

Forces at a point

Question Paper 2

Level	A Level
Subject	Maths
Exam Board	AQA
Module	Mechanics 1
Topic	Statics and Forces
Sub Topic	Forces at a point
Booklet	Question Paper - 2

Time Allowed: 57 minutes

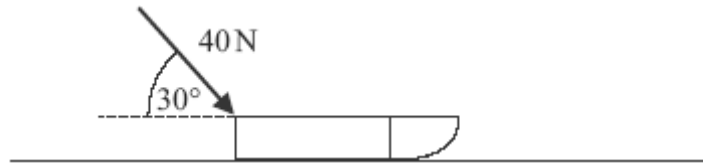
Score: /48

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

Q1. A sledge of mass 8 kg is at rest on a rough horizontal surface. A child tries to move the sledge by pushing it with a pole, as shown in the diagram, but the sledge **does not move**. The pole is at an angle of 30° to the horizontal and exerts a force of 40 newtons on the sledge.



Model the sledge as a particle.

(a) Draw a diagram to show the four forces acting on the sledge. (1)

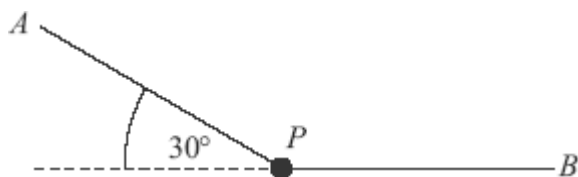
(b) Show that the normal reaction force between the sledge and the surface has magnitude 98.4 N. (3)

(c) Find the magnitude of the friction force that acts on the sledge. (2)

(d) Find the least possible value of the coefficient of friction between the sledge and the surface. (3)

(Total 9 marks)

Q2. A particle, of mass 4 kg, is suspended in equilibrium by two light strings, AP and BP . The string AP makes an angle of 30° to the horizontal and the other string, BP , is horizontal, as shown in the diagram.

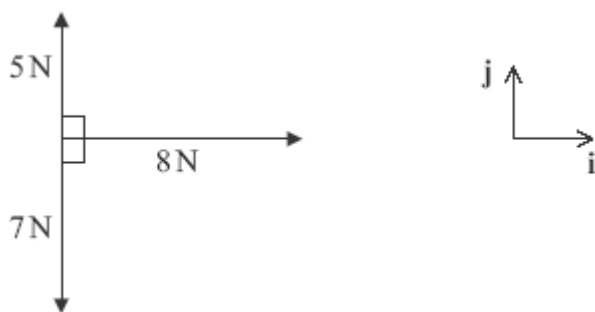


(a) Draw and label a diagram to show the forces acting on the particle. (1)

(b) Show that the tension in the string AP is 78.4 N. (3)

(c) Find the tension in the horizontal string BP . (2)
(Total 6 marks)

Q3. The diagram shows three forces and the perpendicular unit vectors \mathbf{i} and \mathbf{j} , which all lie in the same plane.



(a) Express the resultant of the three forces in terms of \mathbf{i} and \mathbf{j} . (2)

(b) Find the magnitude of the resultant force. (2)

(c) Draw a diagram to show the direction of the resultant force, and find the angle that it makes with the unit vector \mathbf{i} . (3)
(Total 7 marks)

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Q4. A block, of mass 5 kg, slides down a rough plane inclined at 40° to the horizontal. When modelling the motion of the block, assume that there is no air resistance acting on it.

(a) Draw and label a diagram to show the forces acting on the block. (1)

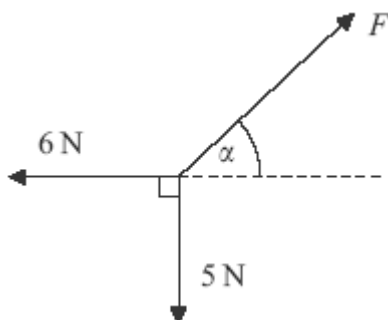
(b) Show that the magnitude of the normal reaction force acting on the block is 37.5 N, correct to three significant figures. (2)

(c) Given that the acceleration of the block is 0.8 m s^{-2} , find the coefficient of friction between the block and the plane. (6)

(d) In reality, air resistance does act on the block. State how this would change your value for the coefficient of friction and explain why. (2)

(Total 11 marks)

Q5. The diagram shows three forces which act in the same plane and are in equilibrium.



(a) Find F . (3)

(b) Find α . (3)

(Total 6 marks)

Q6. A trolley, of mass 100 kg, rolls at a constant speed along a straight line down a slope inclined at an angle of 4° to the horizontal.

Assume that a constant resistance force, of magnitude P newtons, acts on the trolley as it moves. Model the trolley as a particle.

(a) Draw a diagram to show the forces acting on the trolley. **(1)**

(b) Show that $P = 68.4$ N, correct to three significant figures. **(3)**

(c) (i) Find the acceleration of the trolley if it rolls down a slope inclined at 5° to the horizontal and experiences the same constant force of magnitude P that you found in part (b). **(4)**

(ii) Make one criticism of the assumption that the resistance force on the trolley is constant.

(1)
(Total 9 marks)