NO READING Assignment

H.W #9 Due Friday

NO clickers today

Exam

Grades

webCT updated with all scores, please check for errors

* clicker
* H.W (Ave normalized to include H.W 9)
* brp
* Exam 1,2,3
* Class Average (overall % in class)

grade calculator
Final grade calculator } class web page

Physics 2414

Midterm #3 – Spring 2008

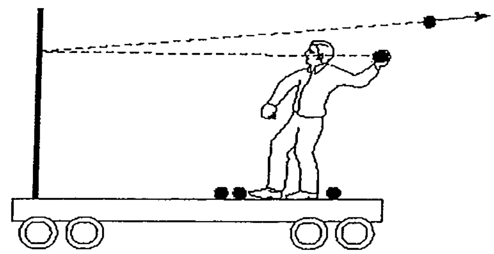
Version A

Multiple Choice (6 pts each)

1) You are on a cart initially at rest on a track with no friction. You throw balls at a partition that is rigidly mounted on the cart. If the balls bounce straight back as shown, is the cart put into motion?

clicker 3-26 p10

A) Yes, it moves to the left
B) Yes, it moves to the right
C) No, it remains in place
D) Yes, it can move either left or right depending on how hard the balls are thrown.
E) Not enough information to determine.



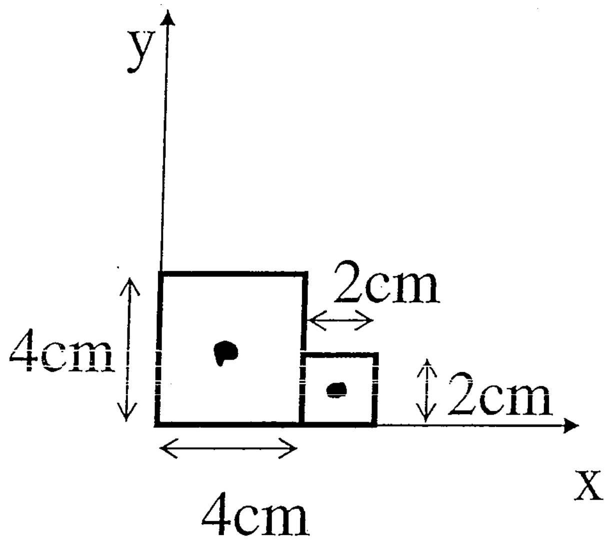
2) Two squares of the **same mass** are shown. Find the center of mass of the two squares.

lecture 4-4 p4

A) Xcm=2 ; Ycm=2
B) Xcm=7/2 ; Ycm=3/2
C) Xcm=3/2 ; Ycm=3/2
D) Xcm=5/2; Ycm=3/2
E) Xcm=7/2; Ycm=5/2

$$X_{cm} = \frac{2\cdot m + 5\cdot m}{m+m}$$

$$Y_{cm} = \frac{2\cdot m + m}{m+m}$$



3) A skier of mass 100 kg starts from rest atop a frictionless hill 100 m high and skies to the bottom of the hill. When the skier reaches the bottom of the hill he picks up a box of mass 20 kg. What is the speed of the skier after he picks up the box?

group Problem 9

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

$V = 44.3$ m/s

conserve $\vec{p}$ $mv = (m+m)v_f$

A) 34.2 m/s
B) 44.3 m/s
C) 33.4 m/s
D) 36.9 m/s
E) cannot be determined unless the angle of the hill is known.

4) In any isolated collision,

all collisions conserve momentum (if no external forces i.e isolated)

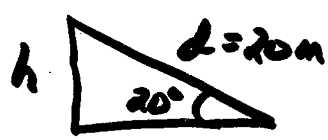
A) Total momentum is not conserved.
B) Total kinetic energy is conserved.
C) Total momentum is conserved.
D) Total momentum is not conserved but total kinetic energy is conserved.
E) Total momentum and total kinetic energy are conserved.

5) A skier of mass = 80kg starts from rest on a hill with a slope of 20 degrees above the horizontal. She skies down the hill and a frictional force of 30 N opposes her motion. What is her velocity 20 m down the hill?

$h = d \sin 20°$

class ex 3-12 p7

A) 11.5 m/s
B) 19.8 m/s
C) 6.7 m/s
D) 16.2 m/s
E) 10.9 m/s



$mgh - F_f d = \frac{1}{2}mv^2$

6) A woman stands on the edge of a cliff. She throws a stone *vertically downward* with an initial speed of 15 m/s. The instant before the stone hits the ground below, it has 150 J of kinetic energy. If she were to throw the stone *horizontally outward* from the cliff with the same initial speed of 15 m/s, how much kinetic energy would it have just before it hits the ground?

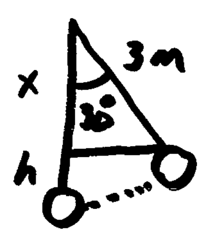
A. 50 J
B. 150 J
C. 450 J
D. 900 J
E. Not enough information was given to answer the question

Don't care about direction with Energy $\quad mgh + \frac{1}{2}mv^2 = \frac{1}{2}mv_f^2$

7) A 2.0 kg pendulum bob on a string 3.0 m long is released with a velocity of 2.0 m/s when the support string makes an angle of 30 degrees with the vertical. What is the velocity of the bob at the bottom of the swing?

H.W #9 p8 chp6 #28

a) 5.42 m/s
b) 7.41 m/s
c) 3.75 m/s
d) 3.44 m/s
e) 2.81 m/s



$x = 3\cos 30° = 2.6\,m$

$h = 3 - x = .4m$

$\frac{1}{2}mv_i^2 + mgh = \frac{1}{2}mv_f^2$

8) A ball of mass M is fired with speed v at a spring, causing the spring to compress a distance x. A second ball of mass 2M and 2v is fired at the same spring compressing the spring a distance x'. What is the ratio of x' to x?

A) 2
B) 1.41
C) 4
D) 2.83
E) 1

$\frac{1}{2}mv^2 = \frac{1}{2}kx^2 \quad \frac{1}{2}(2m)(2v)^2 = \frac{1}{2}kx'^2$

ratio $\frac{x'}{x} = \frac{\sqrt{\frac{2m}{k}}\,2v}{\sqrt{\frac{m}{k}}\,v} = 2\sqrt{2}$

9) You skip two rocks along a lake, throwing them with an identical force for the same amount of time. One rock is heavier than the other. What do you know about the momentum and kinetic energy of the two rocks?

A) they have the same momentum and the same kinetic energy.
B) the heavy rock has a greater momentum and a greater kinetic energy.
C) the heavy rock has a greater momentum, but they have the same kinetic energy.
D) they have the same momentum, but the lighter rock has a greater kinetic energy.
E) the heavy rock has a greater momentum, but the lighter rock has a greater kinetic energy.

clicker questions 3-31 p 9,10

$F\Delta t = \Delta p$
so Δp same
$K = \frac{p^2}{2m}$
lighter one greater K.E

10) A student's life was saved in an automobile accident because an airbag expanded in front of his head. If the car had not been equipped with an airbag, the windshield would have stopped the motion of his head in a much shorter time. Compared to the windshield, the airbag

A) does much more work.
B) exerts a much smaller force.
C) exerts a much smaller impulse.
D) causes a much smaller change in momentum.
E) causes a much smaller change in kinetic energy.

$\vec{F} = \frac{\Delta p}{\Delta t}$

Δp same start and end with same v

Δt longer so less Force

11) A car with a mass of 1000 kg crashes into a parked pickup truck with a mass of 1500 kg. The two vehicles stick together and slide along the road before they stop. Which vehicle had the greatest change in momentum during the collision and which vehicle had the greatest momentum immediately after the collision?

	Greatest Change in magnitude of momentum	Greatest momentum immediately after collision
A)	Car	Car
B)	Car	Truck
C)	Car	Same
D)	Same	Same
E)	Same	Truck

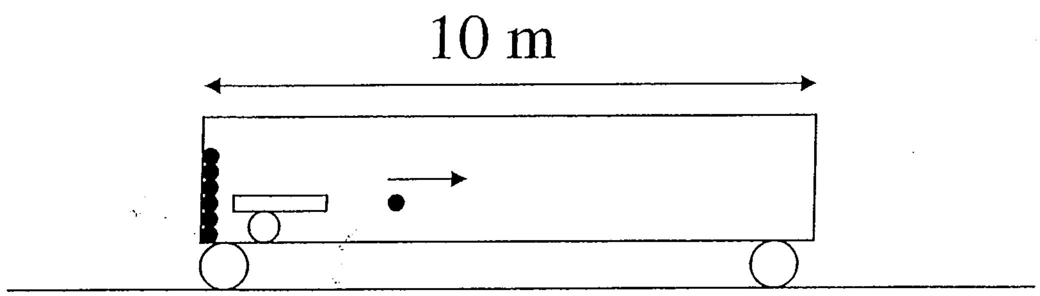
clicker 3-31 p 11

Group problem 9

12) You are in a very light stationary sealed train car of length 10 m on a frictionless track. Inside there is a large number of very heavy cannonballs stacked on one side and a cannon. By shooting the cannonballs inside the train car, what is the maximum distance you can move the train car? (assume that the mass of the train and cannon are very small compared to the mass of all the cannonballs. The cannonballs can never leave the sealed train car)

clicker Question 4-4 p6

A) 10 m
B) 5 m
C) You can move it any distance you want, it depends on the number of cannonballs and how hard you shoot them
D) 20 m
E) You cannot move the train car no matter what you do



13) A spring in a dart gun is compressed 2cm. It is then used to fire a dart which has kinetic energy K. The spring is then compressed to 4cm. What is the new kinetic energy of the dart when fired?

a) K
b) 2K
c) 4K
d) K/2
e) K/4

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

x doubled $(2x)^2 = 4x^2$

4k

14) A ball of putty with mass M is fired at initial velocity v to the right towards an identical mass of putty at rest. The two putty balls stick together. What is the final velocity of the pair?

a) v to the right
b) v to the left
c) zero
d) v/2 to the right
e) v/2 to the left

conserve momentum

$vm + 0 = (m+m)v_f$

$v_f = \frac{v}{2}$

v $v=0$

?

15) 3.0 kg cart, moving to the right with a speed of 1.0 m/s, has a head on collision with a 5.0 kg cart that is initially moving to the left with a speed of 2 m/s. After the collision, the 3.0 kg cart is moving to the left with a speed of 1 m/s. This collision is:

A. elastic
B. inelastic, and the carts do not stick together after the collision
C. completely inelastic in that the carts stick together after the collision.
D. not enough information to determine
E. none of the above

16) My car accelerates from 0 to 20 mph in 3.0 s. How long does it take for it to accelerate from 0 to 60 mph assuming the power of the engine to be independent of velocity and neglecting friction?

A. 3.0 s
B. 9.0 s
C. 12 s
D. 18.0 s
E. 27.0 s

$$P = \frac{W}{t}$$

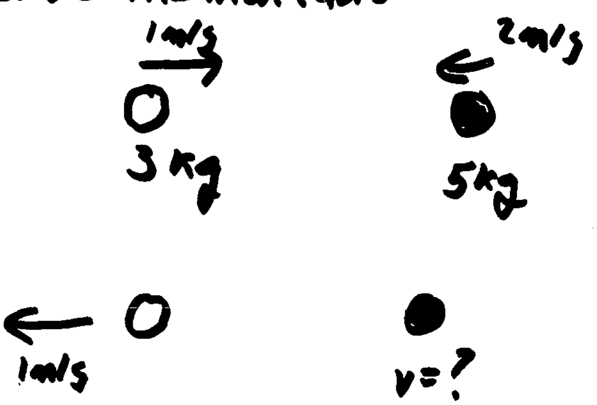
$$t = \frac{W}{P} \qquad W = \Delta K$$

$$W = \frac{1}{2} m v_f^2 - 0 \qquad v_{f_2} = 3 v_{f_1}$$

$$\frac{W_2}{W_1} = \frac{(3 v_{f_1})^2}{(v_{f_1})^2} = 9$$

9 times longer

15) conserve momentum



$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

find $v_{2f} = -\frac{4}{5}$ m/s

Different velocity so cannot stick

K.E after < K.E Before

inelastic

Final Grades based on class Average

A's + B's

many more given out than that shown under current class average

* H.W #9 not yet due
* Bonus clicker points last week of class
* Week's worth of clicker points
* Last H.W Bonus
* Bonus grp problem for survey
* FINAL EXAM (20%)

can have over 100% on clicker, H.W grp problems.

A > 85% Not yet final
B > 70% may drop a few %
C > 55%

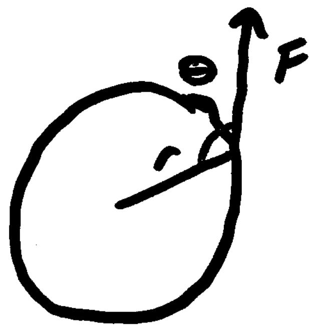
so still lots of A's + B's to be had
many places to gain % points in class

LAST Lecture

We introduced **torque** and **moment of Inertia**

- Torques give rise to rotations

$$\tau = rF\sin\theta$$

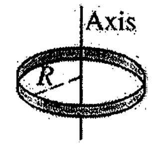
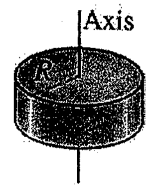
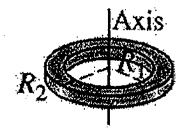
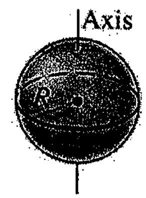
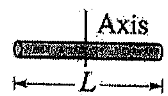
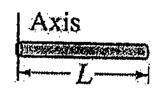
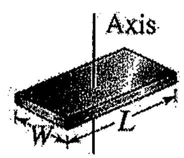


- $\sum \tau = I\alpha$

$I \equiv$ moment of Inertia

$$I = \sum m r^2$$

I Depends on mass, shape and axis of rotation

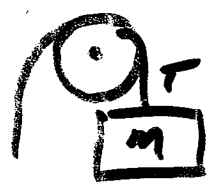
	Object	Location of axis		Moment of inertia
(a)	**Thin hoop,** radius R	Through center		MR^2
(b)	**Thin hoop,** radius R width W	Through central diameter		$\frac{1}{2}MR^2 + \frac{1}{12}MW^2$
(c)	**Solid cylinder,** radius R	Through center		$\frac{1}{2}MR^2$
(d)	**Hollow cylinder,** inner radius R_1 outer radius R_2	Through center		$\frac{1}{2}M(R_1^2 + R_2^2)$
(e)	**Uniform sphere,** radius R	Through center		$\frac{2}{5}MR^2$
(f)	**Long uniform rod,** length L	Through center		$\frac{1}{12}ML^2$
(g)	**Long uniform rod,** length L	Through end		$\frac{1}{3}ML^2$
(h)	**Rectangular thin plate,** length L, width W	Through center		$\frac{1}{12}M(L^2 + W^2)$

ex) A cylindrical <u>3.0 kg</u> pulley with radius $R = 0.4\,m$ is used to lower a 2.0 kg bucket. The bucket starts from rest and falls for 3.0 s

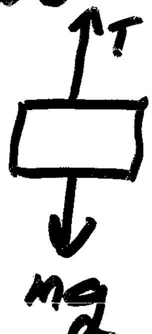
a) what is linear acceleration of bucket

b) How far does it drop

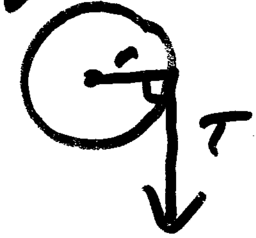
c) what is angular acceleration of pulley



FBD



Pulley



$+\downarrow$

$\theta = 90^\circ$

$\tau = rF\underline{\sin\theta}$

$a_T = r\alpha$

$\alpha = \dfrac{a_T}{r}$

$\Sigma F = ma$

$\Sigma \tau = I\alpha$

$$\boxed{-T + mg = ma}$$

hanging mass

$$rT\underbrace{\sin 90^\circ}_{1} = I\alpha$$

$$\cancel{r}T = \left(\tfrac{1}{2} M r^{\cancel{2}}\right)\left(\frac{a}{\cancel{r}}\right)$$

$$\boxed{T = \tfrac{1}{2} M a}$$

mass pulley

<u>algebra</u>