

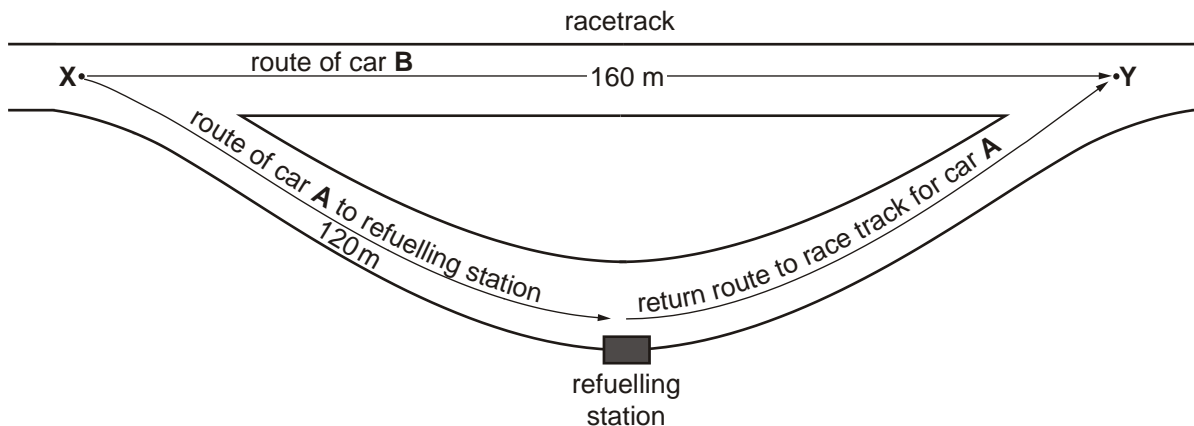
Questions on Motion

1. Draw a line from each unit on the left-hand side to the correct equivalent unit on the right-hand side.

joule (J)	kg m s^{-2}
watt (W)	N m
newton (N)	J s^{-1}

[Total 2 marks]

2. (a) The figure below illustrates a racetrack near a refuelling station.



The cars **A** and **B** are in a race and both have a speed of 80 m s^{-1} . Car **A** has a lead over car **B** of 17.0 s at **X** when **A** leaves the racetrack to refuel. Car **A** travels 120 m from **X** to the refuelling station.

Calculate the following values for car **A**, from the point where it leaves the racetrack until it comes to rest at the refuelling station. Assume the deceleration is constant.

- (i) the average deceleration

deceleration = m s^{-2}

[3]

- (ii) the time taken

time = s

- (b) Car **A** refuels in 9.0 s and then takes 4.0 s to travel to **Y**. During the refuelling of car **A**, car **B** continues to travel at 80 m s^{-1} . Calculate the time difference between the cars **A** and **B** as car **A** arrives back on the racetrack at **Y**.

time = s

[4]

[Total 9 marks]

3. Explain the difference between a *scalar* and *vector* quantity, including one example of each in your explanation.

- (i) a scalar

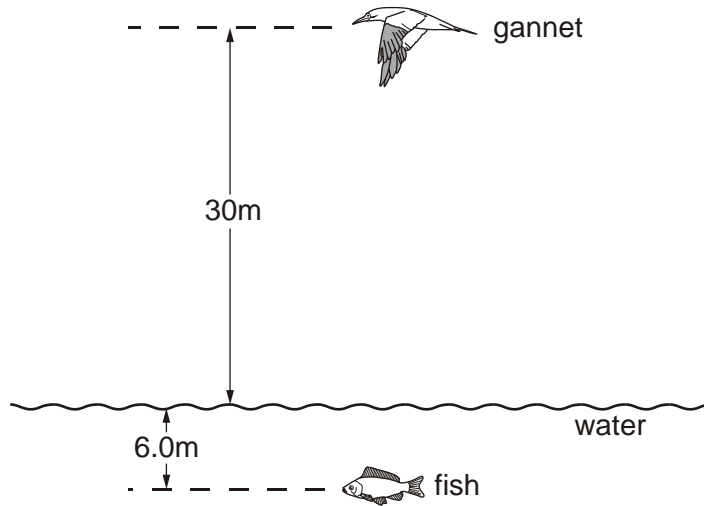
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- (ii) a vector

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[Total 4 marks]

4. The figure below shows a gannet hovering above a water surface.



The gannet is 30 m above the water. It folds in its wings and falls vertically in order to catch a fish that is 6.0 m below the surface.

Ignore air resistance.

(a) Calculate

(i) the speed that the bird enters the water

Speed = m s⁻¹

[2]

(ii) the time taken for the bird to fall to the water surface.

time = s

[2]

(b) The bird does not continue to travel at the acceleration of free fall when it enters the water. State and explain the effect of the forces acting on the bird as it falls

(i) through the air

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

[2]

(ii) through the water.

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.....
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[2]

[Total 8 marks]

5. Fig. 1 shows a long rope that is tied at one end to a high support. A woman swings forwards and backwards across a pool using the other end of the rope.

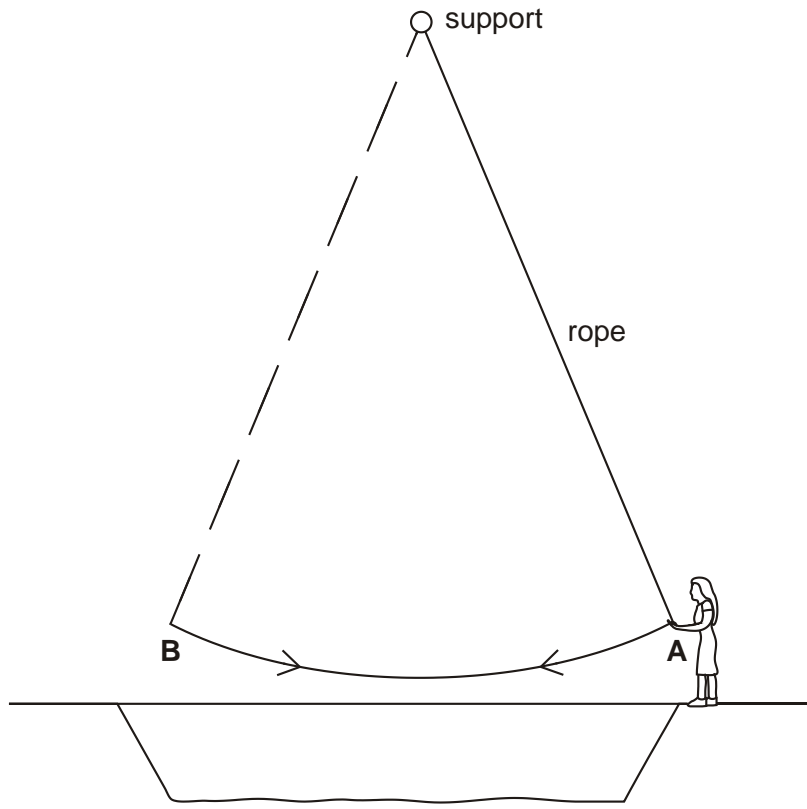


Fig. 1

Fig. 2 shows the variation with time t of the displacement x , of the woman from **A** to **B** and back to **A**.

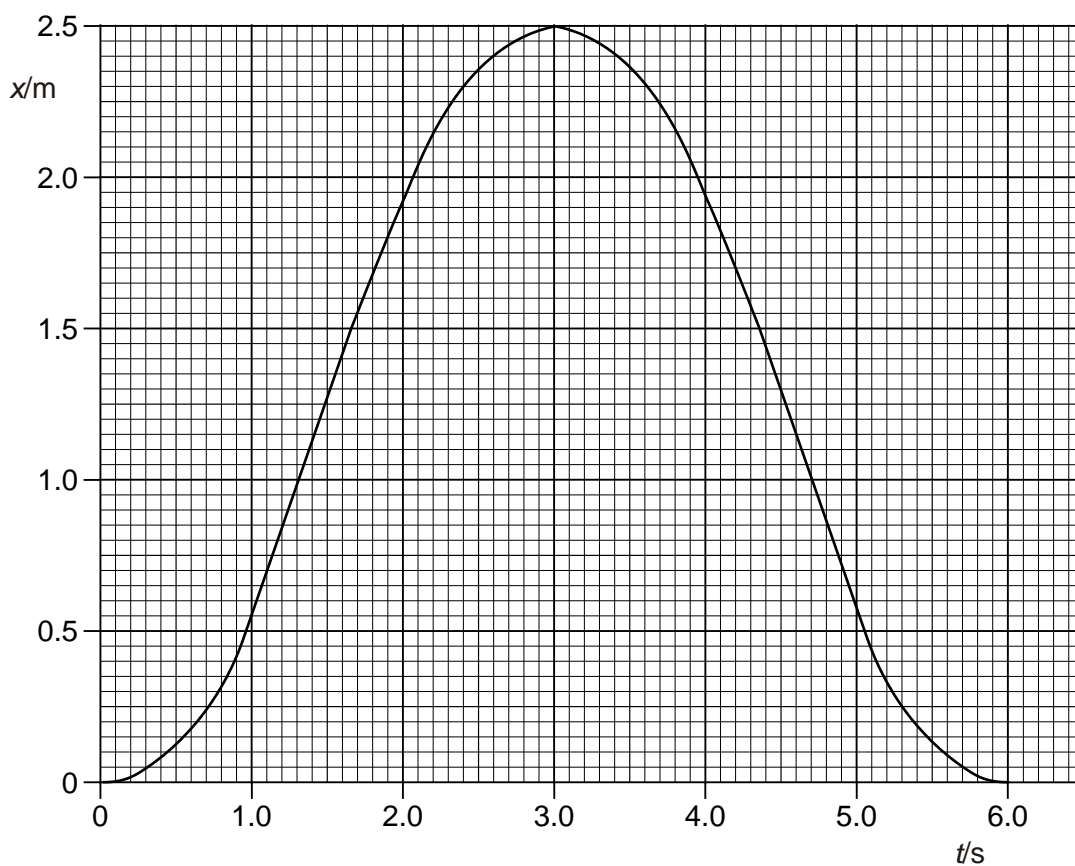


Fig. 2

- (i) State what the gradient of the graph represents and explain why the graph shows both negative and positive gradients.

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.....

.....

.....

[2]

(ii) Mark on Fig. 2 with a cross

- a position where the speed of the woman is zero (label this cross **Z**)
- a position where the speed of the woman is a maximum (label this cross **M**).

[2]

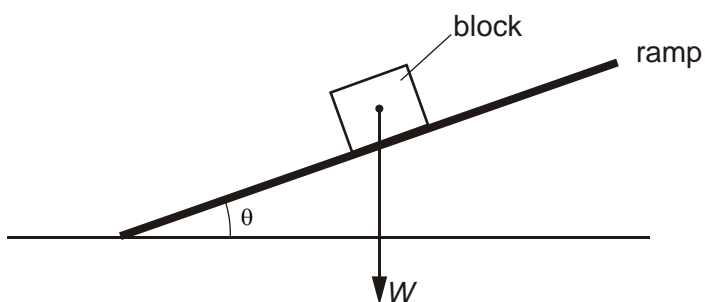
(iii) Use Fig. 2 to calculate the maximum positive speed of the woman. Show on Fig. 2 how you determined your answer.

maximum speed = m s⁻¹

[3]

[Total 7 marks]

6. The figure below shows a wooden block motionless on an inclined ramp.



The angle between the ramp and the horizontal is θ .

(i) The weight W of the block is already shown on the figure. Complete the diagram by showing the normal contact (reaction) force N and the frictional force F acting on the block

[2]

(ii) Write an equation to show how F is related to W and θ .

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.....

[1]

[Total 3 marks]

7. The following is a list of scalar and vector quantities.

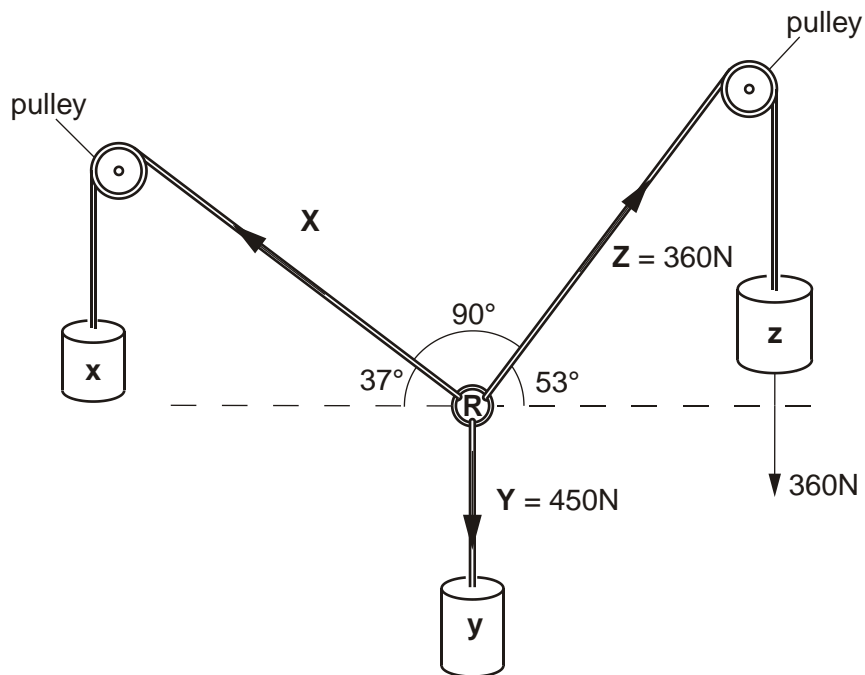
acceleration, density, displacement, energy, power, speed, time, weight.

In the blank spaces provided in the table below, list the quantities as either scalars or vectors.

scalar	vector

[Total 4 marks]

8. The figure below shows three ropes attached to a ring **R**. Three cylinders **x**, **y** and **z**, are supported by these ropes from two pulleys.



- (a) (i) The cylinder **z** has a weight of 360N and a volume of $4.7 \times 10^{-3} \text{m}^3$.

Calculate

- 1 the mass of the cylinder **z**

mass = kg

[1]

- 2 the density of the cylinder **z**.

density = unit

[3]

- (ii) The ring **R** is in equilibrium. Use a **labelled** vector triangle to determine the tension **X**.

tension **X** = N

[4]

- (b) (i) Explain why the sum of the magnitudes of the tensions in any two ropes does not equal the tension in the other rope.

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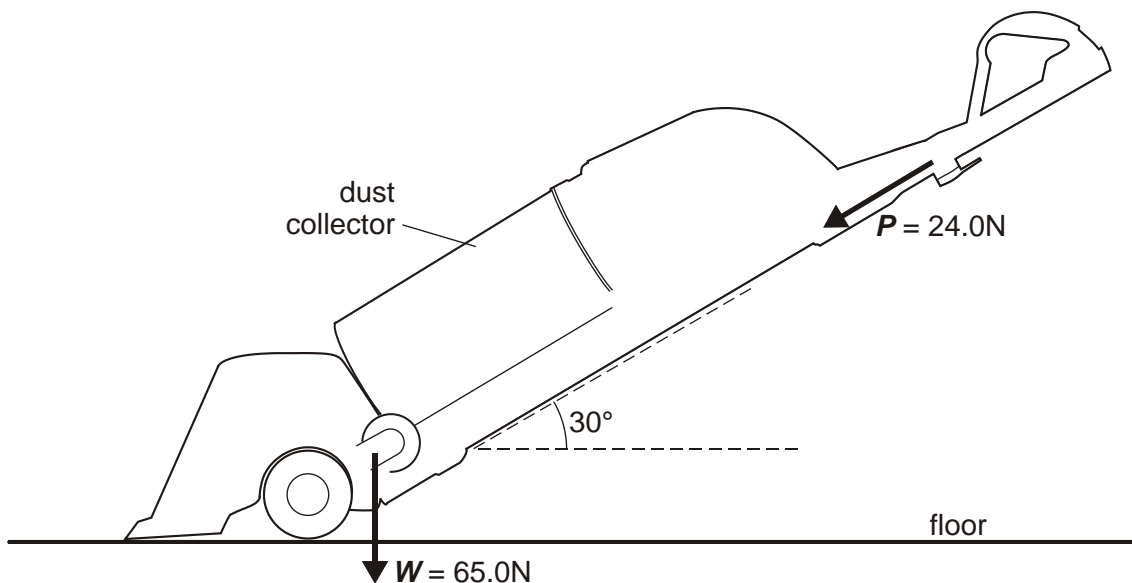
[2]

- (ii) Show that the sum of the vertical components of the tensions **X** and **Z** is equal to the tension **Y**.

[2]

[Total 12 marks]

9. The figure below shows a vacuum cleaner of weight W being pushed with a force P . The force P acts at 30° to the horizontal.



The weight W is 65.0 N and the magnitude of force P is 24.0 N.

- (a) (i) Calculate

- 1 the horizontal component of the force P

horizontal component =N

- 2 the vertical component of the force P .

vertical component =N

[3]

- (ii) Show that the total downward vertical force is 77.0 N.

[1]

- (iii) Hence determine the magnitude of the resultant of the forces W and P .

resultant force =N

[2]

- (iv) The vacuum cleaner is not switched on and is pushed in such a way that it travels at a constant velocity to the left. There are other forces acting on the vacuum cleaner. State and explain the magnitude of the resultant of these other forces.

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.....
.....

[2]

- (b) (i) The total area of the vacuum cleaner in contact with the floor is $4.2 \times 10^{-3} \text{ m}^2$. Calculate the pressure exerted on the floor by the total downward vertical force.

pressure =Pa

[2]

- (ii) State and explain what happens to this pressure if the handle is lifted so that its angle with the horizontal direction is more than 30° . The force **P** and the total area in contact with the floor remain constant.

.....
.....
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[1]

[Total 11 marks]