Momentum

Have a go at the following exam questions.

Edexcel IAL, Unit 4, Jan 15

17 (a) State the principle of conservation of momentum.

(2)

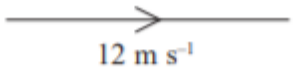
(b) State the relationship between the resultant force acting on an object and the momentum of the object.

(1)

(c) A car is travelling due east with a velocity of 12 m s^{-1}. The driver of the car changes direction to travel due north with a velocity of 15 m s^{-1}.

(i) The initial velocity is shown in the diagram.
Complete the vector diagram to represent the change in velocity. You do not need to draw it exactly to scale.

(2)



(ii) Determine the change in velocity of the car.

(3)

Magnitude of change of velocity = ...

Direction of change of velocity = ...

(iii) The mass of the car is 1500 kg and the change in velocity took 4.0 s.

Calculate the average force that was needed.

(2)

Force = ...

(Total for Question 17 = 10 marks)

OCR A, G484, Jan 11

1 (a) (i) State the principle of *conservation of linear momentum*.

.....

.....

..... **[2]**

(ii) Explain what is meant by an *inelastic collision*.

.....

..... **[1]**

(iii) Fig. 1.1 shows the head-on-collision of two blocks on a frictionless surface.

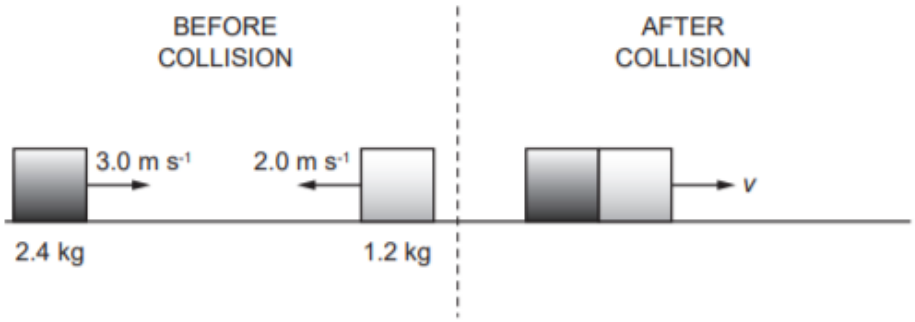


Fig. 1.1

Before the collision, the 2.4 kg block is moving to the right with a speed of 3.0 m s^{-1} and the 1.2 kg block is moving to the left at a speed of 2.0 m s^{-1}. During the collision the blocks stick together. Immediately after the collision the blocks have a common speed *v*.

1 Calculate the speed *v*.

v = ... m s^{-1} **[2]**

2 Show that this collision is inelastic.

(b) Fig. 1.2 shows a helicopter viewed from above.

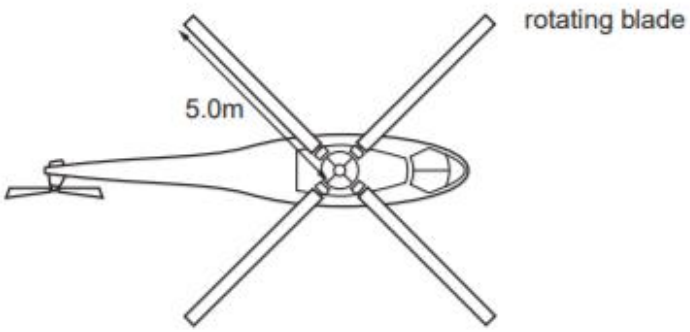


Fig. 1.2

The blades of the helicopter rotate in a circle of radius 5.0 m. When the helicopter is hovering, the blades propel air vertically downwards with a constant speed of $12\,m\,s^{-1}$. Assume that the descending air occupies a uniform cylinder of radius 5.0 m.

The density of air is $1.3\,kg\,m^{-3}$.

(i) Show that the mass of air propelled downwards in a time of 5.0 seconds is about 6000 kg.

[2]

(ii) Calculate

1 the momentum of this mass of descending air

momentum = ... $kg\,m\,s^{-1}$ **[1]**

2 the force provided by the rotating helicopter blades to propel this air downwards

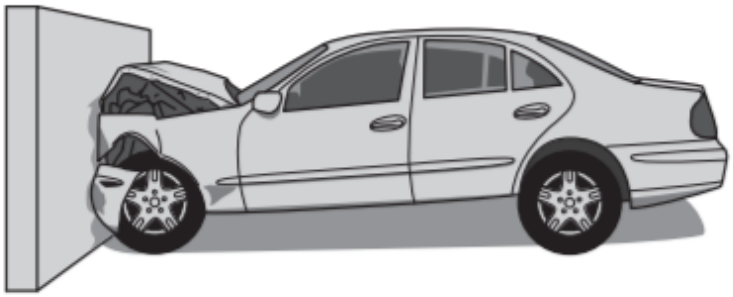
force = ... N **[2]**

3 the mass of the hovering helicopter.

mass = ... kg **[1]**

[Total: 13]

(b) The crumple zone of a car is a hollow structure at the front of the car designed to collapse during a collision. In a laboratory road-test, a car of mass 850 kg was driven into a concrete wall. A video recording of the impact showed that the car, initially travelling at 7.5 ms^{-1}, was brought to rest in 0.28 s when it hit the wall.



(i) Calculate

1 the deceleration of the car, assuming it to be uniform

deceleration = ... ms^{-2} **[1]**

2 the average force exerted by the wall on the car.

force = ... N **[2]**

(ii) The crumple zone of the car is designed to absorb 0.45 MJ of energy before any distortion of the passenger cabin occurs. For this design of crumple zone, calculate the maximum speed of the car at impact.

speed = ... $m s^{-1}$ **[2]**

(c) In a different test, another car of mass 850 kg is travelling at a speed of 7.5 $m s^{-1}$. It makes a head-on collision with a stationary car of mass 1200 kg. Immediately after the impact, both cars move off together with a common speed *v*. Calculate this speed.

v = ... $m s^{-1}$ **[2]**

[Total: 10]