

**8.1 Challenge Problems**

**Challenge Problem 1**

A railway engine of mass 60 tonnes is pulling two trucks each of mass 12 tonnes along a horizontal track. The resistance to motion is 80 N per tonne for the engine and 50 N per tonnes for the trucks. The tractive force exerted by the engine is 27 kN.

- Find
- (a) The acceleration
  - (b) The tension in the coupling between the engine and the first truck.
  - (c) The tension in the coupling between the two trucks.

**Challenge Problem 2**

Two particles of mass 0.5 kg and 0.7 kg are connected by a light inextensible string passing over a fixed smooth pulley. Initially both parts of the string are taut and vertical, and the 0.5 kg mass is moving vertically downwards with a speed of  $3.5 \text{ m s}^{-1}$ . Find the distance it travels before coming instantaneously to rest.

### Challenge Problem 3

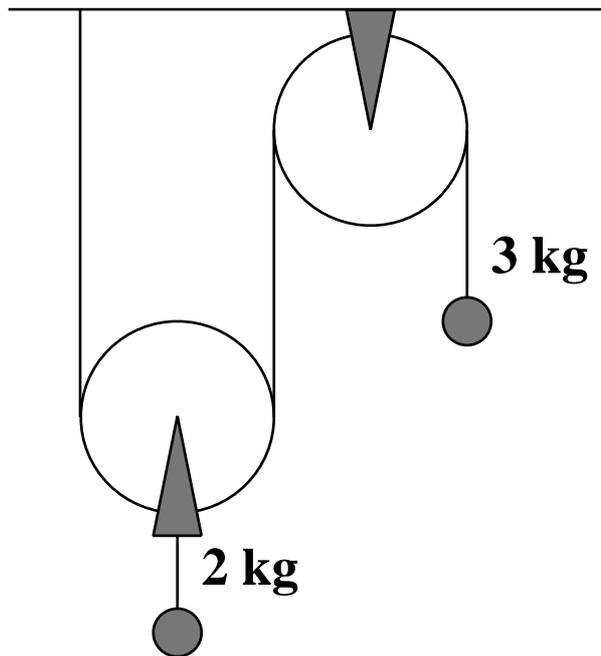
A light inextensible string attached to the ceiling passes under a smooth moveable pulley of mass 2 kg and then over a smooth fixed pulley.

A particle of mass 3 kg hangs freely from the end of the string.

All parts of the string not touching the pulleys are vertical.

If the system is released from rest, find the acceleration of the particle and the tension in the string.

**HINT :** If the acceleration of the particle is  $a \text{ m s}^{-2}$  downward, what must the acceleration upwards of the moveable pulley be ?



**Challenge Problem 4**

A light inextensible string which passes over a smooth fixed pulley  $P$  carries at one end a particle  $A$  of mass  $2\text{ kg}$  and at the other end a smooth light pulley  $Q$ .

A light inextensible string passes over pulley  $Q$  and carries at its ends a particle  $B$  of mass  $1\text{ kg}$  and a particle  $C$  of mass  $2\text{ kg}$ .

- (a) Draw a good sized diagram of the system described.
- (b) Find the acceleration of particle  $A$  when the system is moving freely.
- (c) Find the tension in each of the two strings.

