Momentum Questions for GCSE Physics

1. Calculate the momentum of a car with a mass of 1,000 kg, moving at 20 m/s.

p = mv

= 1000 x 20

= ***20,000 kgm/s***

2. A tennis ball of mass 0.2 kg is moving at 10 m/s. What is its momentum?

p = mv

= 0.2 x 10

= ***2 kgm/s***

3. Rearrange the formula p=mv to calculate velocity when momentum and mass are given?

v = p / m

4. A cyclist and their bicycle have a total mass of 80kg. If their momentum is 320 kgm/s, what is their velocity.

p = m v

320 = 80 x v

320 / 80 = v = ***4 m/s***

5. What is the mass of an object with momentum 500 kgm/s moving at 25 m/s?

p = m v

500 = m x 25

500 / 25 = m

= ***20kg***

6. State the law of conservation of momentum.

The momentum before a collision or explosion is equal to the momentum after the collision or explosion provided that no external forces act.

7. Two objects collide. Object A has a mass of 2 kg and a velocity of 4 m/s, and object B has a mass of 3 kg and a velocity of −2 m/s. What is the total momentum before the collision?

For A: $p = m\,v$ $= 2 \times 4 = 8$ kgm/s

For B: $p = m\,v$ $= 3 \times (-)2 = (-)6$ kgm/s

Total momentum = 8 + (-)6 = ***2 kgm/s***

8. A 1,500 kg car moving at 10 m/s collides with a stationary 2,000 kg truck. If they stick together after the collision, calculate their combined velocity?

Momentum before collision = Momentum after collision

(1500 x 10) + (2000 x 0) = (1500 + 2000) v

15000 = 3500 v

15000 / 3500 = v $=$ ***4.3 m/s***

9. A 5 kg ball moving at 8 m/s hits a stationary ball of mass 2 kg. After the collision, the first ball moves at 2 m/s. What is the velocity of the second ball?

Momentum before collision = Momentum after collision

(5 x 8) + (2 x 0) = (5 x 2) + (2 x v)

40 = 10 + 2v

40 – 10 = 2v *30 = 2v* *30 / 2 = v* $=$ ***15 m/s***

10. Two ice skaters, one weighing 60 kg and the other 50 kg, push off each other from a stationary position. If the 60 kg skater moves at 2 m/s, find the velocity of the 50 kg skater.

Momentum before the push = 0

0 = (60 x 2) + (50 x v)

0 = 120 + 50v *-120 = 50v* *v = (-)120 / 50* $=$ ***-2.4 m/s***

11. A bullet of mass 0.01 kg is fired at 400 m/s from a gun of mass 2 kg. What is the recoil velocity of the gun?

Momentum before gun fires = 0

0 = Momentum of gun + Momentum of bullet

0 = (2 x v) + (0.01 x 400)

0 = 2v + 4 *-4 = 2v* *-4 / 2 = v* = ***-2 m/s***

12. In an explosion, a 10 kg object splits into two pieces. One piece of mass 4 kg moves left at 6 m/s. Calculate the velocity of the second piece.?

[10kg – 4kg = 6kg] *0 = (4 x 6) + (6 x v)*

0 = 24 + 6v

-24 = 6v

-24 / 6 = v = ***(-)4 m/s***

[If you assume negative is left then you get an answer of 4 m/s]

13. A stationary rocket with a total mass of 1,000 kg ejects gas at 500 m/s. If 200 kg of gas is ejected, find the velocity of the rocket after ejection.

0 = (800 x v) + (200 x 500)

0 = 800v + 100,000

-100,000 = 800v *-100,000 / 800 = v* = ***-125 m/s***

[If you assume that the gas has a negative velocity then you get 125 m/s]

14. Two carts on a frictionless track collide elastically. Cart A has mass 3 kg and moves at 5 m/s. Cart B has mass 2 kg and is stationary. After the collision, Cart A moves at 2 m/s. Find the velocity of Cart B.

(3 x 5) + (2 x 0) = (3 x 2) + (2 x v)

15 + 0 = 6 + 2v

15 – 6 = 2v

9 / 2 = v = ***4.5 m/s***

15. A 1,000 kg car traveling at 15 m/s collides head-on with a 1,200 kg car traveling at −10 m/s. If they stick together, calculate their final velocity.

(1000 x 15) + (1200 x (-)10) = (1000 + 1200) v

15000 – 12000 = 2200 v

3000 = 2200 v

3000 / 2200 = v = ***1.4 m/s***

16. A 1,200 kg car traveling at 25 m/s collides with a 9000 kg truck moving at 15 m/s in the same direction. After the collision, the two vehicles stick together. Calculate the final velocity of the combined system.

(1200 x 25) + (9000 x 15) = (1200 + 9000) v

30,000 + 135,000 = 10,200 v

165,000 = 10,200 v

165,000 / 10,200 = v = ***16.2 m/s***

17. Two ice hockey players, one 75 kg moving at 4 m/s and the other 65 kg moving at −3 m/s, collide and hold onto each other. Determine their velocity after the collision.

(75 x 4) + (65 x (-)3) = (75 + 65) v

300 + (-)195 = 140 v

105 = 140 v

105 / 140 = v = ***0.75 m/s***

18. A trolley of mass 8 kg moving at 6 m/s collides with a stationary trolley of mass 12 kg. After the collision, the 8 kg trolley moves at 2 m/s. Find the velocity of the 12 kg trolley.

(8 x 6) + (12 x 0) = (8 x 2) + (12 x v)

48 = 16 + 12 v

48 – 16 = 12v *32 = 12v* *32/12 = v* = ***2.7 m/s***

19. Explain why momentum is conserved in a closed system but not in an open system.

In a closed system there are no external forces acting.

In an open system there may be external forces acting.

20. A 5,000 kg spacecraft is stationary in space. To propel itself, it ejects 1,000 kg of fuel at 2,500 m/s relative to the spacecraft. Calculate the final velocity of the spacecraft after the fuel is ejected.

[the spacecraft's mass decreases by 1000kg] *0 = (1000 x 2500) + (4000 x v)*

0 = 2500,000 + 4000 v

-2500,000 = 4000 v

-2500,000 / 4000 = v = ***-625 m/s***