Physics 12

1-Demensional Momentum and Impulse Problem SET 2020

1. *A child in a boat throws a 5.40-kg package out horizontally with a speed of 10.0m/s. Calculate the velocity of the boat immediately after, assuming it was initially at rest. The mass of the child is 26.0 kg and that of the boat is 55.0 kg. (see explosion example) answer:* v = -.667 m/s

2. *Dustin is running for a touchdown and is tacked from behind. If Dustin has a mass of 95 kg and was moving 4.2 m/s when he was tackled by Jake (85kg) running at 5.5 m/s in the same direction, what was their mutual speed immediately after the touchdown-saving tackle? (inelastic)* v = 4.76 m/s

3. *A 12,500-kg railroad car travels alone on a level frictionless track with a constant speed of 18.0m/s. A 5750-kg additional load is dropped on a car. What then will be the car's speed? v* = 12.3 m/s

4. A 15-g bullet strikes and becomes embedded in a 1.10-kg block of wood placed on a horizontal surface just in front of the gun. If the coefficient of kinetic friction between the block and the surface is 0.25, and the impact drives the block a distance of 9.5 m and before it comes to rest, what was the original speed of the block and bullet after the collision? What was the speed of the bullet before impact? *v = 6.823 m/s, 507.2 m/s.*

5. A tennis ball may leave the racket of a player on the serve with a speed of 65.0 m/s. If the ball's mass is 0.0600 kg and it is in contact with the racket for 0.0300 s, what is the average force on the ball? Would this force be large enough to lift a 60-kg person? F = 130. N, nope

6. A 0.145-kg baseball pitched at 39.0 m/s is hit on horizontal line drive straight back toward the pitcher at 52.0 m/s. If the contact time between bat and ball is 1.00×10^{-3} s, calculate the average force between the ball and the bat during contact. F = +13195 N (towards the outfield)

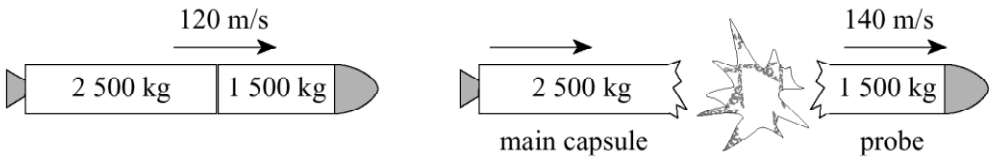
7.

A puck sliding on a frictionless table undergoes a change in momentum due to a constant force. Which of the following expressions could be used to determine the change in momentum?

A. $F \times \Delta d$
B. $F \times \Delta t$
C. $F \times \Delta v$
D. $F \times (\Delta v / \Delta t)$

8.

A 4 000 kg space vehicle consists of a 2 500 kg main capsule and a 1 500 kg probe. The space vehicle is travelling at 120 m/s when an explosion occurs between the capsule and the probe. As a result, the probe moves forward at 140 m/s, as shown in the diagram below.



a) (i) What is the speed of the main capsule after the explosion? **(3 marks)**

(ii) What is the magnitude of the impulse given to the probe? **(2 marks)**

9.

Impulse is measured in which units?

A. J
B. N
C. $N \cdot m$
D. $N \cdot s$

10.

Which expression is equal to the net force on an object?

A. $\frac{\Delta p}{\Delta t}$

B. $\frac{W}{\Delta t}$

C. $m\Delta v$

D. ΔE

11.

Impulse is defined as

A. total energy.
B. total momentum.
C. a change in energy.
D. a change in momentum.

12.

Which of the following is a correct unit for impulse?

A. N
B. $\mathrm{N \cdot m}$
C. N/s
D. $\mathrm{N \cdot s}$

13.

A ball is thrown at 15 m/s towards various barriers. In which case does the ball experience the greatest impulse?

A. The ball hits a wall and rebounds at 2.0 m/s.
B. The ball hits a wall and rebounds at 7.0 m/s.
C. The ball hits a wall, sticks to it and stops moving.
D. The ball breaks a window and continues moving at 10 m/s in the same direction.

14.

A 1.2 kg ball moving due east at 40 m/s strikes a stationary 6.0 kg object. The 1.2 kg ball rebounds to the west at 25 m/s. What is the speed of the 6.0 kg object after the collision?

A. 3.0 m/s
B. 13 m/s
C. 15 m/s
D. 65 m/s

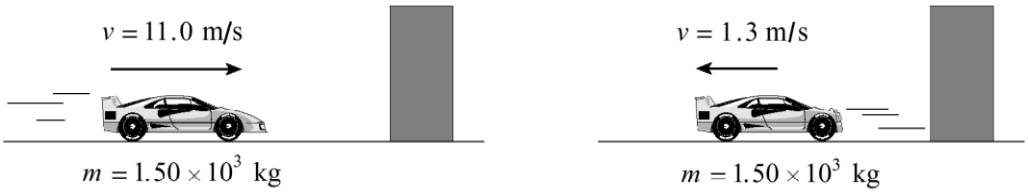
15.

A 0.080 kg tennis ball travelling east at 15 m/s is struck by a tennis racquet, giving it a velocity of 25 m/s, west. What are the magnitude and direction of the impulse given to the ball?

	MAGNITUDE	DIRECTION
A.	0.80 N·s	Eastward
B.	0.80 N·s	Westward
C.	3.2 N·s	Eastward
D.	3.2 N·s	Westward

16.

A 1.50×10^3 kg car travelling at 11.0 m/s collides with a wall as shown.



The car rebounds off the wall with a speed of 1.3 m/s. If the collision lasts for 1.7 s, what force does the wall apply to the car during the collision?

A. 8.6×10^3 N
B. 1.1×10^4 N
C. 1.5×10^4 N
D. 1.8×10^4 N

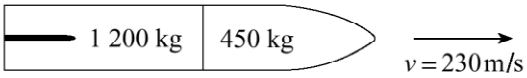
17.

A 1 500 kg car travelling at 25 m/s collides with a 2 500 kg van stopped at a traffic light. As a result of the collision the two vehicles become entangled. With what initial speed will the entangled mass move off, and is the collision elastic or inelastic?

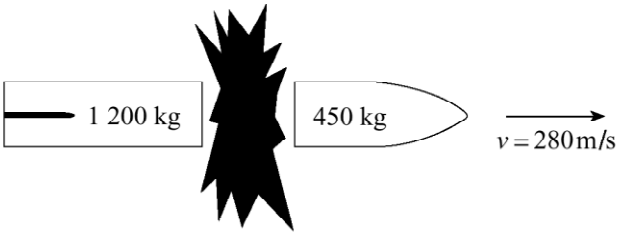
	SPEED	TYPE OF COLLISION
A.	9.4 m/s	Elastic
B.	9.4 m/s	Inelastic
C.	15 m/s	Elastic
D.	15 m/s	Inelastic

18.

A space vehicle made up of two parts is travelling at 230 m/s as shown.



An explosion causes the 450 kg part to separate and travel with a final velocity of 280 m/s as shown.



a) What was the momentum of the space vehicle before the explosion? **(2 marks)**

b) What was the magnitude of the impulse on the 1 200 kg part during the separation? **(3 marks)**

19.

A stationary life raft of mass 160 kg is carrying two survivors with masses of 55 kg and 72 kg, respectively. They dive off the raft at the same instant, the 55 kg person due East at 4.4 m/s and the 72 kg person due West at 4.2 m/s. At what speed and in what direction does the raft start to move?

Answers:

7. B
8. i) 108 m/s ii) 3.0×10^4 N•s
9. D
10. A
11. D
12. D
13. B
14. B
15. D
16. B
17. B
18. a) 379500 N•s b) -2.2×10^4 kg•m/s
19. 0.377 m/s [east]