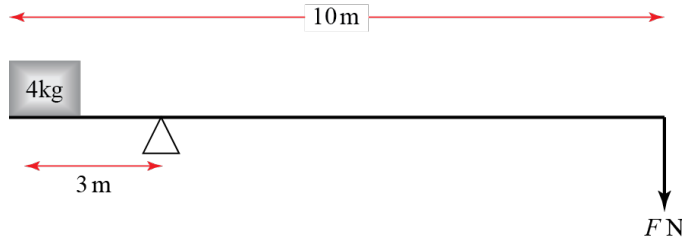


SECTION B: MECHANICS K

Answer ALL questions.

- 4.1** A light see-saw is 10 m long with the pivot 3 m from the left.

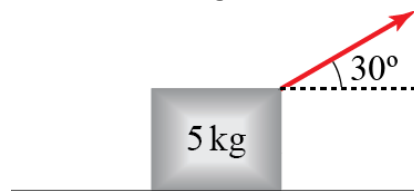
Figure 1



- a** A 4 kg weight is placed on the left-hand end of the see-saw. Write down the anticlockwise moment about the pivot. **(3 marks)**
- b** A force of magnitude F N is applied to the right-hand end of the see-saw. The force acts vertically downwards. Write down the clockwise moment about the pivot due to this weight. **(1 mark)**
- c** Find the value of F for which the system is in equilibrium. **(3 marks)**

- 5.3** An object resting on a rough surface is attached to a rope angled at 30° to the horizontal. The rope is pulled with a force of P N. The mass of the object is 5 kg.

Figure 1



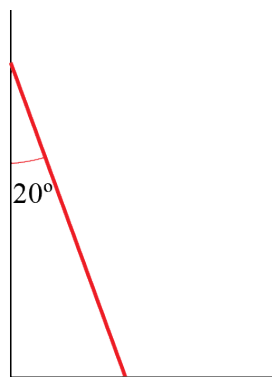
- a** Draw a diagram showing all the forces acting on the object. Describe the origin of each force using words. **(4 marks)**
- b** By resolving forces in the horizontal and vertical directions, calculate the magnitude of each force in the diagram, giving your answers in terms of P where appropriate. **(4 marks)**
- c** If $P = 20$, the object does not slip. Use this information to give a bound on μ in the form of an inequality. **(6 marks)**

8.3 A ball falling vertically through viscous fluid is subject to a drag force of magnitude kv N, where v m s⁻¹ is the speed of the ball at time t seconds. The mass of the ball is 1 kg.

- a** Draw a force diagram showing the forces on the ball. **(2 marks)**
- b** Find an expression for v when the ball is in equilibrium. **(2 mark)**
- c** Explain why $\frac{dv}{dt} = g - kv$ **(3 marks)**
- d** Show, by substitution, that $v = \frac{g}{k}(1 - e^{-kt})$ satisfies this equation in part c. **(3 marks)**
- e** Explain why this solution agrees with your answer to part **b**. **(1 mark)**
- f** Describe one limitation of this model. **(1 mark)**

7.1 A 10 m long, uniform ladder has a mass of 6 kg and makes an angle of 20° with a smooth vertical wall. It stands on a rough horizontal floor, which has coefficient of friction 0.3 with the bottom of the ladder.

Figure 1



- a** Draw a diagram showing all the forces acting on the ladder. Describe the origin of each force using words. **(4 marks)**
- b** Calculate the magnitude of each force and hence determine whether or not the ladder slips. **(13 marks)**