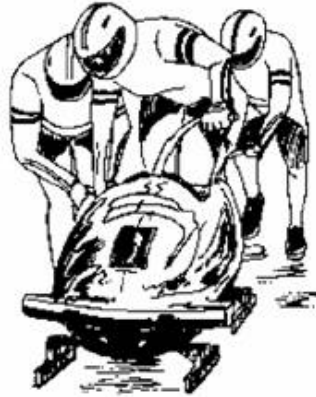


**Q1.** To get a bobsleigh moving quickly, the crew push it hard for a few metres and then jump in.



(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)

(Total 4 marks)

**Q2.** 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)

**Q3.** 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)

**Q4.** A man's car will not start, so two friends help him by pushing it.



Mass of car = 800 kg

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

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

.....  
.....  
..... Answer .....  $\text{m/s}^2$

(2)

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

.....  
.....  
..... Answer ..... watts

(2)

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

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

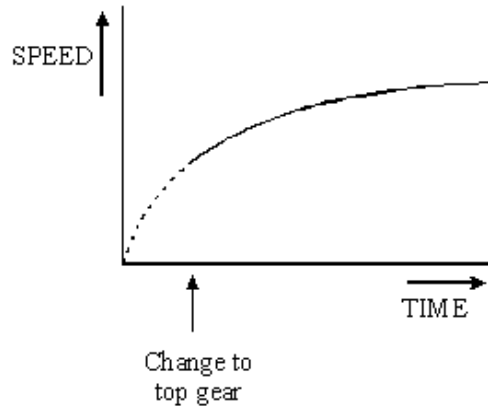
What does this tell you about the mass of the second car?  
(You can ignore forces of friction.)

.....  
.....

(2)

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

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



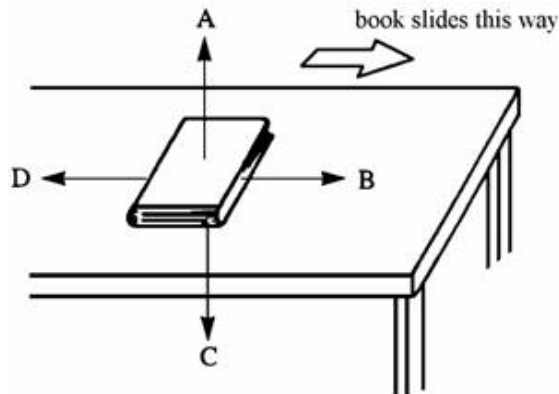
Explain why the speed of the lorry increases at first but then levels out.

.....

.....

(3)  
(Total 9 marks)

- Q5.** 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? .....

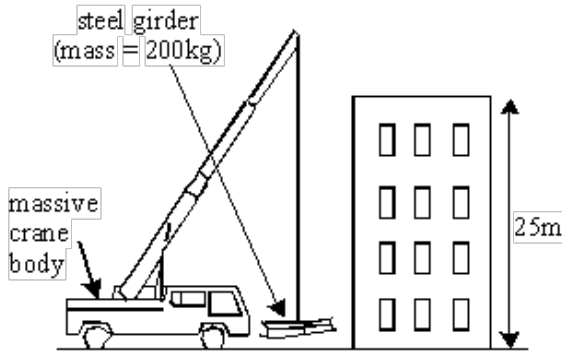
(1)

- (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)

**Q6.** 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)

(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  $0.3 \text{ m/s}^2$ .  
 Calculate the **force** which the crane applies to the girder to produce this acceleration.  
 (Show your working.)

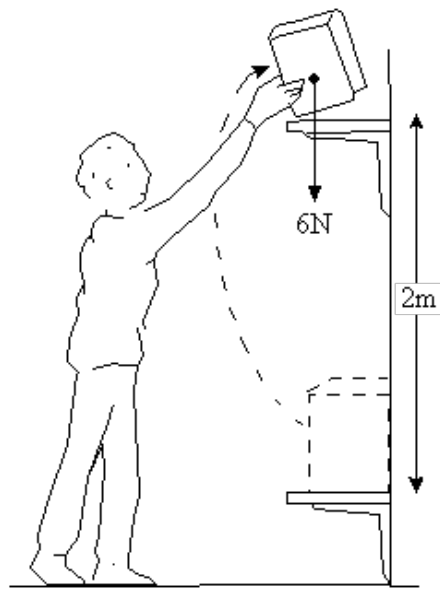
.....  
 .....  
 .....

Answer ..... N

(3)  
 (Total 9 marks)

- Q7.** 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  $9.8\text{m/s}^2$ .

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

.....  
.....  
.....

Answer ..... kg.

(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.

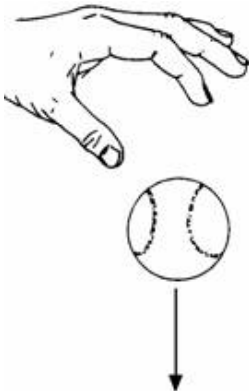
Explain, in as much detail as you can, why this happens.

.....  
.....  
.....

(3)

(Total 9 marks)

**Q8.** Complete the following sentences.



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

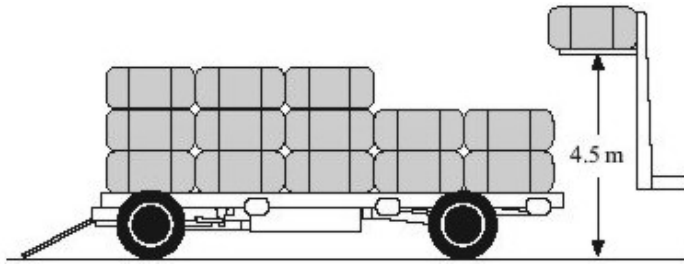
This happens because the ..... pulls the ball  
towards it with a force called .....

Forces are measured in units called .....

(Total 3 marks)

**Q9.** 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.

.....

.....

.....

.....

Work done = ..... J

**(Total 3 marks)**



**Q10.** 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.

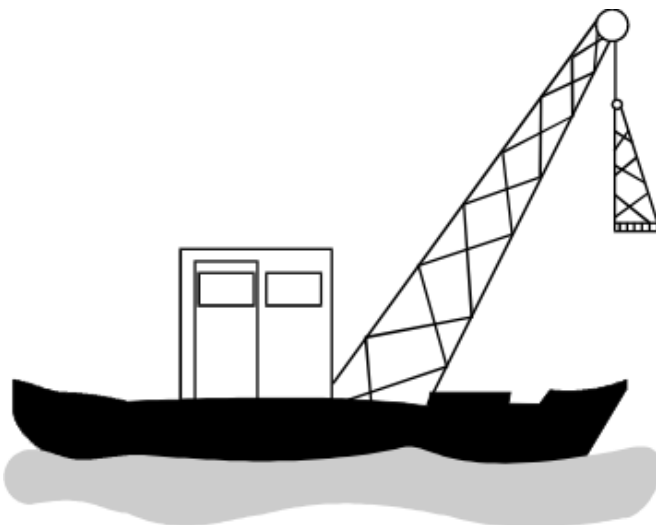
joule (J)	metre (m)	newton (N)
-----------	-----------	------------

The first one has been done for you.

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

(Total 2 marks)

**Q11.** A crane on a barge lifts a girder and then carries it along the river.



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)

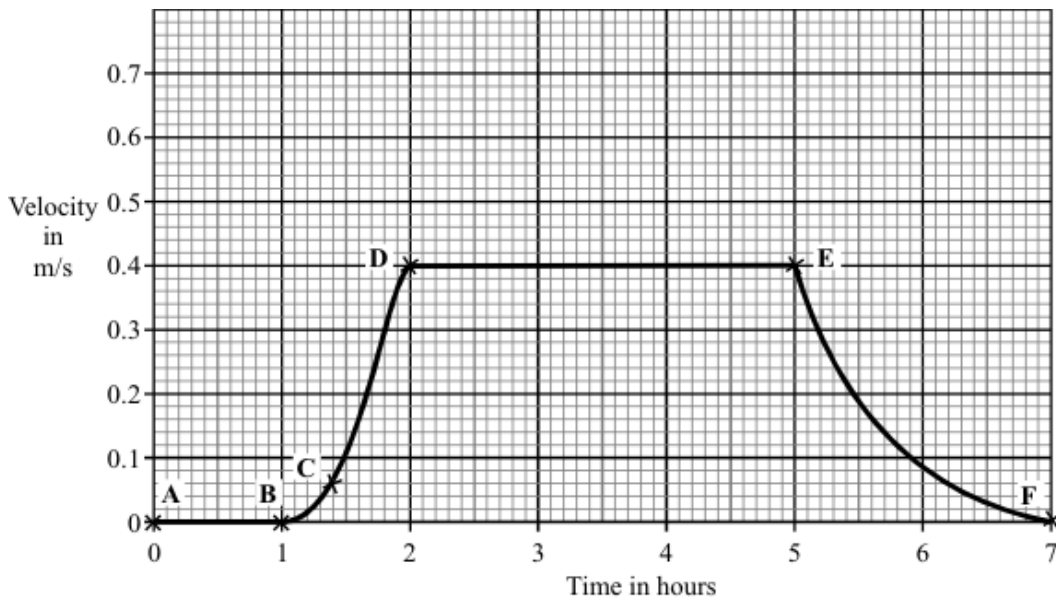
Show clearly how you work out your answer and give the unit.

.....  
.....  
.....  
.....  
.....

Work done = .....

(3)

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



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)

**Q12.** The manufacturer of a family car gave the following information.

Mass of car 950 kg

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.

.....

.....

.....

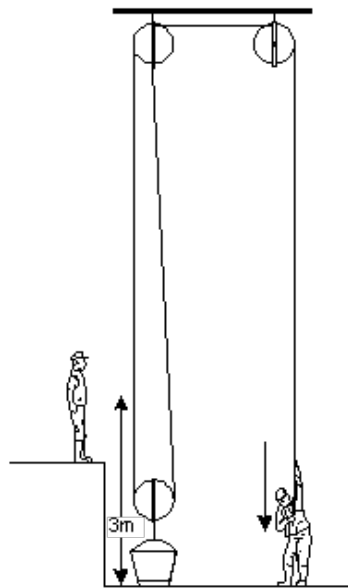
(2)

- (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)

- Q13.** The diagram below shows one way of lifting a bucket of bricks.



- (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.

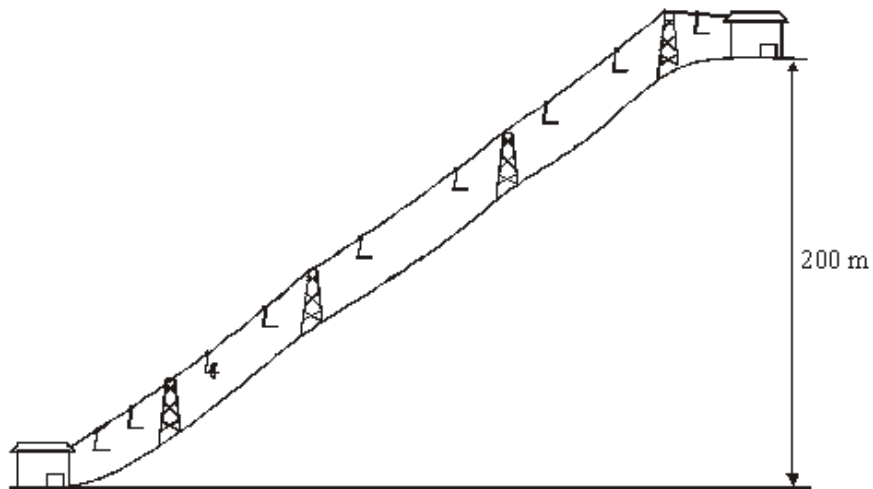
Calculate the work done on the bricks.

.....  
.....

Answer ..... J

(2)  
(Total 4 marks)

**Q14.** (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.

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

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

.....  
 .....

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)

- Q15.** The picture shows an advert for an electric mobility scooter.

Lightweight – only 40 kg  
 Maximum speed 2.5 m/s  
 Powered by two 12 V batteries  
 Maximum range 25 km

The ShopMobile Co.

- (a) The batteries are joined in series.

- (i) What is the potential difference provided by the batteries to the motor?

.....

(1)

- (ii) The batteries supply a *direct current (d.c.)*.

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

.....  
 .....

(1)

- (b) At 2.5 m/s on flat ground, the motor takes a current of 3.0 A from the batteries.

- (i) Explain why a bigger current is taken from the batteries when the scooter is going uphill at 2.5 m/s.

.....  
 .....  
 .....  
 .....

(2)

- (ii) What effect does travelling uphill have on the range of the scooter?

.....

(1)

- (c) The mass of the scooter driver is 80 kg.

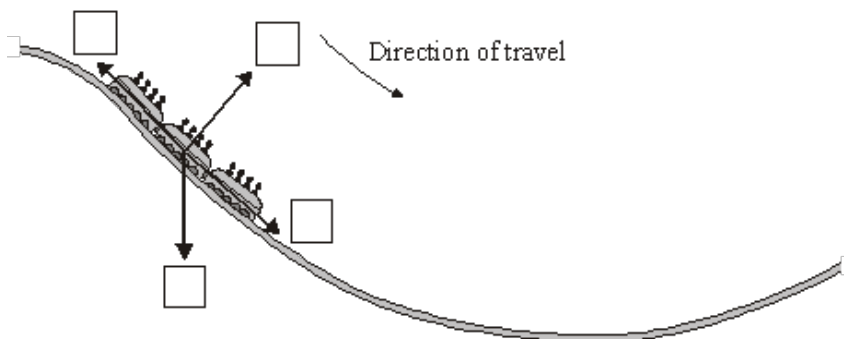
Use the equation in the box to calculate the kinetic energy of the scooter **and** driver when they are travelling at maximum speed.

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

**Q16.** 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 = 10 N/kg

- (i) Calculate the maximum gravitational field strength that seems to act on the passengers during the ride.

.....  
.....

Maximum gravitational field strength = ..... N/kg

(1)

- (ii) One of the passengers has a mass of 80 kg.

Use the equation in the box to calculate the maximum weight this passenger seems to have during the ride.

$\text{weight} = \text{mass} \times \text{gravitational field strength}$
--

Show clearly how you work out your answer.

.....  
.....

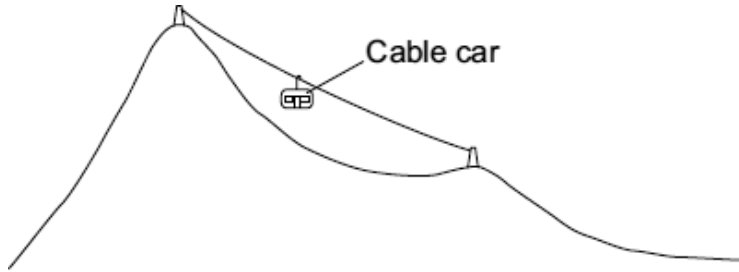
Maximum weight = ..... N

(2)

(Total 5 marks)



**Q17.** (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.

Use the equation in the box to calculate the weight of the cable car and skiers.

$\text{weight} = \text{mass} \times \text{gravitational field strength}$
--

gravitational field strength = 10 N/kg

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

.....  
 .....

Weight = .....

(3)

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

Use the following equation to calculate the work done to lift the cable car and skiers.

$\text{work done} = \text{force applied} \times \text{distance moved in the direction of force}$
--

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.

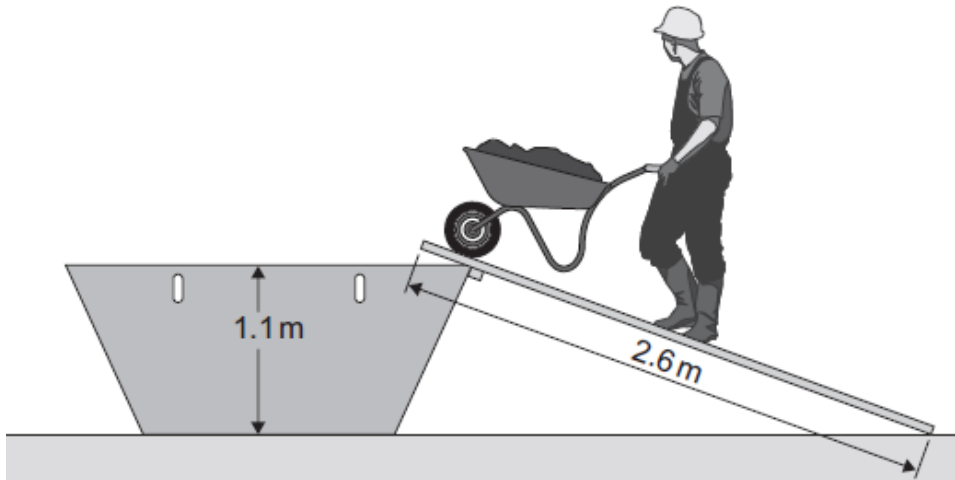
Suggest why skiers should be made aware of the benefits of wearing a helmet.

.....  
.....

(1)

**(Total 9 marks)**

**Q18.** (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.

Use information from the diagram and the equation in the box to calculate the work done to push the wheelbarrow up the plank to the skip.

$\text{work done} = \text{force applied} \times \text{distance moved in the direction of force}$
--

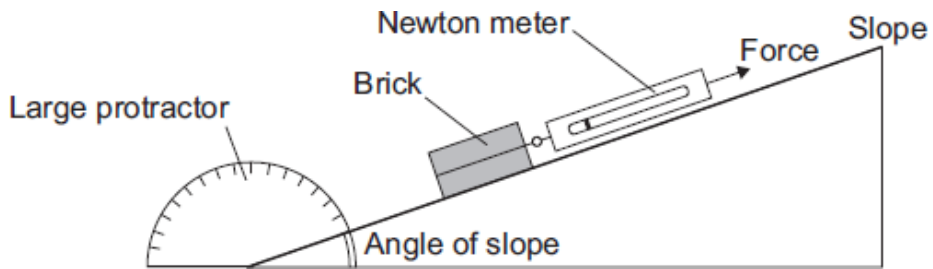
Show clearly how you work out your answer.

.....  
.....

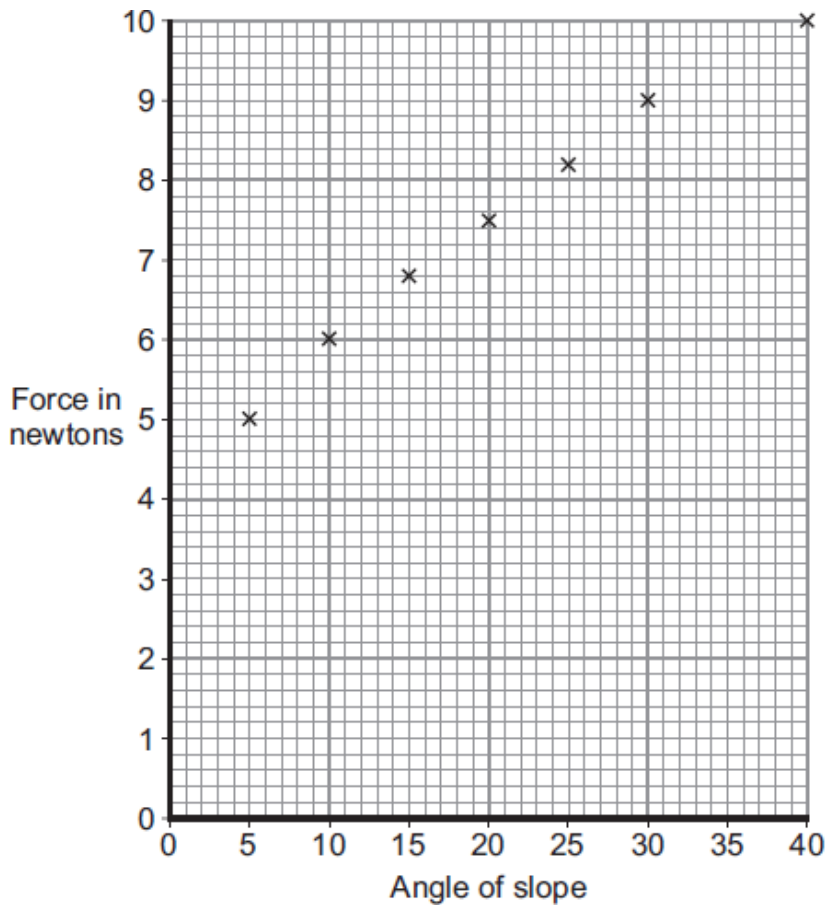
Work done = ..... J

(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.



- (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)

**Q19.** 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



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.

Use the correct equation from the Physics Equations Sheet.

.....  
.....  
.....

Work done = .....

**(3)**  
**(Total 8 marks)**

