** accept south*

1

[6]

Q15.

(a) (i) as one goes up so does the other

or (directly) proportional

accept change by the same ratio

1

(ii) steeper straight line through the origin

judge by eye

1

(iii) Yes with reason

eg data would have been checked / repeated

accept produced by a reliable/ official/ government source

*do **not** accept it needs to be reliable*

or No with reason

eg does not apply to all conditions / cars / drivers

or are only average values

or Maybe with a suitable reason

eg cannot tell due to insufficient information

1

(b) (i) stopping distance = thinking distance + braking distance

1

(ii) any **two** from:

factors must be to do with increasing braking distance

- smooth road / loose surface
- rain / snow / ice

  accept wet road/ petrol spills

  *do **not** accept condition of road unless suitably qualified*
- badly maintained brakes

  accept worn brakes

  accept bad/ worn/ rusty brakes

  *do **not** accept old brakes*
- worn tyres

  accept bald tyres

  accept lack of grip on tyres

  *do **not** accept old tyres*
- downhill slope/gradient
- heavily loaded car

2

[6]

Q16.

(a) 4

*allow **1** mark for extracting correct information 12*

2

m/s^2

ignore negative sign

1

(b) 9 (s)

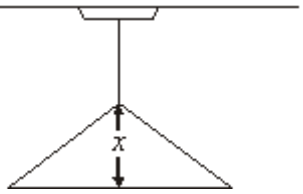
1

[4]

Q17.

(a) centre of **X** should appear to be on the continued line of the flex and in the body of the lamp as judged by eye

example



1

(b) below

1

(c) (D)→B→F→A→C→(E)

*all four correct for **3** marks*
***or** any two correct for **2** marks*
***or** just one correct for **1** mark*

3

[5]

Q18.

(a) MN

accept 5.8, 8 seconds must include unit

1

(b) LM

accept 0.8, 5.8 seconds must include unit

1

(c) (i) 0.8

1

(ii) drinking alcohol

1

(d) <u>straight</u> (by eye) line starting at 0.8 seconds

1

line drawn steeper than LM starting before L

ignore lines going beyond 2 seconds but line must exceed 2.5 metres per second before terminating

1

[6]

Q19.

(a) (i) friction

accept any way of indicating the correct answer

1

(ii) gravity

accept any way of indicating the correct answer

1

(b) (i) accelerates **or** speed / velocity increases

accept faster and faster (1 mark)

*do **not** accept faster pace / falls faster*
or suggestions of a greater but constant speed

1

downwards / falls

accept towards the Earth / ground

this may score in part (b)(ii) if it does not score here and there is no contradiction between the two parts

1

(ii) constant speed / velocity **or** terminal velocity / speed or zero acceleration

stays in the same place negates credit

1

[5]

Q20.

(a) concentration / tiredness / drugs / alcohol

accept any reasonable factor that could affect a driver's reactions

*do **not** accept speed or any physical condition unrelated to the driver*

1

(b) 31.25

*credit for **1** mark correct attempt to calculate the area under the slope **or** for using the equation*
distance = average velocity (speed) × time

*credit for **1** mark use of correct velocity change (12.5) and correct time (5) **or** answer of 62.5*

3

(c) 2.5

*credit for **1** mark triangle drawn on slope **or** correct equation **or** two correct pairs of coordinates*

credit for 1 mark use of correct velocity change (12.5) and correct time (5)
accept time = between 4.8 and 5.2 if used in (b)

do not accept an attempt using one pair of coordinates taken from the slope

3

metres / second / second **or** metres / second / squared **or** m/s^2 **or** ms^{-2}

1

(d) (i) force = mass × acceleration

accept correct transformation

accept F = m × a

accept 

provided subsequent use of Δ is correct

*do **not** accept an equation in units*

1

(ii) 2250

credit their (c) × 900 for 2 marks

*credit **1** mark for correct substitution*

2

[11]

Q21.

(a) (i) kinetic energy = $\frac{1}{2}$ × mass × speed^2

accept ke = $\frac{1}{2}$ *mv*^{2}

*do **not** accept KE =* $\frac{1}{2}$ *ms*^{2}

1

(ii) 13

allow 1 mark for correct substitution or transformation

2

(b)

*if B is at the top of the curve - **no** marks*

PE at A maximum
PE at B minimum
PE at C just less than **or** = to A

*do **not** accept wavy lines **or** very non-symmetrical*

accept straight lines or curves

1

difference between A and B is 5000 to 5200

1

[5]

Q22.

(i) momentum (change in) = mass × velocity (change in)

accept ... speed

1

(ii) 9000

*1500 × 6 for 1 mark but **not** from incorrect equation*

2

kilogram metre(s) per second **or** kg m/s

1

(iii) **either** 7.5 (m/s)

or change in momentum of car B change in momentum of car A (1)
9000 = 1200 × v (1)

or v = 9000 ÷ 1200 (1)

or error carried forward from part (ii)

examples

5 (m/s) if 6000 offered in (ii) (3)

12.5(m/s) if 15000 offered in (ii)

(3)

3

[7]

Q23.

(a) 60

1

(b) $5\frac{1}{2}$ hours

must include unit

1

(c) 30

1

(d) 30 minutes or

$\frac{1}{2}$ hour

must include unit

1

(e) D **and** E

accept finish for E

accept correct numbers from axes with units

1

least steep part of the graph

accept covers smallest distance in a set time

accept only moves 5 km in 1 ½ hours (accept anything between 5 and 6)

ignore horse is tired

1

[6]

Q24.

(a) (i) accelerating

accept getting faster

accept speed / velocity increasing

1

(ii) acceleration <u>increases</u>

accept velocity / speed increases <u>more</u> rapidly

*do **not** accept velocity / speed increases*

1

(b) (i) acceleration = $\frac{\text{change in velocity}}{\text{time (taken)}}$

accept $a = \frac{v - u}{t}$ ***or*** $a = \frac{v_1 - v_2}{t}$

do ***not*** *accept velocity for change in velocity*
do ***not*** *accept change in speed*

do ***not*** *accept* $a = \frac{v}{t}$

1

(ii) 15

allow ***1*** *mark for an answer of 900* ***or*** *for* <u>*correct*</u> *use of 540 seconds*

2

(iii) velocity includes direction

accept velocity is a vector (quantity)
accept converse answer

1

[6]

Q25.

(a) (i) work (done) = force (applied) × distance (moved)

accept W = F × s or W = F × d

accept 

provided subsequent method is correct

1

(ii) 240 000

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

2

joules

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

1

(b) 800 (watts)

accept 0.8 kW
accept their (a)(ii) ÷ 300 correctly evaluated for ***2*** *marks*
allow ***1*** *mark for correct substitution*
(a)(ii) ÷ 5 correctly evaluated for ***1*** *mark*

2

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

- needs to raise the chair / lift
- lifting more than one chair

allow lifting more than 2 people
implication of a heavier weight

- energy transfer to the surroundings correctly qualified

  accept loss for transfer

  *do **not** accept motor inefficient*

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

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

1

(ii) electrical

accept electric

potential

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

1

[8]

Q26.

(a) **Quality of written communication**

for correct use of term speed in all correct examples

Q ✓ Q ✗

1

*describes all 3 sections correctly for **2** marks*
*describes 2 or 1 section correctly for **1** mark*

max 2

A – **B** constant <u>speed</u>

*do **not** accept pace for speed*

B – **C** (has accelerated) to a higher (constant) <u>speed</u>

C – **D** goes back to original / lower (constant) <u>speed</u>

*allow for **1** mark, initial and final (constant) speeds are the same accept velocity for speed*
ignore reference to direction

(b) 62.5

allow answer to 2 s.f.

*allow **1** mark for drawing a correct triangle **or** for using two correct pairs of coordinates*

*allow **1** mark for correct use of y/x*

ignore units

3

[6]

Q27.

(a) (i) <u>constant</u> speed

*do **not** accept normal speed*
*do **not** accept it is stopped / stationary*

1

in a straight line

accept any appropriate reference to a direction

*constant velocity gains **2** marks*

*'not accelerating' gains **2** marks*
*terminal velocity alone gets **1** mark*

1

(ii) goes down owtte
accept motorbike (it) slows down

1

(b) (i) 20 (m/s)
ignore incorrect units

1

(ii) acceleration = $\frac{\text{change in velocity}}{\text{time (taken)}}$

*do **not** accept velocity for change in velocity*
accept change in speed

accept $a = \frac{v - u}{t}$ ***or*** $a = \frac{v_1 - v_2}{t}$

or $a = \frac{\Delta v}{t}$

*do **not** accept* $a = \frac{v}{t}$

1

(iii) 4

or their (b)(i) ÷ 5
*allow **1** mark for correct substitution*

2

m/s^2

*m/s/s **or** ms^{-2} **or** metres per second squared **or** metres per second per second*

1

(c) vehicle may skid / slide
loss of control / brakes lock / wheels lock
*accept greater stopping distance **or** difficult to stop*

1

due to reduced friction (between tyre(s) and road)
accept due to less grip
*do **not** accept <u>no</u> friction*

1

(d) any **three** from:
*do **not** accept night time / poor vision*

- <u>increased</u> speed
- <u>reduced</u> braking force
- <u>slower</u> (driver) reactions

*NB specific answers may **each** gain credit eg tiredness (1), drinking alcohol (1), using drugs (1), driver distracted (1) etc*

- poor vehicle maintenance

  *specific examples may **each** gain credit eg worn brakes or worn tyres etc*

- increased mass / weight of vehicle

  accept large mass / weight of vehicle

- poor road surface

- more streamlined

  *if candidates give three answers that affect stopping distance but not specific to increase award **1** mark only*

3

[13]

Q28.

(a) (i) gpe = weight × height

accept Ep = mgh
accept pe= mgh

1

(ii) 1200

accept values using 9.8 (1)
*allow **1** mark for correct substitution*

2

(b) (i) 120

accept $\frac{\text{their (a)(ii)} \times 6}{60}$

1

(ii) 300

allow b(i) ÷ 0.4 for both marks
*allow **1** mark for correct transformation*

2

[6]

Q29.

(a) (i) **either**

the momentum in a particular direction after (the collision) is the same as the momentum in that direction before (the collision)

*accept 'momentum before equals momentum after' for **1** mark*

or total momentum after (the collision) equals the total momentum before (the collision) (2)

*accept 'momentum before equals momentum after' for **1** mark*

2

(ii) explosion(s)
or (action of a) rocket (motor(s))
or (action of a) jet (engine)

or firing a gun

accept any other activity in which things move apart as a result of the release of internal energy eg throwing a ball

1

(iii) momentum = mass × velocity **or** any correctly transposed version

accept momentum = mass × speed
accept p = mv
*do **not** accept momentum = ms*
or M = mv

1

(iv) 0.8

*if answer 0.8 not given, any **two** for (1) each:*
*momentum of **X** = 0.2 × 1.2*
*= momentum of **X and Y** after impact*
*= 0.3 × v **or** = (0.1 + 0.2) × v*

3

m/s

1

to the right

1

(v) any **one** from:

conservation of momentum (applies)

no external forces

*do **not** accept just 'no (other) forces act'*

friction is negligible / insignificant

no friction

no air resistance

1

(b) force = (change in) momentum ÷ time

or any correctly transposed version

1

4000 **or** 4 kilonewtons

dependent on correct or no equation
*force = 5 ÷ 0.00125 gains **1** mark*

2

[13]

Q30.

(i) kinetic energy = $\frac{1}{2} \times \text{mass} \times \text{speed}^2$

accept velocity for speed

accept KE = $\frac{1}{2}mv^2$

1

(ii) 32 000

accept 32 kJ

1

[2]

Q31.

(a) B

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

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

accept converse

2

(b) (i) gravity

1

(ii) air resistance

1

(iii) go up

1

(iv) stays the same

1

(c) bigger the area, the bigger force Y

accept the converse

or bigger the area more drag

accept when the parachute opens then force Y bigger

or bigger the area more air resistance

need the relation of area to force

1

[7]

Q32.

(a) (i) gravity/weight

1

(ii) 2193750000000 or 2.19×10^{12}

not *2.19^{12}*

allow 1 mark for the correct conversion to 7500 (m/s)

allow one mark for answer 2193750(J)

2

transferred to heat

ignore extras of sound and light

accept changed to heat

accept lost due to friction

1

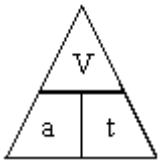
(b) (i) acceleration = $\frac{\text{change in velocity}}{\text{time (taken)}}$

accept word speed instead of velocity

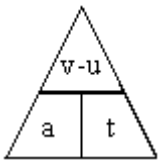
accept a = $\frac{v - u}{t}$

***or** correct rearrangement*

do not accept



even if subsequent calculation correct



can gain credit if subsequent calculation correct

1

(ii) 2

ignore + or – signs

m/s^2 1

accept m/s/s or ms^{-2}

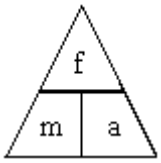
2

(c) (i) force = mass × acceleration

accept correct rearrangement

accept F = m × a

do not accept



unless subsequent calculation correct

1

(ii) 156 000

accept 78 000 × their (b)(ii)(only if (b)(i) correct)

1

[9]

Q33.

(a) Total momentum (of a system of bodies) remains constant

accept momentum before (a collision) = momentum after (a collision)

1

Provided no external force acts

1

(b) (i) rotate the compressor

1

(ii)
- fuel is mixed with the air and ignited
- causing an increase in the pressure **or** temperature **or** speed of the gases

  accept air out faster than air in
  *accept gases have momentum **or***
- force backwards
- exhaust gases have momentum (backwards) **or** force (backwards)

  if the answer is in terms of force then this third point must be scored before the fourth can be credited
- engine **or** aircraft has (equal) momentum forwards **or** force forwards

4

(c) m = 350

answer 0.35 one mark only

*allow one mark if 105 000 **or** 475-175 **or** 300 have been used*

2

[9]

Q34.

(a) (i) gravitational potential

accept gravitational

accept potential

1

(ii) 2250 (N)

1

forces must be balanced
or
forces are equal and opposite

*do **not** accept because it is not moving*
*do **not** accept 'equilibrium' by itself*
*do **not** accept 'it is not balanced'*
*do **not** accept 'forces are equal'*
*do **not** accept 'forces are the same'*

1

(b) 1500

***1** mark for correct substitution*

2

[5]

Q35.

(a) (i) zero

accept nothing

1

speed is zero

accept not moving

1

(ii) A

1

largest mass **or** weight

accept heaviest luggage

*do **not** accept largest luggage*

1

(iii) momentum does change

accept yes

1

direction is changing

accept velocity is changing
*do **not** accept answers in terms of speed changing*

1

(b) kg m/s

1

[7]