WHA

CP1 and CP2 Calculations

EXAM BOOKLET

MCKELVIE. S

(c) After the 3 seconds, the weight lifter drops the mass.
The velocity of the mass just before it hits the floor is 6.4 m/s.

Calculate the momentum of the mass just before it hits the floor.
State the unit.

(3)

The mass is 240Kg

momentum = ... unit = ...

(b) The mass of one water drop is 0.000 08 kg.

Calculate its weight.

(gravitational field strength is 10 N/kg)

(2)

weight = ... N

(c) The water drop falls to the ground, 13 m below, in 1.7 s.

Calculate the average speed of the drop while it is falling.

(2)

average speed = ... m/s

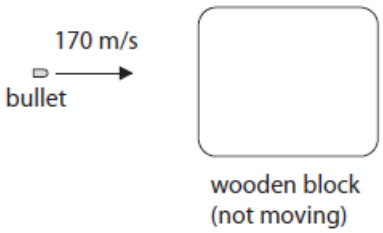
(ii) The car now accelerates in a straight line.
Its average acceleration is 12 m/s^2.

Calculate the increase in velocity of the car in 4.0 s.

(3)

speed = ... m/s

4 (a) The diagram shows a bullet moving towards a wooden block.



(i) The bullet is moving with a velocity of 170 m/s.
The mass of the bullet is 0.030 kg.

Show that the momentum of the bullet is about 5.0 kg m/s.

(1)

(ii) The bullet collides with the wooden block and sticks in it.
The bullet and the wooden block move off together.
The mass of the wooden block is 0.80 kg.

Calculate the velocity of the wooden block and bullet immediately after the collision.

(3)

velocity = ... m/s

2 Andrew skis down a hill.

(b) Andrew returns to the top of the hill and starts again.

(i) His mass is 67 kg.

Show that his momentum is about 2000 kg m/s when his velocity is 31 m/s.

(2)

(ii) He falls over when his momentum is 2000 kg m/s.

After he falls over, he slows down by sliding across the snow.

It takes 2.3 s for his momentum to reduce to zero.

Calculate the average force on Andrew as he slows down.

(2)

force = ... N

(iii) The child and cart have a total mass of 50 kg. They travel at a velocity of 4 m/s.

Calculate the momentum of the child and cart.

(2)

momentum = ... kg m/s

(iv) The father applies a steady force for a time of 1.5 s. The momentum of the child and cart increases by 450 kg m/s.

Calculate the force which the father applies.

(2)

force = ... N

(c) Both vehicles are travelling at 13 m/s.

The driver of the truck then accelerates at 1.2 m/s^2 until both vehicles are travelling at 20 m/s.

(i) Calculate the time taken for this acceleration.

(3)

time = ... s

(ii) The mass of the car is 1400 kg.

Calculate the resultant force on the car needed to produce an acceleration of 1.2 m/s^2.

(2)

force = ... N

(d) When the car and passengers reach E, they have a total momentum of 150 000 kg m/s.

The total mass of the car and passengers is 9500 kg.

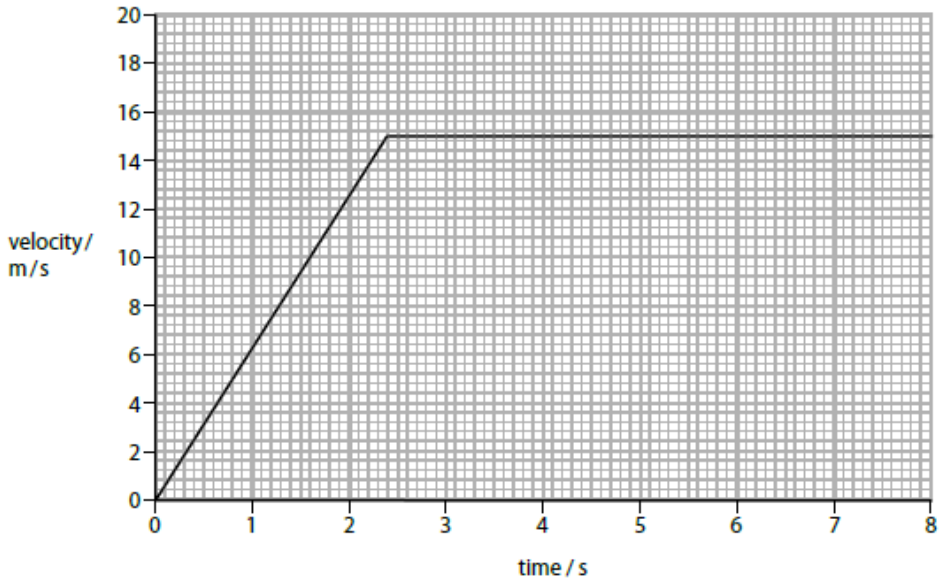
Calculate the velocity of the car and passengers at E.

(3)

velocity = ... m/s

Forces and motion

6 (a) The graph represents the motion of a cyclist at the start of an Olympic race.



(i) Calculate the initial acceleration.

(2)

acceleration = ... m/s²

(ii) Another cyclist has a smaller initial acceleration but then reaches a constant velocity of 17 m/s.
Draw her motion on the graph above.

(1)

5 (b) The mass of the skateboard is 1.8 kg and the mass of the skateboarder is 42 kg.

Calculate the velocity at which the skateboard moves backwards if the skateboarder jumps forwards at a velocity of 0.3 m/s.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

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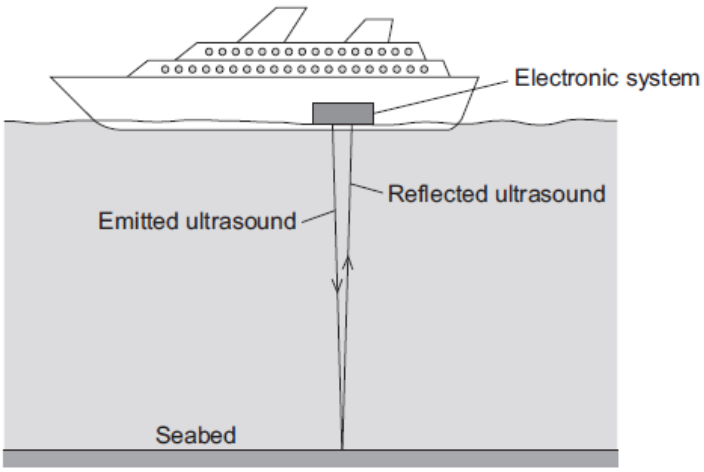
Velocity of skateboard = ... m/s

1 (b) **Figure 1** shows how ultrasound is used to measure the depth of water below a ship.

Figure 1



A pulse of ultrasound is sent out from an electronic system on-board the ship.

It takes 0.80 seconds for the emitted ultrasound to be received back at the ship.

Calculate the depth of the water.

Speed of ultrasound in water = 1600 m/s

Use the correct equation from the Physics Equations Sheet.

[3 marks]

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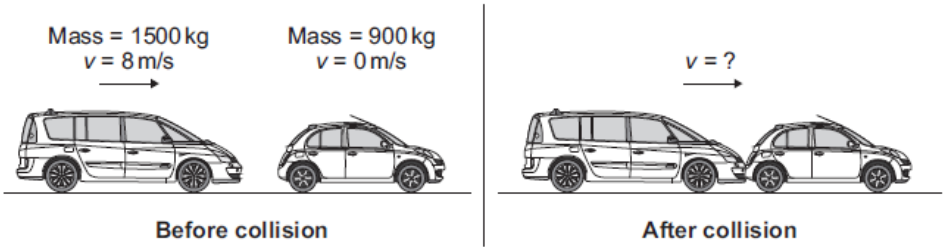
Depth of water = ... metres

4 (c) The car did not stop in time. It collided with the stationary car in front, joining the two cars together.

Figure 5 shows both cars, just before and just after the collision.

Figure 5



4 (c) (i) The momentum of the two cars was conserved.

What is meant by the statement 'momentum is conserved'?

[1 mark]

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.....

4 (c) (ii) Calculate the velocity of the two joined cars immediately after the collision.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

.....

.....

.....

.....

.....

Velocity = ... m/s

(b) (i) State the equation linking average speed, distance moved and time taken.

(1)

(ii) Calculate the average speed of person X in the queue.

Give the unit.

(3)

average speed = ... unit .....

(b) The speed of light in a vacuum is 300 000 km/s.

The average time for a ray of light to travel to the Moon and back is about 2.6 s.

Show that the Moon is about 400 000 km from the Earth.

(3)

4 A lorry carries a load of hot asphalt – a runny mixture of small stones and tar.

(a) The mass of the lorry and its load is 17 000 kg.

The velocity is 13 m/s.

(i) State the equation linking momentum, mass and velocity.

(1)

(ii) Calculate the total momentum of the lorry and its load.

(2)

momentum = ... kg m/s

(b) A car travels at 20 m/s.

The mass of the car is 1500 kg.

(i) State the equation linking momentum, mass and velocity.

(1)

(ii) Calculate the momentum of the car.

(2)

momentum = ... kg m/s

(c) In a crash test, a car runs into a wall and stops.

(Author: Brady Holt, 2010)

The momentum of the car before the crash is 22500 kg m/s.

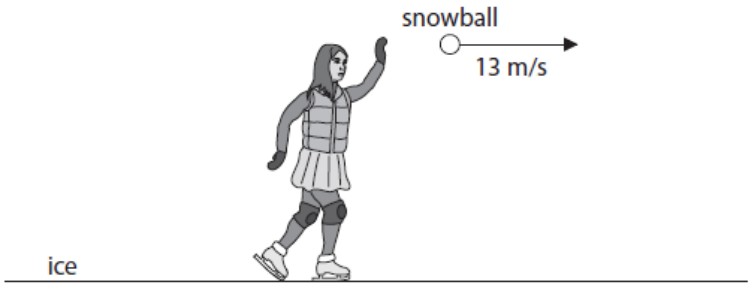
The car stops in 0.14 s.

(i) Calculate the average force on the car during the crash.

(2)

average force = ... N

5 An ice skater throws a 0.23 kg snowball with a velocity of 13 m/s.



(a) (i) State the equation linking momentum, mass and velocity.

(1)

(ii) Calculate the initial momentum of the snowball.

(2)

initial momentum = ... kg m/s

11 An underground train enters a station.

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(a) The mass of the train and its passengers is 250 000 kg.

The total kinetic energy is 18 MJ.

(i) State the relationship between kinetic energy (KE), mass and velocity.

(1)

(ii) Calculate the velocity of the train as it enters the station.

(3)

velocity = ... m/s

6 The photograph shows a hammer just before it hits a nail.

(a) The mass of the hammer is 0.50 kg.

When it hits the nail, the hammer is travelling downwards with a velocity of 3.1 m/s.

(i) State the relationship between momentum, mass and velocity.

(1)

(ii) Calculate the momentum of the hammer.

(2)

momentum = ... kg m/s

(iii) The hammer stops quickly when it hits the nail.

The momentum of the hammer reduces to zero in 0.070 s.

Calculate the amount of force that causes this to happen.

(2)

(ii) The card takes 0.040 s to travel through the light gate.

The student calculates that the average speed of the trolley through the light gate is 1.15 m/s.

Calculate the width of the card.

(2)

width = ... cm

(iii) The trolley travels 1.2 m along the track from the start before the card reaches the light gate.

Show that acceleration of the trolley along this distance is approximately 0.55 m/s^2.

(2)

(b) The table shows some data about the Earth's orbit of the Sun.

orbital radius (R)	1.5×10^8 km
time for one orbit (T)	3.2×10^7 s

Use the following equation to calculate the orbital speed, *v*, of the Earth.

$$v = \frac{2 \times \pi \times R}{T}$$

(3)

v = ... m/s