AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



EXAM QUESTION PACK

4.5.2 WORK DONE AND ENERGY TRANSFER (PACK 2)

SCORE	PERCENTAGE
/134	%

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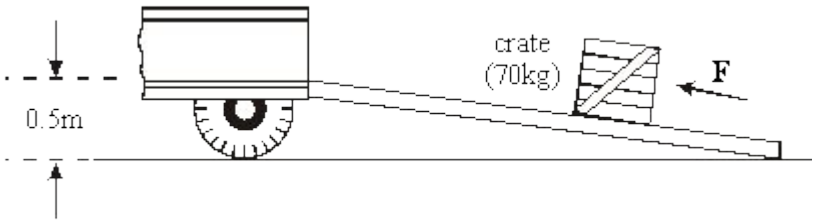
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Q1.

The diagram below shows a plank being used as a simple machine.
The crate is slid up the plank into the back of the lorry.



(i) The mass of the crate is 70kg. Calculate the weight of the crate.

_____

_____ Weight _____ N

(2)

(ii) Calculate the work done when the crate is lifted a vertical distance of 0.5m.

_____

_____

_____

_____ Work done _____

(4)

(Total 6 marks)

Q2.

(a) When an object is moving it is said to have momentum.
Define momentum.

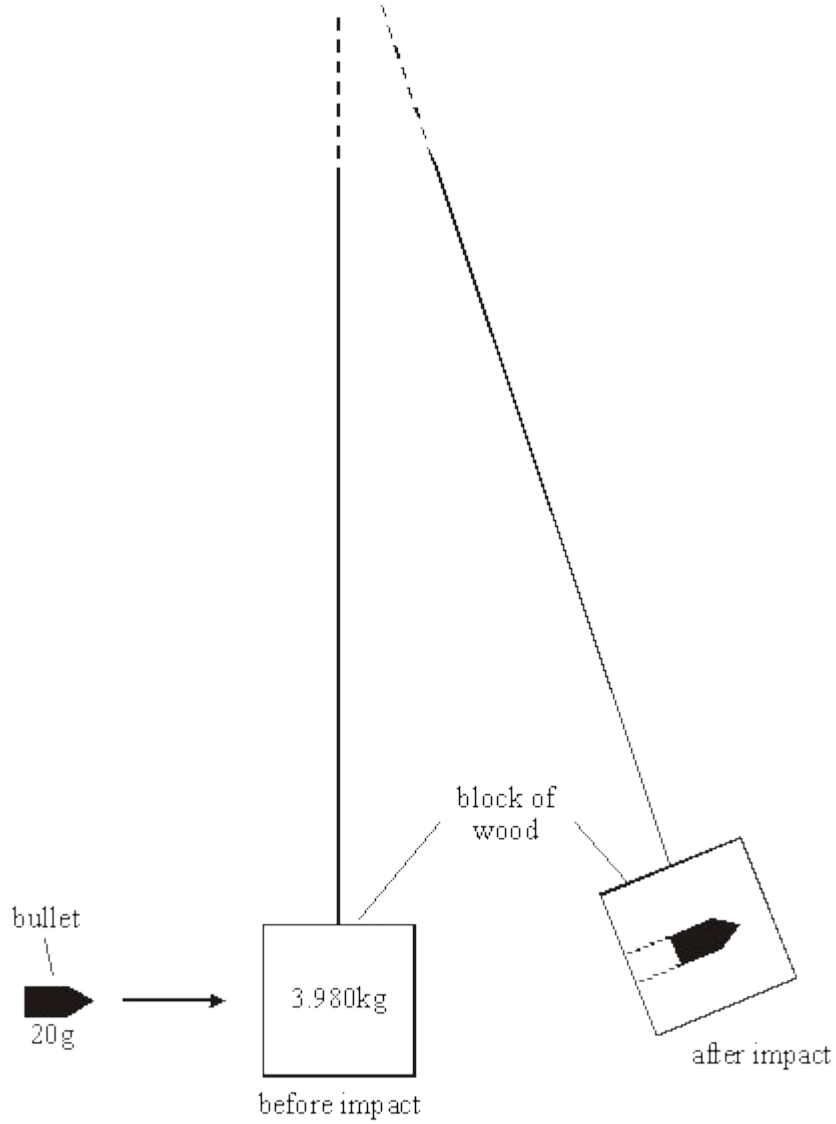
_____

_____

(1)

(b) The diagram below shows one way of measuring the velocity of a bullet.

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A bullet is fired into a block of wood suspended by a long thread.
The bullet stops in the wooden block.
The impact of the bullet makes the block swing.
The velocity of the wooden block can be calculated from the distance it swings.

In one such experiment the block of wood and bullet had a velocity of 2 m/s **immediately after** impact. The mass of the bullet was 20 g and the mass of the wooden block 3.980 kg.

(i) Calculate the combined mass of the block of wood and bullet.

_____ Mass _____

(1)

(ii) Calculate the momentum of the block of wood and bullet **immediately after** impact.

_____

_____

_____

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_____

_____ Momentum _____

(3)

(iii) State the momentum of the bullet **immediately before** impact.

_____

(1)

(iv) Calculate the velocity of the bullet **before** impact.

_____

_____

_____

_____ Velocity _____ m/s

(3)

(v) Calculate the kinetic energy of the block of wood and bullet **immediately after** impact.

_____

_____

_____

_____ Kinetic energy _____ J

(3)

(vi) The kinetic energy of the bullet before the impact was 1600 joules. This is much greater than the kinetic energy of the bullet and block just after the impact.
What has happened to the rest of the energy?

_____

_____

_____

_____

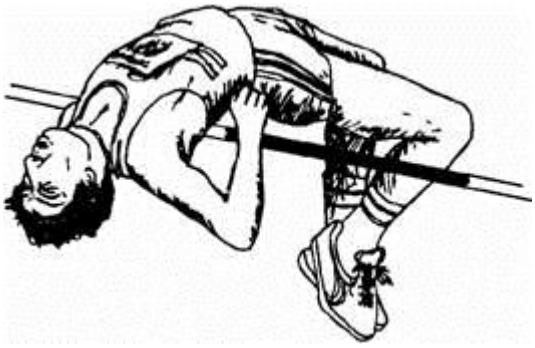
(1)

(Total 13 marks)

Q3.

The diagram shows a high jumper.

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In order to jump over the bar, the high jumper must raise his mass by 1.25 m.
The high jumper has a mass of 65 kg. The gravitational field strength is 10 N/kg.

(a) The high jumper just clears the bar.

Calculate the gain in his gravitational potential energy.

_____

_____

_____

_____

_____

_____

Gain in gravitational potential energy _____ J

(4)

(b) Calculate the minimum speed the high jumper must reach for take-off in order to jump over the bar.

(joule, J) **(kilogram, kg)** **[(metre/second)^2, (m/s)^2**

_____

_____

_____

_____

_____

Speed _____ m/s

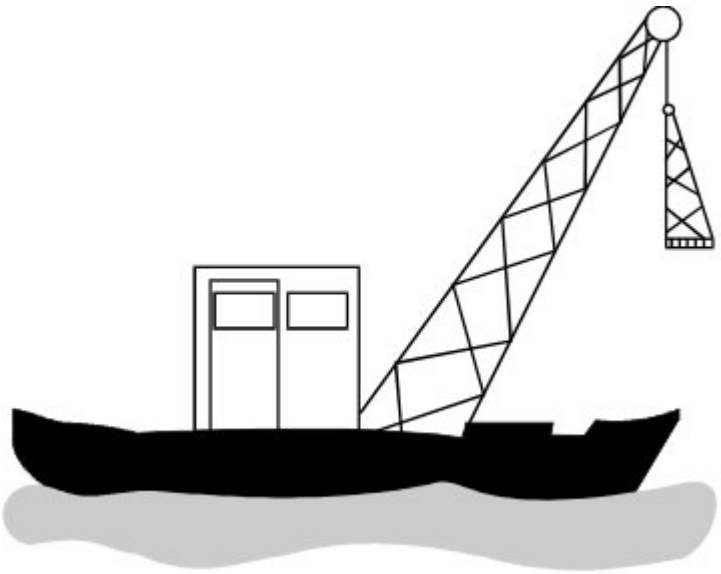
(3)

(Total 7 marks)

Q4.

A crane on a barge lifts a girder and then carries it along the river.

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The girder has a weight of 1 000 000 N and is lifted to a height of 1500 cm.

(a) Complete the sentence.

The weight of the girder is caused by the Earth's gravitational field strength acting on its _____ .

(1)

(b) Calculate the work done in lifting the girder.

Write the equation you are going to use.

_____

(1)

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

_____

_____

_____

_____

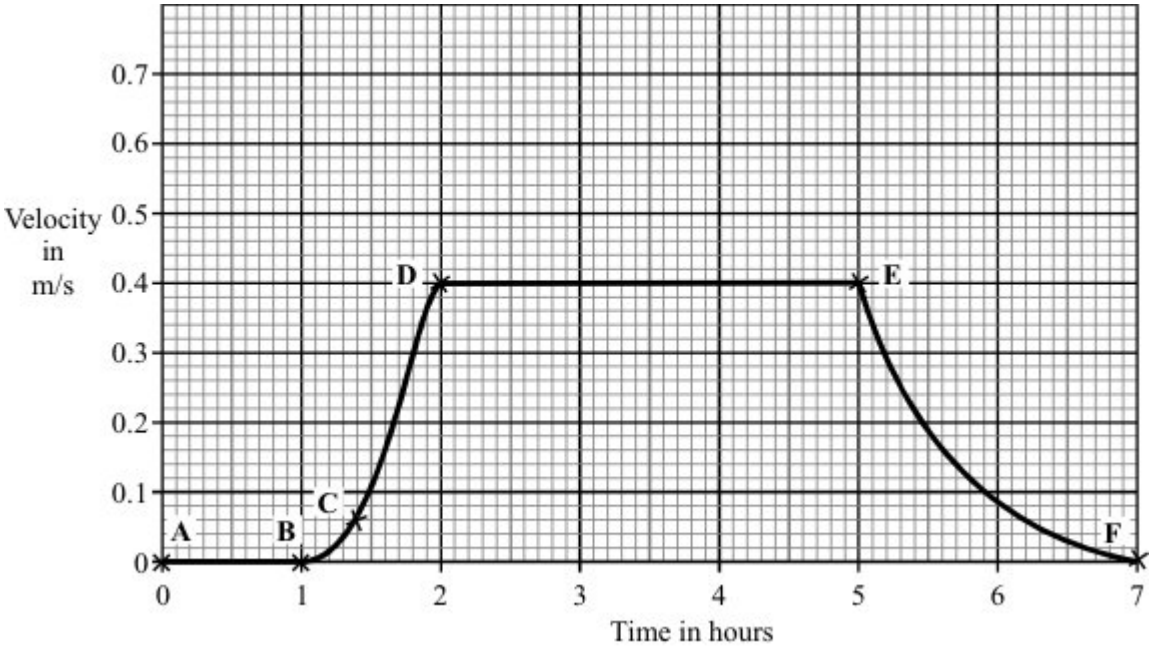
_____

Work done = _____

(3)

(c) The velocity–time graph represents the motion of the barge after the girder had been lifted.

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

Describe the motion of the barge over this period of seven hours. You must refer to the points **A**, **B**, **C**, **D**, **E** and **F** in your description.

_____

_____

_____

_____

_____

_____

_____

_____

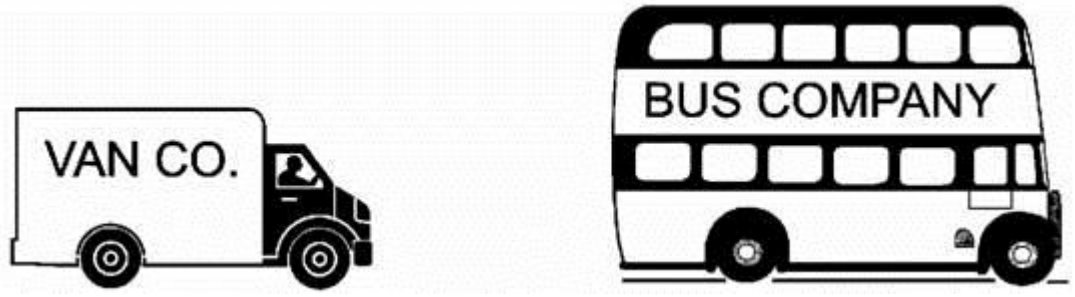
(5)

(Total 10 marks)

Q5.

'SPEED KILLS' - was the heading of an advertising campaign. The scientific reason for this is that energy is transferred from the vehicle to the person it knocks down.

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(a) The bus and the van are travelling at the same speed. The bus is more likely to cause more harm to a person who is knocked down than the van would. Explain why.

_____

_____

_____

(2)

(b) A car and its passengers have a mass of 1200 kg. It is travelling at 12 m/s.

(i) Calculate the increase in kinetic energy when the car increases its speed to 18 m/s.

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

_____

_____

_____

_____

_____

_____

_____

_____

Increase in kinetic energy = _____

(5)

(ii) Explain why the increase in kinetic energy is much greater than the increase in speed.

_____

_____

_____

(1)

(Total 8 marks)

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Q6.

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



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

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

The first one has been done for you.

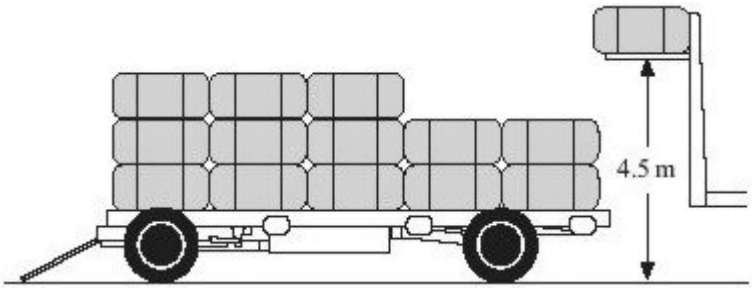
Quantity	Unit
energy (transferred)	joule
force	
distance (moved)	
work done	

(Total 2 marks)

Q7.

A forklift truck was used to stack boxes on to a trailer.

It lifted a box weighing 1900 N through 4.5 m.



Calculate the work done on the box. Show your working.

_____

_____

_____

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_____

Work done = _____ J

(Total 3 marks)

Q8.

A rollercoaster car stops above a vertical drop. Suddenly it falls under gravity.



The drop is 60 metres high and at the bottom of the drop the car travels at 125 km/h. The acceleration experienced by the people in the car is 10 m/s^2. The mass of the car and its passengers is 1210 kg.

Calculate the force exerted on the car and its passengers. Show your working.

_____

_____

_____

_____

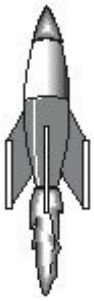
_____

Force = _____ N

(Total 3 marks)

Q9.

A rocket has a mass of 5000 kg and is travelling at a speed of 600 m/s.



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Calculate the rocket's kinetic energy in kilojoules. Show your working.

_____

_____

_____

_____

_____

Kinetic energy = _____ kJ

(Total 3 marks)

Q10.

A car which is moving has kinetic energy.



The faster a car goes, the more kinetic energy it has. The kinetic energy of this car was 472 500 J when travelling at 30 m/s.
Calculate the total mass of the car.
Show clearly how you work out your answer and give the unit.

_____

_____

_____

_____

_____

_____

_____

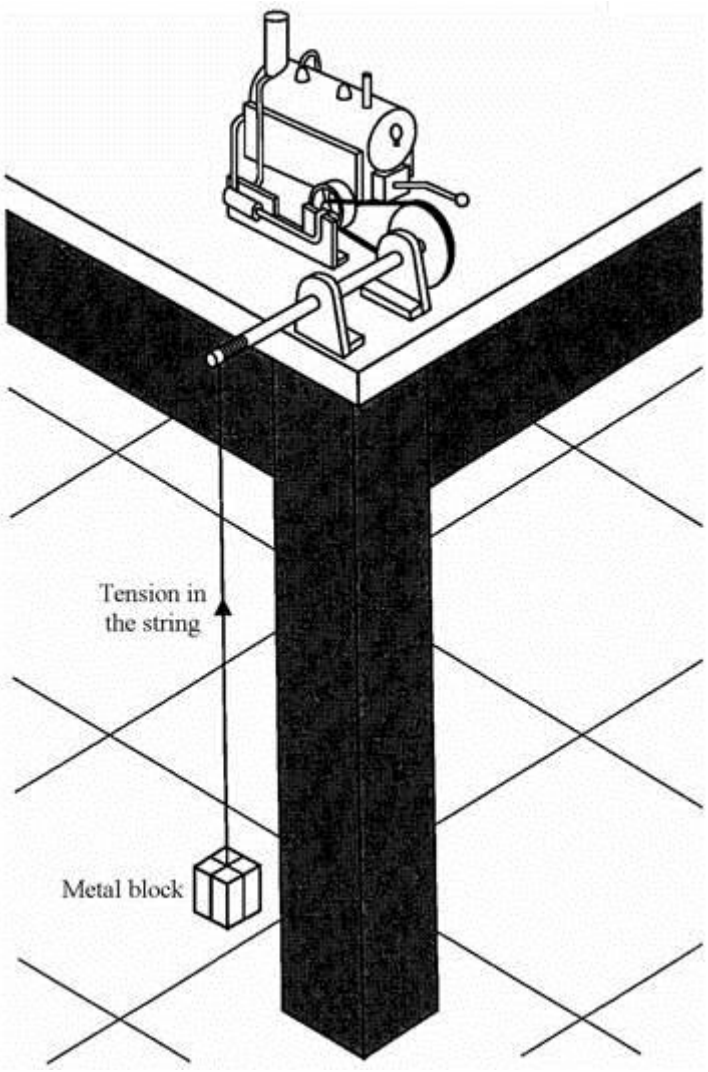
Mass of the car = _____

(Total 5 marks)

Q11.

The drawing shows an investigation using a model steam engine to lift a load.

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In part of the investigation, a metal block with a weight of 4.5 N was lifted from the floor to a height of 90 cm.

(a) Explain what causes the weight of the metal block.

_____

_____

_____

(2)

(b) (i) What is the tension in the string when the block is lifted at a steady speed?

_____

(1)

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

_____

_____

(1)

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(c) (i) Calculate the work done in lifting this load. Write the equation you are going to use, show clearly how you get to your answer and give the unit.

Equation _____

_____

Work = _____

(3)

(ii) How much useful energy is transferred to do the work in part (c) (i)?

_____

(1)

(d) In another part of the investigation, 250J of work is done in one minute. Use the equation:

$$\text{power} = \frac{\text{work done}}{\text{time taken}}$$

to work out the useful power output. Give the unit.

_____

_____

Power = _____

(2)

(Total 10 marks)

Q12.

Mira and Susan are rock climbing. They are using a nylon climbing rope. Mira has fastened herself to the rock face and to one end of the rope. The other end of the rope is fastened to Susan. This means that, if Susan falls, the rope will hold her. Susan weighs 540 N.

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(a) (i) Use the words *distance*, *force* and *work* to write an equation which shows the relationship between them

_____

(1)

(ii) What vertical distance up the rock face does Susan climb when she does 2000 J of work against gravity? Show your working and give your answer to the nearest 0.1 m.

_____

_____

Distance = _____ metres

(2)

(iii) How much gravitational energy will Susan gain when she does 2000 J of work against gravity?

_____

(1)

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(b) The climbers dislodge a 3 kg stone which falls down the rock face.

What is the speed of the stone when its kinetic energy is 600 J?

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

Show clearly how you get to your answer and give the unit.

_____

_____

_____

Speed = _____

(3)

(c) The climbing rope is made of nylon. Nylon is very strong. Another advantage is that it stretches. This means that, if Susan falls, it transfers some of her kinetic energy to elastic (or strain) energy at the end of the fall.

Explain, in terms of *force* and *deceleration*, what would happen if Susan fell and the climbing rope did **not** transfer any of her kinetic energy to elastic energy.

_____

_____

_____

_____

_____

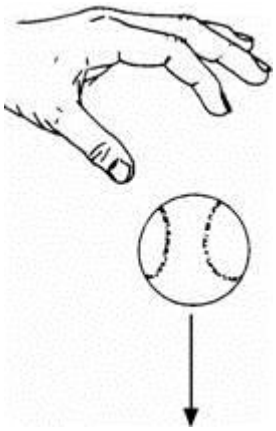
_____

(3)

(Total 10 marks)

Q13.

Complete the following sentences.



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When you drop a ball, it falls to the ground.

This happens because the _____ pulls the ball

towards it with a force called _____ .

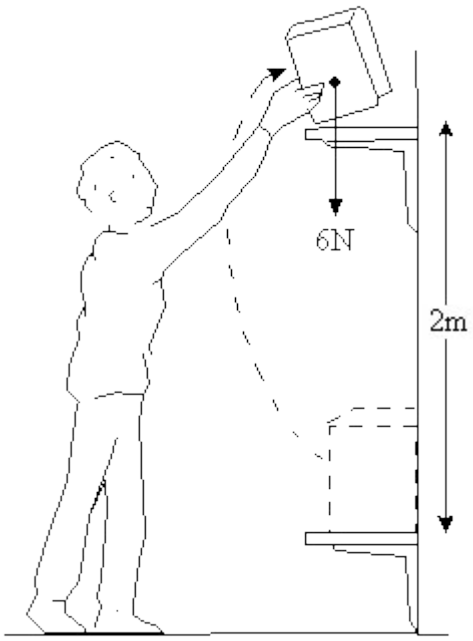
Forces are measured in units called _____ .

(Total 3 marks)

Q14.

A book weighs 6 newtons.

A librarian picks up the book from one shelf and puts it on a shelf 2 metres higher.



(a) Calculate the work done on the book. [Show your working].

_____

_____

_____

(3)

(b) The next person to take the book from the shelf accidentally drops it.

The book accelerates at 9.8m/s².

Use this information to calculate the mass of the book. [Show your working].

_____

_____

_____

Answer _____ kg.

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(3)

(c) If the book was dropped from an aeroplane high in the sky, it would accelerate to begin with. Eventually it would fall at a steady speed.

Explain, in as much detail as you can, why this happens.

_____

_____

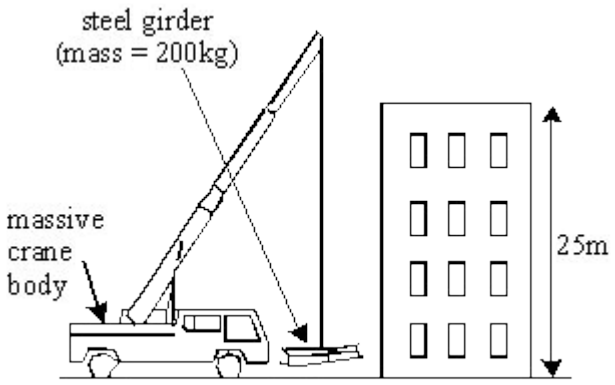
_____

(3)

(Total 9 marks)

Q15.

A crane is used to lift a steel girder to the top of a high building.



When it is lifted by the crane:

- the girder accelerates from rest to a speed of 0.6 m/s in the first 3 seconds;
- it then rises at a steady speed.

(a) Calculate the **acceleration** of the girder.

(Show your working.)

_____

_____

_____

_____

(3)

(b) (i) What is the **weight** of the steel girder?

Answer _____ N

(1)

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(ii) Calculate the **power** of the crane motor as it lifts the girder at a steady speed of 0.6 m/s.

(*Show your working. You can ignore the weight of the cable and hook which is small compared to the weight of the girder.*)

_____

_____

_____

Answer _____ W

(2)

(c) A new motor is fitted to the crane. This motor accelerates the girder at 0.3 m/s^2.

Calculate the **force** which the crane applies to the girder to produce this acceleration.

(Show your working.)

_____

_____

_____

Answer _____ N

(3)

(Total 9 marks)

Q16.

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

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

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

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

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

_____

_____

_____

Answer _____ m/s

(4)

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

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

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_____

_____

(2)

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

(Show your working.)

_____

_____

_____

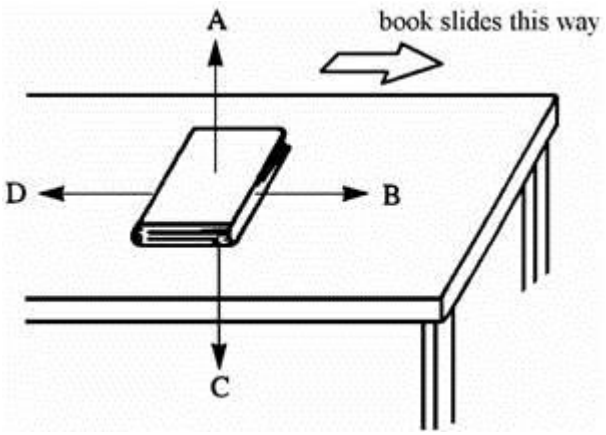
_____

(4)

(Total 10 marks)

Q17.

When you slide a book across a table, there is a force of friction between the book and the table.



(a) Which arrow shows the force of friction that acts on the book? _____

(1)

(b) The force of friction will slow the book down.
Write down **one** other effect that the force of friction will have on the book.

_____

(1)

(Total 2 marks)

Q18.

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

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Mass of car = 800 kg

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

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

_____

_____

_____ Answer _____ m/s^2

(2)

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

_____

_____

_____ Answer _____ watts

(2)

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

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

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

_____

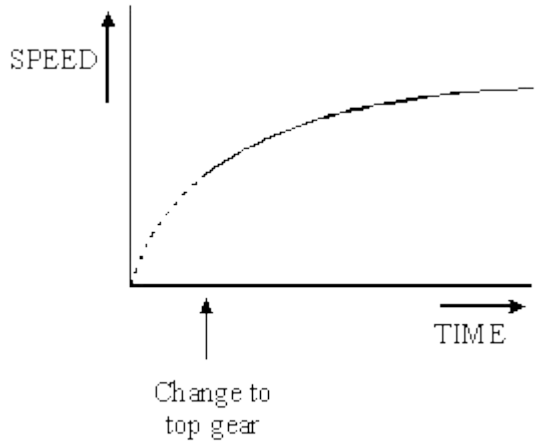
_____

(2)

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

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

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

_____

_____

(3)

(Total 9 marks)

Q19.

A cyclist accelerates from a set of traffic lights.

The driving force of the back tyre on the ground is 250 N.

(a) How much work is done by this force when the cyclist travels 5 metres?
(Show your working.)

_____

_____

_____

Answer _____ joules (J)

(2)

(b) What happens to the energy transferred by this force?

_____

_____

_____

(2)

(Total 4 marks)

Q20.

A cyclist accelerates from a set of traffic lights.

The driving force of the back tyre on the ground is 250 N.

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(a) How much work is done by this force when the cyclist travels 5 metres?
(Show your working.)

_____

_____

_____

Answer _____ joules (J)

(2)

(b) What happens to the energy transferred by this force?

_____

_____

_____

(2)

(Total 4 marks)

Q21.

To get a bobsleigh moving quickly, the crew push it hard for a few metres and then jump in.



(a) Choose from the following words to complete the sentences below.

distance **energy** **force** **speed** **time**

You can calculate the work done by the bobsleigh crew like this:

work done = _____ × _____

The work done by the crew is transferred to the bobsleigh as kinetic _____

(3)

(b) Which of the following units is used for the amount of work done?
Underline the correct one.

joules **newtons** **metres** **metres per second**

(1)

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(Total 4 marks)

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