Physics 2414
Practice questions for Exam III

1) A heavy and light marble leave a marble gun with the same initial velocity and are fired towards identical springs. Which marble compresses its spring more?

$K = \frac{1}{2}mv^2$ if same velocity, larger mass has more kinetic energy so will compress spring more

a) The heavy one
b) The light one.
c) They both compress the springs the same amount.
d) Not enough information to tell.

2) A 4.0 kg ball is traveling at 4.0 m/s and strikes a wall. The 4.0 kg ball bounces off the wall with a velocity of 3.0 m/s. If the contact with the wall by the ball lasts for 0.1 seconds, then the magnitude of the change in momentum of the ball is

a) 24 kg m/s
b) 28 kg m/s
c) 4 kg m/s
d) 16 kg m/s
e) 12 kg m/s

$p = mv$
$p_i = 16$
$p_f = -12$
$\Delta p = 16 - (-12) = 28$

3) A truck weighs twice as much as a car and is traveling at twice the speed of the car. What is the ratio of the truck's kinetic energy to the car's kinetic energy?

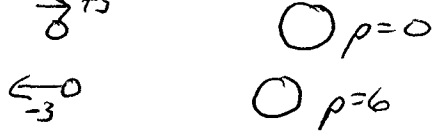
A) 1
B) 2
C) 4
D) 8
E) 16

$K_1 = \frac{1}{2}m_1 v_1^2$ $K_2 = \frac{1}{2}m_2 v_2^2$ $m_1 = 2m_2$ $v_1 = 2v_2$ $\frac{K_2}{K_1} = \frac{\frac{1}{2}(2m)(2v)^2}{\frac{1}{2}(m)v^2} = 8$

4) A golf ball is fired at a bowling ball initially at rest and bounces back elastically. Compared to the bowling ball, the golf ball after the collision has

A) more momentum but less kinetic energy.
B) more momentum and more kinetic energy.
C) less momentum and less kinetic energy.
D) less momentum but more kinetic energy.
E) none of the above.

If golf ball comes in with $p = +3$



$\Delta p_{golfball} = -\Delta p_{bowling\ ball}$

So after collision golfball = 3
bowling ball = 6

Since $K = \frac{p^2}{2m}$ & $m_B >> m_b$ K smaller for bowling ball

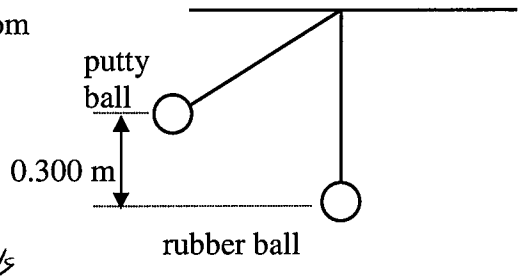
5) A light Honda car and a heavy Ford pickup truck are both out of gas. The truck has twice the mass of the car. You push both the car and the truck for the same amount of time with the same force. Ignoring friction what can you say about the momentum and kinetic energy of the car and the truck?

Δp same since FΔt same

A) They have the same momentum and the same kinetic energy.
B) The truck has more momentum and more kinetic energy than the car.
C) The car has more momentum and more kinetic energy than the truck.
(D) They have the same momentum, but the car has more kinetic energy than the truck.
E) They have the same momentum, but the truck has more kinetic energy than the car.

$K = \frac{p^2}{2m}$ Truck less K.E since mass larger

6) A ball of putty with a mass of 0.500 kg is released from a height of 0.300 m and collides with a rubber ball of mass 1.50 kg that is initially stationary. The two balls then stick together. What is the velocity of the two balls stuck together right after the collision?



A) 2.42 m/s
B) 1.21 m/s
C) 1.00 m/s
(D) 0.61 m/s
E) 0.43 m/s

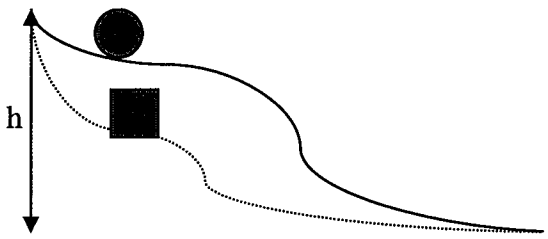
$mgh = \frac{1}{2}mv^2 \quad v = \sqrt{2gh} = 2.42 m/s$

$m_1 v = (m_1 + m_2) v_f$

$v_f = \frac{.5 \cdot 2.42}{.5 + 1.5} = .61 m/s$

7) Two water slides at a pool are shaped differently, but have the same length and start at the same height h. Two riders (a circle and a square) start from rest at the same time on different slides and slide to the bottom. Which rider is traveling fastest at the bottom and which rider makes it to the bottom first? Ignore friction.

	Fastest at Bottom	First to the bottom
A)	square	square
B)	circle	circle
C)	Both have same speed	Both arrive at same time
(D)	Both have same speed	square
E)	Both have same speed	circle



Since h same, v at bottom same
since square lower at all points it is moving faster than circle so arrives first

8) Water leaves a hose at a rate of 1.5 kg/s with a speed of 20 m/s and is aimed at the side of a car, which stops it (That is, we ignore any splashing back). What is the magnitude of the force exerted by the water on the car?

A) 20 N
B) 30 N
C) 40 N
D) 25 N
E) 50 N

$F = \frac{\Delta p}{\Delta t} = \frac{m(v_f - v_i)}{\Delta t}$ in 1 s $m = 1.5\ kg$

$F = \frac{1.5\ kg\,(0-20)}{1\ s} = 30\ N$

9) A 3.0 kg mass slides down a frictionless incline from a height of 4.0 m. A 6.0 kg mass also slides down the frictionless incline from the 12.0 m height. The ratio of the velocity of the 3.0 kg mass at the bottom of the incline to the velocity of the 6.0 kg mass at the bottom of the incline is,

a) 0.58
b) 0.71
c) 1.00
d) 1.41
e) 1.50

$mgh_1 = \frac{1}{2}mv_1^2 \quad v_1 = \sqrt{2gh_1}$

$mgh_2 = \frac{1}{2}mv_2^2 \quad v_2 = \sqrt{2gh_2}$

$\frac{v_1}{v_2} = \sqrt{\frac{h_1}{h_2}} = \sqrt{\frac{4}{12}} = .58$

10) A 30 kg mass falls from a height of 4.0 m. The momentum of the mass just before it hits the ground is,

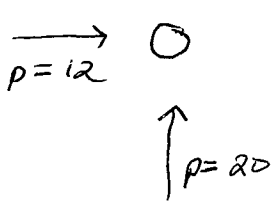
a) 144.2 kg m/s
b) 265.6 kg m/s
c) 320.0 kg m/s
d) 442.4 kg m/s
e) 502.1 kg m/s

$mgh = \frac{1}{2}mv^2 \Rightarrow v = \sqrt{2gh}$

$p = mv = m\sqrt{2gh} = 265.6$

11) A 4.0 kg object is moving at 5.0 m/s NORTH. It strikes a 6.0 kg object that is moving EAST at 2.0 m/s. The objects have a completely inelastic (stick together) collision. The velocity of the 6.0 kg object after the collision is,

a) 2.33 m/s at an angle of 35.0 degrees NORTH of EAST
b) 2.33 m/s at an angle of 59.0 degrees NORTH of EAST
c) 2.00 m/s at an angle of 59.0 degrees NORTH of EAST
d) 2.00 m/s at an angle of 45.0 degrees NORTH of EAST
e) 2.33 m/s at an angle of 45.0 degrees NORTH of EAST



$P_{xi} = 12$

$P_{yi} = 20$

$12 = (m_1 + m_2)\,v_{fx}$ so $v_{fx} = 1.2\ m/s$

$20 = (m_1 + m_2)\,v_{fy}$ $v_{fy} = 2\ m/s$

$v = \sqrt{(1.2)^2 + (2)^2} = 2.33\ m/s$

$\theta = \tan^{-1}\frac{2}{1.2} \Rightarrow \theta = 59^\circ$ North of East

12) A 4.0 kg object is moving at 5.0 m/s NORTH. It strikes a 4.0 kg object that is moving SOUTH at 5.0 m/s. The objects have a completely inelastic (stick together) collision. The kinetic energy lost in the collision is,

a) 20 J
b) 40 J
c) 60 J
d) 80 J
e) 100 J

$P_i = P_f$ $\quad P_i = +20 - 20 = 0$

so $P_f = 0$ so $v_f = 0$

$K_i = \frac{1}{2} m v_1^2 + \frac{1}{2} m v_2^2 = mv^2 = 100J$

$K_f = 0$ so 100J lost

13) I slide an object of mass m to a height h using a frictionless ramp of angle 45 degrees. I then slide an object of mass m to a height h using a frictionless ramp of angle 30 degrees. The ratio of the work I do on the object for the 45 degree angle ramp to the work I do on the object for the 30 degree angle ramp is:

A) 1
B) 2
C) 1.414
D) 1.5
E) Not enough information to determine.

work independent of path since only conservative forces

14) A 3.0 kg mass is located at x = 2.0 cm and y = −4.0 cm. A 3.0 kg mass is located at x = − 5.0 cm and y = 2.0 cm. A 4.0 kg mass is located at x = −3.0 cm and y = − 3.0 cm. Where is the location of the center of mass?

a) Xcm = −0.1 cm, Ycm = −0.5 cm
b) Xcm = −2.1 cm, Ycm = −1.8 cm
c) Xcm = + 2.1 cm, Ycm = −1.8 cm
d) Xcm = −2.1 cm, Ycm = + 1.8 cm
e) Xcm = + 1.1 cm, Ycm = −2.0 cm

$$X = \frac{3(2) + 3(-5) + 4(-3)}{3+3+4} = -2.1$$

$$Y = \frac{3(-4) + 3(2) + 4(-3)}{3+3+4} = -1.8$$