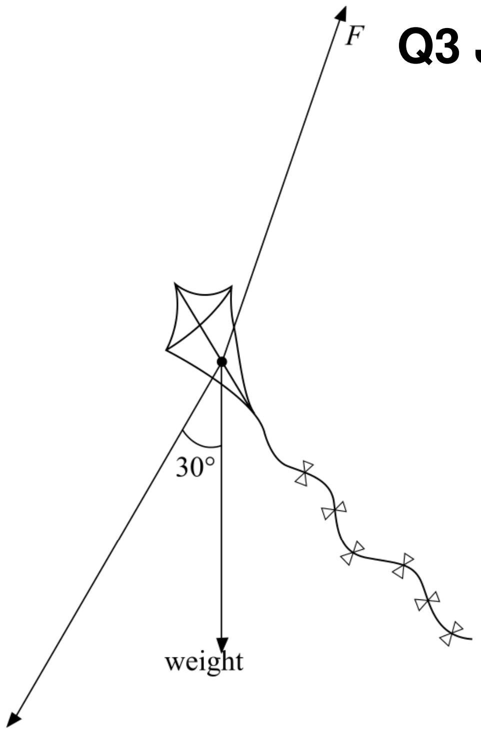
Resolving Past Paper Questions

Jan 2002 to Jan 2009

3 The diagram shows the forces acting on a stationary kite. The force F is the force that the air exerts on the kite.

Q3 Jan 2002



tension, T, in string

(a) Show on the diagram how force F can be resolved into horizontal and vertical components.

(2 marks)

(b) The magnitude of the tension, T, is 25 N.
Calculate

(i) the horizontal component of the tension,

....

(ii) the vertical component of the tension.

....

(2 marks)

(c) (i) Calculate the magnitude of the vertical component of F when the weight of the kite is 2.5 N.

....

(ii) State the magnitude of the horizontal component of F.

....

(iii) Hence calculate the magnitude of F.

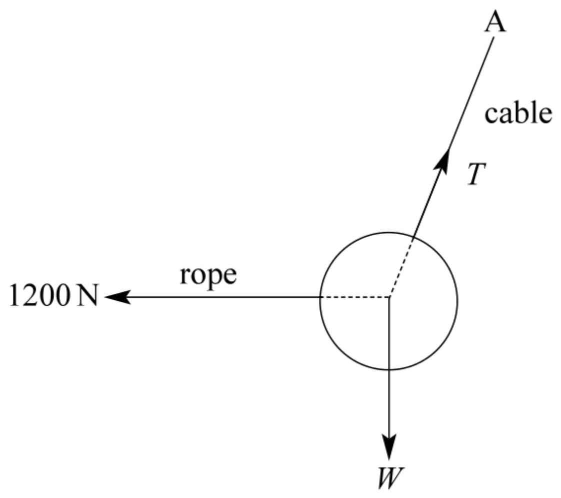
....

....

(4 marks)

4 The diagram shows a 250 kg iron ball being used on a demolition site. The ball is suspended from a cable at point A, and is pulled into the position shown by a rope that is kept horizontal. The tension in the rope is 1200 N.

Q4 Jun 2003



(a) In the position shown the ball is in equilibrium.

(i) What balances the force of the rope on the ball?

....

(ii) What balances the weight of the ball?

....

(2 marks)

(b) Determine

(i) the magnitude of the vertical component of the tension in the cable,

....

....

(ii) the magnitude of the horizontal component of the tension in the cable,

....

....

Continued.....

(iii) the magnitude of the tension in the cable,

....

....

....

....

....

....

(iv) the angle the cable makes to the vertical.

....

....

(6 marks)

2 (a) State the difference between vector and scalar quantities. **Q2 Jan 2005**

....

....

(1 mark)

(b) State **one** example of a vector quantity (other than force) and **one** example of a scalar quantity.

vector quantity ....

scalar quantity ....

(2 marks)

(c) A 12.0 N force and a 8.0 N force act on a body of mass 6.5 kg at the same time.
For this body, calculate

(i) the maximum resultant acceleration that it could experience,

....

....

(ii) the minimum resultant acceleration that it could experience.

....

....

(4 marks)

2 **Figure 1** shows a uniform steel girder being held horizontally by a crane. Two cables are attached to the ends of the girder and the tension in each of these cables is T.

Q2 Jun 2005

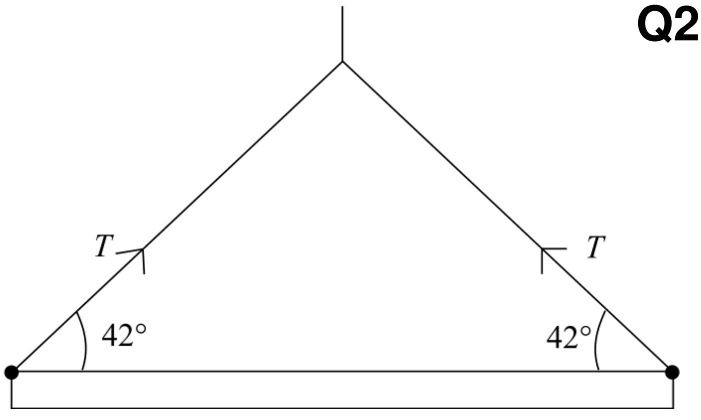


Figure 1

(a) If the tension, T, in each cable is 850 N, calculate

(i) the horizontal component of the tension in each cable,

....

....

(ii) the vertical component of the tension in each cable,

....

....

(iii) the weight of the girder.

....

....

(4 marks)

(b) On **Figure 1** draw an arrow to show the line of action of the weight of the girder.

(1 mark)

6 A fairground ride ends with the car moving up a ramp at a slope of 30° to the horizontal as shown in **Figure 3**.

Q6 Jun 2005

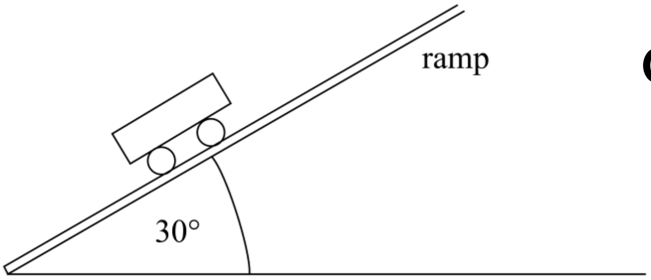


Figure 3

(a) The car and its passengers have a total weight of 7.2×10^3 N. Show that the component of the weight parallel to the ramp is 3.6×10^3 N.

....

....

(1 mark)

(b) Calculate the deceleration of the car assuming the only force causing the car to decelerate is that calculated in part (a).

....

....

(2 marks)

(c) The car enters at the bottom of the ramp at $18\,\text{m}\,\text{s}^{-1}$. Calculate the minimum length of the ramp for the car to stop before it reaches the end. The length of the car should be neglected.

....

....

....

....

(2 marks)

(d) Explain why the stopping distance is, in practice, shorter than the value calculated in part (c).

....

....

....

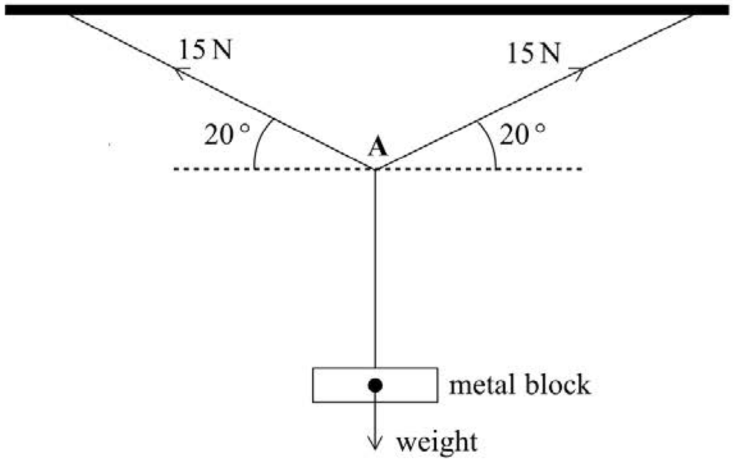
....

(2 marks)

6 **Figure 3** shows a stationary metal block hanging from the middle of a stretched wire which is suspended from a horizontal beam. The tension in each half of the wire is 15 N.

Figure 3

Q6 Jan 2006



(a) Calculate for the wire at **A**,

(i) the resultant horizontal component of the tension forces,

....

....

(ii) the resultant vertical component of the tension forces.

....

....

(3 marks)

(b) (i) State the weight of the metal block.

....

(ii) Explain how you arrived at your answer, with reference to an appropriate law of motion.

....

....

....

....

....

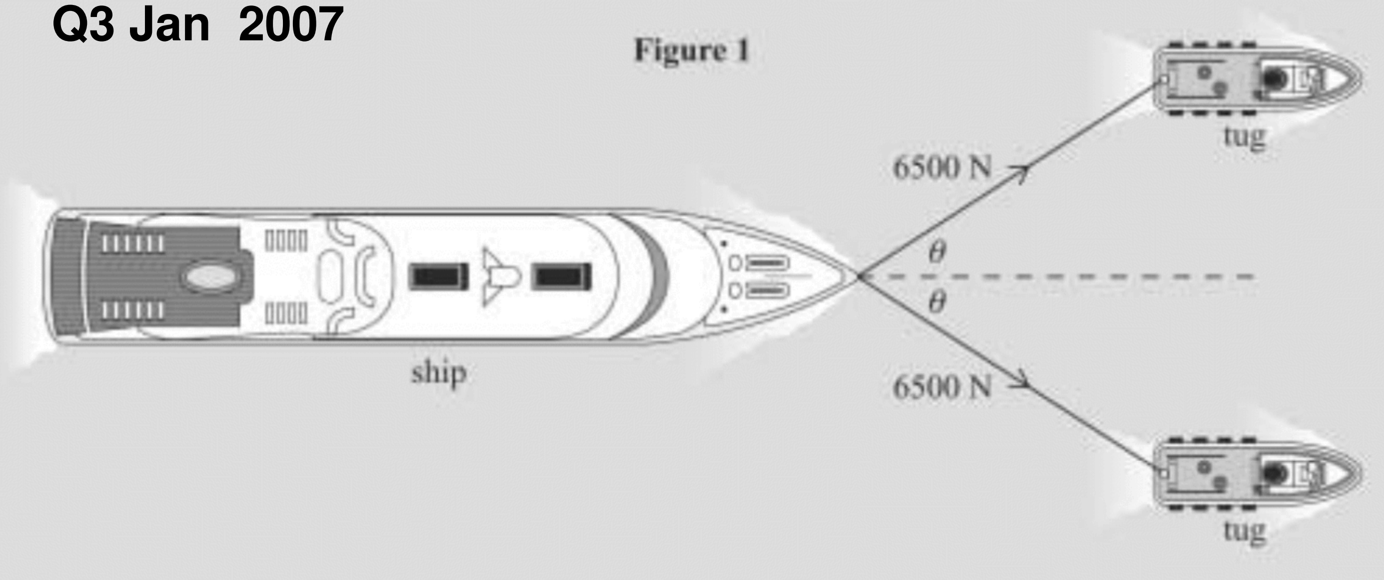
....

(3 marks)

3 **Figure 1** shows a ship being pulled along by cables attached to two tugs.

Q3 Jan 2007

Figure 1



(a) The tension in each cable is 6500 N and the ship is moving at a constant speed of $1.5\,m\,s^{-1}$. When θ is equal to 35°, calculate

(i) the resultant force exerted on the ship by the cables,

....

....

....

(ii) the work done by the tension in the cables in one minute.

....

....

....

(4 marks)

(b) Explain why the work done on the ship does not result in a gain in its kinetic energy.

....

....

(2 marks)

Continued.....

(c) State and explain the initial effect on the ship if the angle θ is reduced while the tension in the cables remains constant.

You may be awarded additional marks to those shown in brackets for the quality of written communication in your answer.

....

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....

....

(3 marks)

1 (a) (i) State what is meant by a scalar quantity.

Q1 Jan 2004

....

....

....

(ii) State **two** examples of scalar quantities.

example 1: ....

example 2: ....

(3 marks)

(b) An object is acted upon by two forces at right angles to each other. One of the forces has a magnitude of 5.0 N and the resultant force produced on the object is 9.5 N.
Determine

(i) the magnitude of the other force,

....

....

....

....

....

....

(ii) the angle between the resultant force and the 5.0 N force.

....

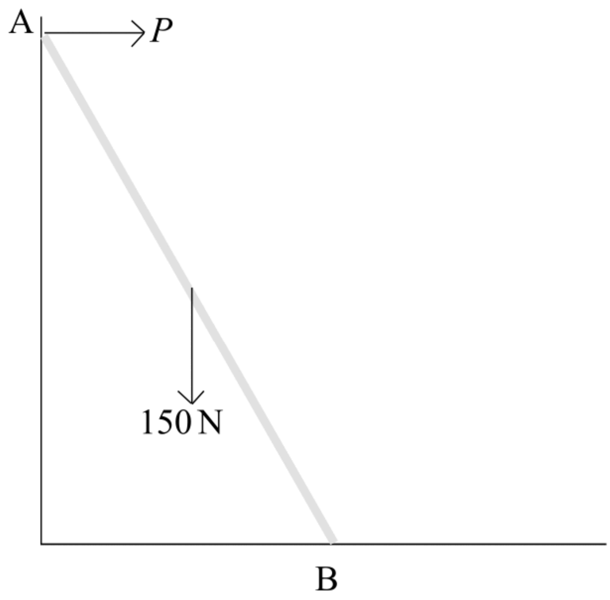
....

(4 marks)

2 **Figure 1** shows two of the forces acting on a uniform ladder resting against a smooth vertical wall.

Q2 Jun 2007

Figure 1



The ladder is 6.0 m long and has a weight of 150 N. The horizontal force, P, exerted on the ladder by the wall is 43 N. Force Q (not shown) is the force the ground exerts on the ladder at B.

(a) Explain why the force, Q must have

(i) a vertical component,

....

....

(ii) a horizontal component.

....

....

(2 marks)

Continued.....

(c) State the

(i) horizontal component of Q, ...

(ii) vertical component of Q. ....

(2 marks)

(d) State and explain the effect on force Q if a person stands on the bottom of the ladder and the direction of P is unchanged.

You may be awarded additional marks to those shown in brackets for the quality of written communication in your answer.

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(3 marks)

5 An aircraft accelerates horizontally from rest and takes off when its speed is $82\,m\,s^{-1}$. The mass of the aircraft is 5.6×10^4 kg and its engines provide a constant thrust of 1.9×10^5 N.

(a) Calculate

Q5 Jan 2008

(i) the initial acceleration of the aircraft,

....

....

(ii) the minimum length of runway required, assuming the acceleration is constant.

....

....

....

(3 marks)

(b) In practice, the acceleration is unlikely to be constant. State a reason for this and explain what effect this will have on the minimum length of runway required.

....

....

....

....

(2 marks)

(c) After taking off, the aircraft climbs at an angle of 22° to the ground. The thrust from the engines remains at 1.9×10^5 N. Calculate

(i) the horizontal component of the thrust,

....

....

(ii) the vertical component of the thrust.

....

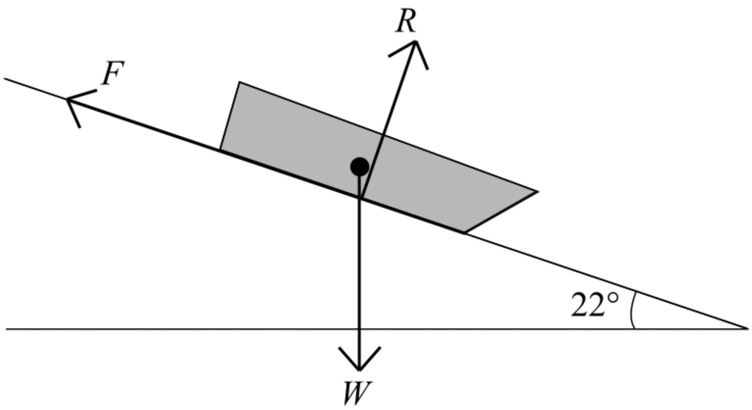
....

(2 marks)

2 **Figure 2** shows a sledge moving down a slope at constant velocity.
The angle of the slope is 22°.

Q2 Jun 2008

Figure 2



The three forces acting on the sledge are weight, W, friction, F, and the normal reaction force, R, of the ground on the sledge.

2 (a) With reference to an appropriate law of motion, explain why the sledge is moving at constant velocity.

....

....

....

....

....

....

(2 marks)

2 (b) The mass of the sledge is 4.5 kg. Calculate the component of W,

2 (b) (i) parallel to the slope,

....

....

....

Continued.....

2 (b) (ii) perpendicular to the slope,

....

....

....

(2 marks)

2 (c) State the values of *F* and *R*.

F ....

R ....

(2 marks)

2 (a) (i) State the difference between a scalar quantity and a vector quantity.

Q2 Jan 2009

....

....

(1 mark)

2 (a) (ii) State **two** examples of a scalar quantity and **two** examples of a vector quantity.

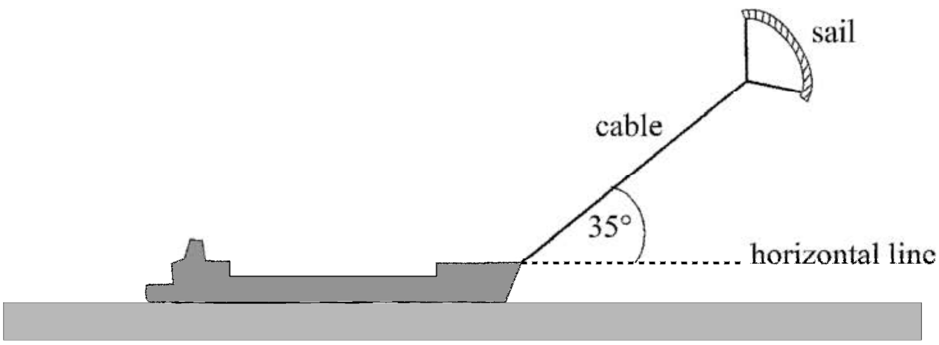
scalar quantities ....

vector quantities ....

(3 marks)

2 (b) **Figure 1** shows a ship fitted with a sail attached to a cable. The force of the wind on the sail assists the driving force of the ship's propellors.

Figure 1



The cable exerts a steady force of 2.8 kN on the ship at an angle of 35° above a horizontal line.

2 (b) (i) Calculate the horizontal and vertical components of this force.

horizontal component of force .... kN

vertical component of force .... kN

(2 marks)

Continued.....

2 (b) (ii) The ship is moving at a constant velocity of $8.3\,\text{m}\,\text{s}^{-1}$ and the horizontal component of the force of the cable on the ship acts in the direction in which the ship is moving.
Calculate the power provided by the wind to this ship, stating an appropriate unit.

Answer ....
(3 marks)

2 (c) The cable has a diameter of 0.014 m. Calculate the tensile stress in the cable when it exerts a force of 2.8 kN on the ship, stating an appropriate unit.
Assume the weight of the cable is negligible.

Answer ....
(5 marks)