Name: Key

Momentum Classwork

Questions to think about with your classmates:

1. Which has a greater momentum, a fat golfer standing on the green or a moving golf ball?

   Moving Golf ball (golfer at rest so no $\vec{p}$.)

2. Why might a wine glass survive a fall onto a carpeted floor but not onto a concrete floor?

   More time to stop on carpet so force is less.

3. Why would it be a poor idea to have your hand against a rigid wall when you catch a fast-moving baseball with you bare hand?

   Less time to stop (hand can't move backward) so force large!

4. Which undergoes the greater change in momentum:
   a) a moving baseball brought to rest
   b) a baseball projected from rest to the speed it had before
   (c) a moving baseball brought to rest and then projected backward to its original speed?

5. In question number 4, in which case is the greatest impulse required? Why? (C) b/c $\vec{F} \cdot t = \Delta\vec{p}$ ($J = \Delta\vec{p}$)

6. When a cue ball collides with another billiard ball--the cue ball stops, the billiard ball moves. The momentum of the cue ball has changed. The momentum of the billiard ball has changed. So momentum in not conserved for the cue ball and the momentum of the billiard ball is not conserved. In what sense do we say that momentum is conserved?

   Momentum is conserved in the system of both balls together... (momentum of cue ball transfers into billiard ball.)

Exercises:

1. In terms of impulse and momentum, why are padded football players much less prone to injury?

   Pads increase collision stopping time so force is less. $F \cdot t = \Delta\vec{p}$

2. A fully dressed person is at rest in the middle of a pond on perfectly frictionless ice and must get to shore. How can this be accomplished?

   Throw a piece of clothing! → Clothing goes one way & person goes the other. (Can't walk since no friction)

3. A railroad diesel engine weighs four times as much as a freight car. If the diesel engine coasts at 5km per hour into a freight car that is initially at rest, how fast do the two coast after they couple together?

DE	FC	DE FC
$m = 4$	$m = 1$	$m = 5$
$v = 5$ km/hr	$v = 0$	$v = ?$
$p = 20$	$p = 0$	$p = 20$

$20 + 0 = 20$

$p = mv$

$20 = 5(v)$

$\frac{20}{5} = \frac{5(v)}{5}$

$4 \text{ km/hr} = v$

4. A popular misconception is that rockets need air to push against. This of course is not true, as shown by rockets on the moon and so forth. How is a rocket propelled in a region completely devoid of an atmosphere? Please use words like momentum in your answer.

Before the rocket fires the momentum is zero.
After firing the exhaust gasses get negative momentum so rocket gets positive momentum to keep total momentum zero as before.

5. A hockey player makes a quick shot, exerting an average force of 30.0N on the hockey puck for 0.313 seconds. What is the magnitude of the impulse given to the puck?

$\vec{J} = F \cdot t$

$\vec{J} = (30.0N)(0.313s) = 9.39 N \cdot s$

6. If the puck in the previous question has a mass of 0.35kg and is at rest initially, what is it's speed as it plows into the goalies mitt?

$F \cdot t = m(v_f - v_i)$ $\qquad v_f = 26.8 m/s$

$9.39 N \cdot s = (.35kg)(v_f - 0) = (.35kg)(v_f)$ 27m/s

7. A 95kg fullback, running at 8.2m/s, collides in midair with a 128kg defensive tackle moving in the opposite direction. Both players end up with zero speed.

order to do...

(1) a) What was the fullback's momentum before the collision?

$(95kg)(8.2m/s) = 779$ 780 N·s

(2) b) What was the change in the fullback's momentum?

$\Delta\vec{p} = \vec{P}_f - \vec{P}_i = 0 - 780 N \cdot s = -780 N \cdot s$

(5) c) What was the change in the tackle's momentum?

$\Delta\vec{p} = \vec{P}_f - \vec{P}_i = 0 - {}^{-}780 N \cdot s = +780 N \cdot s$

(3) d) What was the tackle's original momentum?

if total $\vec{p}$ after is zero then tackle's $\vec{P}_i$ = −780N·s

(4) e) How fast was the tackle moving originally?

$p = mv \Rightarrow -780 N \cdot s = (128kg)(v) = -6.09$ −6.1m/s

8. Railroad Car 1 (RC1) collides elastically with Railroad Car 2 (RC2). RC1 has an initial momentum of 260 and a mass of 6. RC2 is at rest initially and has a mass of 1. If RC1 has an after collision velocity of 25, what is the after collision velocity of RC2?

RC1	RC2	RC1	RC2
m = 6	m = 1	m: 6	m = 1
v	v = 0	v = 25	v = ?
p = 260	p = 0	p = 150	p = 110

260 + 0 = 150 + p

p = 110

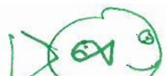
so... p = mv, 110 = (1)(v), v = 110

9. A 5kg fish swimming 1m/s swallows an absent-minded 1kg fish swimming toward it at 4m/s. What is the speed of the larger fish immediately after lunch?

→ −4m/s

m = 5kg
v = 1m/s
P = 5

m = 1kg
v = −4m/s
P = −4
neg. velo.



m = 6kg
v = ?
p = 1

p = mv
1 = 6(v)
v = 1/6 = .1666 0.2m/s

5 + −4 = p
= +1