TAVUA COLLEGE
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WEEKLY HOME STUDY PACKAGE - WEEK 2 (12/07/21 – 16/07/21)

Subject	**PHYSICS**	**Year/Level**	**12**
Strand	MECHANICS		
Sub-strand	MOMENTUM		
Content Learning Outcome	➢ Relate impulse to the change in momentum		

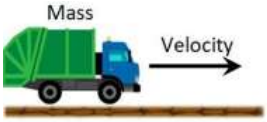
LESSON NOTES/ACTIVITY:

MOMENTUM

It is the product of mass and velocity.
It is a vector quantity.

$$p = mv$$

where; p = momentum ($kgms^{-1}$),
m = mass (kg), v = velocity (ms^{-1})



IMPULSE AND CHANGE IN MOMENTUM

- ➢ Change in momentum is final momentum minus the initial momentum.
- ➢ Change in momentum is also known as an impulse.
- ➢ Impulse is equivalent to a force applied to an object for a period of time.
- ➢ It is the product of the average force and the time.
- ➢ Unit for impulse is Ns or $kgms^{-1}$

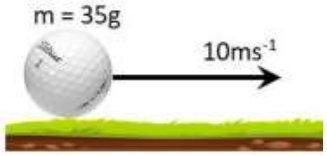
$$\Delta p = p_f - p_i$$

where; Δp = change in momentum ($kgms^{-1}$)
p_f = final momentum ($kgms^{-1}$)
p_i = initial momentum ($kgms^{-1}$)

$$\Delta p = F \times t$$

Example:

1. Find the momentum of a 35g golf ball travelling at $10ms^{-1}$.



Solution:

$m = 35g \div 1000 = 0.035kg$
$v = 10ms^{-1}$

$$p = mv$$
$$p = (0.035)(10)$$
$$p = 0.35 kgms^{-1}$$

2. How long must a 300kg satellite in orbit, fire its thruster rocket in order to increase its speed from 500m/s to 600m/s? The force exerted by the thruster when firing is 1500N.

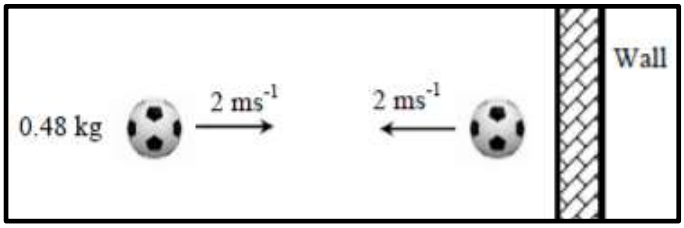
Solution:

$m = 300kg \quad v_i = 500ms^{-1} \quad v_f = 600ms^{-1}$

$$\Delta p = p_f - p_i$$
$$= mv_f - mv_i$$
$$= (300)(600) - (300)(500)$$
$$= 180000 - 150000$$
$$= 30000 kg\,ms^{-1}$$

$$\Delta p = F \times t$$
$$30000 = (1500)t$$
$$\frac{30000}{1500} = t$$
$$t = 20s$$

3. A ball of mass 0.48 kg is kicked at 2 ms^{-1} towards the wall. The ball hits the wall and bounces back directly at 2 ms^{-1} as shown in the diagram.



(i) Calculate the magnitude of change in momentum of the ball.
(ii) Calculate the acceleration of the ball, if the impact time of the ball with the wall was 0.1 seconds.

Solution:

(i)
$$\Delta p = p_f - p_i$$
$$= mv_f - mv_i$$
$$= (0.48)(2) - (0.48)(2)$$
$$= 0.96 - 0.96$$
$$= 0.96 + 0.96$$
$$= 1.92 kgms^{-1}$$

(ii)
$$\Delta p = F \times t$$
$$(1.92) = F(0.1)$$
$$\frac{1.92}{0.1} = F$$
$$F = 19.2N$$

$$F = ma$$
$$19.2 = 0.48a$$
$$\frac{19.2}{0.48} = a$$
$$a = 40ms^{-2}$$

EXERCISE 2

1. Which of the following is the unit of momentum?

   A. kg B. ms^{-1} C. $kg\ ms^{-1}$ D. $kg\ m^{-1}s^{-2}$

   (1 mark)

2. Find the momentum of ship of mass 40000 tonnes moving at 0.2m/s to the south.

   (2 marks)

3. The force on an object is equal to the rate of change of

   A. energy B. velocity C. distance D. momentum

   (1 mark)

4. A soccer ball has a mass of 0.4kg. Initially it is moving to the right at 20m/s but then it is kicked straight back to the left with a velocity of magnitude 30m/s.

   What average net force acts on the ball, assuming the player's foot was in contact with the ball while kicking for 0.01s?

   A. 400N to the right B. 400N to the left C. 2000N to the left D. 2000N to the right

   (1 mark)