Friction

Question Paper

Level	Pre U
Subject	Maths
Exam Board	Cambridge International Examinations
Topic	Mechanics- Friction
Booklet	Question Paper

Time Allowed: **25   minutes**

Score: **/21**

Percentage: **/100**

Grade Boundaries:

1   Two trucks, S and T, of masses 8000 kg and 10 000 kg respectively, are pulled along a straight, horizontal track by a constant, horizontal force of P N. A resistive force of 600 N acts on S and a resistive force of 450 N acts on T. The coupling between the trucks is light and horizontal (see diagram).

450 N   600 N

P N T 8000 kg S 10 000 kg
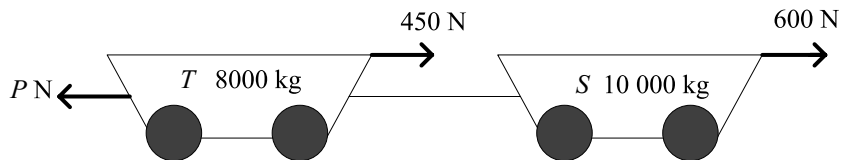
The acceleration of the system is $0.3\,\mathrm{ms^{-2}}$ in the direction of the pulling force of magnitude P.

(i) Calculate the value of P.   [2

Truck S is now subjected to an extra resistive force of 1800 N. The pulling force, P, does not change.

**(ii)** Calculate the new acceleration of the trucks.   [2]

(iii) Calculate the force in the coupling between the trucks.   [2]

2   A particle of mass m kg rests in equilibrium on a rough horizontal table. There is a string attached to the particle. The tension in the string is T N at an angle of θ to the horizontal, as shown in the diagram.

T

θ
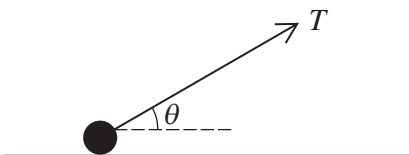
(i) Copy and complete the diagram to show all the forces acting on the particle.   [1]

(ii) The coefficient of friction between the particle and the table is μ and the particle is on the point of slipping. Show that $T = \dfrac{\mu mg}{\cos\theta + \mu\sin\theta}$.   [4]

(iii) Given that $\mu = 0.75$, find the value of θ for which T is a minimum.   [4]

3
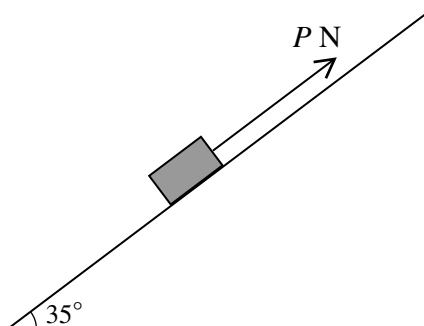
The diagram shows a block of wood, weighing $100\,\text{N}$, at rest on a rough plane inclined at $35°$ to the horizontal. The coefficient of friction between the block and the plane is 0.2. A force of $P\,\text{N}$ acts on the block up the slope.

   (i) Find the maximum possible value of the friction acting on the block.   [2]

  (ii) Given that the block is on the point of moving *up* the slope, find P.   [2]

 (iii) Given that the block is on the point of moving *down* the slope, find P.   [2]