Review

Physics unit 6

Name KEY

Momentum and impulse

b 1. Which has more momentum, an 18-wheeler parked at the curb or a Volkswagen rolling down a hill?
a. the 18-wheeler (b. the Volkswagen) c. they are equal d. Could be either mv parked v = 0 m/s

b. 2. Momentum is defined to be
a. mass times speed
(b. mass times velocity)
c. mass times acceleration
d. weight times velocity

a 3. If a sports car with a mass of 1000 kg travels down the road with a velocity of 20 m/s, its momentum is 20,000
mv (a. kg/(m/s)) b. m/(kg/s) c. kg (m/s) d. kg(m/s^2)

d 4. A stunt person who is shot by a bandit and falls backward from a balcony into an air bag rather than onto the ground will not be hurt because the
a. momentum change is less for the air bag.
b. momentum is less for the air bag.
c. impulse is less for the air bag.
(d. increased stopping time means a smaller stopping force.) impulse = $F\Delta t$

b 5. Assuming that your teacher jumps off the roof of a garage and lands on the ground, how will the impulse the ground exerts on him if he lands on grass compare to that if he lands on concrete? same but $F\Delta t$
a. The impulse will be larger if he lands on concrete.
(b. The impulse will be greater if he lands on the grass.) Forces the same but Δt longer
c. The impulses will be the same independent of the surface.
d. It is not possible to compare the impulses.

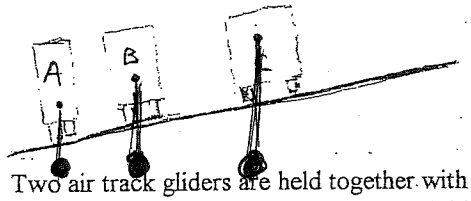
d 6. What is the impulse of a 5 N force acting for 20 seconds.
a. 4 Ns b. 15 Ns c. 25 Ns (d. 100 Ns) $F\Delta t = (5N)(20s) = 100 Ns$

d 7. What change in momentum occurs when a force of 20 N acts for 5 seconds?
a. 4 Ns b. 15 Ns c. 25 Ns (d. 100 Ns)

E 8. Which dot represents the center of mass of the two pucks?

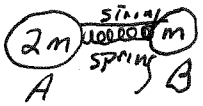
a little closer to the more massive object.

d 9. The centers of mass of three trucks parked on a hill are shown by the dots. Which truck(s) will tip over?



(d. none will tip) IT appears all plumb bobs hanging from the center of masses are over the base.

d 10. Two air track gliders are held together with a string. The mass of glider A is twice that of B. A spring is tightly compressed between the gliders. If the gliders are initially at rest and the spring between the gliders is released by burning the string, what is the total momentum of both gliders after the release?
a. twice the momentum of A
b. half the momentum of A
c. Twice the momentum of B
(d. zero)



$\Sigma P_{before} = \Sigma P_{after}$
$0 = m_A v_A + m_B v_B$
so if $\Sigma P_{before} = 0$ then $\Sigma P_{after} = 0$
Conservation of momentum

C 11. A pitcher throws a fast ball to the catcher. Which player causes a greater change in the momentum of the ball?
a. the pitcher b. the catcher (c. both are the same) d. can't tell for given data

C 12. A pitcher throws a fast ball to the catcher. Which player uses a greater impulse?
a. the pitcher b. the catcher (c. both are the same) d. can't tell from given data

B 13. A pitcher throws a fast ball to the catcher. Which uses a greater force? $F\Delta t$
(a. the pitcher) b. the catcher ~~c. both are the same~~ d. can't tell from given data

pitcher - more time less force catch - less time more force

A 14. Which object has the least momentum?

A. $m = 1kg$ (A) 100 $v = 100 m/s$

B. $m = 10kg$ (B) 120 $v = 12 m/s$

C. $m = .5kg$ (C) 500 $v = 1000 m/s$

D. $m = 100 kg$ (D) $v = 2 m/s$ 200

Key To review

B 15. What is the velocity of object AB after the collision? The masses are equal in size and locked together after the collision.

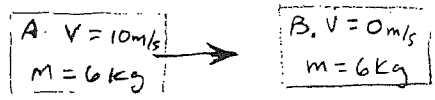
a. 0 m/s (b. 5 m/s) c. 10 m/s d. 20 m/s

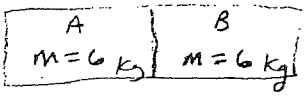
$m_A v_A + m_B v_B = v'(m_A + m_B)$

$(6kg)(10m/s) + (6kg)(0m/s) = (12kg)v'$

$60 kg\,m/s = (12kg)v'$

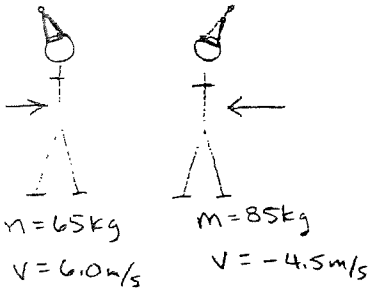
$v' = \frac{60 kg\,m/s}{12kg} = 5 m/s$





Complete 3 of the 4 problems listed below.

1. A 65 kg ice skater traveling at 6.0 m/s runs head-on into an 85 kg skater traveling at -4.5 m/s. At what speed and in what direction do the skaters travel if they move together after the collision and do not fall down.
What type of collision does this represent? inelastic



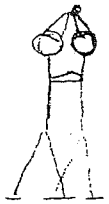
$m_{left\ side} V_{left\ side} + m_{right\ side} V_{right\ side} = V'(m_{left} + m_{right})$

$(65kg)(6.0m/s) + (85kg)(-4.5m/s) = (150kg)V'$

$390 kg\,m/s - 382.5 kg\,m/s = (150kg)V'$

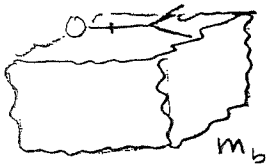
$7.5 kg\,m/s = (150kg)V'$

$V' = \frac{7.5 kg\,m/s}{150kg} = .05 m/s$ To the right



2. An 80 kg stunt man jumps from a tower into an airbag. If the stunt man hits the bag with an initial velocity of 30 m/s, and comes to a stop in 0.75 seconds, How large was the force acting to stop the stunt man?
What was the gain in momentum of the air bag necessary to stop the stunt man if the bag and air have a combined mass of 100 kg?

$V = 30 m/s$
$m = 80 kg$



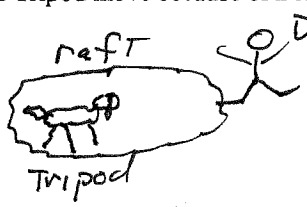
$F\Delta t = m\Delta V$

$F = \frac{m\Delta V}{\Delta t} = \frac{(80kg)(0m/s - 30m/s)}{\frac{3}{4}s}$ ($V_f - V_i$)

$F = \frac{(80kg)(-30m/s)}{.75s} = \frac{(80kg)(-30m/s)}{\frac{3}{4}s} = -3200N$

gain in momentum of airbag $= m\Delta V = (100kg)(30m/s - 0m/s) = 3000 N\cdot s$ ($V_f - V_i$)

3. Dr. J, mass 70 kg, and Tripod, mass 40 kg, decide to do a little fishing in their raft, mass 120 kg. After a short time Dr. J becomes very hot and decides to jump from the raft into the water. If Dr. J jumps to the right at 5 m/s, at what velocity and in what direction will the raft and Tripod move because of Dr. J's jump?



Dr. J. Tripod raft

$m_{DJ} V_{DJ} + m_T V_T + m_r V_r$

Before Jump all velocities zero

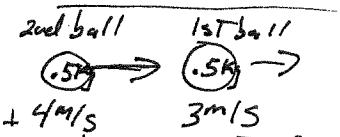
so $0 = (m_T + m_r) V_{T\&r} + m_{DJ} V_{DJ}$

since opp. directions their ps equal

so $V_{T\&r} = \frac{m_{DJ} V_{DJ}}{m_T + m_r} = \frac{(70kg)(5m/s)}{40kg + 120kg} = \frac{350}{160kg} = 2.19 \frac{m}{s}$ left

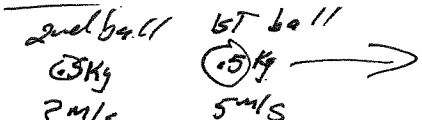
4. A pool ball, mass 0.5 kg, is rolling along on a frictionless surface at 3 m/s. A second ball with the same mass, is rolling in the same direction at 4 m/s. After the two balls collide the first ball is moving in the same direction with a new velocity of 5 m/s. In what direction and at what velocity is the second ball moving after the collision occurs?

Before



right is positive direction

After collision



$m_1 V_1 + m_2 V_2 = m_1 V_1' + m_2 V_2'$

$(.5kg)(3m/s) + (.5kg)(4m/s) = (.5kg)V_1' + (.5kg)(5m/s)$

$V_1' = \frac{1.5 kg\,m/s + 2 kg\,m/s - 2.5 kg\,m/s}{.5kg} = \frac{2 kg\,m/s}{.5kg} = 2 m/s$ right