2.

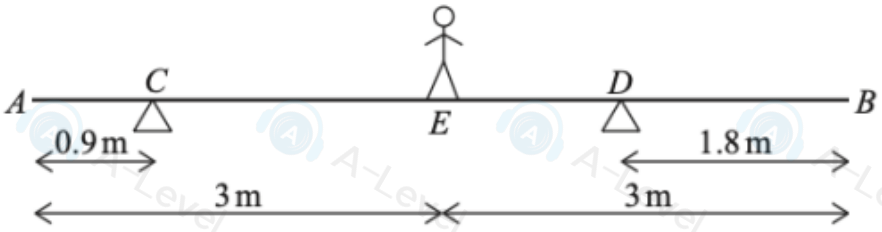

Figure 1

A non-uniform beam AB has length 6 m and mass 50 kg. The beam rests horizontally on two supports at C and D, where $AC = 0.9$ m and $DB = 1.8$ m.

A child of mass 25 kg stands on the beam at E, where $AE = EB = 3$ m, as shown in Figure 1.

The beam is in equilibrium.

The magnitude of the normal reaction between the beam and the support at C is R_C newtons.

The magnitude of the normal reaction between the beam and the support at D is R_D newtons.

The beam is modelled as a rod and the child is modelled as a particle.

The centre of mass of the beam is between C and D and is a distance x metres from D.

Given that $2R_D = 3R_C$

(a) show that $x = 1.38$

(6)

The child remains at E and a block of mass M kg is placed on the beam at B.

The block is modelled as a particle.

Given that the beam is on the point of tilting,

(b) find the value of M.

(3)

Leave blank

3.

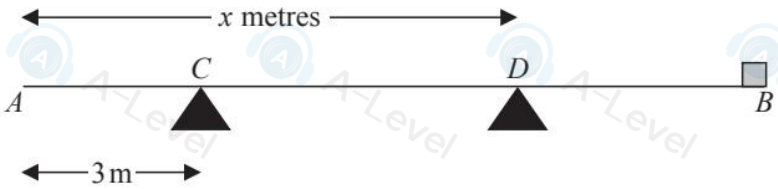

Figure 1

A plank AB has length 8 m and mass 12 kg. The plank rests on two supports. One support is at C, where $AC = 3$ m and the other support is at D, where $AD = x$ metres. A block of mass 3 kg is placed on the plank at B, as shown in Figure 1. The plank rests in equilibrium in a horizontal position. The magnitude of the force exerted on the plank by the support at D is twice the magnitude of the force exerted on the plank by the support at C. The plank is modelled as a uniform rod and the block is modelled as a particle.

Find the value of x.

(7)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Leave blank

3. Two particles A and B have mass $2m$ and km respectively. The particles are moving in opposite directions along the same straight smooth horizontal line so that the particles collide directly. Immediately before the collision A has speed $2u$ and B has speed u. The direction of motion of each particle is reversed by the collision. Immediately after the collision the speed of A is $\frac{u}{2}$.

(a) Find, in terms of m and u, the magnitude of the impulse exerted by B on A in the collision.

(3)

(b) Show that $k < 5$

(4)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Leave blank

4.

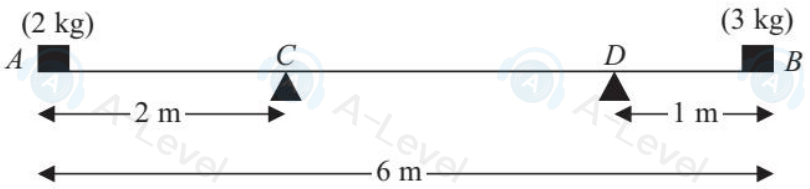

Figure 2

A plank AB, of length 6 m and mass 4 kg, rests in equilibrium horizontally on two supports at C and D, where $AC = 2$ m and $DB = 1$ m. A brick of mass 2 kg rests on the plank at A and a brick of mass 3 kg rests on the plank at B, as shown in Figure 2. The plank is modelled as a uniform rod and all bricks are modelled as particles.

(a) Find the magnitude of the reaction exerted on the plank

(i) by the support at C,

(ii) by the support at D.

(6)

The 3 kg brick is now removed and replaced with a brick of mass x kg at B. The plank remains horizontal and in equilibrium but the reactions on the plank at C and at D now have equal magnitude.

(b) Find the value of x.

(4)

Leave blank

1. Two particles, P and Q, have masses $2m$ and $3m$ respectively. They are moving towards each other, in opposite directions, along the same straight line, on a smooth horizontal plane. The particles collide. Immediately before they collide the speed of P is $2u$ and the speed of Q is u. In the collision the magnitude of the impulse exerted on P by Q is $5mu$.

(a) Find the speed of P immediately after the collision.

(3)

(b) State whether the direction of motion of P has been reversed by the collision.

(1)

(c) Find the speed of Q immediately after the collision.

(3)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA