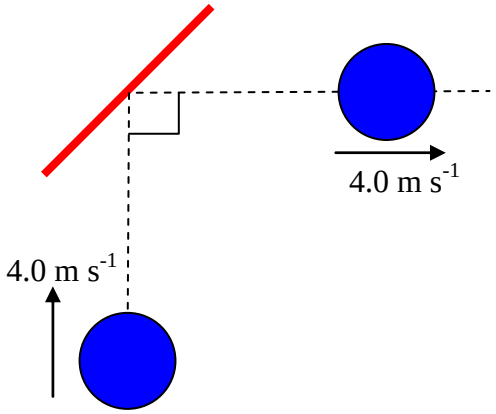
Extension Worksheet – Topic 2, Worksheet 2

1 A ball of mass 0.25 kg travelling at 4.0 m s^{-1} on a horizontal floor hits a wall and rebounds with the same speed as shown in the diagram.



Calculate the impulse delivered to the ball in magnitude and direction. [3]

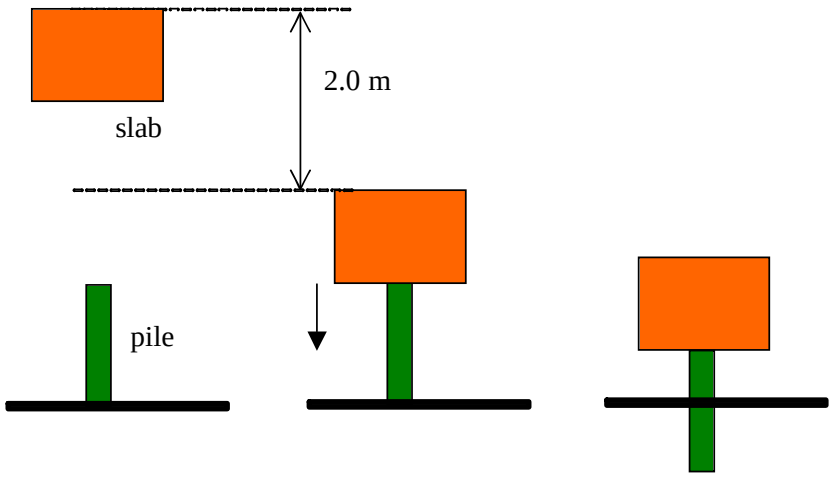
2 A rocket of mass 4000 kg (including fuel) ejects gases at a rate of 200 kg s^{-1} at a speed of 1800 m s^{-1} relative to the rocket. The rocket is initially at rest on the surface of a planet where g = 8.0 m s^{-2}. Calculate:

a the force exerted on the gases by the rocket engine. [2]

b the initial net force on the rocket. [1]

c the initial acceleration of the rocket. [1]

3 A slab of mass 54 kg falls from rest from a height of 2.0 m above a pile of mass 18 kg as shown in the diagram.



a Calculate the speed of the slab as it impacts the pile. [2]

b Calculate the common speed with which the pile and the slab move immediately after impact. [2]

c The pile is driven to a depth of 0.50 m in the ground. Calculate the average upward force the ground exerted on the pile. [3]

4 After a body has fallen vertically by a certain distance the gravitational potential energy of the body decreased by ΔE_P and an amount of thermal energy Q was generated. The change in the body's kinetic energy during this time is

A ΔE_P

B $\Delta E_P + Q$

C $\Delta E_P - Q$

D Q [1]

5 The graph shows the variation with distance of the net force acting on a body of mass 6.0 kg that is initially at rest.

a Determine the maximum acceleration of the mass during its displacement by 10 m. [1]

b Calculate the work done on the mass when the mass has moved 4.0 m. [2]

c Calculate the speed of the mass at $x = 4.0$ m. [2]

6 The graph shows the variation with time of the net force acting on a body of mass 0.50 kg that is initially at rest.

a Determine the maximum acceleration of the mass during the 10 s interval. [1]

b Calculate the velocity of the mass at t = 10 s. [3]

c Calculate the average power developed by the net force during the 10 s interval. [2]

d Calculate the average force acting on the ball. [1]

e Calculate the distance travelled during the 10 s. [2]