Momentum Test Study Guide 18-19 Name: Key

$p = mv$ $\Delta p = mv_f - mv_i$ $F\Delta t = mv_f - mv_i$ $\mathbf{p_i = p_f}$

1) Show mathematically and explain how a 2500 kg truck moving at 15 m/s can have the same momentum as a 10.0 kg tricycle moving at an unknown speed.

$(2500\,kg)(15\,m/s) = +37,500\ kgm/s$ $(10.0kg)(v) = 37,500\ kgm/s$

$v = +3,750\ m/s$

The tricycle would have to travel @ 3750 m/s!

2) What is the purpose of a crash mat placed underneath a climbing wall?

Crash mats increase the time of impact which will decrease the force experienced by the falling climber.

3) A 0.4 kg American football sits at rest at the thirty yard line. A football player kicks the ball, giving it a velocity of +5.5 m/s. What impulse (change in momentum) did the football player provide to the ball? $\Delta p = mv_f - mv_i$ $\Delta p = (.4kg)(5.5\,m/s) - (.4kg)(0\,m/s)$

$\Delta p = +2.2\ kgm/s$

4) A 1500 kg truck is moving at +12.5 m/s. To avoid a frog in the road, the driver slams on the brakes for 3.5 seconds, slowing the truck to +2.6 m/s. What force did the brakes apply on the truck?

$Ft = mv_f - mv_i$ $F(3.5s) = (1500\,kg)(2.6\,m/s) - (1500kg)(12.5\,m/s)$

$F(3.5s) = -14850$ $F = -4242\ N$

5) Two identical boxes sit at rest. Box A has a force of 5 N applied to it while box B has a 10 N force applied. Is it possible for box A to experience a <u>larger</u> impulse that box B? Explain your answer using what you know about impulse. Yes, the 5N force could be applied for a longer period of time which would provide a greater impulse than the 10N force.

6) Two identical eggs are thrown. One at a brick wall and the other at a sheet.

a. Which egg experiences a greater impulse? The impulse on each is equal. Both had the same momentum to start and both ended with 0 momentum so the change was identical.

b. Which egg experienced a greater change in momentum?

c. Which egg experienced a greater force? How does the time this force acted compare to the time the other egg felt its force? The egg that hits the brick wall experiences a larger force over a shorter period of time and would therefore break.

7) What are the three types of collisions? Give an example of each.

Separation - Gun firing a bullet Elastic - Billiard balls bouncing off each other

Inelastic - Two lumps of clay colliding

8) Why did the bouncy side of the bouncing dart cause the cart to move faster than the non-bouncy side? (use conservation of momentum to explain this) The bouncing side provides a greater impulse than the non-bouncy side. This means more momentum is being transferred into the cart when the bouncy side hits.

9) A person stands at rest on rollerblades while holding a heavy rock. The person throws the rock forward with a speed of 5.0 m/s.

a. What type of collision is this? Separation

b. What direction does the person on the rollerblades move after throwing the rock. Why? Backwards. Conservation of momentum tells us that $P_{before} = P_{after}$ $P_{before} = 0$, when the rock is thrown, it now has a positive momentum so the person would need a negative momentum to keep $P = 0$.

c. Is the speed of the rollerblader greater than or less than that of the rock? Why?
Rollerblader has less speed than the rock since they have more mass

10) While standing motionless on his rollerblades, a student, who has a mass of 78 kg, throws a 0.50 kg tennis ball forward. The student moves backwards at -4.3 m/s.

a. What type of collision is this? Separation

b. With what velocity was the tennis ball initially thrown? $(m_1+m_2)v_i = m_1v_{1f} + m_2v_{2f}$

$(78kg + .50kg)\,0^m/s = (78kg)(-4.3^m/s) + (.50kg)(v_f)$

$0 = -335.4 + (.50kg)v_f \qquad 335.4 = (.50kg)v_f$

$v_f = +671^m/s$

11) A 0.25 kg baseball moves at +14.5 m/s towards a stationary catcher, who has a mass of 88 kg.

a. What type of collision is this? Inelastic

b. Does the velocity of the baseball increase, decrease or stay constant after hitting the catchers mitt? Why? Decreases since some of its momentum is transferred to the catcher's mitt.

Nice Arm!

12) Two dodgeballs (both with a mass of 0.80 kg) collide in midair. Initially, ball A was moving at 26.7 m/s, while ball B was moving at 15.7 m/s in the opposite direction. After they collide, ball A is moving at 1.4 m/s in it original direction.

a. What type of collision is this? Elastic

b. What is the velocity of ball B following the collision? $m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$

$(.80kg)(26.7^m/s) + (.80kg)(-15.7^m/s) = (.80kg)(1.4^m/s) + (.80kg)v_f$

$8.8 = 1.12 + (.80kg)v_f \qquad 7.68 = (.80kg)v_f$

$v_f = +9.6^m/s$

13) An object experiences a net force of 0 N under what conditions? Can the object be accelerating, why or why not? It is either @ rest or moving at a constant velocity. Since acceleration can only occur if an object is not in equilibrium then it cannot be accelerating when $\Sigma F = 0N$.

14) Why/how does the spin cycle of a washing machine remove water from wet clothes? Be sure to use the word inertia in your explanation. The inertia of both the clothes and water would make the travel straight forward. The F_n from the machine moves both objects in a circle. When the water reaches one of the many holes in the machine, it does not experience the F_n so it continues out of the machine

15) A force of 5 N is applied to a resting bowling ball and force of 5 N is applied to a resting soccer ball. What would you observe in regards to the motion of the bowling ball and the soccer ball following the collision? Why? The soccer ball would accelerate more

$F = ma$

A bowling ball has more mass and therefore less acceleration than the soccer ball.