1.5 Forces

01. 0625_s23_qp_41 Q: 2

Fig. 2.1 shows a motorcyclist accelerating along a straight horizontal section of track.

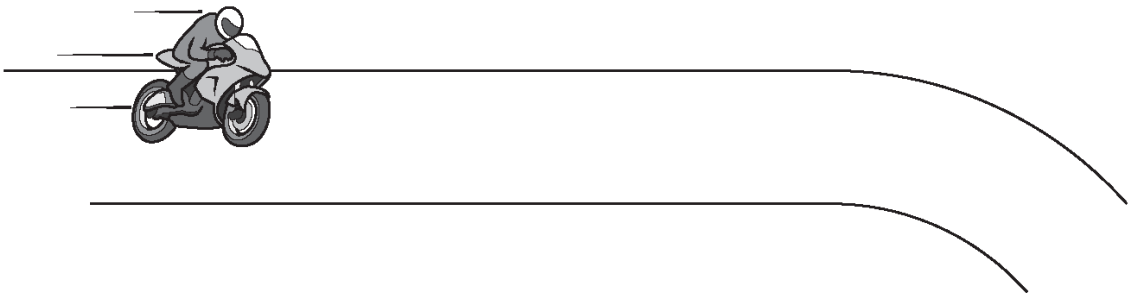

Fig. 2.1

The motorcyclist and motorcycle have a combined mass of 240 kg.

(a) On the straight horizontal section of the track, the motorcyclist accelerates from rest at $7.2\,m/s^2$.

(i) The motorcyclist reaches the end of the straight section of track in 5.3 s.

Calculate the speed of the motorcyclist at the end of the straight section.

speed = ... [2]

(ii) Calculate the resultant force on the motorcyclist and motorcycle on the straight section of track.

resultant force = ... [2]

(b) At the end of the straight section, the track remains horizontal but bends to the right, as shown in Fig. 2.1.

When the motorcyclist reaches the bend, she travels around the bend in a circular path at a constant speed.

(i) Velocity is a vector quantity.

State how a vector quantity differs from a scalar quantity.

.....

..... [1]

(ii) Describe what happens to the velocity of the motorcyclist as she travels around the bend at constant speed.

.....

..... [1]

(iii) Explain why there must be a resultant force on the motorcyclist as she travels around the bend.

.....

.....

..... [2]

02. 0625_s23_qp_43 Q: 1

Fig. 1.1 shows a balloon filled with helium gas.

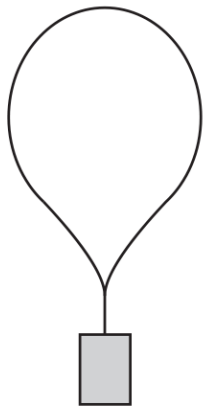

Fig. 1.1

The mass of the balloon is 120 kg.

(a) Calculate the weight of the balloon. Show your working.

weight = ... [1]

(b) The resultant force on the balloon is 54 N.

Show that the acceleration of the balloon is 0.45 m/s^2.

[2]

(c) The balloon accelerates upwards from rest at $0.45\,m/s^2$ for 8.0 s.

Calculate the velocity of the balloon after 8.0 s.

velocity = ... [2]

(d) Calculate the distance travelled by the balloon in the first 8.0 s.

distance = ... [2]

03. 0625_w23_qp_43 Q: 2

(a) Fig. 2.1 is a graph that shows how the extension of a spring varies with the load suspended from it.

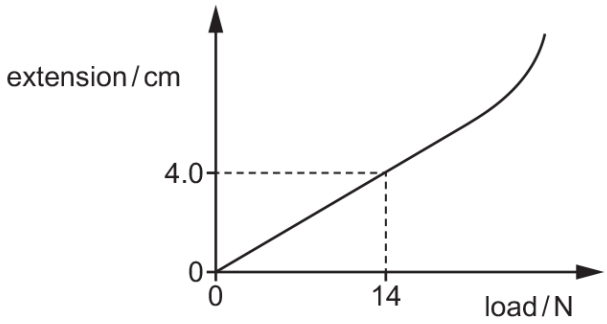

Fig. 2.1

(i) Determine the spring constant of this spring.

spring constant = ... [3]

(ii) On Fig. 2.1, mark the limit of proportionality and label this point L. [1]

(b) Fig. 2.2 shows a car travelling at constant speed around corner A on a road.

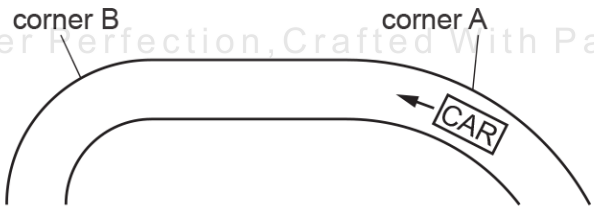

Fig. 2.2

(i) On Fig. 2.2, mark with an arrow the direction of the resultant force acting on the car as it travels around corner A. [2]

(ii) Corner B has a smaller radius than corner A. The car travels at the same speed around corner B as around corner A.

State how the resultant force changes due to the car travelling around a corner of smaller radius.

..... [1]

04. 0625_s22_qp_41 Q: 1

A car of mass *m* is travelling along a straight, horizontal road at a constant speed *v*.

At time *t* = 0, the driver of the car sees an obstruction in the road ahead of the car and applies the brakes.

The car does **not** begin to decelerate at *t* = 0.

(a) Explain what is meant by deceleration.

.....

.....

..... [2]

(b) Suggest **one** reason why the car does **not** begin to decelerate at *t* = 0.

.....

..... [1]

(c) Fig. 1.1 is the distance–time graph for the car from *t* = 0.

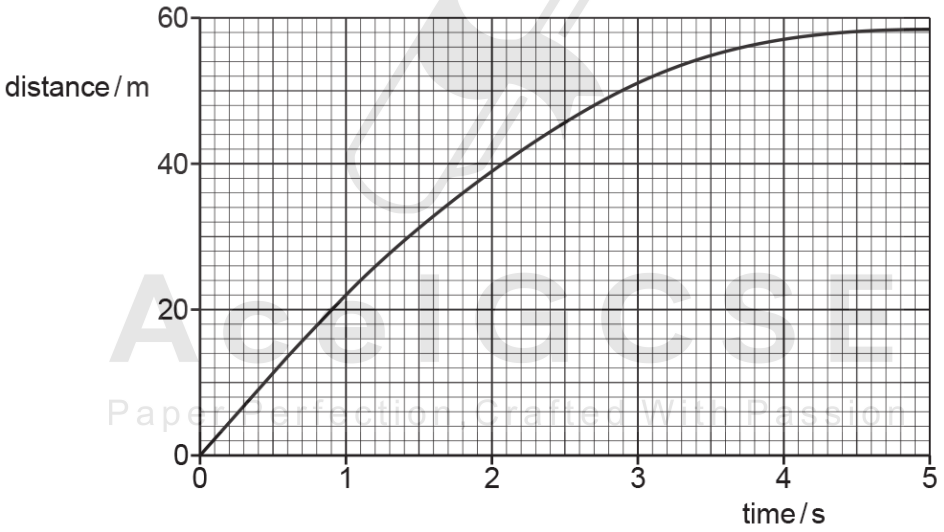

Fig. 1.1

(i) State the property of a distance–time graph that corresponds to speed.

..... [1]

(ii) Using Fig. 1.1, determine the initial speed *v* of the car.

v = ... [2]

(d) When the car is decelerating, there is a constant resistive force F on the car due to the brakes.

The deceleration of the car is greater than $\frac{F}{m}$ and is **not** constant.

Explain why:

(i) the deceleration of the car is greater than $\frac{F}{m}$

.....

..... [1]

(ii) the deceleration is **not** constant.

.....

.....

..... [2]

05. 0625_s22_qp_42 Q: 2

Fig. 2.1 shows an object of mass 2.0 kg on a bench. This object is connected by a cord, passing over a pulley, to an object of mass 3.0 kg.

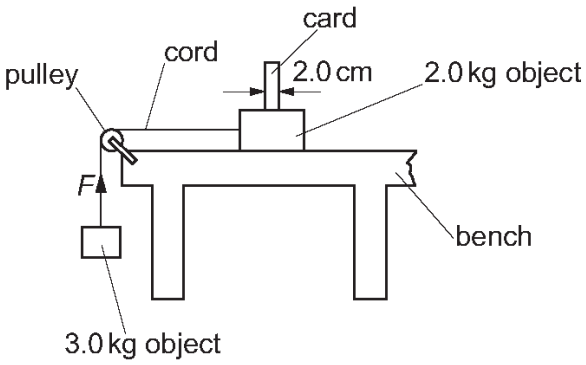

Fig. 2.1

The 2.0 kg object is released from rest and accelerates at 4.0 m / s^2.

(a) Calculate the resultant force acting on the 2.0 kg object.

force = ... [2]

(b) Calculate the upward force *F* exerted by the cord on the 3.0 kg object.

force *F* = ... [3]

(c) The objects have a constant acceleration.

(i) Show that the speed of the objects 0.80 s after release is 3.2 m / s.

[2]

(ii) A card, of width 2.0 cm, is fixed to the 2.0 kg object. As the 2.0 kg object moves to the left, the card passes through a beam of light that is perpendicular to the card.

Using the speed given in **(c)(i)**, calculate the time taken for the card to pass through the beam of light.

time = ... [2]

06. 0625_s22_qp_43 Q: 3

(a) Fig. 3.1 shows a boat stored in a shed. The boat is suspended from the ceiling of the shed by two ropes.

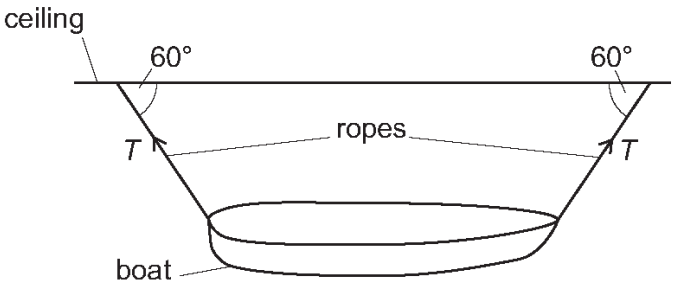

Fig. 3.1

The tension T in each of the ropes is 75 N.

(i) Draw a vector diagram to determine the resultant of the forces exerted by the two ropes on the boat. State the scale you used.

scale = ...

magnitude of resultant force = ...

direction of resultant force = ... [4]

(ii) Determine the mass of the boat.

mass = ... [1]

(b) Force is a vector.

Draw a circle around **two** other quantities in the list which are vectors.

acceleration	**density**	**energy**	**mass**
momentum	**power**	**refractive index**	

[2]

07. 0625_w22_qp_41 Q: 2

A force is a vector quantity.

(a) (i) State **two** features of a vector quantity.

1. .....

2. .....
[2]

(ii) State the names of **two** other quantities that are vectors.

1. .....

2. .....
[2]

(b) A student suspends a spring from a clamp stand and measures the length l_0 of the spring.

Fig. 2.1 shows the apparatus.

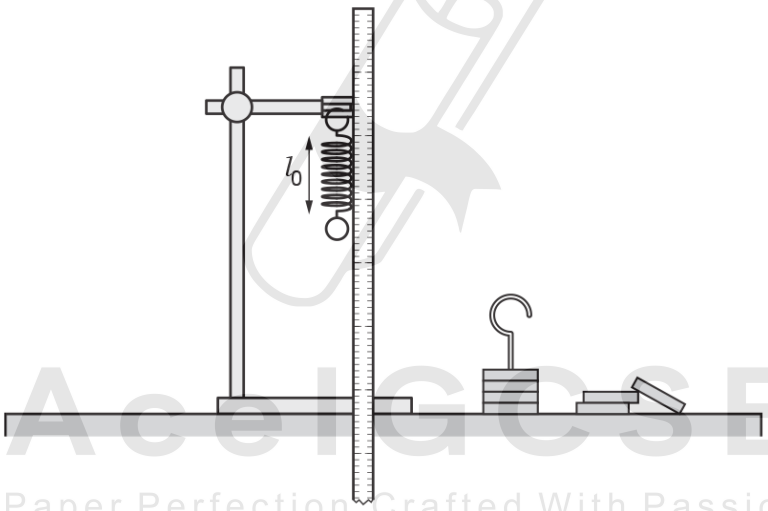

Fig. 2.1 (not to scale)

The student then suspends loads of different weights from the spring and measures the length of the spring for each load. He then plots a graph of the length of the spring against weight.

Fig. 2.2 is the graph that the student plots.

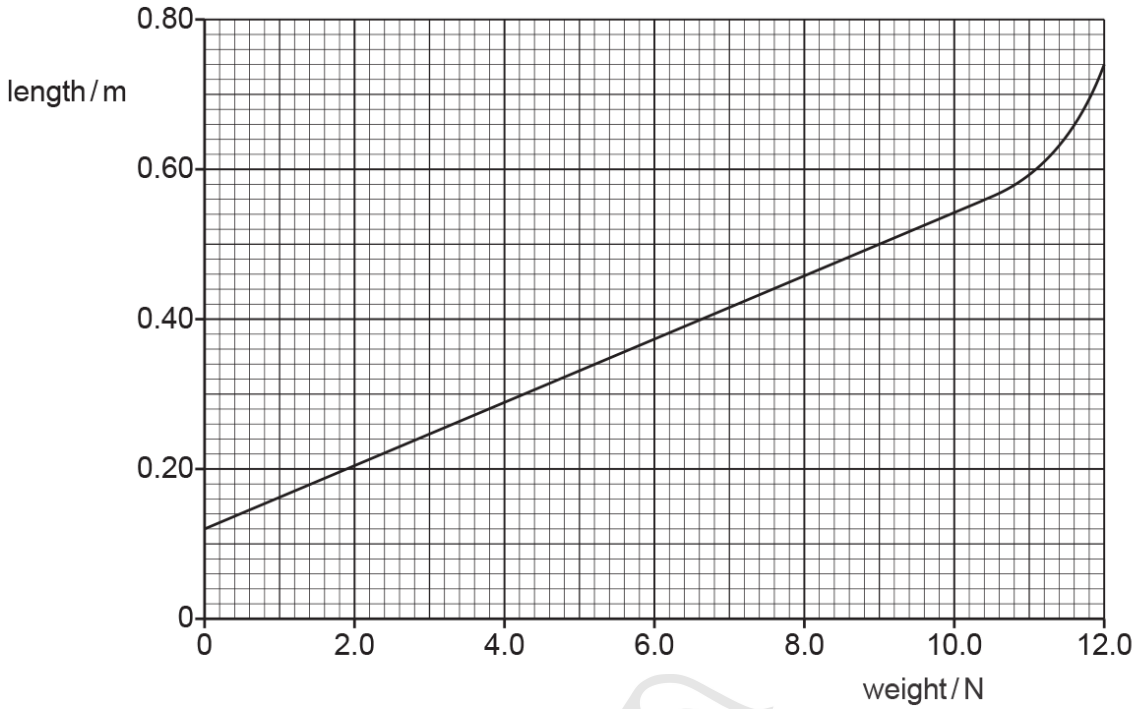

Fig. 2.2

(i) Using Fig. 2.2, determine the initial length l_0 of the spring.

l_0 = ... [1]

(ii) State what is meant by the limit of proportionality and, using Fig. 2.2, determine the weight of the load that causes this spring just to reach the limit of proportionality.

limit of proportionality .....

.....

.....

weight = ...

[2]

(iii) Using Fig. 2.2, determine the spring constant of this spring.

spring constant = ... [3]

08. 0625_w22_qp_41 Q: 3

A rock climber, of total mass 62 kg, holds herself in horizontal equilibrium against a vertical cliff. She pulls on a rope that is fixed at the top of the cliff and presses her feet against the cliff.

Fig. 3.1 shows her position.

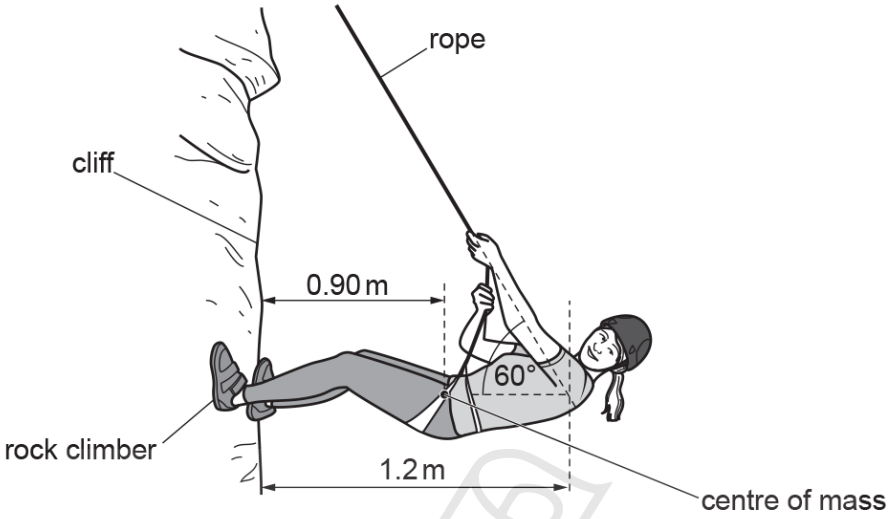

Fig. 3.1 (not to scale)

(a) Calculate the total weight of the climber.

weight = ... [1]

(b) State the **two** conditions needed for equilibrium.

1. .....

2. .....

[2]

(c) The climber's centre of mass is 0.90 m from the cliff.

(i) Calculate the moment about her feet due to her weight.

moment = ... [2]

(ii) The line of the rope meets the horizontal line through her centre of mass at a distance of 1.2 m from the cliff, as shown in Fig. 3.1. The rope is at an angle of 60° to the horizontal.

Determine the tension in the rope.

tension = ... [3]

09. 0625_w22_qp_43 Q: 1

An aeroplane accelerates along a horizontal runway before take-off.
The aeroplane accelerates for 35 s. The speed of the aeroplane when it takes off is 72 m/s.

Fig. 1.1 shows how the speed of the aeroplane varies between time $t = 0$ and $t = 35$ s.

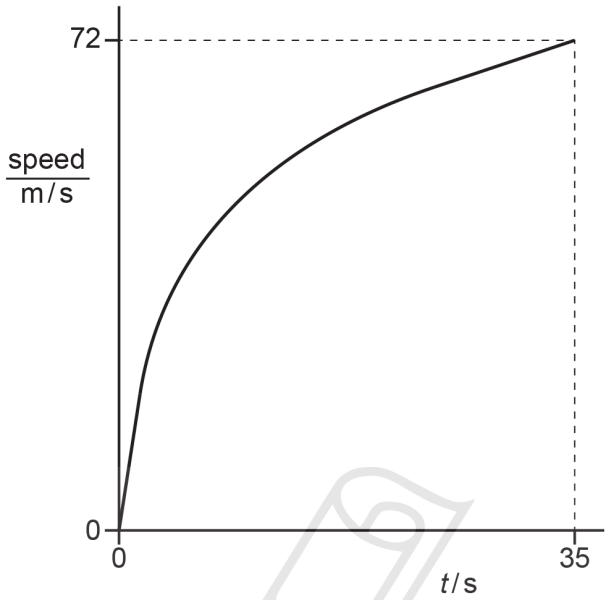

Fig. 1.1

(a) Define acceleration.

.....

..... [1]

(b) **(i)** Calculate the average acceleration of the aeroplane between $t = 0$ and $t = 35$ s.

acceleration = ... [1]

(ii) The combined mass of the aeroplane, its passengers and its fuel on take-off is 1.1×10^5 kg.

Calculate the average resultant force on the aeroplane between $t = 0$ and $t = 35$ s.

force = ... [2]

(iii) The force provided by the engines of the aeroplane is constant.

Give **one** possible explanation for the change in acceleration of the aeroplane between $t = 0$ and $t = 35\,s$.

.....

..... [1]

(iv) On Fig. 1.2, sketch a graph to show how the acceleration of the aircraft varies between $t = 0$ and $t = 35\,s$.

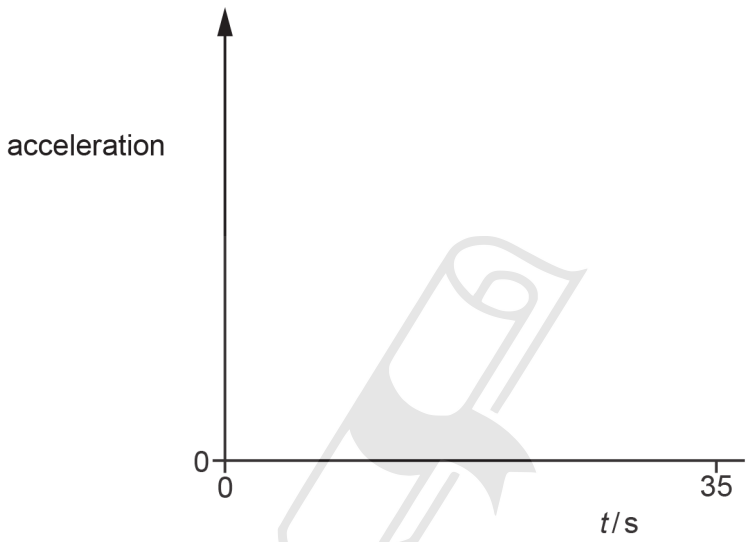

Fig. 1.2

[3]

10. 0625_m21_qp_42 Q: 2

(a) (i) State what is meant by the *moment* of a force about a point.

..... [1]

(ii) Fig. 2.1 shows a large crane on a construction site lifting a block of mass 14 000 kg.

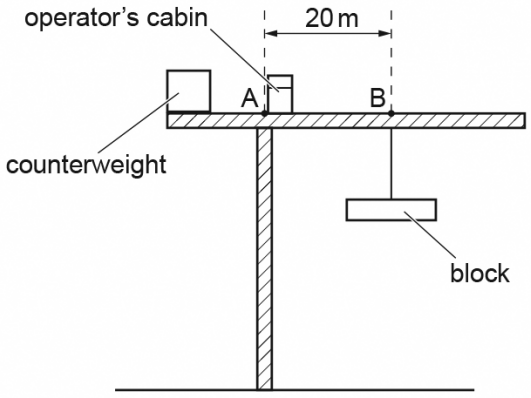

Fig. 2.1

Calculate the moment about A due to the 14 000 kg block suspended from B.

moment = ... [2]

(b) (i) Speed is a scalar quantity and velocity is a vector quantity. State the difference between a scalar quantity and a vector quantity.

.....

..... [2]

(ii) Write down **one** other scalar quantity and **one** other vector quantity.

scalar quantity .....

vector quantity .....

[2]

(c) Fig. 2.2 shows two forces acting on an object.

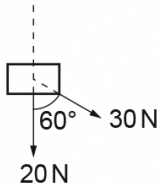

Fig. 2.2 (not to scale)

Draw a scale diagram to determine the resultant force acting on the object. State the scale you use.

scale .....

magnitude of resultant force = ...

direction of resultant relative to the direction of the 20 N force = ...

[4]

[Total: 11]

11. 0625_s21_qp_41 Q: 1

A skydiver of mass 76 kg is falling vertically in still air. At time $t = 0$, the skydiver opens his parachute.

Fig. 1.1 is the speed–time graph for the skydiver from $t = 0$.

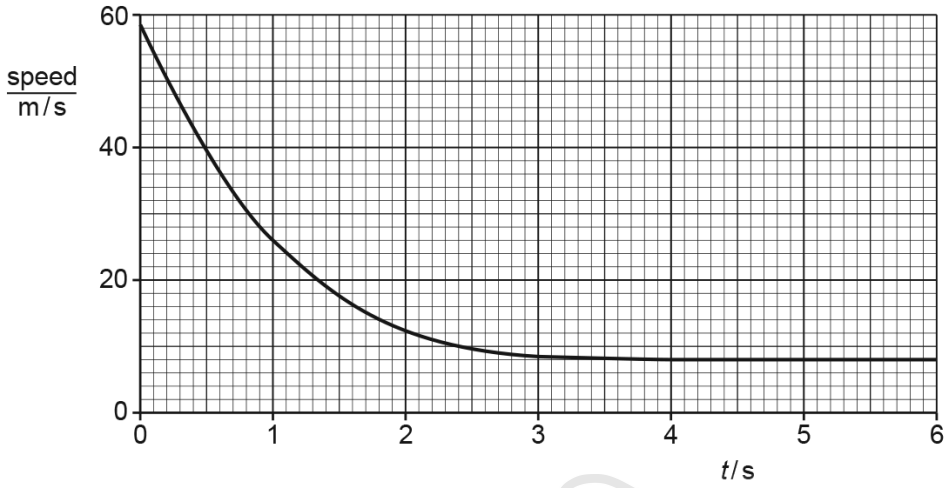

Fig. 1.1

(a) Using Fig. 1.1, determine:

(i) the deceleration of the skydiver immediately after the parachute opens

deceleration = ... [2]

(ii) the force due to air resistance acting on the skydiver immediately after the parachute opens.

force = ... [3]

(b) Explain, in terms of the forces acting on the skydiver, his motion between $t = 0$ and $t = 6.0$ s.

.....

.....

.....

..... [3]

(c) Explain why opening the parachute cannot reduce the speed of the skydiver to zero.

.....

.....

..... [2]

[Total: 10]

12. 0625_s21_qp_42 Q: 2

(a) Define the *moment* of a force.

..... [1]

(b) Fig. 2.1 shows an object of negligible weight. The object is in equilibrium.

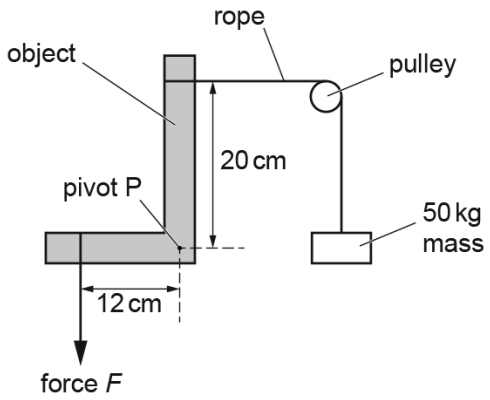

Fig. 2.1

The object is free to rotate about its pivot P.

Calculate the value of force *F*.

F = ... [2]

(c) Describe an experiment involving vertical forces to show that there is no net moment on an object in equilibrium. You may draw a diagram in the space provided.

.....

.....

.....

.....

.....

..... [3]

[Total: 6]

13. 0625_w21_qp_41 Q: 1

Some physical quantities are scalars and other physical quantities are vectors.

(a) State how a vector quantity differs from a scalar quantity.

.....

..... [1]

(b) Circle the vector quantities in the list.

acceleration energy mass momentum temperature time speed velocity

[2]

(c) A microphone in a recording studio has a mass of 0.55 kg and a weight *W*.

(i) Calculate *W*.

W = ... [1]

(ii) The microphone is suspended from the ceiling by a cord attached to a small ring. Fig. 1.1 shows the microphone pulled to one side and kept stationary by a horizontal thread.

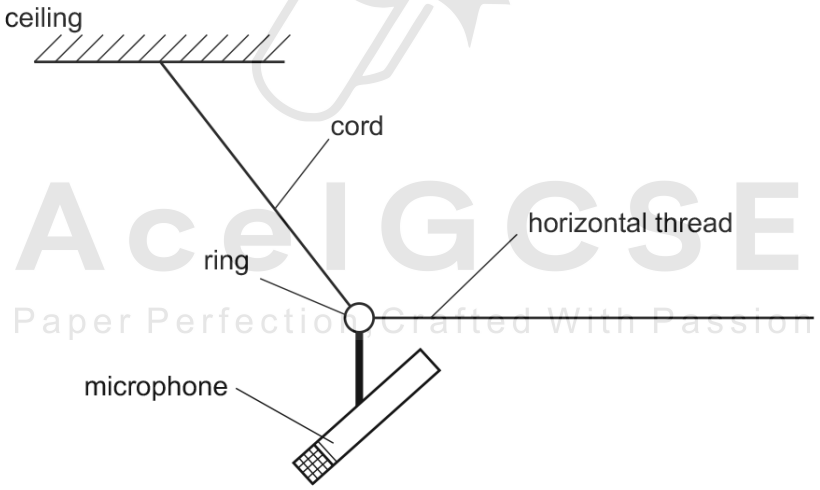

Fig. 1.1 (not to scale)

The tension T in the horizontal thread is 8.1 N.

Determine graphically the magnitude and the direction, relative to the vertical, of the resultant of W and T. Use a scale of 1.0 cm to 1.0 N or greater.

magnitude of resultant = ...

direction of resultant = ... relative to vertical
[3]

(iii) State and explain how the magnitude and direction of the resultant in **(c)(ii)** compares with the force on the ring due to the tension in the cord.

.....

.....

..... [2]

14. 0625_w21_qp_42 Q: 2

(a) State Hooke's law.

.....

..... [1]

(b) Fig. 2.1 shows the extension–load graph for a spring.

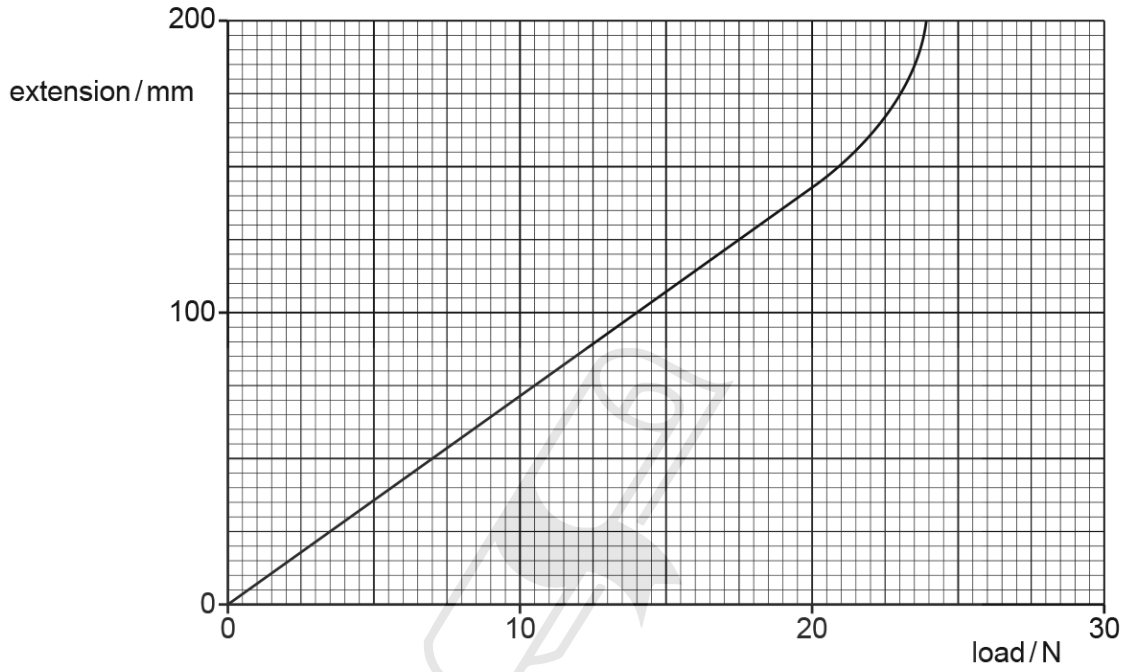

Fig. 2.1

(i) On Fig. 2.1, mark and label the region where the spring obeys Hooke's law. [1]

(ii) Calculate the spring constant *k*.

k = ... [2]

(iii) The original length of the spring is 120 mm.

Calculate the length of the spring when a load of 8.5 N is applied to the spring.

length = ... [2]

(c) The weight of an object is 4.0 N on a planet where the acceleration of free fall is 8.7 m / s^2.

Calculate the mass of the object.

mass = ... [2]

---

15. 0625_w21_qp_43 Q: 1

A ship sails in a straight line between two ports.
Fig. 1.1 shows the speed–time graph of the ship for the first 100 minutes of its journey between the two ports.

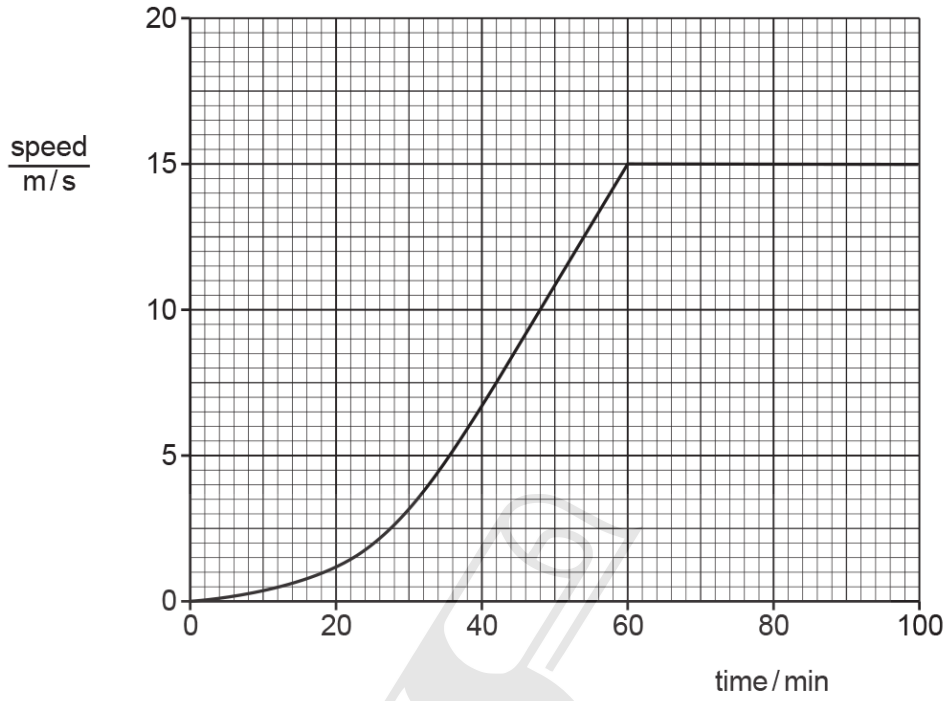

Fig. 1.1

(a) Calculate the maximum acceleration during the first 100 minutes of the ship's journey.

maximum acceleration = ... [2]

(b) Calculate the total distance travelled by the ship between time = 42 min and time = 100 min.

distance travelled = ... [3]

(c) At a time not shown on the graph, the acceleration of the ship is $0.0087\,m/s^2$. The total mass of the ship and its passengers is 2.3×10^7 kg.

(i) Calculate the resultant force on the ship.

force = ... [2]

(ii) Explain why the force on the ship due to the ship's engine is greater than the value you calculated in **(c)(i)**.

.....

..... [1]

16. 0625_s20_qp_43 Q: 3

In a double-decker bus there are two passenger compartments, one above the other.

(a) Fig. 3.1 shows a double-decker bus on a tilted platform.

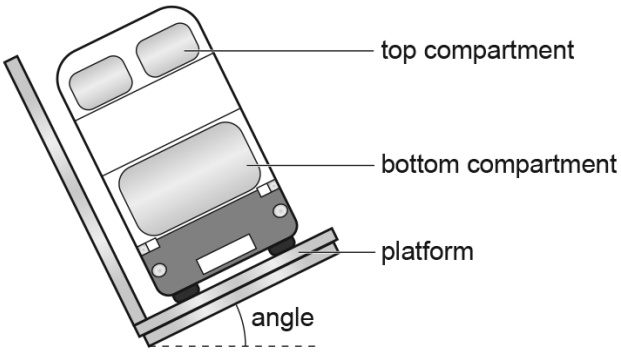

Fig. 3.1

The platform is used to test the stability of the bus.

The angle the bus makes with the horizontal is gradually increased until the bus begins to topple to the left.

Explain why the bus begins to topple.

.....

.....

..... [1]

(b) There are 30 passengers in the upper compartment of the bus and 2 passengers in the bottom compartment of the bus.

State how this affects the stability of the bus and the reason for this.

.....

.....

..... [2]

(c) A bus is travelling along a straight road. The bus and the driver have a combined mass of 16 000 kg when there are no passengers in it. The bus has 73 passengers. The average mass of each of the passengers is 65 kg.

(i) Calculate the total mass of the bus, the driver and the 73 passengers.

mass = ... [2]

(ii) The fully loaded bus accelerates uniformly from rest to a speed of 14 m/s. The time taken to reach a speed of 14 m/s is 20 s.

Calculate the resultant force on the bus during the acceleration.

force = ... [2]

[Total: 7]

17. 0625_w20_qp_42 Q: 1

A sky-diver jumps out of a hot-air balloon, which is 4000 m above the ground. At time = 30 s, she opens her parachute.

Fig. 1.1 is the speed-time graph of her fall.

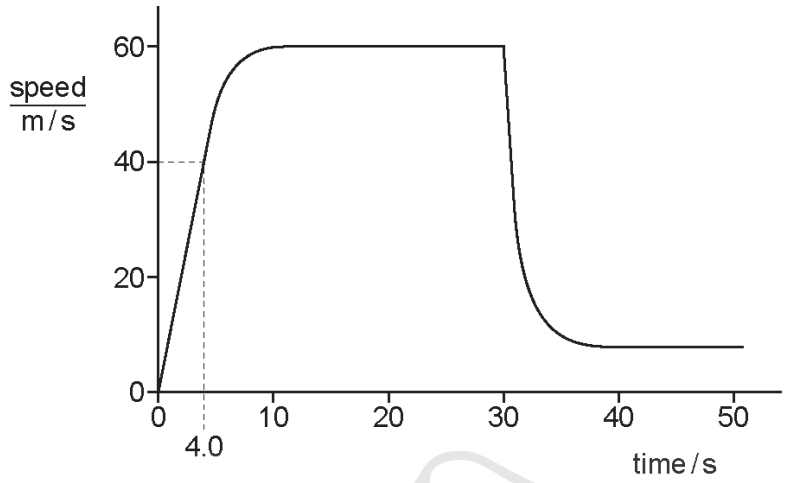

Fig. 1.1

(a) **(i)** Label with the letter X the point on the graph where the sky-diver opens her parachute. [1]

(ii) Label with the letters Y and Z the **two** parts of the graph where the sky-diver falls at terminal velocity. [1]

(b) Describe, in terms of the forces acting on the sky-diver, her motion between leaving the balloon and opening her parachute.

.....

.....

.....

.....

.....

..... [4]

(c) Calculate the average speed of the sky-diver in the first 4.0 s of her fall.

average speed = ... [2]

18. 0625_w20_qp_42 Q: 2

(a) Define the moment of a force about a point.

.....

..... [1]

(b) Fig. 2.1 shows a uniform rod of wood suspended from a pivot.

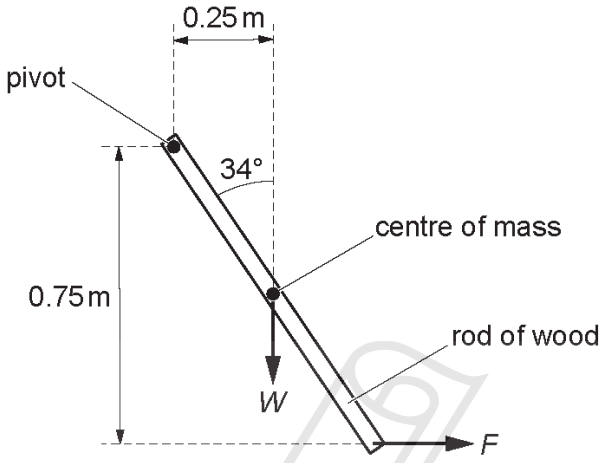

Fig. 2.1 (not to scale)

The rod is held stationary by a horizontal force *F* acting as shown.
The mass of the rod is 0.080 kg.

Calculate:

(i) the weight *W* of the rod

weight = ... [1]

(ii) the moment of *W* about the pivot

moment = ... [2]

(iii) the moment of *F* about the pivot

moment = ... [1]

(iv) the force *F*.

force = ... [2]

(c) The angle between the rod and the vertical is increased.

State whether the force *F* needed to hold the rod stationary must be increased, decreased or stay the same.
Explain your answer.

.....

.....

.....

..... [2]

---

19. 0625_w20_qp_43 Q: 1

(a) Fig. 1.1 shows a trolley travelling down a ramp.

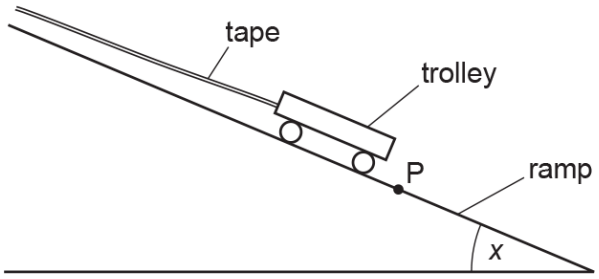

Fig. 1.1

The trolley has a piece of paper tape attached to it. The tape passes through a machine which makes a dot on the tape every 0.02 s.

Fig. 1.2 shows a section of the tape.

Fig. 1.2

(i) State how the dots on the tape show that the trolley was moving with constant speed.

..... [1]

(ii) When the trolley reaches the point P, the ramp is tilted so that the angle *x* is greater.

Describe and explain the change in motion of the trolley.

description .....

.....

explanation .....

.....

[2]

(b) Another trolley is released from the top of the ramp.

Fig. 1.3 shows the speed–time graph for this trolley.

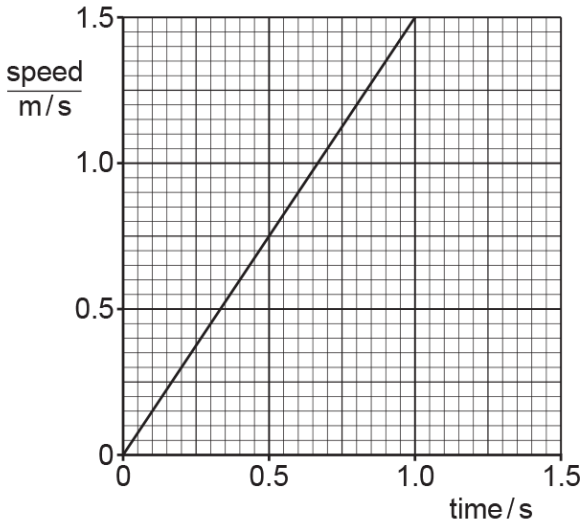

Fig. 1.3

Using Fig. 1.3, calculate the distance travelled by the trolley in the first 0.5 s.

distance = ... [2]

(c) Fig. 1.4 shows a metal ball at rest in a tube of liquid.

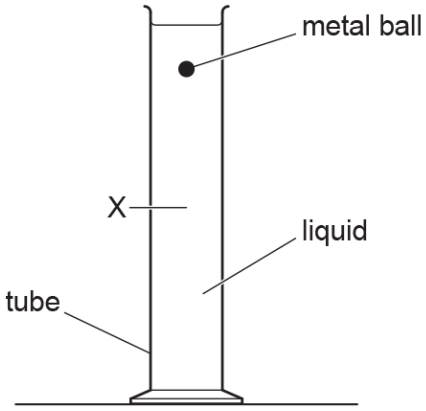

Fig. 1.4

The ball is released and reaches terminal velocity at point X.

Explain the motion of the ball as it falls from rest until it reaches point X.

Use ideas of force and acceleration in your answer.

.....

.....

.....

.....

..... [3]

20. 0625_w20_qp_43 Q: 3

(a) **(i)** Speed is a scalar quantity.

State **one** other scalar quantity.

..... [1]

(ii) Velocity is a vector quantity.

State **one** other vector quantity.

..... [1]

(b) Fig. 3.1 shows a model car travelling at constant speed on a flat circular track.

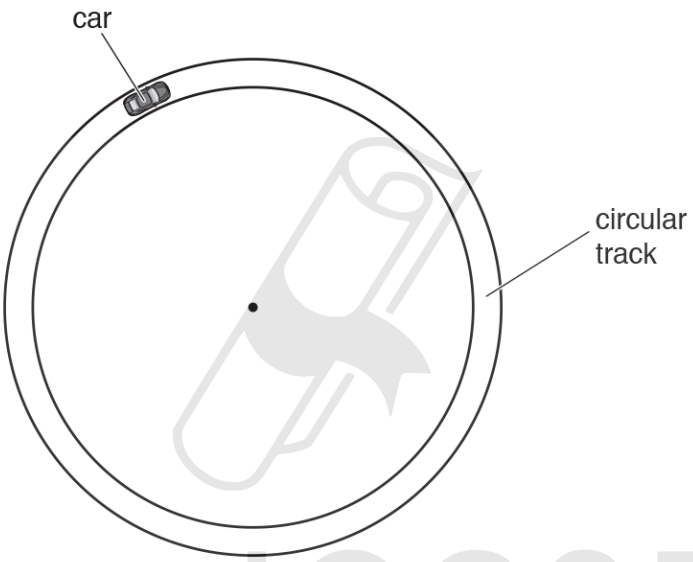

Fig. 3.1

The speed of the car is 0.30 m/s. In one complete revolution around the track, the car travels 3.9 m.

(i) Calculate the time taken for the car to complete one revolution around the track.

time = ... [2]

(ii) On Fig. 3.1, draw and label with the letter F an arrow to show the resultant force acting on the car. [1]

(iii) The speed of the car increases and at point P on Fig. 3.2 the car does not stay on the track.

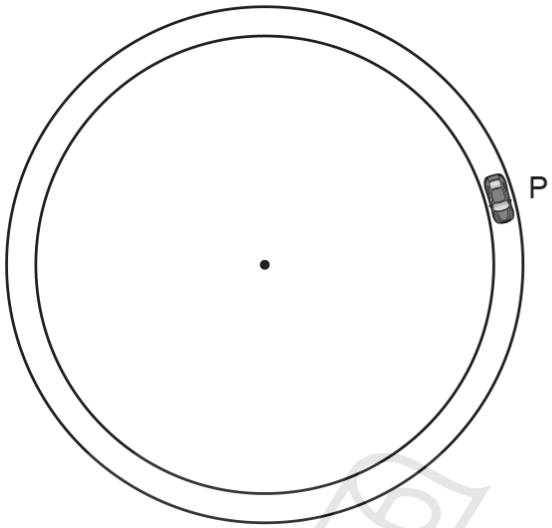

Fig. 3.2

1. Suggest, in terms of the force acting on the car, why the car does not stay on the track at point P.

.....

..... [1]

2. On Fig. 3.2, draw and label an arrow with the letter S to show the direction of motion of the car as it leaves the track at point P. [1]

21. 0625_m19_qp_42 Q: 3

(a) An object is moving in a straight line at constant speed.

State **three** ways in which a force may change the motion of the object.

1 .....

2 .....

3 .....

[2]

(b) Fig. 3.1 shows an object suspended from two ropes. The weight of the object is 360 N. The magnitude of the tension in each rope is *T*.

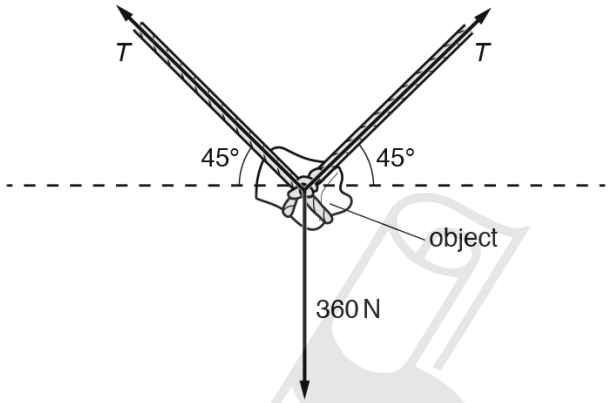

Fig. 3.1

In the space below, determine the tension *T* by drawing a vector diagram of the forces acting on the object.

State the scale you have used.

scale .....

T = ...

[5]

[Total: 7]

22. 0625_s19_qp_41 Q: 2

Fig. 2.1 shows a sign that extends over a road.

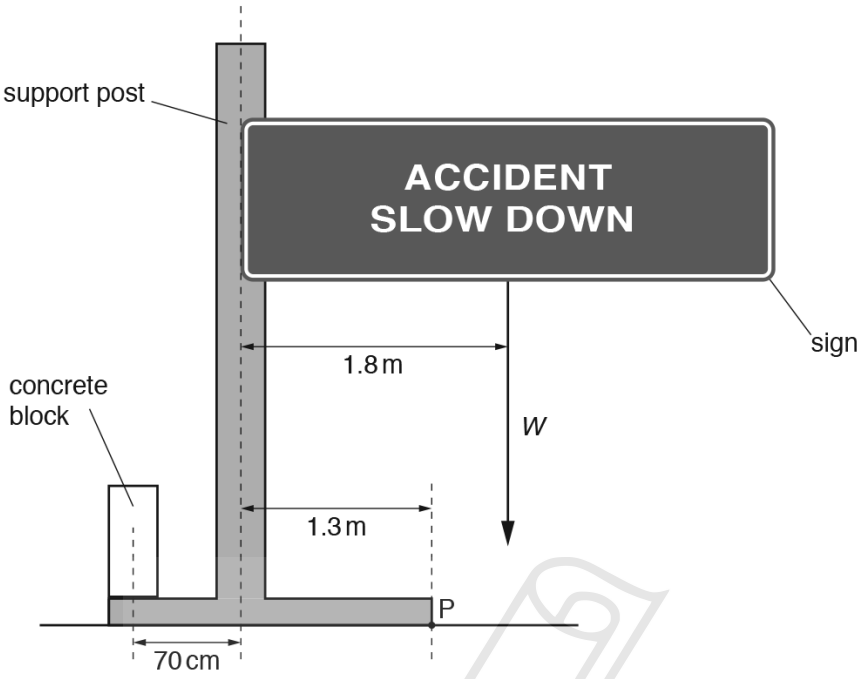

Fig. 2.1

The mass of the sign is 3.4×10^3 kg.

(a) Calculate the weight *W* of the sign.

W = ... [2]

(b) The weight of the sign acts at a horizontal distance of 1.8 m from the centre of the support post and it produces a turning effect about point P.

Point P is a horizontal distance of 1.3 m from the centre of the support post.

(i) Calculate the moment about P due to the weight of the sign.

moment = ... [3]

(ii) A concrete block is positioned on the other side of the support post with its centre of mass a horizontal distance of 70 cm from the centre of the support post.

1. State what is meant by *centre of mass*.

.....

..... [1]

2. The weight of the concrete block produces a moment about point P that exactly cancels the moment caused by the weight *W*.

Calculate the weight of the concrete block.

weight = ... [2]

(c) The concrete block is removed. The sign and support post rotate about point P in a clockwise direction.

State and explain what happens to the moment about point P due to the weight of the sign as it rotates.

.....

.....

..... [2]

[Total: 10]

23. 0625_w19_qp_41 Q: 1

A car accelerates from rest at time $t = 0$ to its maximum speed.

Fig. 1.1 is the speed-time graph for the first 25 s of its motion.

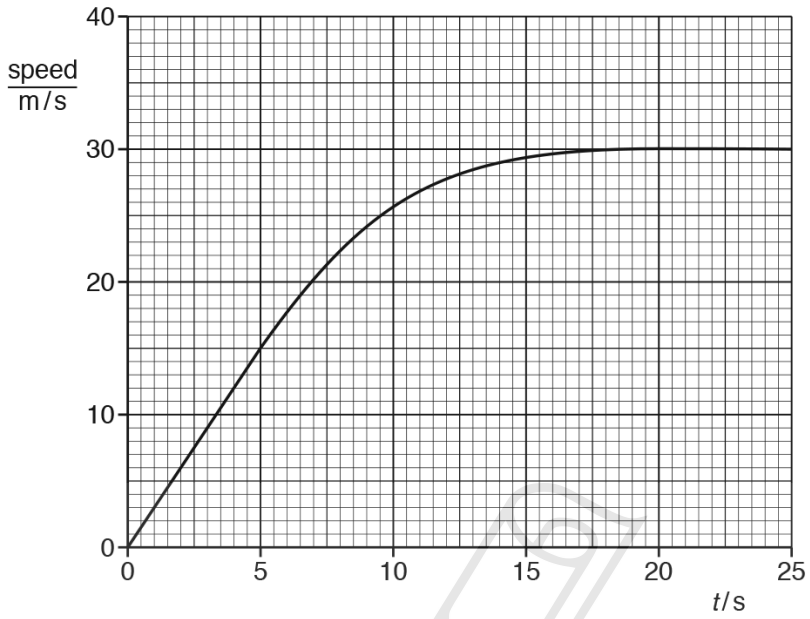

Fig. 1.1

(a) The mass of the car is 2300 kg.

For the time between $t = 0$ and $t = 5.0$ s, determine:

(i) the acceleration of the car

acceleration = ... [2]

(ii) the resultant force acting on the car.

resultant force = ... [2]

(b) Describe the motion of the car between $t = 10$ s and $t = 15$ s. Explain how Fig. 1.1 shows this.

.....

.....

.....

..... [3]

(c) Between $t = 10$ s and $t = 15$ s, the force exerted on the car due to the engine remains constant.

Suggest and explain why the car moves in the way shown by Fig. 1.1.

.....

.....

..... [2]

[Total: 9]

24. 0625_w19_qp_42 Q: 2

(a) State the **two** conditions which must be true for an object to be in equilibrium.

condition 1 .....

condition 2 .....

[2]

(b) Fig. 2.1 shows a uniform metre rule PQ in equilibrium.

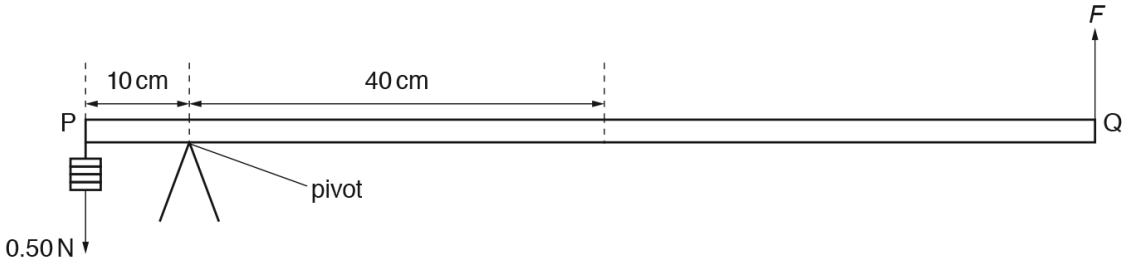

Fig. 2.1

The distance PQ is 100 cm. The mass of the metre rule is 0.12 kg and its weight is *W*.

(i) On Fig 2.1, draw and label:

1. an arrow to show the force *W* acting on PQ at the centre of mass

2. an arrow to show the force *R* acting on PQ at the pivot.

[2]

(ii) By taking moments about the pivot, calculate *F*.

F = ... [4]

(iii) Calculate *R*.

R = ... [2]

[Total: 10]

25. 0625_w19_qp_43 Q: 2

(a) **(i)** State, in words, the equation that defines the *moment of a force*.

.....

..... [2]

(ii) State what is meant by the *moment of a force*.

..... [1]

(iii) *Force* is a vector quantity.

Explain what is meant by the term *vector*.

.....

..... [1]

(b) Fig. 2.1 shows a tower crane used to lift a load on a construction site.

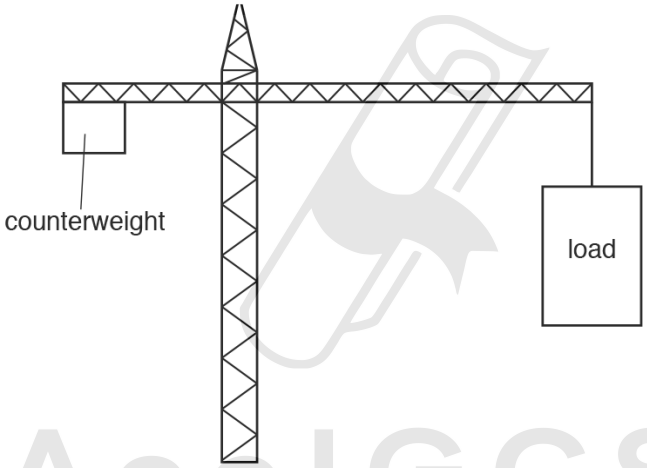

Fig. 2.1

Explain how the counterweight prevents the crane from toppling over.

.....

.....

..... [2]

[Total: 6]

26. 0625_m18_qp_42 Q: 3

(a) Complete the statement by writing in the blank spaces.

The moment of a force about a pivot is equal to .....

multiplied by..... [1]

(b) Fig. 3.1 shows a horizontal rod of length 2.4 m and weight 160 N. The weight of the rod acts at its centre. The rod is suspended by two vertical ropes X and Y. The tension in each rope is 80 N.

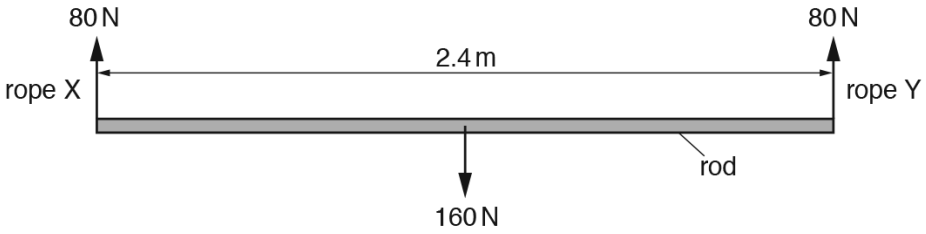

Fig. 3.1

(i) State the name given to the point at which the weight of the rod acts.

..... [1]

(ii) Calculate the mass of the rod.

mass = ... [1]

(iii) The rod is in equilibrium.

Using data from Fig. 3.1, explain why.

.....

.....

.....

.....

.....

..... [4]

[Total: 7]

27. 0625_w18_qp_41 Q: 1

A train of mass 5.6×10^5 kg is at rest in a station.

At time $t = 0$ s, a resultant force acts on the train and it starts to accelerate forwards.

Fig. 1.1 is the distance-time graph for the train for the first 120 s.

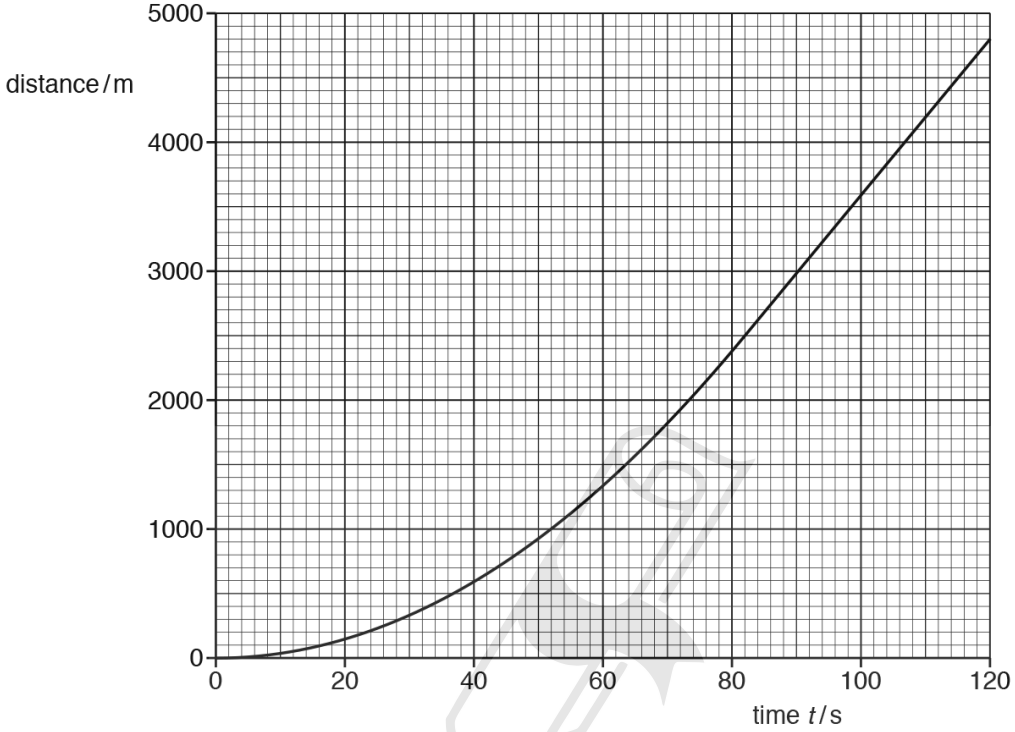

Fig. 1.1

(a) (i) Use Fig. 1.1 to determine:

1. the average speed of the train during the 120 s

average speed = ...[1]

2. the speed of the train at time $t = 100$ s.

speed = ...[2]

(ii) Describe how the acceleration of the train at time $t = 100\,s$ differs from the acceleration at time $t = 20\,s$.

.....

.....

.....[2]

(b) (i) The initial acceleration of the train is $0.75\,m/s^2$.

Calculate the resultant force that acts on the train at this time.

resultant force = ...[2]

(ii) At time $t = 120\,s$, the train begins to decelerate.

State what is meant by *deceleration*.

.....

.....[1]

[Total: 8]

28. 0625_w18_qp_41 Q: 2

Fig. 2.1 shows a uniform plank AB of length 2.0 m suspended from two ropes X and Y.

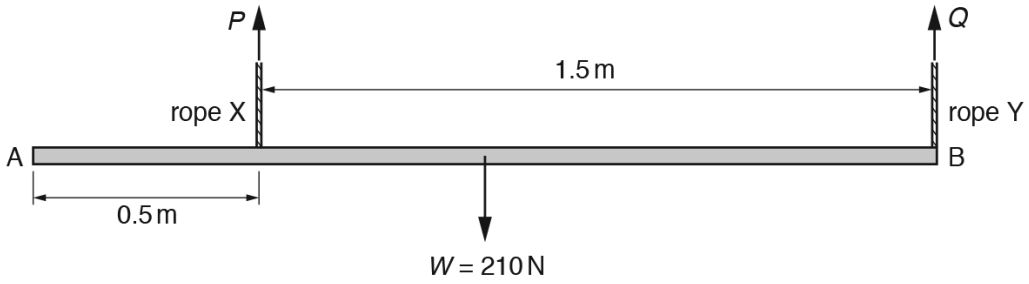

Fig. 2.1

The weight W of the plank is 210 N. The force in rope X is P. The force in rope Y is Q.

(a) State, in terms of P, the moment of force P about B.

.....[1]

(b) Calculate:

(i) the moment of W about B

moment = ...[1]

(ii) the force P

force P = ...[2]

(iii) the force Q.

force Q = ...[2]

[Total: 6]

29. 0625_w18_qp_42 Q: 1

A lorry is travelling along a straight, horizontal road.

Fig. 1.1 is the distance-time graph for the lorry.

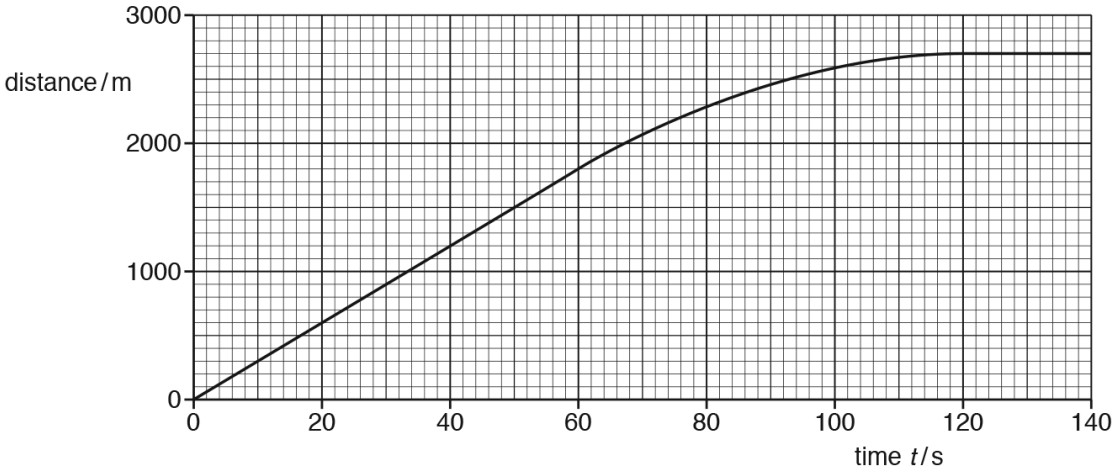

Fig. 1.1

(a) Using Fig. 1.1, determine:

(i) the speed of the lorry at time $t = 30$ s

speed = ...[2]

(ii) the average speed of the lorry between time $t = 60$ s and time $t = 120$ s.

average speed = ...[2]

(b) At time $t = 30\,s$, the total resistive force acting on the lorry is $1.4 \times 10^4\,N$.

(i) Using Fig. 1.1, determine the magnitude of the acceleration of the lorry at time $t = 30\,s$.

acceleration = ...[1]

(ii) Determine the forward force on the lorry due to its engine at time $t = 30\,s$.

forward force = ...[1]

(c) Describe the motion of the lorry between time $t = 60\,s$ and time $t = 130\,s$.

.....

.....

.....[2]

[Total: 8]

30. 0625_m17_qp_42 Q: 1

(a) Fig. 1.1 shows the axes used to plot distance-time graphs.

Fig. 1.1

On Fig. 1.1, draw graphs for an object that is

(i) moving with constant speed, labelling the graph A,

(ii) moving with decreasing speed, labelling the graph B. [2]

(b) Fig. 1.2 shows the axes used to plot speed-time graphs.

Fig. 1.2

On Fig. 1.2, draw graphs for an object that is

(i) moving with constant acceleration, labelling the graph S,

(ii) moving with increasing acceleration, labelling the graph T. [2]

(c) A plane is at rest on an airport runway. The brakes of the plane are released and the engine of the plane provides a constant accelerating force.

Using the following data, calculate the take-off speed of the plane. Ignore any resistive forces.

constant forward force = 56 000 N
mass of plane = 16 000 kg
time of travel along runway = 16 s

speed = ...[4]

[Total: 8]

31. 0625_m17_qp_42 Q: 3

(a) A stationary object is acted upon by a number of forces.

State the conditions which **must** be true if the object

(i) does not accelerate,

.....[1]

(ii) does not rotate.

.....[1]

(b) Fig. 3.1 shows a boat that has been lifted out of a river. The boat is suspended by two ropes. It is stationary.

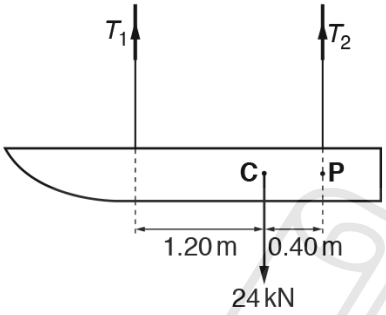

Fig. 3.1 (not to scale)

The weight of the boat, acting at the centre of mass, is 24 kN. The tensions in the ropes are T_1 and T_2.

Determine

(i) the moment of the weight of the boat about the point **P**,

moment = ...[1]

(ii) the tension T_1,

T_1 = ...[3]

(iii) the tension T_2.

T_2 = ...[2]

[Total: 8]

32. 0625_w17_qp_41 Q: 1

Fig. 1.1 shows the speed-time graph for the motion of a car.

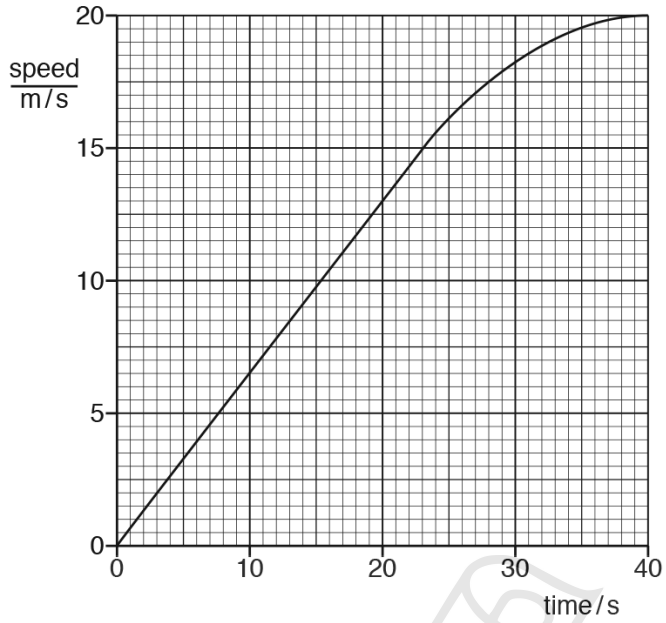

Fig. 1.1

The mass of the car is 1200 kg.

(a) Calculate, for the first 20 s of the motion,

(i) the distance travelled by the car,

distance = ...[2]

(ii) the acceleration of the car,

acceleration = ...[2]

(iii) the resultant force acting on the car.

resultant force = ...[2]

(b) Describe the motion of the car in the period of time from 25 s to 40 s.

.....

.....[1]

[Total: 7]

33. 0625_w17_qp_41 Q: 2

(a) State Hooke's Law.

.....

.....[1]

(b) For forces up to 120 N, a spring obeys Hooke's Law.

A force of 120 N causes an extension of 64 mm.

(i) On Fig. 2.1, draw the force-extension graph for the spring for loads up to 120 N. [1]

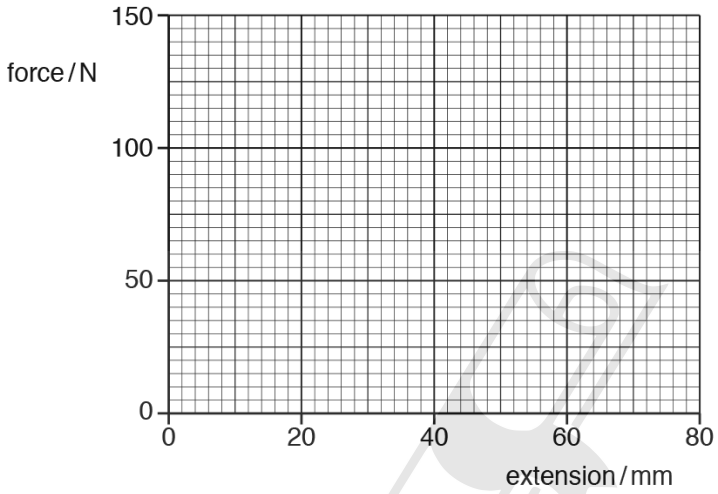

Fig. 2.1

(ii) Calculate the spring constant k of the spring.

k = ...[2]

(c) A student makes a spring balance using the spring in **(b)**. The maximum reading of this balance is 150 N.

The student tests his balance with a known weight of 140 N. He observes that the reading of the balance is not 140 N.

Suggest and explain why the reading is **not** 140 N.

.....

.....

.....[2]

[Total: 6]

34. 0625_w17_qp_42 Q: 2

(a) An object is moving in a straight line at constant speed. A resultant force begins to act upon the object.

State the ways in which the force may change the motion of the object.

.....

.....

.....

.....[2]

(b) State **one** other effect a force could have on the object.

.....[1]

(c) The mass of a car is 1400 kg. The car, initially at rest, is moved along a level road by a resultant force of 3500 N. The car reaches a speed of 30 m/s.

(i) Calculate the average acceleration of the car.

acceleration = ...[2]

(ii) Calculate the time for which the force is applied.

time = ...[2]

(iii) State the name of a force which opposes the motion of the car.

.....[1]

[Total: 8]

35. 0625_w17_qp_43 Q: 1

A truck accelerates uniformly along a straight, horizontal road. The mass of the truck is 2.0×10^4 kg.

(a) The speed of the truck increases from rest to 12 m/s in 30 s.

Calculate

(i) the distance travelled by the truck during this time,

distance = ...[2]

(ii) the resultant force on the truck.

resultant force = ...[4]

(b) To maintain a uniform acceleration, the forward force on the truck must change.
Explain why.

.....

.....

.....[2]

[Total: 8]