

# Momentum and Impulse Test Practice

# Q1

- *Determine whether the following statements are true or false.*
- 1. Momentum is not equal to the mass of an object divided by its velocity.
- 2. The momentum of an object can change.
- 3. Two objects with the same mass will always have the same momentum.
- 4. All moving objects don't have momentum.
- 5. When an object speeds up, it gains momentum.
- 6. Objects with different masses can't have the same momentum.
- 7. Direction does not matter when you are measuring momentum.
- 8. Momentum can be transferred from one object to another.
- 9. When objects collide, some momentum is lost.
- 10. A tiny bullet can have more momentum than a huge truck.

## Q2

- *Fill in the blank to complete the statement.*
- A moving car has momentum. If it moves twice as fast, its momentum is ? as much.
- Two cars, one twice as heavy as the other, move down a hill at the same speed. Compared to the lighter car, the momentum of the heavier car is ? as much.

# Q3

- Complete:

Object	Mass (kg)	Velocity (m/s)	Momentum (kg x m/s)
13. Bird	0.04	19	
14. Football Player	100	10	
15. Skier	60	20	
16. Bullet	0.004	600	
17. Frog	0.9	12	
18. Meteorite	0.1	1,000	
19. Baseball	0.14	30	
20. Wagon	2	3	
21. Satellite	3,000	8,000	

# Q4

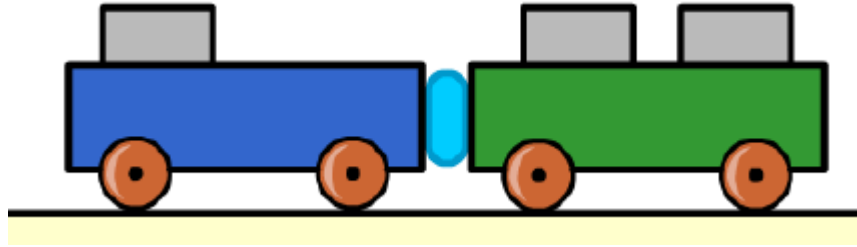
- Suppose you are traveling in a bus at highway speed on a nice summer day and the momentum of an unlucky bug is suddenly changes as it splatters onto the front window.
- a. Compared to the force that acts on the bug, how much force acts on the bus? (more) (same)
- b. Although the momentum of the bus is very large compared to the momentum of the bug, the change in momentum of the bus, compared to the change in momentum of the bug is (more) (same)
- c. Which experiences the greater acceleration? (HINT: think of Newton's second law) (bus) (both the same)
- d. Which, therefore, suffers the greater damage? (bus) (both the same)

# Q5

- An aircraft carrier has a mass of 1,000,000kg and a velocity of 15m/s. What is its momentum?

# Q6

- Two trolleys collide and stick together. From the data below, calculate the velocity of the trolleys after the collision.



**trolley A**

mass = 3 kg

velocity = 8 m/s

momentum = 24 kg m/s

**trolley B**

mass = 5 kg

velocity = -4 m/s

momentum = -20 kg m/s

## Q7

- During a Scottish rugby game a ball of mass  $0.5\text{kg}$  is kicked from stationary to a velocity of  $8\text{m/s}$ . The kicker's foot is in contact with ball for  $0.1$  seconds. What force does the kicker use?

## Q8

- A tennis ball is rolled at a toy car of mass  $0.1\text{kg}$ . The car is moved with a velocity of  $0.5\text{m/s}$ . If the ball and car are in contact for  $0.05$  seconds, with what force is the tennis ball rolled?

# Q9

- A railway truck *A* of mass 3000 kg moves north on straight horizontal rails at a speed of  $5\text{ms}^{-1}$ . Another truck *B* of mass 4000 kg moves south towards *A* at a speed of  $u\text{ms}^{-1}$ . When they collide, they stay together as a single body *C*, which continues to move north at a speed of  $1\text{ms}^{-1}$ .
- (a) Find the speed of *B* before the collision.

## Q9 continued

- (b) Find the magnitude of the impulse exerted on A and B during the collision.

# Q10

- A golf club undergoes an *inelastic* collision with a golf ball and gives it an initial velocity of  $60 \text{ m s}^{-1}$ . The ball is in contact with the club for  $15 \text{ ms}$  and the mass of the ball is  $4.5 \times 10^{-2} \text{ kg}$ .
- (a) Explain what is meant by an inelastic collision.
- (b) Calculate (i) the change in momentum of the ball,

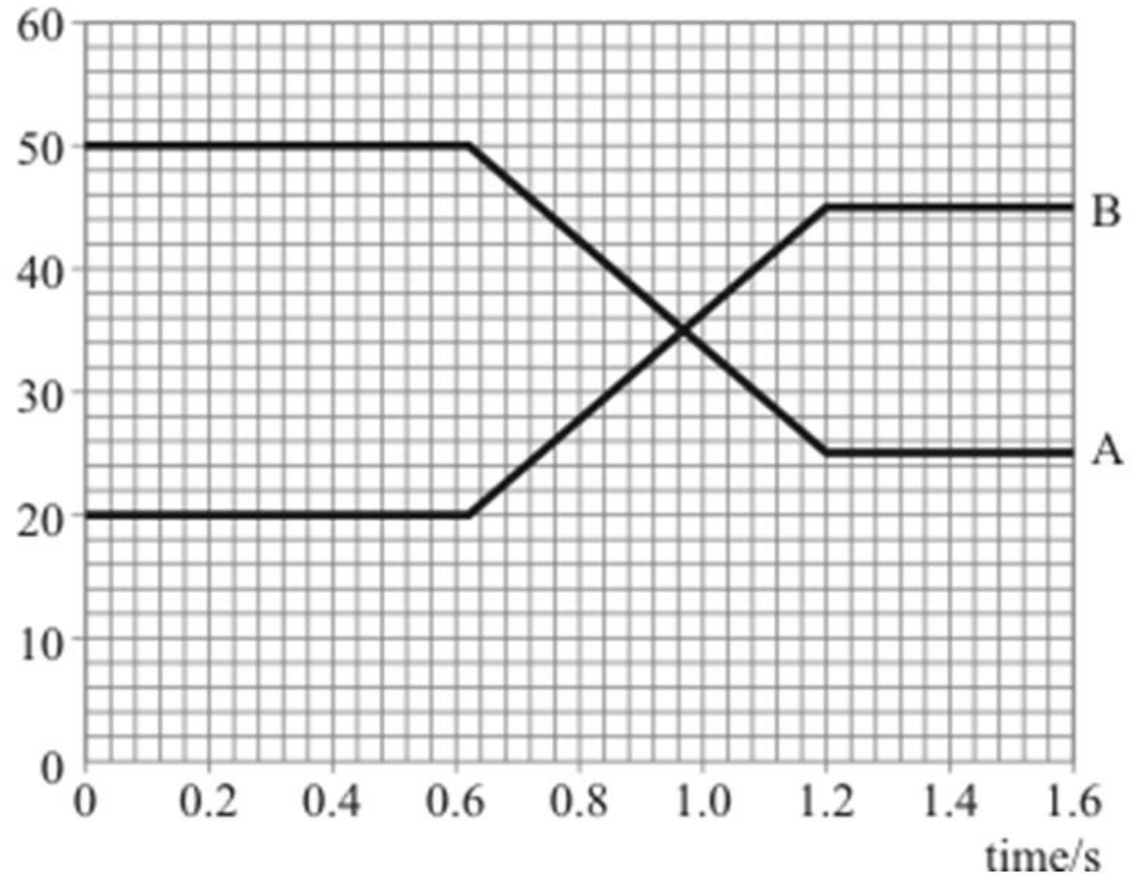
# Q11

- In a football match, a player kicks a stationary football of mass 0.44 kg and gives it a speed of  $32 \text{ m s}^{-1}$ .
- (a) (i) Calculate the change of momentum of the football.
  
- (ii) The contact time between the football and the footballer's boot was 9.2 m s. Calculate the average force of impact on the football.

# Q12

- The graph shows how the momentum of two colliding railway trucks varies with time. Truck **A** has a mass of  $2.0 \times 10^4$  kg and truck **B** has a mass of  $3.0 \times 10^4$  kg. The trucks are travelling in the same direction.

momentum/ $10^3$  kg m s<sup>-1</sup>



# Q12 continued

- (a) Calculate the change in momentum of
- (i) truck **A**,
- (ii) truck **B**.

# Q12 continued

- (b) Complete the following table.

	Initial velocity/ $\text{m s}^{-1}$	Final velocity/ $\text{m s}^{-1}$	Initial kinetic energy/J	Final kinetic energy/J
truck A				
truck B				

- (c) State and explain whether the collision of the two trucks is an example of an elastic collision.

# Q13

- (a) State **two** quantities that are conserved in an elastic collision.
- quantity 1:
- quantity 2: .....
- .....
- (b) A gas molecule makes an elastic collision with the walls of a gas cylinder. The molecule is travelling at  $450 \text{ m s}^{-1}$  at right angles towards the wall before the collision.

# Q13 continued

- (i) What is the magnitude and direction of its velocity after the collision?
- (ii) Calculate the change in momentum of the molecule during the collision if it has a mass of  $8.0 \times 10^{-26}$  kg.
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# Q14

- A steel ball whose mass is 2.0 kg is rolling at a rate of 2.8 m/s. What is its momentum?
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# Q15

- A marble is rolling at a velocity of 1.5 m/s with a momentum of 0.10 kg x m/s. What is its mass?
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# Q16

- A particle A, of mass 6 kg, travelling in a straight line at  $5 \text{ m s}^{-1}$  collides with a particle B, of mass 4 kg, travelling in the same straight line, but in the opposite direction, with a speed of  $3 \text{ m s}^{-1}$ . Given that after the collision particle A continues to move in the same direction at  $1.5 \text{ m s}^{-1}$ , what speed does particle B move with after the collision?