AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



EXAM QUESTION PACK

4.5.2 WORK DONE AND ENERGY TRANSFER (PACK 1)

SCORE	PERCENTAGE
/282	%

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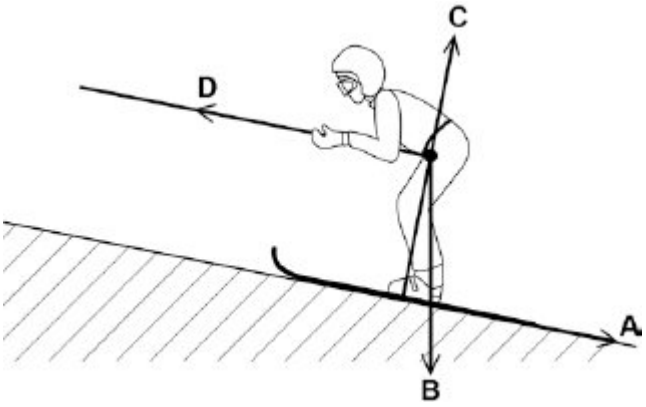
Q1.

Figure 1 shows a skier using a drag lift.

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

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

Figure 1



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

Tick **one** box.

A ☐

B ☐

C ☐

D ☐

(1)

(b) Which arrow represents the normal contact force?

Tick **one** box.

A ☐

B ☐

C ☐

D ☐

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(1)

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

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

work done = force × distance

_____

_____

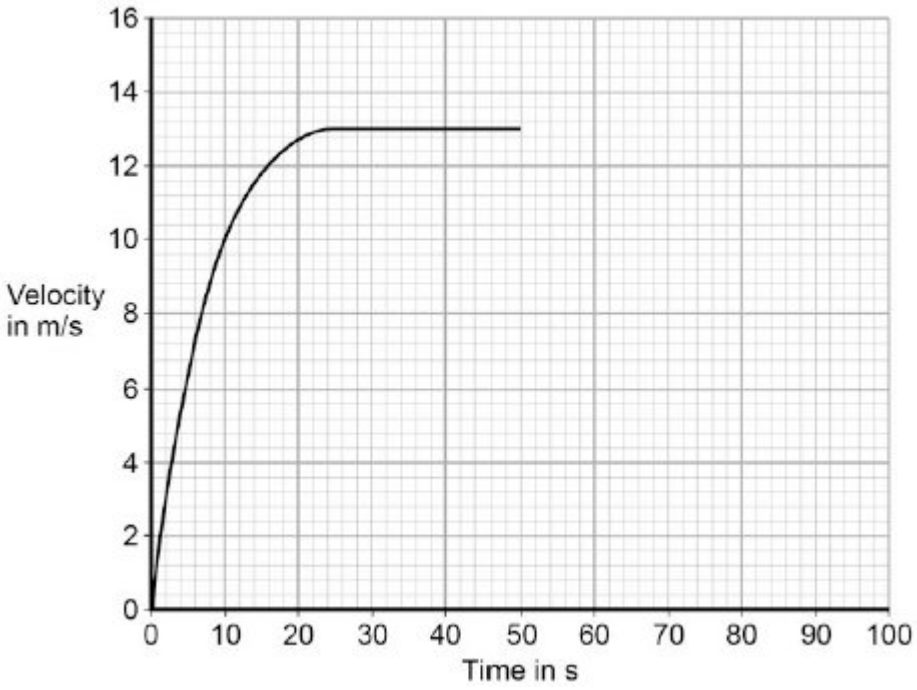
Work done = _____ J

(2)

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

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

Figure 2



After 50 seconds the skier starts to slow down.

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

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

(2)

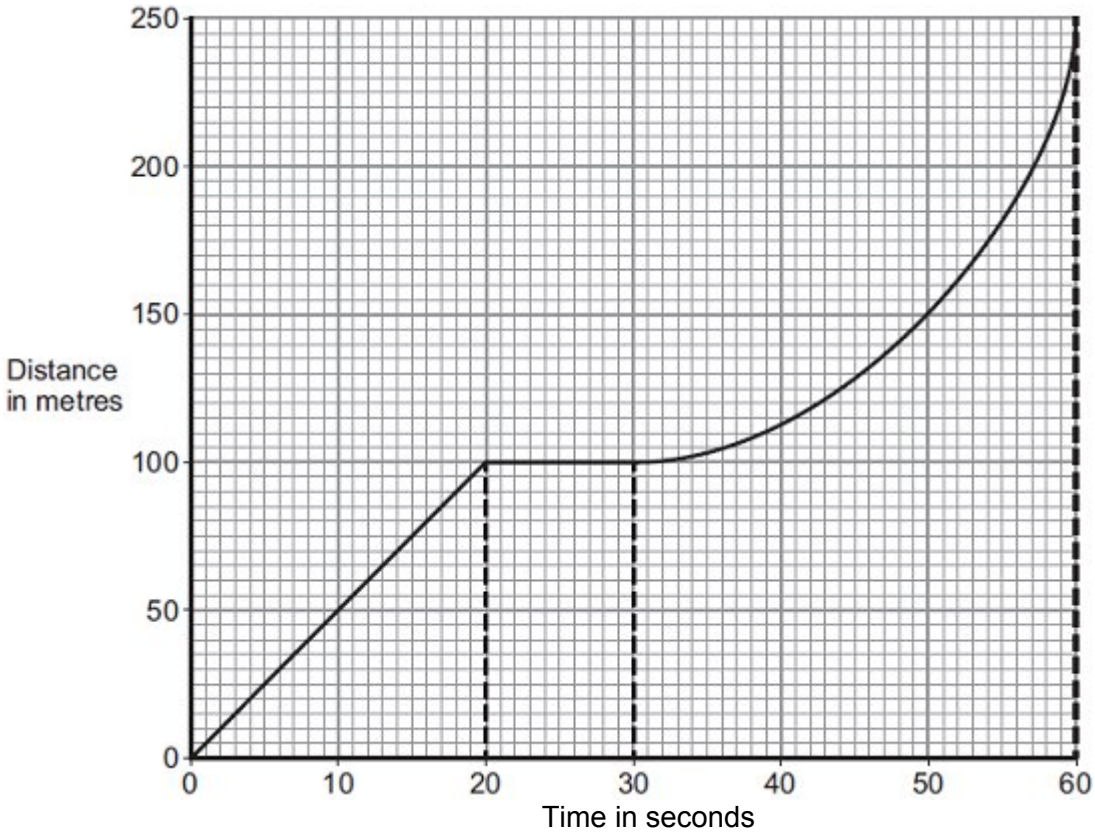
(Total 6 marks)

Q2.

A bus is taking some children to school.

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(a) The bus has to stop a few times. The figure below shows the distance–time graph for part of the journey.



(i) How far has the bus travelled in the first 20 seconds?

Distance travelled = _____ m

(1)

(ii) Describe the motion of the bus between 20 seconds and 30 seconds.

_____

_____

(1)

(iii) Describe the motion of the bus between 30 seconds and 60 seconds.

Tick (✓) **one** box.

	Tick (✓)
Accelerating	
Reversing	
Travelling at constant speed	

(1)

(iv) What is the speed of the bus at 45 seconds?

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Show clearly on the figure above how you obtained your answer.

_____

_____

_____

Speed = _____ m / s

(3)

(b) Later in the journey, the bus is moving and has 500 000 J of kinetic energy.

The brakes are applied and the bus stops.

(i) How much work is needed to stop the bus?

_____

Work = _____ J

(1)

(ii) The bus stopped in a distance of 25 m.

Calculate the force that was needed to stop the bus.

_____

_____

Force = _____ N

(2)

(iii) What happens to the kinetic energy of the bus as it is braking?

_____

_____

_____

_____

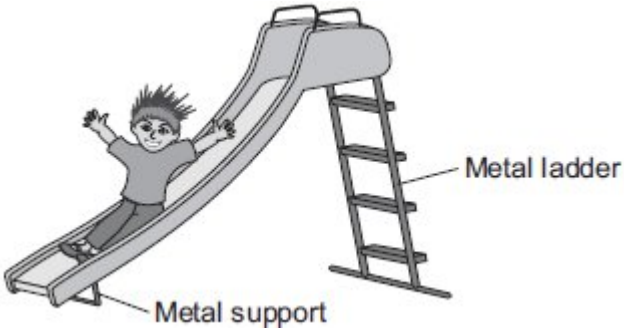
(2)

(Total 11 marks)

Q3.

The figure below shows a slide in a children's playground.

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(a) A child of mass 18 kilograms goes down the slide.

The vertical distance from the top to the bottom of the slide is 2.5 metres.

Calculate the decrease in gravitational potential energy of the child sliding from the top to the bottom of the slide.

Gravitational field strength = 10 N / kg

_____

_____

_____

Decrease in gravitational potential energy = _____ J

(2)

(b) The slide is made of plastic.

(i) The child becomes electrically charged when he goes down the slide.

Explain why.

_____

_____

_____

_____

(2)

(ii) Going down the slide causes the child's hair to stand on end.

What conclusion about the electrical charge on the child's hair can be made from this observation?

_____

_____

Give a reason for your answer.

_____

_____

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(2)

(iii) Why would the child **not** become electrically charged if the slide was made from metal?

_____

_____

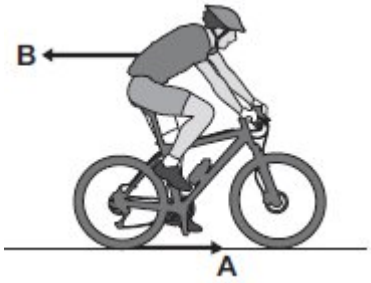
(1)

(Total 7 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**?

_____

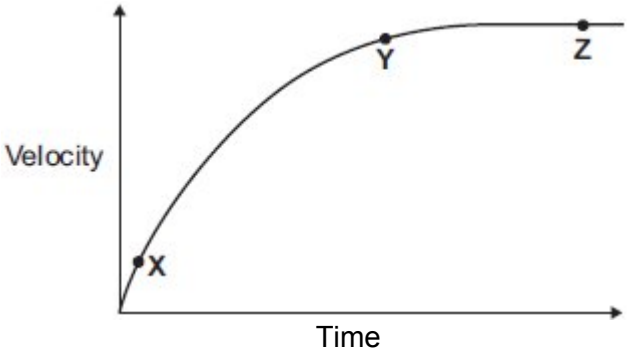
(1)

(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

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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

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_____

_____

_____

_____

(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 _____ .

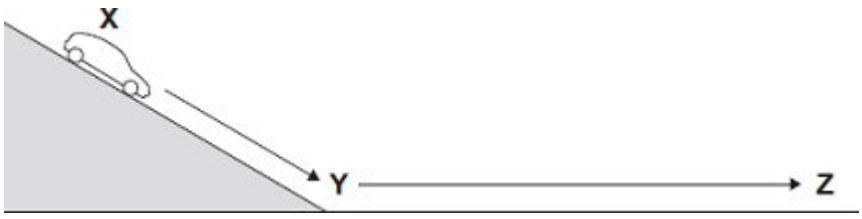
At the same time, the _____ of the brakes increases.

(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)

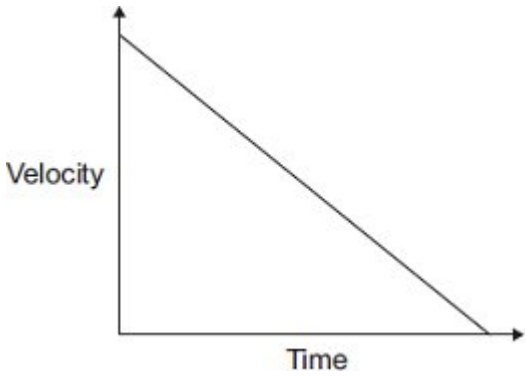
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(ii) What type of energy does the car have at **Y**?

_____

(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**?

_____

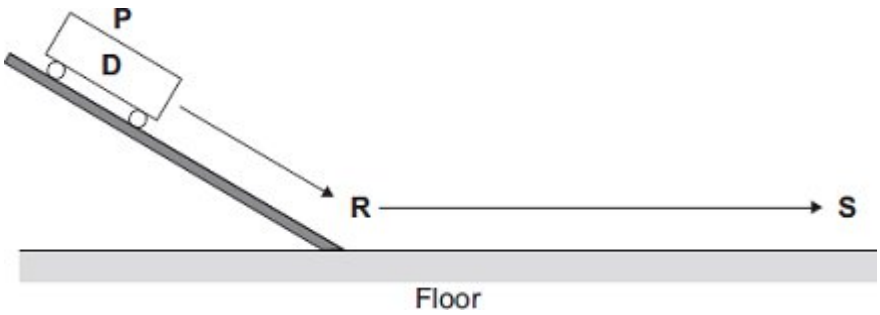
(1)

(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.



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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.

_____

_____

_____

_____

_____

_____

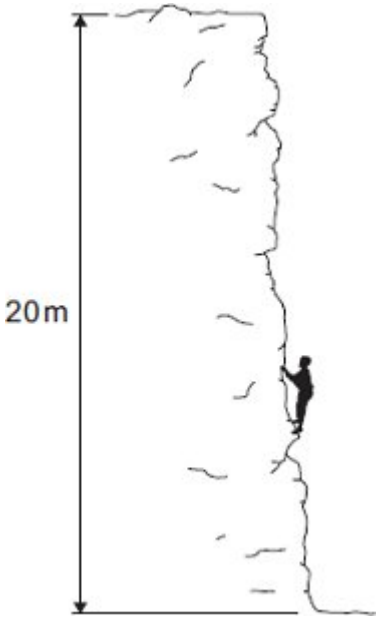
(3)

(Total 12 marks)

Q6.

The diagram shows a climber part way up a cliff.

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(a) Complete the sentence.

When the climber moves up the cliff, the climber

gains gravitational _____ energy.

(1)

(b) The climber weighs 660 N.

(i) Calculate the work the climber must do against gravity, to climb to the top of the cliff.

_____

_____

Work done = _____ J

(2)

(ii) It takes the climber 800 seconds to climb to the top of the cliff.
During this time the energy transferred to the climber equals the work done by the climber.

Calculate the power of the climber during the climb.

_____

_____

Power = _____ W

(2)

(Total 5 marks)

Q7.

(a) The stopping distance of a vehicle is made up of two parts, the thinking distance and the braking distance.

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(i) What is meant by *thinking distance*?

_____

_____

(1)

(ii) State **two** factors that affect thinking distance.

1. _____

_____

2. _____

_____

(2)

(b) A car is travelling at a speed of 20 m/s when the driver applies the brakes. The car decelerates at a constant rate and stops.

(i) The mass of the car and driver is 1600 kg.

Calculate the kinetic energy of the car and driver before the brakes are applied.

_____

_____

_____

Kinetic energy = _____ J

(2)

(ii) How much work is done by the braking force to stop the car and driver?

Work done = _____ J

(1)

(iii) The braking force used to stop the car and driver was 8000 N.

Calculate the braking distance of the car.

_____

_____

_____

_____

Braking distance = _____ m

(2)

(iv) The braking distance of a car depends on the speed of the car and the braking force applied.

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State **one** other factor that affects braking distance.

_____

_____

(1)

(v) Applying the brakes of the car causes the temperature of the brakes to increase.

Explain why.

_____

_____

_____

_____

(2)

(c) Hybrid cars have an electric engine and a petrol engine. This type of car is often fitted with a regenerative braking system. A regenerative braking system not only slows a car down but at the same time causes a generator to charge the car's battery.

State and explain the benefit of a hybrid car being fitted with a regenerative braking system.

_____

_____

_____

_____

_____

_____

(3)

(Total 14 marks)

Q8.

A car has an oil leak. Every 5 seconds an oil drop falls from the bottom of the car onto the road.

(a) What force causes the oil drop to fall towards the road?

_____

(1)

(b) The diagram shows the spacing of the oil drops left on the road during part of a journey



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Describe the motion of the car as it moves from **A** to **B**.

_____

Explain the reason for your answer.

_____

_____

_____

_____

(3)

(c) When the brakes are applied, a braking force slows down and stops the car.

(i) The size of the braking force affects the braking distance of the car.

State **one** other factor that affects the braking distance of the car.

_____

(1)

(ii) A braking force of 3 kN is used to slow down and stop the car in a distance of 25 m.

Calculate the work done by the brakes to stop the car and give the unit.

_____

_____

_____

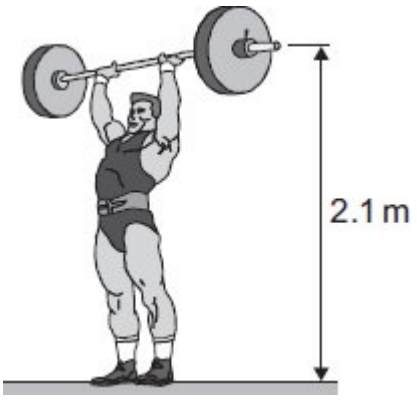
Work done =_____

(3)

(Total 8 marks)

Q9.

A powerlifter lifts a 180 kg bar from the floor to above his head.



(a) Use the equation in the box to calculate the weight of the bar.

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weight = mass × gravitational field strength

gravitational field strength = 10 N/kg

Show clearly how you work out your answer.

_____

_____

Weight = _____ N

(2)

(b) The powerlifter uses a constant force to lift the bar a distance of 2.1 m.

Use the equation in the box to calculate the work done by the powerlifter.

work done = force applied × distance moved in direction of force

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

Choose the unit from the list below.

joule **newton** **watt**

_____

_____

Work done = _____

(3)

(c) At the end of the lift, the powerlifter holds the bar stationary, above his head, for two seconds.

How much work does the powerlifter do on the bar during these two seconds?

Draw a ring around your answer.

0 **90** **360** **900**

Give a reason for your answer.

_____

_____

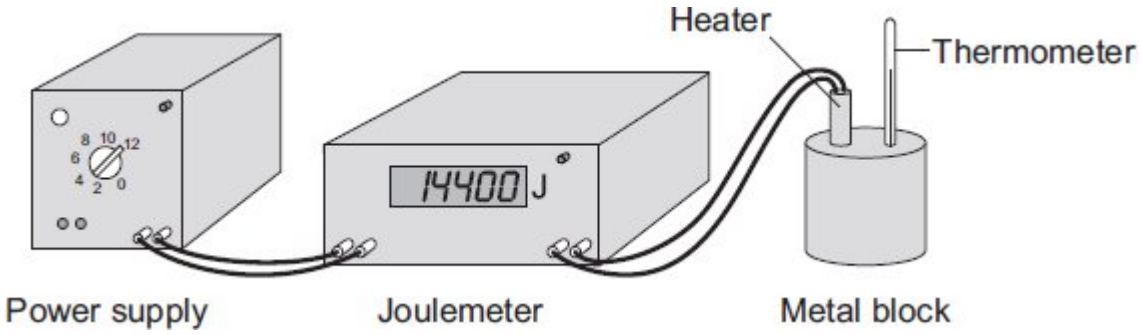
(2)

(Total 7 marks)

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Q10.

A student used an electric heater to heat a metal block. The student measured the energy input to the heater with a joulemeter.



Before starting the experiment, the student reset the joulemeter to zero. The student switched the power supply on for exactly 10 minutes. During this time, the reading on the joulemeter increased to 14 400.

(a) (i) Calculate the energy transferred each second from the power supply to the heater.

Show clearly how you work out your answer.

_____

_____

Energy transferred each second = _____ J/s

(2)

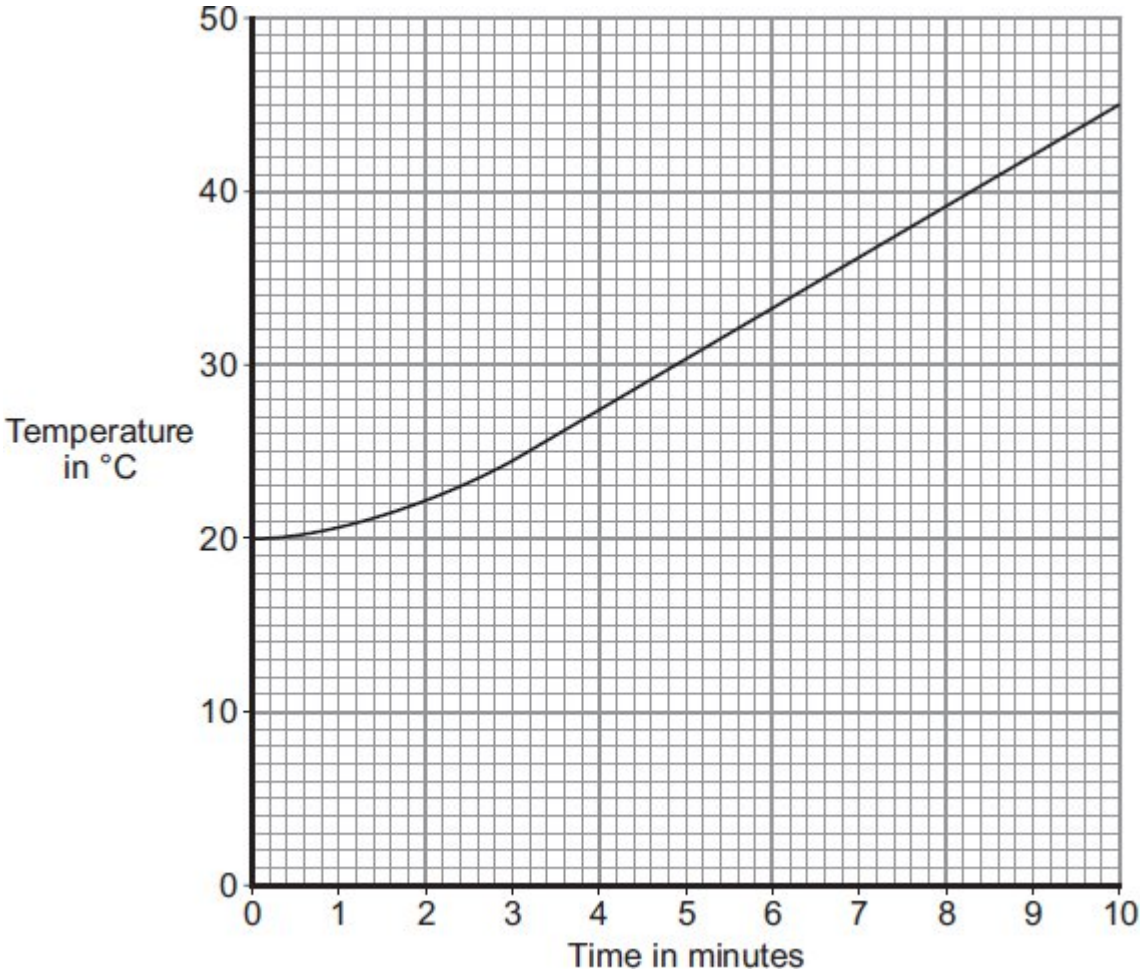
(ii) What is the power of the heater?

_____

(1)

(b) The student measured the temperature of the metal block every minute. The data obtained by the student is displayed in the graph.

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(i) What range of temperatures did the student measure?

From _____ °C to _____ °C

(1)

(ii) Before starting the experiment, the student had calculated that the temperature of the block would go up by 36 °C.

The student's data shows a smaller increase.

Which **one** of the following statements gives the most likely reason for this?

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

The student does not read the thermometer accurately. ☐

The block transfers energy to the surroundings. ☐

The power supply is not connected correctly to the joulemeter. ☐

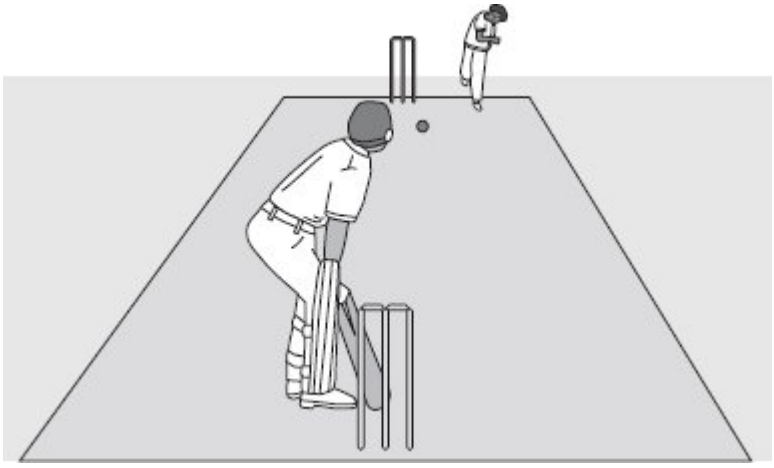
(1)

(Total 5 marks)

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Q11.

The picture shows players in a cricket match.



(a) A fast bowler bowls the ball at 35 m/s. The ball has a mass of 0.16 kg.

Use the equation in the box to calculate the kinetic energy of the cricket ball as it leaves the bowler's hand.

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

Show clearly how you work out your answer.

_____

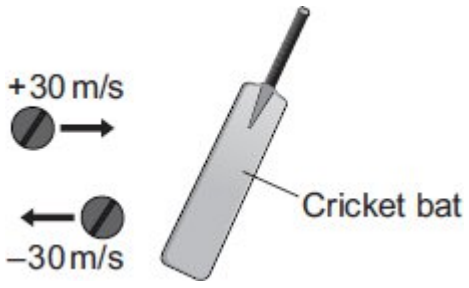
_____

_____

Kinetic energy = _____ J

(2)

(b) When the ball reaches the batsman it is travelling at 30 m/s. The batsman strikes the ball which moves off at 30 m/s in the opposite direction.



(i) Use the equation in the box to calculate the change in momentum of the ball.

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

Show clearly how you work out your answer.

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_____

_____

Change in momentum = _____ kg m/s

(2)

(ii) The ball is in contact with the bat for 0.001 s.

Use the equation in the box to calculate the force exerted by the bat on the ball.

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

Show clearly how you work out your answer.

_____

_____

Force = _____ N

(1)

(c) A fielder, as he catches a cricket ball, pulls his hands backwards.

Explain why this action reduces the force on his hands.

_____

_____

_____

_____

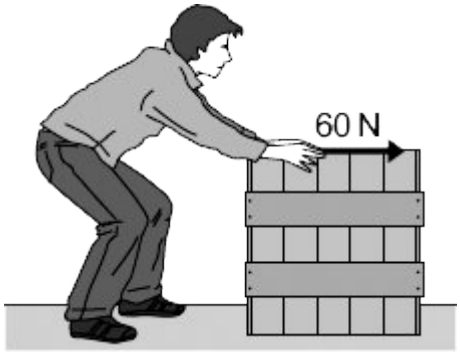
_____

(2)

(Total 7 marks)

Q12.

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



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

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

(1)

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

_____ N

Give the reason for your answer.

_____

_____

(2)

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

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

Choose the unit from the list below.

joule **newton** **watt**

_____

_____

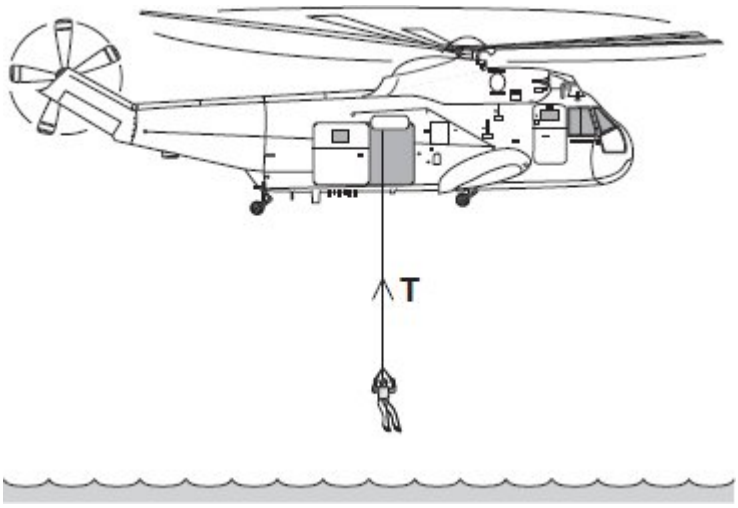
Work done = _____

(3)

(Total 6 marks)

Q13.

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



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

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

weight = mass × gravitational field strength

gravitational field strength = 10 N/kg

Show clearly how you work out your answer.

_____

_____

Weight = _____ N

(2)

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

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

Force **T** = _____ N

(1)

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

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

gravitational potential	heat	sound

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

(1)

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

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

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

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

Choose the unit from the list below.

coulomb (C) **hertz (Hz)** **watt (W)**

_____

_____

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Power = _____

(3)

(Total 7 marks)

Q14.

The picture shows an electric bicycle. The bicycle is usually powered using a combination of the rider pedalling and an electric motor.



(a) A 36 volt battery powers the electric motor. The battery is made using individual 1.2 volt cells.

(i) Explain how a 36 volt battery can be produced using individual 1.2 volt cells.

To gain full marks, you must include a calculation in your answer.

_____

_____

_____

_____

(2)

(ii) The battery supplies a direct current (d.c.).

What is a *direct current (d.c.)*?

_____

_____

(1)

(iii) When fully charged, the battery can deliver a current of 5 A for 2 hours. The battery is then fully discharged.

Calculate the maximum charge that the battery stores.

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

_____

_____

Charge stored = _____

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(3)

(b) When powered only by the electric motor, the bicycle can carry a 90 kg rider at a maximum speed of 6 m/s. Under these conditions, the maximum distance that the bicycle can cover before the battery needs recharging is 32 km.

The bicycle has a mass of 30 kg.

(i) Calculate the maximum kinetic energy of the bicycle **and** rider when the rider is not pedalling.

Show clearly how you work out your answer.

_____

_____

Kinetic energy = _____ J

(2)

(ii) The bicycle can be fitted with panniers (bags) to carry a small amount of luggage.

What effect would fitting panniers and carrying luggage have on the distance the bicycle can cover before the battery needs recharging?

_____

Give a reason for your answer.

_____

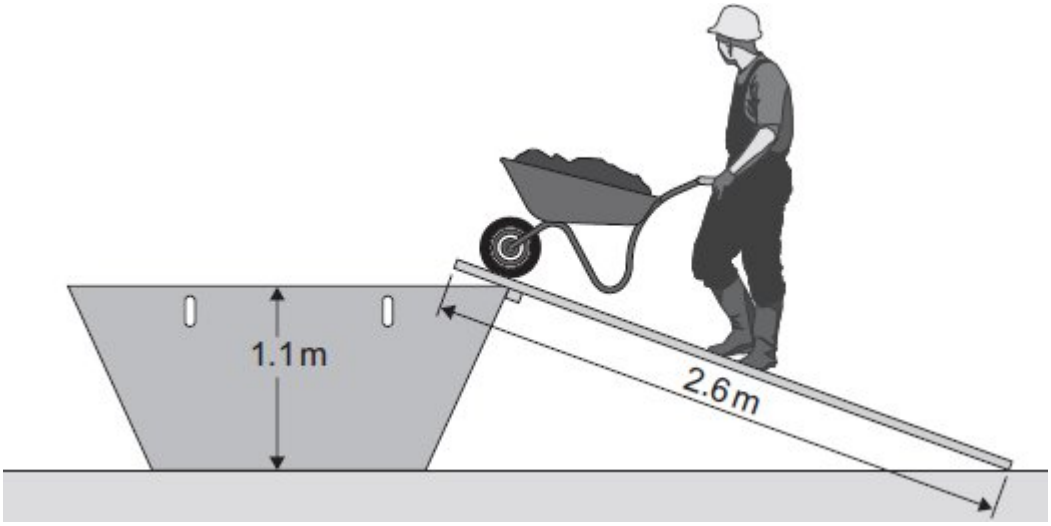
_____

(2)

(Total 10 marks)

Q15.

(a) The diagram shows a builder using a plank to help load rubble into a skip.



The builder uses a force of 220 N to push the wheelbarrow up the plank.

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Use information from the diagram to calculate the work done to push the wheelbarrow up the plank to the skip.

Show clearly how you work out your answer.

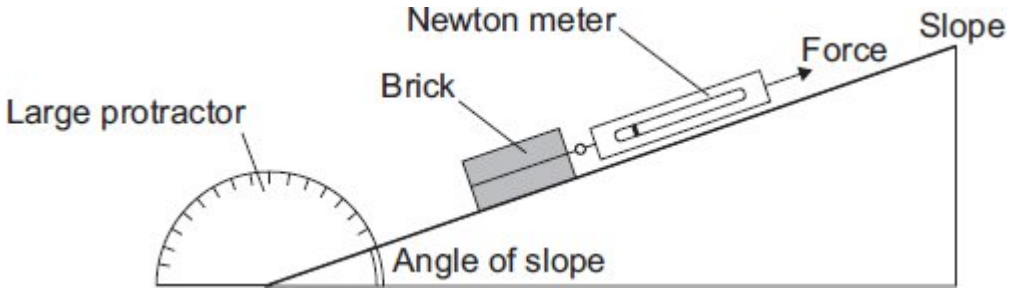
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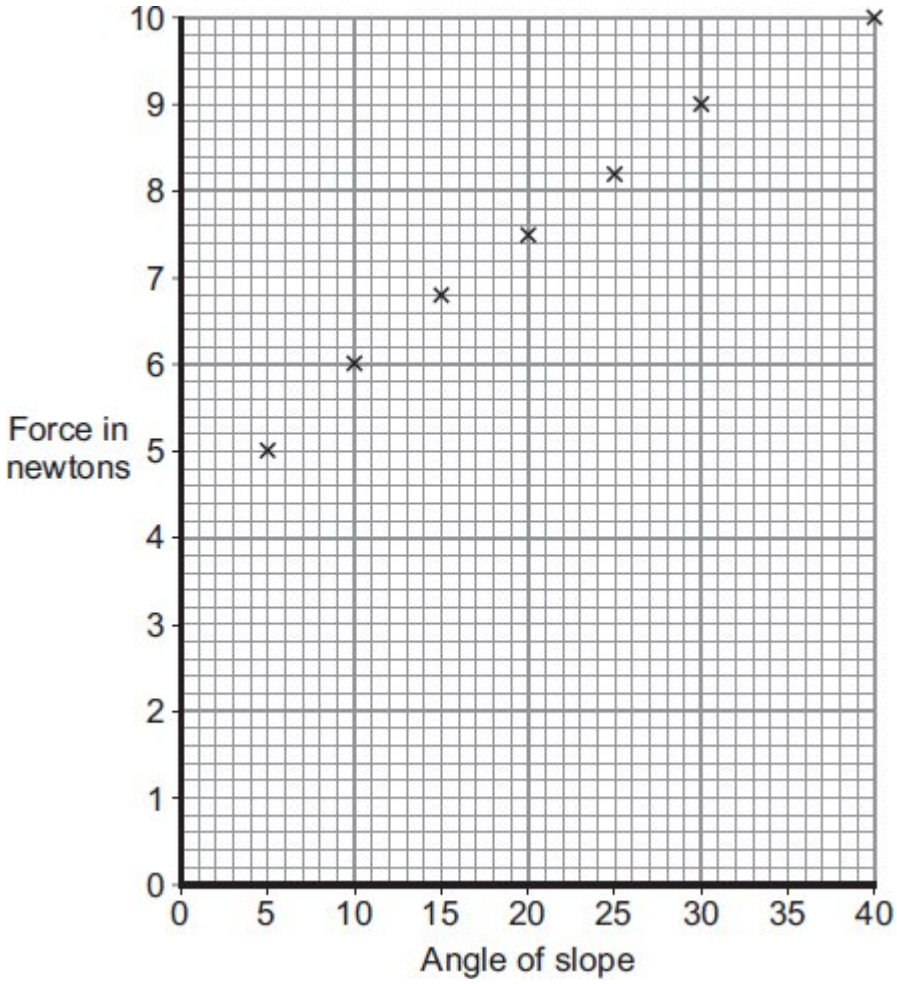
Work done = _____ J

(2)

(b) A student investigated how the force needed to pull a brick up a slope, at a steady speed, depends on the angle of the slope.
The apparatus used by the student is shown in the diagram.



The student used the results from the investigation to plot the points for a graph of force used against the angle of the slope.



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(i) Draw a line of best fit for these points.

(1)

(ii) How does the force used to pull the brick up the slope change as the angle of the slope increases?

_____

_____

(1)

(iii) Consider the results from this experiment.
Should the student recommend that the builder use a long plank or a short plank to help load the skip?

Draw a ring around your answer.

long plank **short plank**

Explain the reason for your answer.

_____

_____

_____

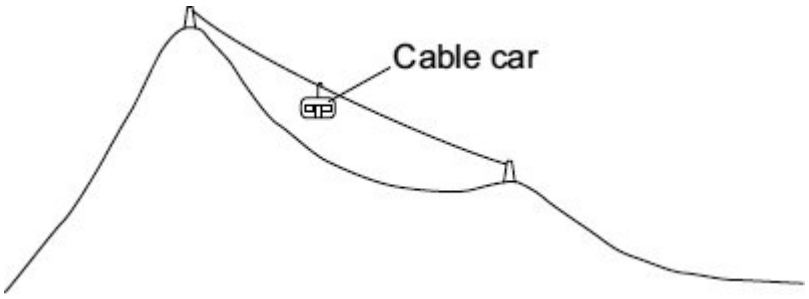
_____

(2)

(Total 6 marks)

Q16.

(a) The diagram shows a cable car used to take skiers to the top of a mountain.



(i) The total mass of the cable car and skiers is 7500 kg.

Calculate the weight of the cable car and skiers.

gravitational field strength = 10 N/kg

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

_____

_____

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Weight = _____

(3)

(ii) The cable car moves at a constant speed. It lifts skiers through a vertical height of 800 metres in 7 minutes.

Calculate the work done to lift the cable car and skiers.

Show clearly how you work out your answer.

_____

_____

Work done = _____ J

(2)

(b) The diagram shows a skier who is accelerating down a steep ski slope.



(i) Draw an arrow on the diagram to show the direction of the resultant force acting on the skier.

(1)

(ii) How and why does the kinetic energy of the skier change?

_____

_____

_____

_____

(2)

(c) Last year, 18 000 skiers suffered a head injury. It is thought that nearly 8000 of these injuries could have been avoided if the skier had been wearing a helmet. However, at present, there are no laws to make skiers wear helmets.

Suggest why skiers should be made aware of the benefits of wearing a helmet.

_____

_____

(1)

(Total 9 marks)

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Q17.

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

.

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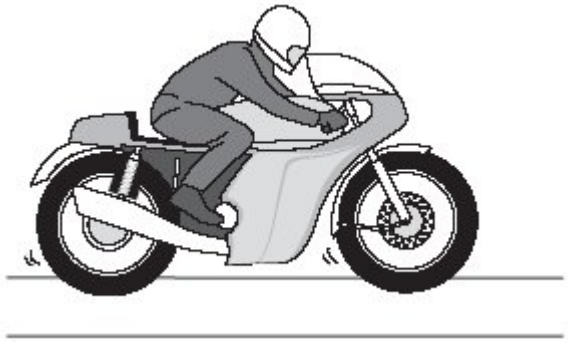
sound

(1)

(Total 6 marks)

Q18.

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?

_____

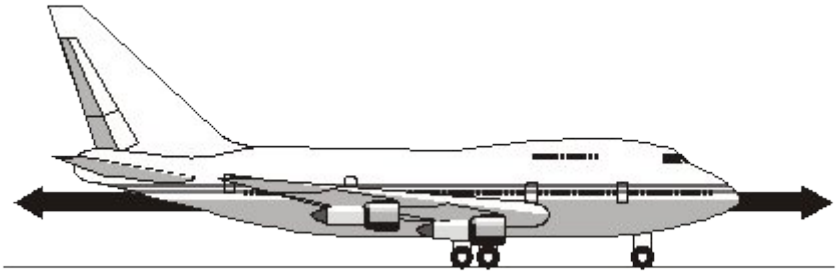
(1)

(Total 4 marks)

Q19.

(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.

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(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.

_____

_____

_____

_____

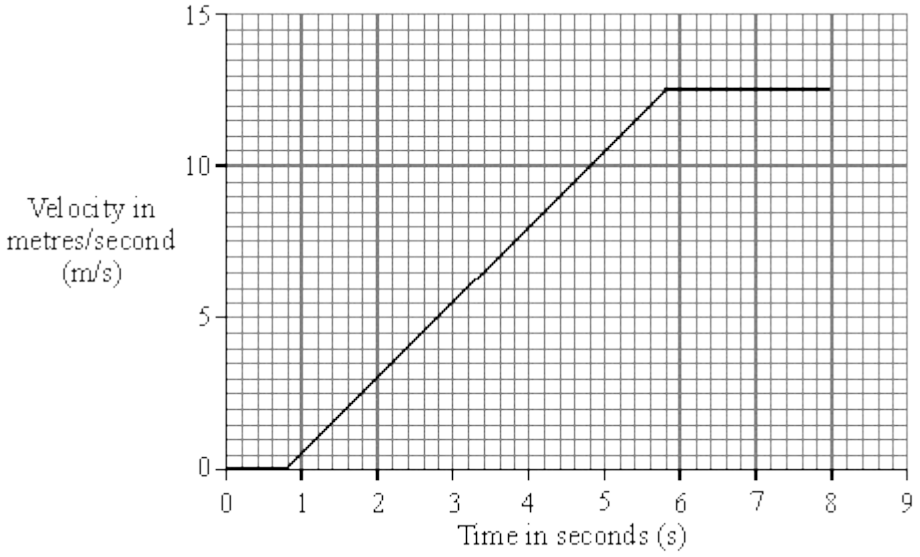
(2)

(Total 7 marks)

Q20.

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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)

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

_____

_____

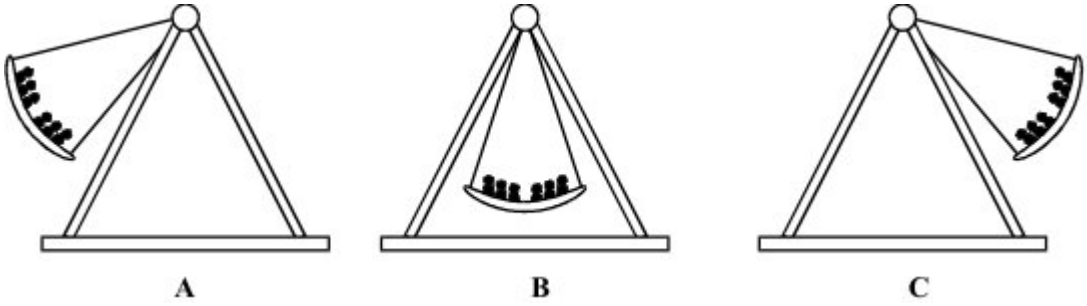
Force = _____ newtons

(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.

_____

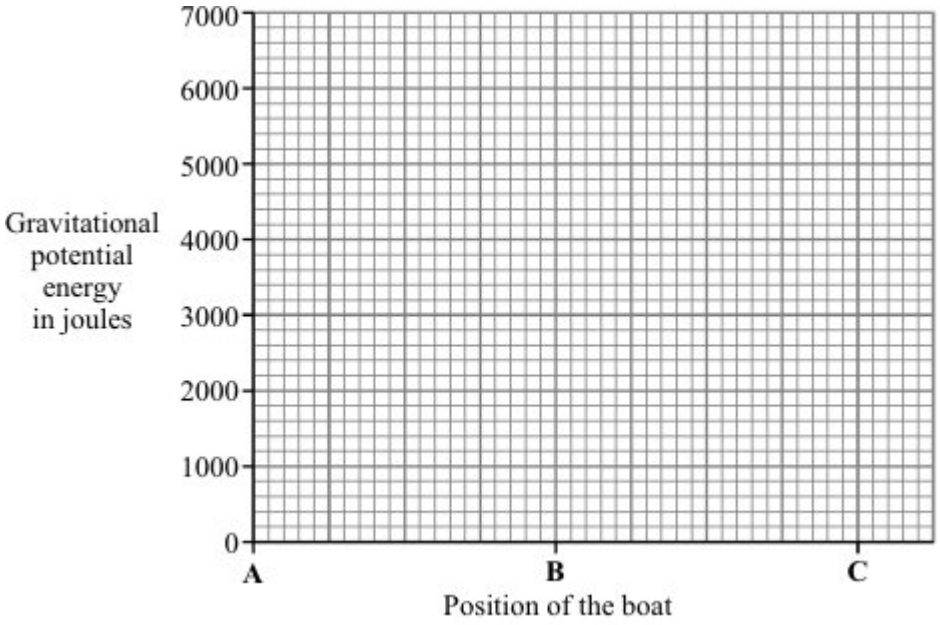
_____

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.

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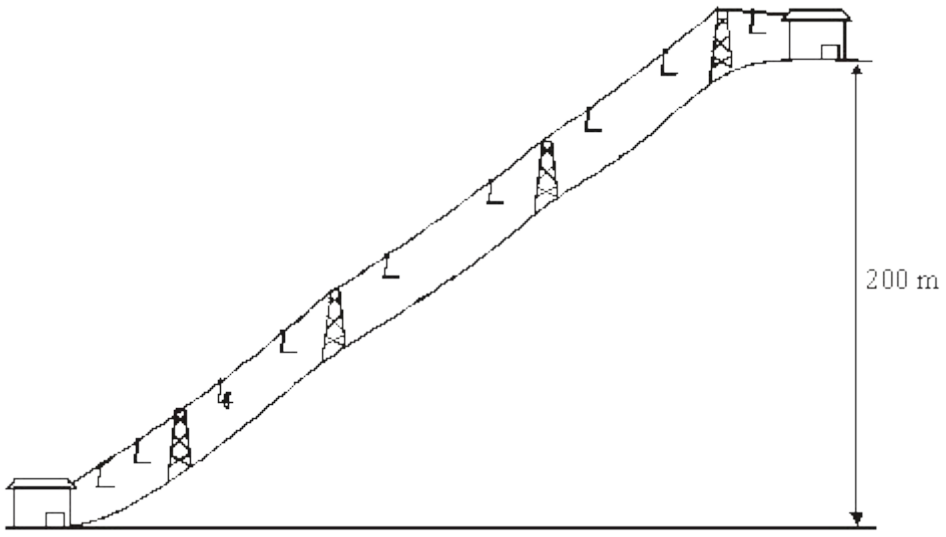


(2)

(Total 5 marks)

Q22.

(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.

_____

_____

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_____

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

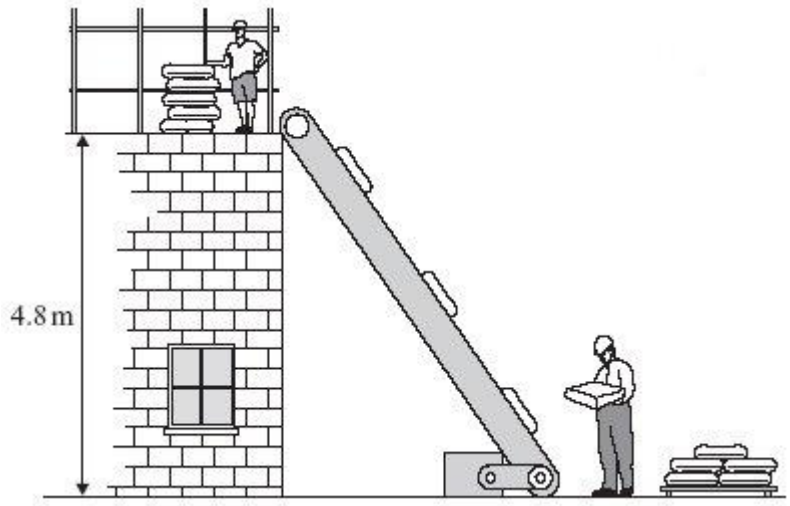
is usefully transferred as gravitational _____ energy.

(1)

(Total 8 marks)

Q23.

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.

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_____

(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)

Q24.

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)

_____

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_____

Kinetic energy = _____ joules

(1)

(Total 2 marks)

Q25.

(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)

Q26.

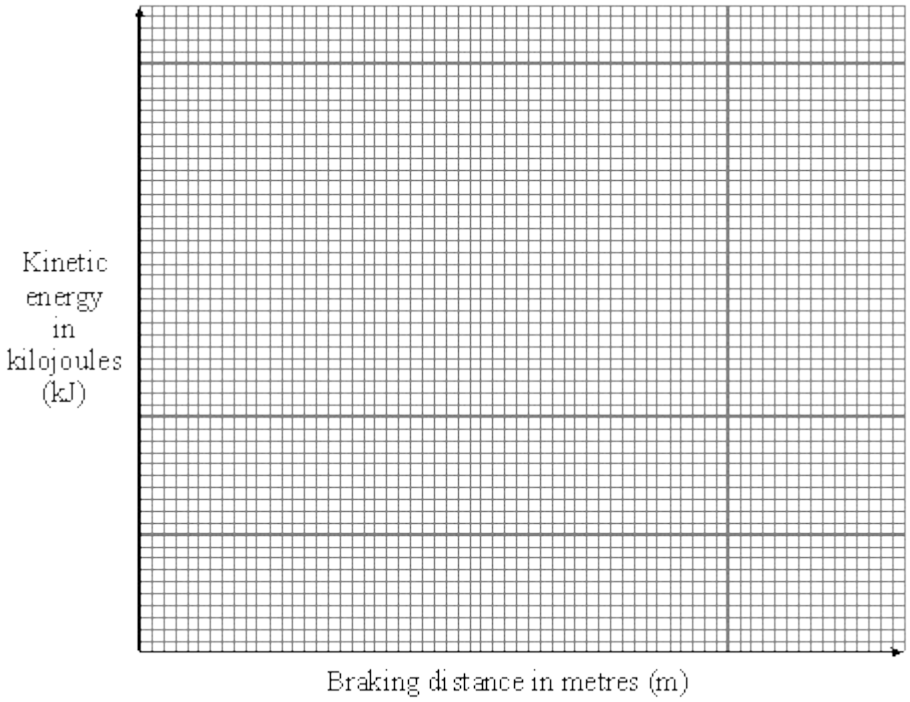
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The table shows the braking distances for a car at different speeds and kinetic energy. The braking distance is how far the car travels once the brakes have been applied.

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.

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_____

_____

Braking distance = _____ m

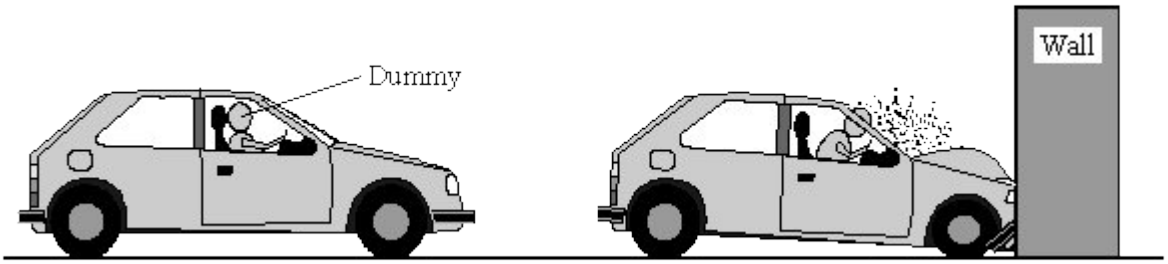
(2)

(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 _____

_____

_____

_____

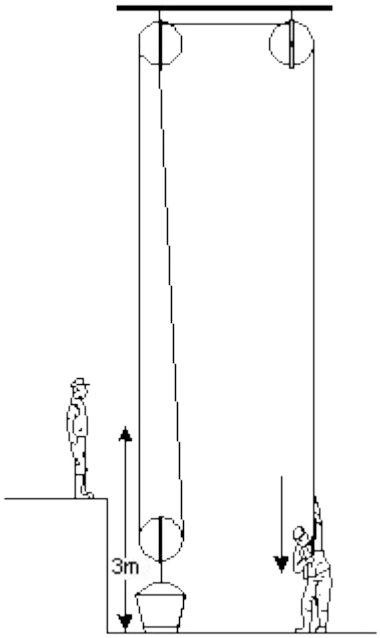
(2)

(Total 11 marks)

Q27.

The diagram below shows one way of lifting a bucket of bricks.

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(a) When the free end of the rope is pulled down, the load is lifted.

Complete the following sentence.

The work done in pulling the rope down is used to increase the _____

energy of the _____ and bricks.

(2)

(b) The weight of the bricks is 100 N and they are lifted 3 m.

Calculate the work done on the bricks.

_____

_____

Answer _____ J

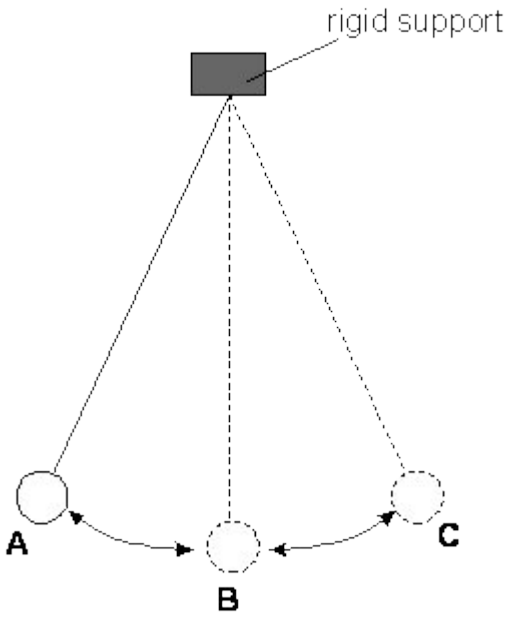
(2)

(Total 4 marks)

Q28.

The diagram below shows an experiment where a pendulum swings backwards and forwards.
A pendulum is a small heavy weight suspended by a light string.

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(a) (i) In which position, A, B or C, does the pendulum have least potential energy?
Explain your answer.

_____

(1)

(ii) In which position, A, B or C, does the pendulum have greatest kinetic energy?

Explain your answer.

_____

(1)

(iii) After a few minutes the size of the swings becomes smaller.
Explain why this happens.

_____

_____

(1)

(b) If the experiment were repeated on the Moon the pendulum would swing more slowly.
Suggest a reason for this.

_____

_____

(2)

(Total 5 marks)

Q29.

The manufacturer of a family car gave the following information.

Mass of car 950 kg

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The car will accelerate from 0 to 33 m/s in 11 seconds.

(a) Calculate the acceleration of the car during the 11 seconds.

_____

_____

_____

(2)

(b) Calculate the force needed to produce this acceleration.

_____

_____

_____

(2)

(c) The manufacturer of the car claims a top speed of 110 miles per hour. Explain why there must be a top speed for any car.

_____

_____

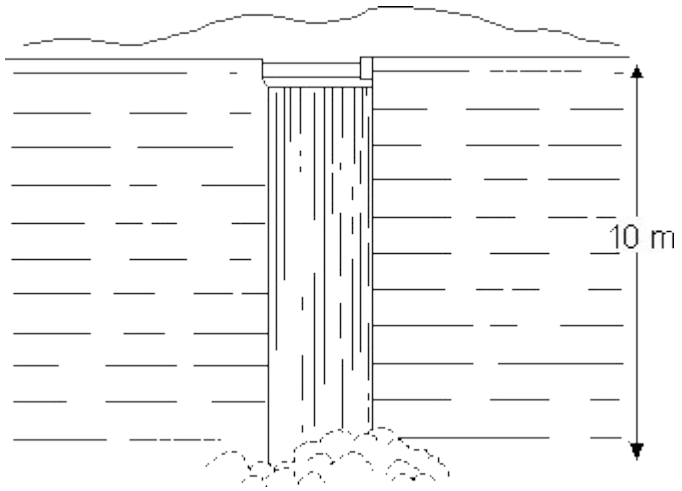
_____

(3)

(Total 7 marks)

Q30.

The diagram below shows water falling over a dam at the end of a reservoir. The water falls a vertical distance of 10 m.



(a) Calculate the potential energy of 1 kg of water at the top of the waterfall.

_____

_____

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Answer _____ J

(2)

(b) What will be the kinetic energy of 1 kg of the water just before it lands in the pool?

_____

Answer _____ J

(1)

(c) Use your answer to (b) to calculate the speed of the water as it lands at the bottom of the waterfall.

_____

_____

_____

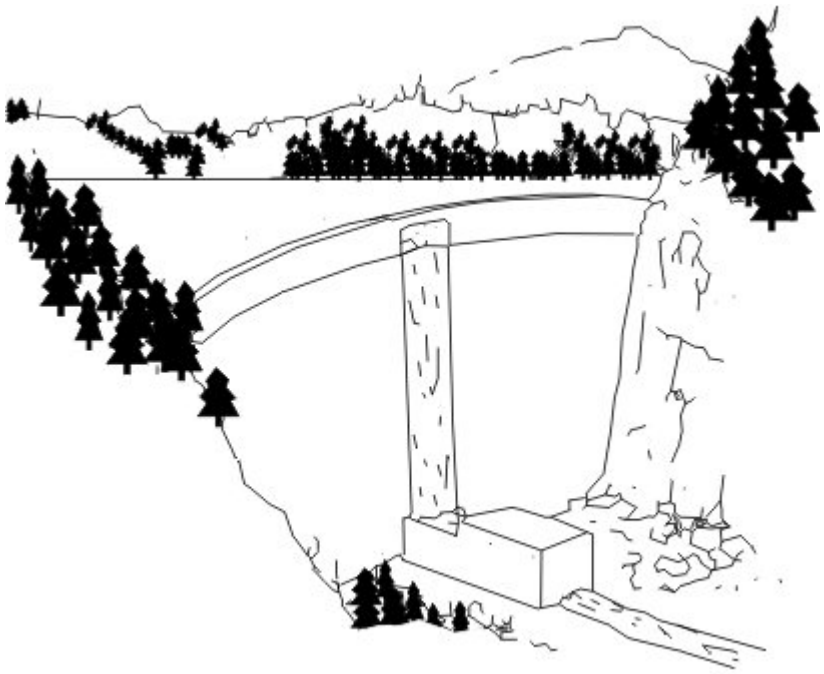
Answer _____ m/s

(3)

(Total 6 marks)

Q31.

The diagram below shows water falling from a dam. Each minute 12 000 kg of water falls vertically into the pool at the bottom.



The time taken for the water to fall is 2 s and the acceleration of the water is 10 m/s^2.

(a) Assume the speed of the water at the bottom of the dam is zero. Calculate the speed of the water just before it hits the pool at the bottom.

_____

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_____

(2)

(b) Use your answer to part (a) to calculate the average speed of the falling water.

_____

(1)

(c) Calculate the height that the water falls.

_____

_____

(2)

(d) What weight of water falls into the pool each minute?

_____

_____

(2)

(e) How much work is done by gravity each minute as the water falls?

_____

_____

(2)

(f) A small electrical generator has been built at the foot of the waterfall. It uses the falling water to produce electrical power.

(i) How much energy is available from the falling water each minute?

_____

(ii) How much power is available from the falling water?

_____

_____

(iii) If the generator is 20% efficient, calculate the electrical power output of the generator.

_____

_____

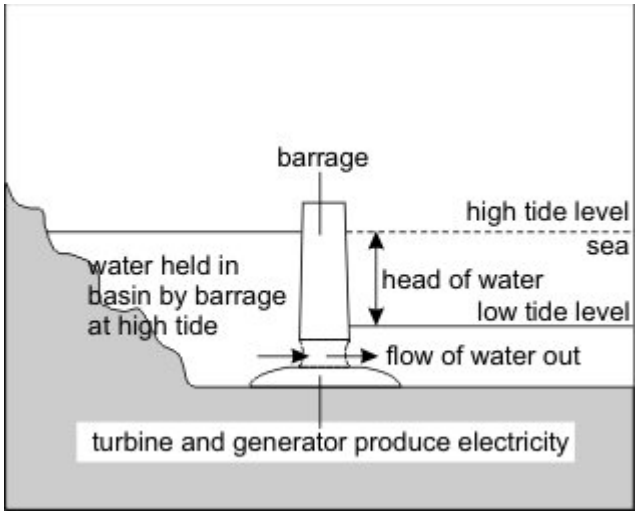
(4)

(Total 13 marks)

Q32.

The outline diagram below shows a tidal power generating system.

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Gates in the barrage are open when the tide is coming in and the basin is filling to the high tide level. The gates are then closed as the tide begins to fall.

Once the tide outside the barrage has dropped the water can flow through large turbines in the barrage which drive generators to produce electrical energy.

In one second 1.2×10^9 kg of water flows through the turbines at a speed of 20 m/s.

(a) Calculate the total kinetic energy of the water which passes through the turbines each second.

_____

_____

_____

(3)

(b) As the height of water in the basin falls, the water speed through the turbines halves.

(i) What mass of water will now pass through the turbines each second?

_____

(ii) By how much will the power available to the generators decrease?

_____

_____

_____

_____

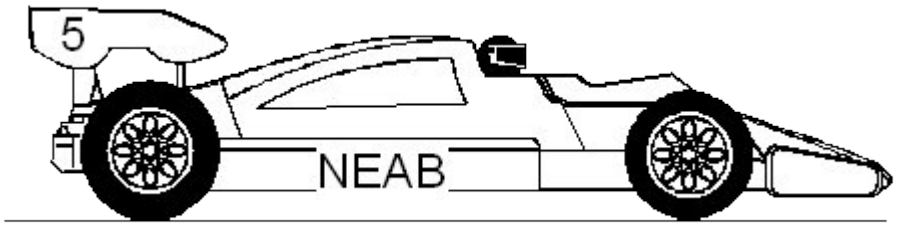
(5)

(Total 8 marks)

Q33.

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

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(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.

_____

_____

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_____

_____

_____

_____

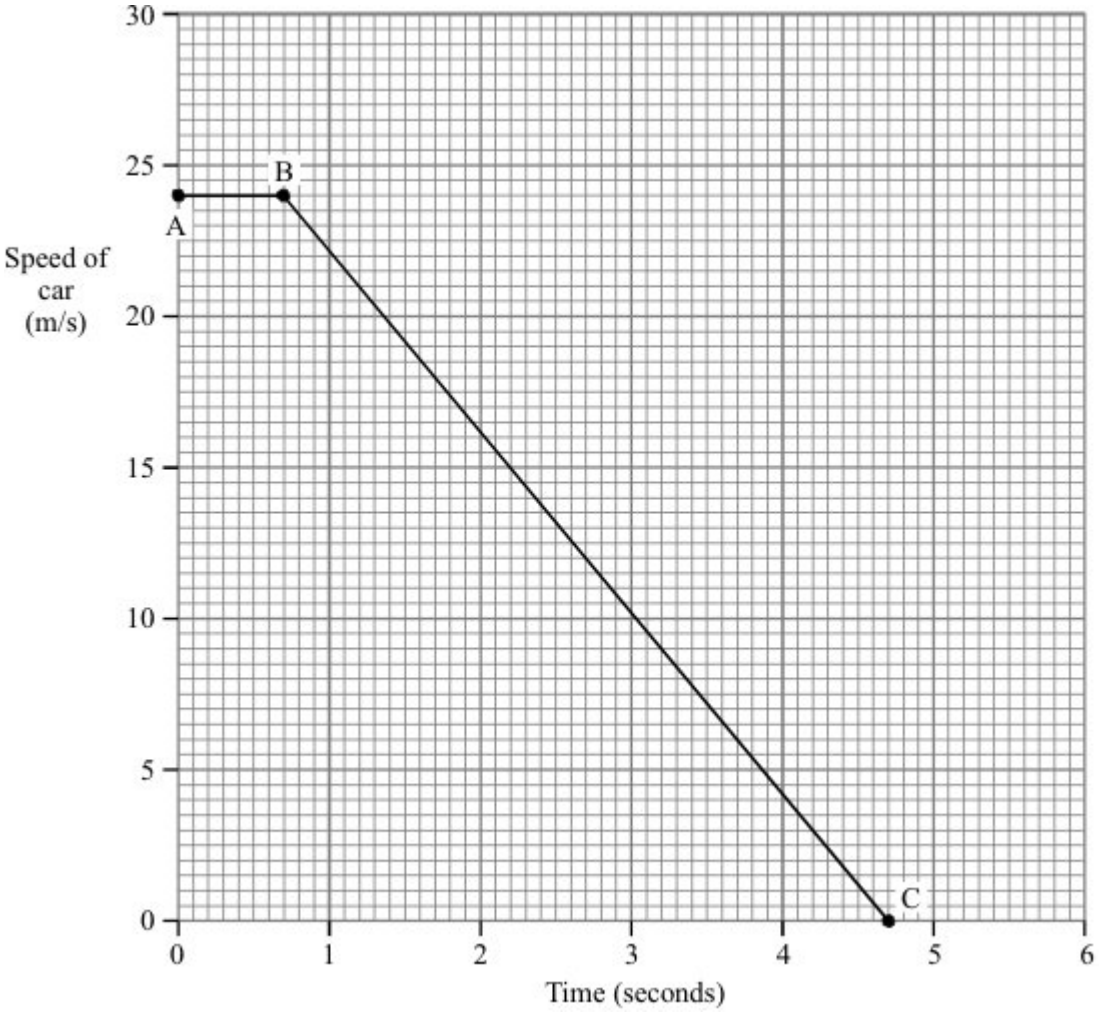
(12)

(Total 16 marks)

Q34.

A car driver sees a dog on the road ahead and has to make an emergency stop.

The graph shows how the speed of the car changes with time after the driver first sees the dog.



(a) Which part of the graph represents the “reaction time” or “thinking time” of the driver?

_____

(1)

(b) (i) What is the thinking time of the driver?

Time _____ seconds

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(1)

(ii) Calculate the distance travelled by the car in this thinking time.

_____

_____

_____

Distance _____ m

(3)

(c) Calculate the acceleration of the car after the brakes are applied.

_____

_____

_____

_____

_____

Acceleration _____

(4)

(d) Calculate the distance travelled by the car during braking.

_____

_____

_____

_____

_____

Distance _____ m

(3)

(e) The mass of the car is 800 kg. Calculate the braking force.

_____

_____

_____

_____

_____

Braking force _____ N

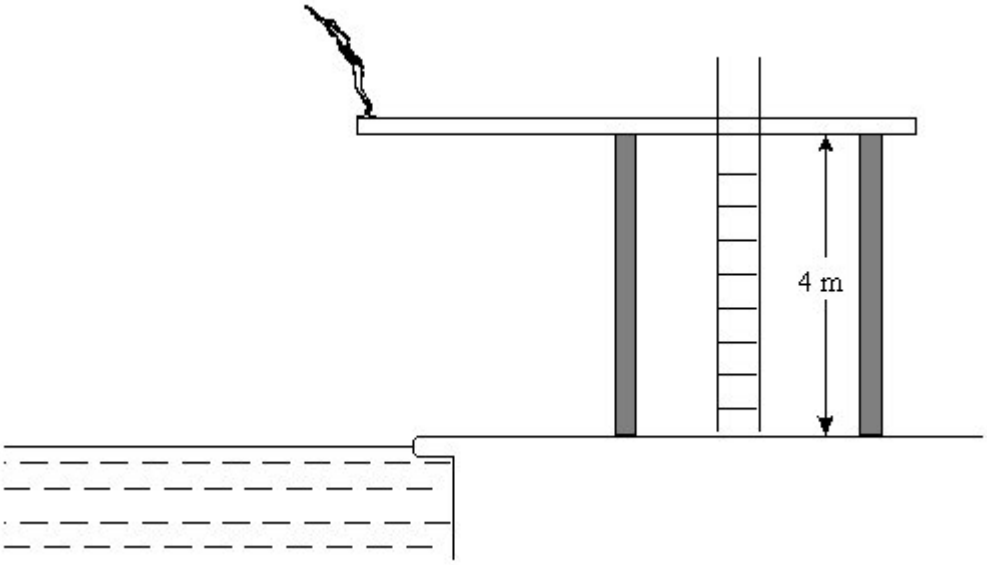
(3)

(Total 15 marks)

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Q35.

The diagram shows a diver diving from the end of a diving board.



The height of the diving board above the poolside is 4 m. The mass of the diver is 50 kg. Gravitational field strength is 10 N/kg.

(a) Calculate the gain of gravitational potential energy as the diver climbs from the poolside to the diving board.

_____

_____

_____

(4)

(b) The diver enters the water at a speed of 8 m/s.

Calculate the kinetic energy of the diver as she hits the water.

_____

_____

_____

(4)

(c) As she hits the water her kinetic energy is different from the potential energy she gained as she climbed to the diving board. Explain why.

_____

_____

_____

_____

(2)

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(Total 10 marks)

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