2 Fig. 2.1 shows a 0.50 kg trolley placed at the top of a smooth ramp.

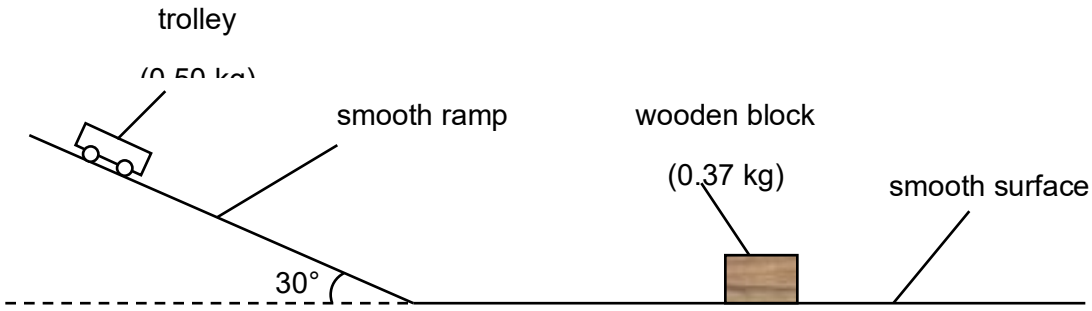
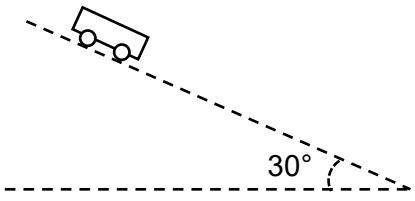


Fig. 2.1

When released from rest, the trolley accelerates down the ramp. It then travels at a constant velocity of 3.2 m s^{-1} along a smooth horizontal surface before colliding with a wooden block of mass 0.37 kg, which is initially at rest. During the collision, the trolley and wooden block are in contact for a duration of time of 0.10 s.

After the collision, the speed of the trolley decreases to 0.64 m s^{-1} and the trolley travels in the same direction as before.

(a) **(i)** In Fig. 2.2, draw a free-body diagram of all the forces acting on the trolley when it is moving down the ramp.



[1]

Fig. 2.2

(ii) Calculate the acceleration of the trolley down the ramp.

[2]

acceleration = ……..……. m s^{-2}

(b) Calculate the magnitude of the average force *F* between the trolley and wooden block during the collision.

[2]

force = ……..…..…… N

(c) Use the principle of conservation of momentum to calculate the speed of the wooden block after the collision.

[2]

speed = ……..…….. m s^{-1}

(d) The experiment is now repeated with the wooden block being replaced by a toy car at rest, and has the same mass of 0.50 kg as the trolley. The trolley accelerates down the ramp upon release.

Explain the subsequent motion of the trolley and the toy car if the trolley collides elastically into the toy car with the same velocity of 3.2 m s^{-1}.

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.... [2]

....

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