MATHSAURUS

A Level Mathematics Year 2 Exam Questions by Topic
Chapter 19: Forces and motion

These questions are taken from the Specimen Exam materials and the real 2018 papers for the new syllabus AS and A-level mathematics courses and arranged by chapter of the textbooks by Goldie et al (available here: `https://amzn.to/39umfr5` and `https://amzn.to/3hE8kBL`). There are a mixture of questions from OCR A, OCR B (MEI), Edexcel and AQA. Although the style of questions varies a little across the exam boards the content of the syllabus is almost identical so these are suitable for students preparing for any exam board.

Free problem sets for all other chapters, as well as video solutions, full past papers and other content for GCSE and A-level maths can be found at:

`https://mathsaurus.com/`

OCR B MEI Sample Paper 1 Question 5:

5 Dora is trying to pull a loaded sledge along horizontal ground. The only resistance to motion of the sledge is due to friction between it and the ground.

Fig. 5

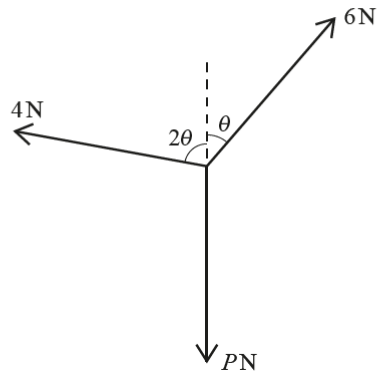
Initially she pulls with a force of 100 N inclined at 32° to the horizontal, as shown in Fig.5, but the sledge does not move.

(i) Determine the frictional force between the ground and the sledge. Give your answer correct to 3 significant figures. **[2]**

(ii) Next she pulls with a force of 100 N inclined at a smaller angle to the horizontal. The sledge still does not move. Compare the frictional force in this new situation with that in part **(i)**, justifying your answer. **[2]**

OCR A 2018 Paper 3 Question 10:

10 Three forces, of magnitudes 4 N, 6 N and P N, act at a point in the directions shown in the diagram.



The forces are in equilibrium.

(i) Show that $\theta = 41.4°$, correct to 3 significant figures. **[4]**

(ii) Hence find the value of P. **[2]**

The force of magnitude 4 N is now removed and the force of magnitude 6 N is replaced by a force of magnitude 3 N acting in the same direction.

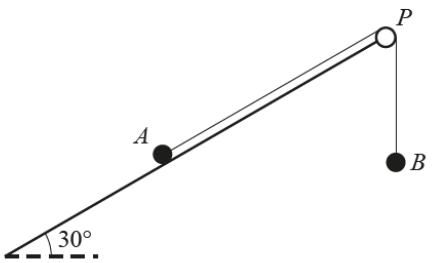
(iii) Find

(a) the magnitude of the resultant of the two remaining forces, **[3]**

(b) the direction of the resultant of the two remaining forces. **[2]**

OCR A 2018 Paper 3 Question 12:

12 One end of a light inextensible string is attached to a particle A of mass m kg. The other end of the string is attached to a second particle B of mass λm kg, where λ is a constant. Particle A is in contact with a rough plane inclined at 30° to the horizontal. The string is taut and passes over a small smooth pulley P at the top of the plane. The part of the string from A to P is parallel to a line of greatest slope of the plane. The particle B hangs freely below P (see diagram).



The coefficient of friction between A and the plane is μ.

(i) It is given that A is on the point of moving down the plane.

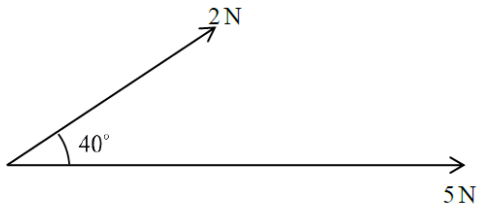
(a) Find the exact value of μ when $\lambda = \frac{1}{4}$. **[7]**

(b) Show that the value of λ must be less than $\frac{1}{2}$. **[2]**

(ii) Given instead that $\lambda = 2$ and that the acceleration of A is $\frac{1}{4}g\,\text{m s}^{-2}$, find the exact value of μ. **[5]**

OCR A Sample Paper 3 Question 9:

9 Two forces, of magnitudes 2 N and 5 N, act on a particle in the directions shown in the diagram below.



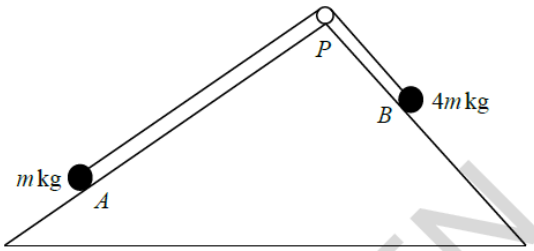
(i) Calculate the magnitude of the resultant force on the particle. **[3]**

(ii) Calculate the angle between this resultant force and the force of magnitude 5 N. **[1]**

OCR A Sample Paper 3 Question 13:

13 Particle A, of mass m kg, lies on the plane Π_1 inclined at an angle of $\tan^{-1}\frac{3}{4}$ to the horizontal. Particle B, of $4m$ kg, lies on the plane Π_2 inclined at an angle of $\tan^{-1}\frac{4}{3}$ to the horizontal. The particles are attached to the ends of a light inextensible string which passes over a smooth pulley at P. The coefficient of friction between particle A and Π_1 is $\frac{1}{3}$ and plane Π_2 is smooth. Particle A is initially held at rest such that the string is taut and lies in a line of greatest slope of each plane.

This is shown on the diagram below.



(i) Show that when A is released it accelerates towards the pulley at $\frac{7g}{15}\,\text{m s}^{-2}$. **[6]**

(ii) Assuming that A does not reach the pulley, show that it has moved a distance of $\frac{1}{4}$ m when its speed is $\sqrt{\frac{7g}{30}}\,\text{m s}^{-1}$. **[2]**