TOPIC TEST

A-level MATHS

Forces

Specification content coverage: R2, R4, R5

In this test you will be assessed on:

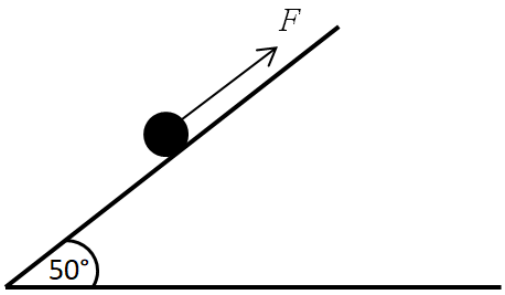
- understanding and using Newton's second law for motion in situations where forces need to be resolved
- resolving forces in two dimensions
- the equilibrium of a particle under coplanar forces
- understanding and using addition of forces and resultant forces.

The test comprises two sections. The questions in section A will test you on the basics of the topic. Those in section B require a bit more thinking.

Section A: The basics

1 (a) A particle of weight 17 N is held in equilibrium by a force F N on a smooth plane inclined at 50º to the horizontal.

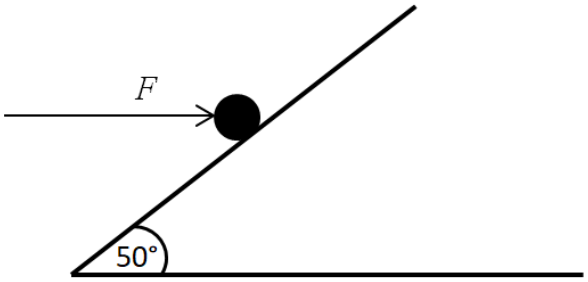
F acts parallel to the plane as shown in the diagram.



Find F.

[2 marks]

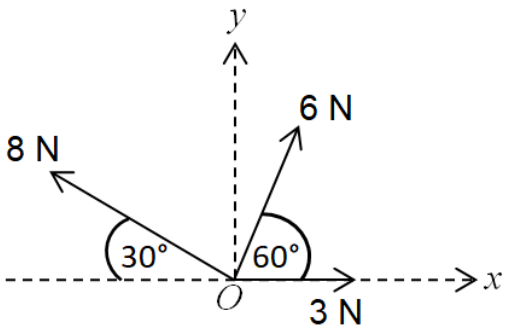
1 (b)



Find F if instead it acts horizontally as shown in the diagram.

[2 marks]

2 Three forces act at a point O as shown in the diagram.



2 (a) Find the component of the resultant of the three forces in the x-direction and the y-direction.

[3 marks]

2 (b) Hence find:

2 (b) (i) the magnitude of the resultant of the three forces.

[2 marks]

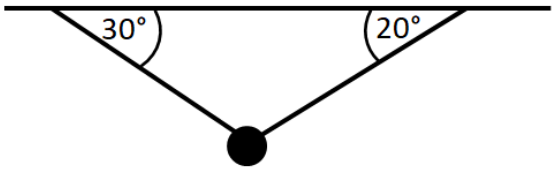
2 (b) (ii) the angle the resultant force makes with the positive x-direction, giving your answer to the nearest 0.1^{o}.

[2 marks]

Section B: A bit more thinking

3 **In this question use g = 10 m s^{-2}.**

A particle of mass 4 kg is help in equilibrium by two strings, inclined at angles of 30° and 20° to the horizontal, as shown in the diagram.

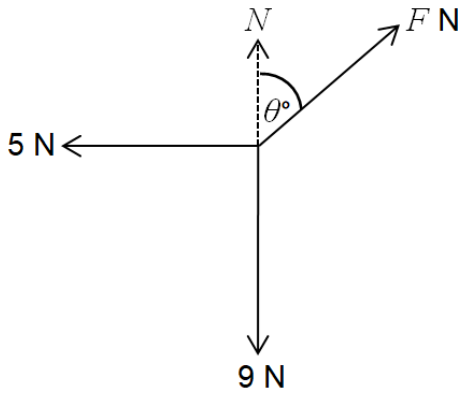


Find the tension in each string.

[3 marks]

4 (a) A particle, with mass 8 kg, rests in equilibrium on a smooth horizontal surface.

Three forces of magnitudes 5 N, 9 N and F N act on the particle on bearings of 180°, 270° and θ° respectively, as shown in the diagram.



Find F and θ (giving your answer to the nearest 0.1°).

[3 marks]

4 (b) The force of 5 N stops acting on the particle.

Find the magnitude and direction (as a bearing) of the subsequent acceleration.

[2 marks]

5 (a) Two forces of (6**i** – 7**j**) newtons and (a**i** + b**j**) newtons act on a particle of mass 3 kg. The resultant force acts in a direction parallel to 2**i** – 5**j**.

Find the angle between the resultant force and **j**.

[2 marks]

5 (b) Show that $5a + 2b = -16$.

[3 marks]

5 (c) Given that $a = -2$, find the speed of the particle 5 seconds after it is released from rest.

[4 marks]

6 **In this question use g = 9.81 m s^{-2}.**

A particle of mass 0.5 kg is held on a rough plane inclined at $\theta°$ to the horizontal where $\sin\theta = 0.8$. The particle is released from rest and travels 6.5 m during the first 4 s of its motion.

Find the magnitude of the resistive force acting against the motion of the particle.

[4 marks]