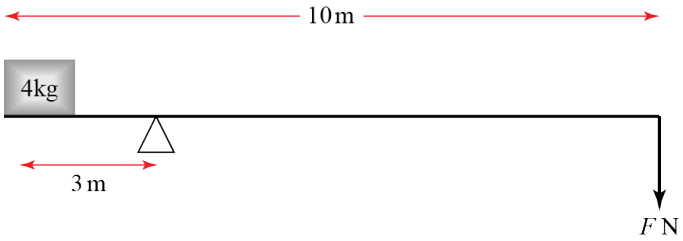
## SECTION B: MECHANICS K

**Answer ALL questions.**

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

**Figure 1**



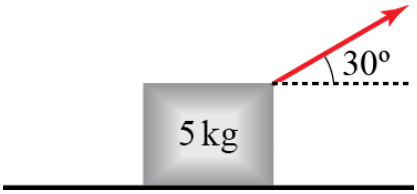

**a** A 4 kg weight is placed on the left-hand end of the see-saw. Write down the anticlockwise moment about the pivot. **(3 marks)**

**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 $\mu$ 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 $\dfrac{\mathrm{d}v}{\mathrm{d}t} = g - kv$ **(3 marks)**

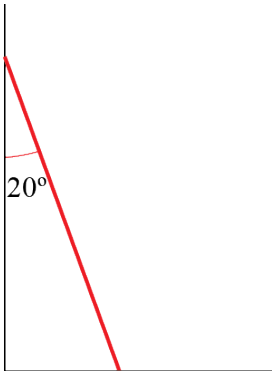
**d** Show, by substitution, that $v = \frac{g}{k}\left(1 - e^{-kt}\right)$ satisfies this equation in part c. **(3 marks)**

**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 horiztonal 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)**