Practice MC Momentum 2014_2015 Name Key Hr.____

1) A 4.0-N force acts for 3.0 s on an object. The force suddenly increases to 15 N and acts for one more second. What impulse was imparted by these forces to the object? **C**

A) 19 N·s B) 15 N·s C) 27 N·s D) 12 N·s

Impulse = F·t   Impulse = F·t + F·t; 4(3) + 15(1) = 27 N·s

2) A 0.060-kg tennis ball, initially moving at a speed of 12 m/s, is struck by a racket causing it to rebound in the opposite direction at a speed of 18 m/s. What is the change in momentum of the ball? **D**

A) 1.1 kg·m/s B) 0.72 kg·m/s C) 0.36 kg·m/s D) 1.8 kg·m/s

$\Delta P = P_f - P_i = .0600(-18) - .06(12) = -1.8$ kgm/s

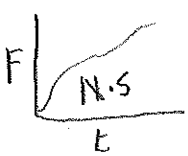
3) A car of mass m, traveling with a velocity v, strikes a parked station wagon, who's mass is 2m. The bumpers lock together in this head-on inelastic collision. What fraction of the initial kinetic energy is lost in this collision? **A**

A) 2/3 B) 1/2 C) 1/4 D) 1/3

$P_i = P_f$; $mv = 3m v_f$; $v_f = \frac{v}{3}$

$\frac{\frac{1}{2} 3m (\frac{v}{3})^2}{\frac{1}{2} m v^2}$ $\frac{\frac{1}{6} v^2}{\frac{1}{2} v^2} = \frac{1}{3}$ Retained $1 - \frac{1}{3} = \frac{2}{3}$ "Lost"

4) The area under the curve on a Force versus time (F vs. t) graph represents **A**



A) impulse. B) momentum. C) kinetic energy. D) work.

5) When a light beach ball rolling with a speed of 6.0 m/s collides with a heavy exercise ball at rest, the beach ball's speed after the collision will be, approximately, **A**

A) 6.0 m/s. B) 3.0 m/s. C) 12 m/s. D) 0.

6) A railroad car, of mass 200 kg, rolls with negligible friction on a horizontal track with a speed of 10 m/s. A 70-kg stunt man drops straight down a distance of 4.0 m, and lands in the car. How fast will the car be moving after this happens? **B**

A) 2.8 m/s B) 7.4 m/s C) 4.7 m/s D) 10 m/s

$P_i = P_f$; 2000 = 270V; V = 7.4

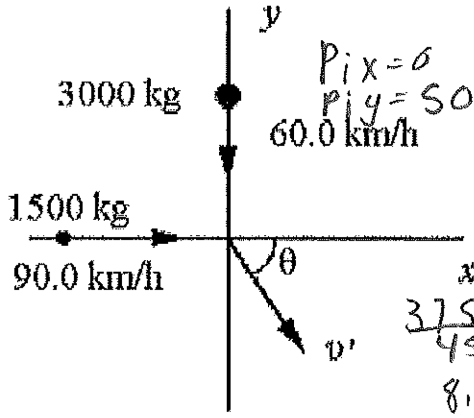


FIGURE 7-1

7) A 1500-kg car traveling at 90.0 km/h east collides with a 3000-kg car traveling at 60.0 km/h south. The two cars stick together after the collision. (See Fig. 7-1.) What is the speed of the cars after collision?

A) 21.7 m/s B) 13.9 m/s C) 8.33 m/s D) 17.4 m/s

8) A machine gun, of mass 35.0 kg, fires 50.0-gram bullets, with a muzzle velocity of 750 m/s, at the rate of 300 rounds per minute. What is the average force exerted on the machine gun mount?

A) 188 N B) 438 N C) 219 N D) 94.0 N

9) You (50-kg mass) skate on ice at 4.0 m/s to greet your friend (40-kg mass), who is standing still, with open arms. As you collide, while holding each other, with what speed do you both move off together?

A) zero B) 23 m/s C) 5.0 m/s D) 2.2 m/s

10) A 50-kg pitching machine (excluding the baseball) is placed on a frozen pond. The machine fires a 0.40-kg baseball with a speed of 35 m/s in the horizontal direction. What is the recoil speed of the pitching machine? (Assume negligible friction.)

A) 4.4×10^3 m/s B) 0.14 m/s C) 0.70 m/s D) 0.28 m/s

11) Two objects move on a level frictionless surface. Object A moves east with a momentum of 24 kg·m/s. Object B moves north with momentum 10 kg·m/s. They make a perfectly inelastic collision. What is the magnitude of their combined momentum after the collision?

A) 26 kg·m/s
B) 34 kg·m/s
C) 14 kg·m/s
D) cannot be determined without knowing masses and velocities

12) A 0.10-kg ball is dropped onto a table top. The speeds of the ball right before and right after hitting the table top are 5.0 m/s and 4.0 m/s, respectively. If the collision between the ball and the table top lasts 0.15 s, what is the magnitude of the average force exerted on the ball by the table top?

A) 1.3 N B) 0.67 N C) 3.0 N D) 6.0 N

$P_{ix} = P_{fx}$ $0 = 5(-8) + 4(10)$ $P_{iy} = P_{fy}$ $10(4) = 1 V_f$ $V_f = 40$

13) A small bomb, of mass 10 kg, is moving toward the North with a velocity of 4.0 m/s. It explodes into three fragments: a 5.0-kg fragment moving west with a speed of 8.0 m/s; a 4.0-kg fragment moving east with a speed of 10 m/s; and a third fragment with a mass of 1.0 kg. What is the velocity of the third fragment? (Neglect air friction.) C

A) zero
B) 40 m/s south
C) 40 m/s north
D) none of the above

14) In an elastic collision, if the momentum is conserved, then which of the following statements is true about kinetic energy? C

A) Kinetic energy is lost.
B) Kinetic energy is gained.
C) Kinetic energy is also conserved.
D) none of the above

15) A handball of mass 0.10 kg, traveling horizontally at 30 m/s, strikes a wall and rebounds at 24 m/s. What is the change in the momentum of the ball? A

A) 5.4 kg·m/s
B) 72 kg·m/s
C) 1.2 kg·m/s
D) 0.60 kg·m/s

$\Delta P = [.10(30) - .1(-24)]$

16) A 3.0-kg object moves to the right at 4.0 m/s. It collides head-on with a 6.0-kg object moving to the left at 2.0 m/s. Which statement is correct? P_i $3(4) + 6(-2) = 0$ $P_i = P_f$ A

A) The total momentum both before and after the collision is zero.
B) The total momentum both before and after the collision is 24 kg·m/s.
C) The total momentum before the collision is 24 kg·m/s, and after the collision is 0 kg·m/s.
D) None of the above is true.

17) A 2000-kg car, traveling to the right at 30 m/s, collides with a brick wall and comes to rest in 0.20 s. What is the average force the car exerts on the wall? C

A) 60,000 N to the right
B) 12,000 N to the right
C) 300,000 N to the right
D) none of the above

$\Delta P = (0 - 2000(30)) = F \Delta t$ $-60000 = F(.2)$ $F = -300,000$ N car Newton's 3rd

18) A car of mass 1000 kg moves to the right along a level, straight road at a speed of 6.0 m/s. It collides directly with a stopped motorcycle of mass 200 kg. What is the total momentum after the collision? D

A) 10,000 kg·m/s to the right
B) zero
C) 2000 kg·m/s to the right
D) 6000 kg·m/s to the right

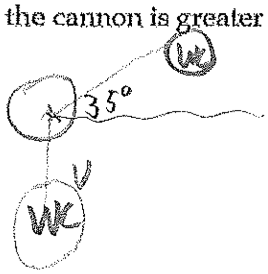
$P_i = 1000(6) + 200(0) = +6000$ kg m/s $P_i = P_f$

19) In a game of pool, the white cue ball hits the #9 ball and is deflected at a 35° angle to the original line of motion. What is the angle of deflection below the original line of motion for the #9 ball? D

A) 75°
B) 35°
C) 90°
D) 55°

20) When a cannon fires a cannonball, the cannon will recoil backward because the A

A) momentum of the cannonball and cannon is conserved.
B) momentum of the cannon is greater than the energy of the cannonball.
C) energy of the cannonball and cannon is conserved.
D) energy of the cannon is greater than the energy of the cannonball.



$P_{ix} + P_{iy} = P_f$ m cos35 i m sin35 j + m cos θ i + m sin θ j
$P_{ix} + P_{iy} =$
$0 + mV = 1$

Momentum Free Response Practice 2014_15

Name Key Hr._

1. A 1500 kg cannon and platform is at rest on a frozen lake. In addition to the cannon on the platform there are two 70 kg cannon balls. The cannon is loaded with a 70 kg cannon ball is fired horizontally at 300 m/s.

A) What is the speed of the cannon after the shot is fired? $-13.38\frac{m}{s}$

B) How far will the platform and cannon travel if the uk=.05? 182.56 m

$P_i = P_f$

$1500(0) + 70(0) + 70(0) = 1570 V_f + 70(300)$

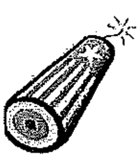
$V_f = -13.38$

KE = TE

$\frac{1}{2}mv^2 = mg\mu_k d$

$\frac{1}{2}(-13.38)^2 = 9.8(.05)d$

$d = 182.56\,m$



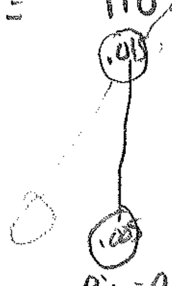
2. A firework with a mass of 15g initially at rest explodes into three parts. One of the parts, of mass 5.0g, moves at 34 m/s **along the** negative y-axis. A second part with a mass 2.4g moves at 34° E of N with a speed of 6.0 m/s. Determine the third part's speed and direction of motion. (Assume the mass is completely conserved.)

A) Velocity 20.81 m/s

B) Direction 2.89° W of S

$P_f = -.008\,i + -.1581\,j$

$.0076\vec{V} = -1.05\frac{m}{s}\,i + 20.79\,j$



$P_{ix} = 0\,\frac{kg\,m}{s}$

$P_{iy} = .005(-34) = -.17\,\frac{kg\,m}{s}$

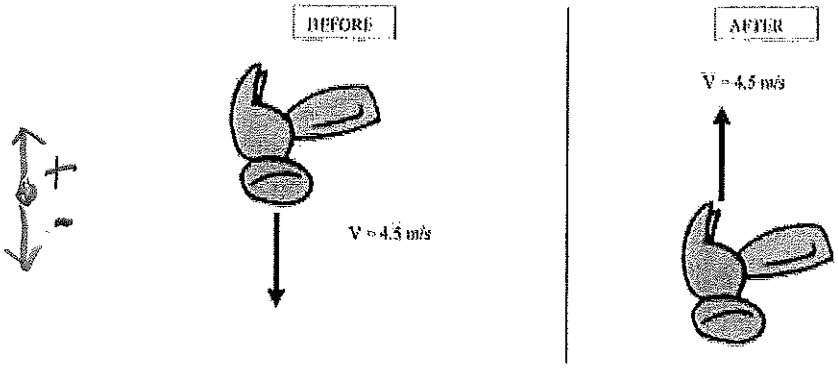
$P_i = 0$

$P_f =$

[redacted]

	m	v	p	θ	i	j
	.005	-34	-.17	270	0	-.17
Pf	.0024	6	.0144	56	.008	.0119
	.0076	V	.0076V		-.008	-.1581
	.015 kg				0i +	0j

$P_i = 0$



3. The head of a hammer with a mass of 2 kg strikes a nail and bounces back with the same speed in the opposite direction. This elastic collision last for a time of .075 sec.

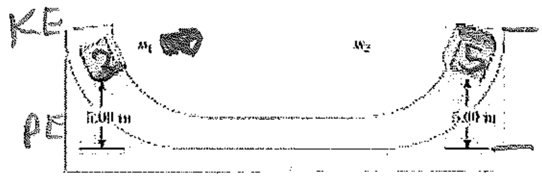
A) What is the average force the hammer exerts on the nail? 240N

B) How much Kinetic Energy was "Lost"? 0 J because its Elastic!!

$$\Delta p = F \Delta t$$

$$[2(4.5) - 2(-4.5)] = F(.075)$$

$$F = \frac{18}{.075} = 240 \text{ N}$$



$\frac{1}{2}mv^2 = mgh$

$\frac{1}{2}v^2 = 9.8(5)$

$v = \sqrt{98}$

$= 9.89 \frac{m}{s}$

Figure A

4. Two blocks of masses m_1 = 3.00 kg and m_2 = 5.00 kg are each released from rest at a height of 5.00 m on a frictionless track, as shown in Figure A, and undergo an **elastic** head-on collision.

A) Determine the velocity of each block just before the collision.

Vleft block = 9.89 m/s   Vright block= -9.89 m/s

B) Determine the velocity of each block immediately after the collision.

Vleft block = -14.83 m/s   Vright block= 4.945

$V_{fA} = \frac{3(9.89) + 5(-9.89) - (9.89 - 9.89)(5)}{(3+5)}$

$V_{fB} = \frac{3(9.89) + 5(-9.89) + (9.89 - -9.89)(3)}{(3+5)}$

C) Determine the maximum heights to which EACH *MASS* rises after the collision.

Vleft block = 11.22 m   H_right block= 1.25 m

KE = PE

$\frac{1}{2}mv^2 = mgh$

$\frac{1}{2}(14.83)^2 = 9.8h$

KE = PE

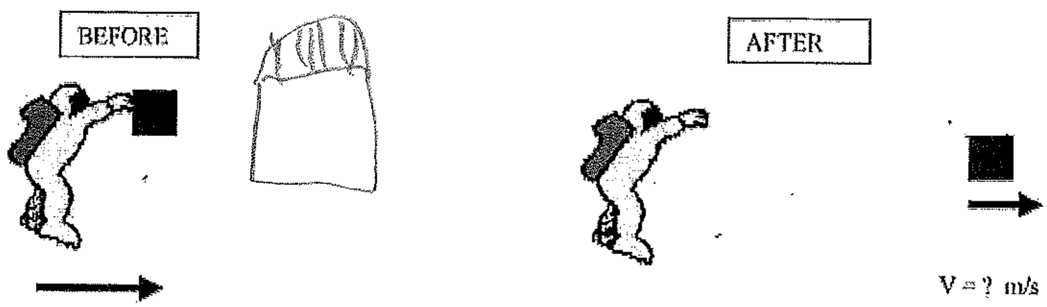
$\frac{1}{2}mv^2 = mgh$

$\frac{1}{2}mv^2 = mgh$

$\frac{1}{2}(4.945)^2 = 9.8h$

h = 1.25 m

5. A 60 kg astronaut is floating toward the front of her stationary spaceship at .2 m/s relative to her spaceship. She wishes to stop moving relative to the ship. To accomplish this task she decides to throw away the 2.5 kg book she is carrying.



A) Should she throw her book toward or away from the spaceship?

Toward

B) At what speed should she throw her book? +5 m/s

$P_i = P_f$

$60(.2) + 2.5(.2) = 60(0) + 2.5\vec{V}$

CR = 0 | Stick - Inelastic
CR |
CR = 1 | Bounce off - Elastic

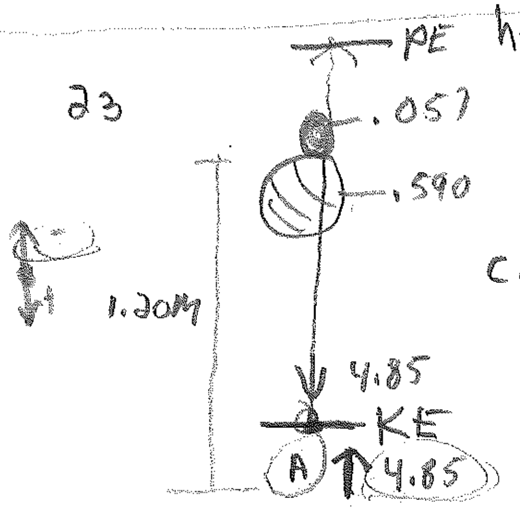
Atom/molecule
Ridig surface

$V_{FA} =$
$V_{FB} =$

$\Delta P = P_F - P_I$

$\Delta KE = KE_f - KE_i$

23



h = 8.41m

KE = PE
$\frac{1}{2}mv^2 = mgh$
$\frac{1}{2}(12.84)^2 = 9.8h$
$p_i = p_f$
$KE_i = KE_f$

PE

CR = 1

KE

$$V_{FB} = \frac{P_A + P_B + CR(V_A - V_B)\, m_a}{m_a + m_b}$$

$$V_F = \frac{.590(-4.85) + .057(4.85) + (4.85 - 4.85)(.590)}{(.590 + .057)}$$

$V_F = -12.84 \frac{m}{s}$

PE = KE
$mgh = \frac{1}{2}mv^2$
$9.8(1.20) = \frac{1}{2}v^2$
$v = 4.85 \frac{m}{s}$

S = 1.20
$x_i = 0$
$v_i = 0$
v_f
$a = +9.8 m/s^2$
t

$s = x_i t + v_i t + \frac{1}{2}at^2$
$1.20 = 0 + 0t + \frac{1}{2}(+9.8)t^2$
$\frac{1.20}{4.9} = \frac{+4.9t^2}{4.9}$
$\sqrt{.245} = \sqrt{t^2}$
$t = .495$
$V_F = V_i + at = 0 + 9.8(.495)$
$V_F = 4.85 \; m/s$