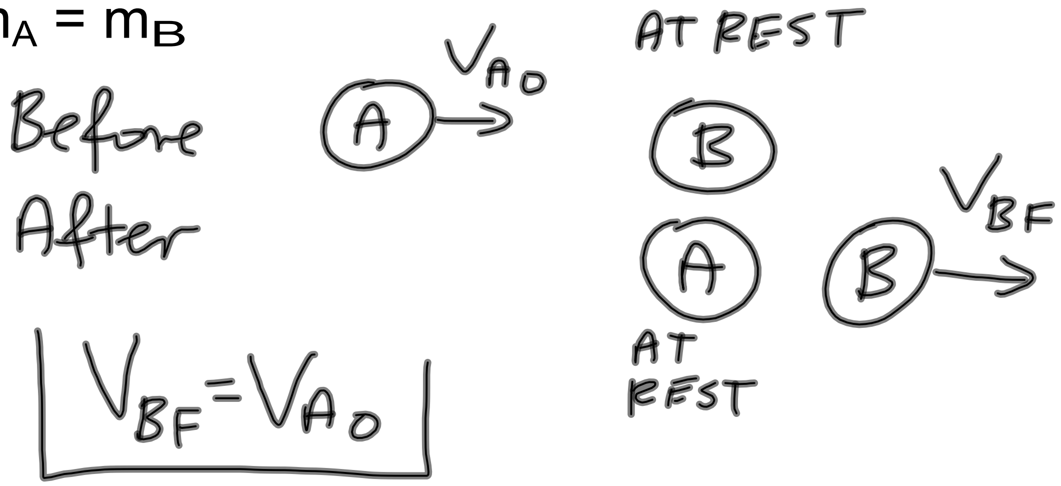
Impulse/momentum final review.

1) Elastic collisions: on-center in 1-D.

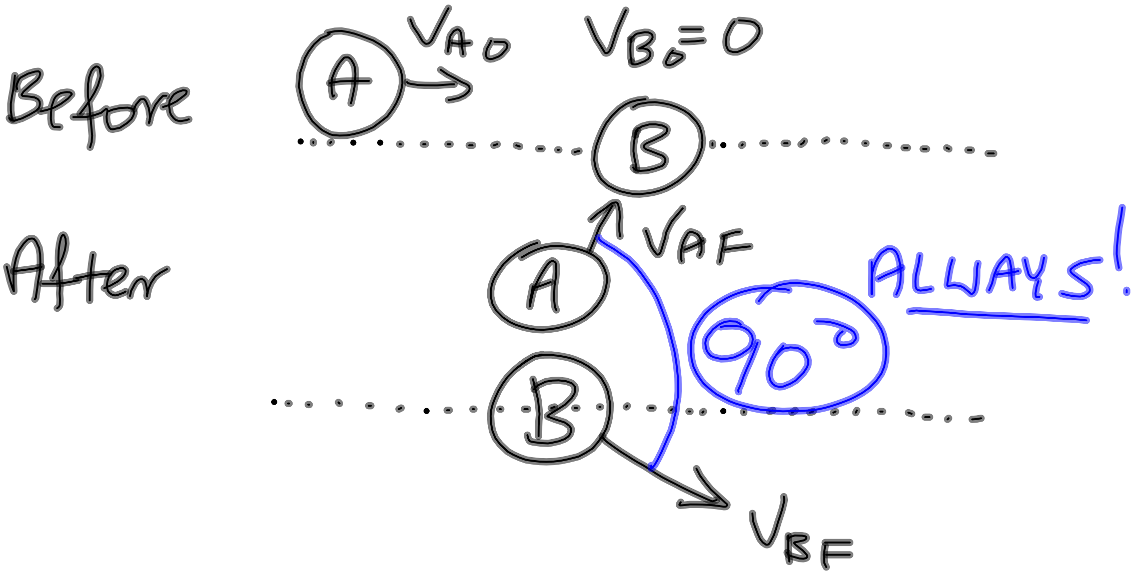
$m_A = m_B$



Dec 9-10:22 AM

2) Elastic collisions: off-center in 2-D.

Glancing collision, where $m_A = m_B$



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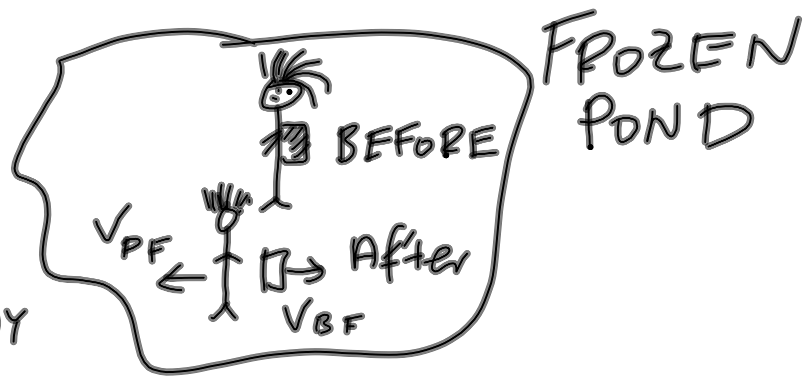
3)



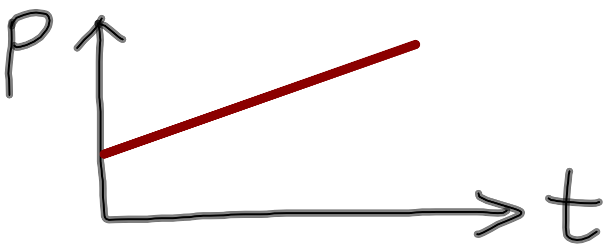
μ_{LAND} = TINY

$\mu_{H_2O} = 0$

How to get to the edge of the pond?
Toss the backpack in the direction opposite to the one you want to go.
Conservation of momentum for the you-backpack system.

Dec 9-10:58 AM

4)

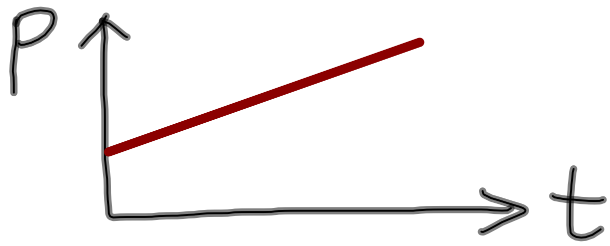


The above p-t graph shows a spacecraft while it is firing its rocket engines in space. What does the slope of this graph represent?

A) The mass of the spacecraft.
B) The velocity of the spacecraft.
C) The net force on the spacecraft.
D) The work done on the spacecraft.

Dec 9-10:23 AM

4)



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$SLOPE = \frac{\Delta P}{\Delta t}$

$J = \Delta P$

$F \cdot \Delta t = \Delta P$

$F = \frac{\Delta P}{\Delta t}$

Dec 9-10:23 AM

5) SPORTS.

HOW TO INCREASE THE RANGE?

⇒ FOLLOW THRU.

INCREASES RANGE
—— " —— TIME
—— " —— IMPULSE
—— " —— ΔP

Dec 9-11:07 AM

1. A 900 kg car A traveling east at 15.0 m/s collides with a 750 kg car B traveling north at 20.0 m/s. the cars stick together. In what direction does the wreckage move just after the collision?

a) 48.0° N of E
b) 36.9° N of E
c) 53.1° N of E
d) 42.0° N of E

Dec 3-8:07 AM

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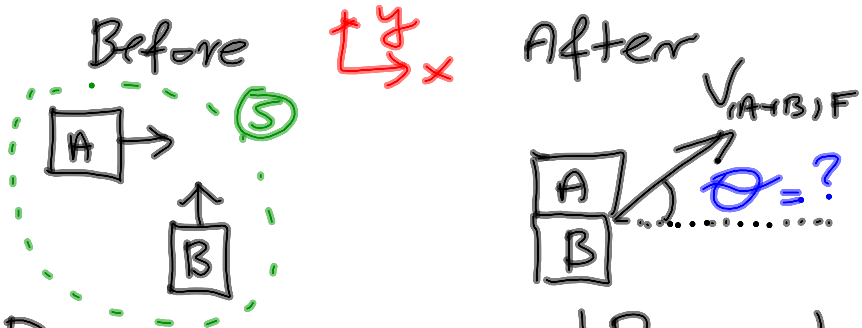


(x) $P_{A0x} = P_{(A+B)Fx}$

(y) $P_{B0y} = P_{(A+B)Fy}$

$\theta = \tan^{-1}\left|\frac{P_{(AB)Fy}}{P_{(AB)Fx}}\right|$

$\theta = 48°$

Dec 3-8:07 AM

CAR CRASHES. 3x

SAFETY FEATURES:

AIR BAGS

CRUMPLE ZONES

Feb 11-8:10 AM

$V_i = 60$ mph?

$V_f = 0$

$|\Delta p| = J_{ext.}$

$J_{ext} = F \cdot \Delta t$

$J_{ext} = F \cdot \Delta t$

Feb 11-8:16 AM

SEATBELTS: N1L

- provide the net external force which is necessary to keep you inside the car, so you can accelerate (slow down) with the car, so all the safety features (airbags, crunple zones, etc.) can work to your advantage to increase time of the crash (delta t), therefore decrease forces acting on you during crash.

Feb 11-8:21 AM

Review problem
Physics APB
Mr. Szakiel
12-3-12

1. A 50 kg block m1 is used to compress a spring by 10 m, as shown. Block m1 is released from rest and it separates from the spring at location 2. As block m1 passes location 3, another block m2 is dropped from negligible height and sticks to block m1. Two blocks together m1m2 travel up an incline plane and become airborne at location 5. At the top of their trajectory (at location 6) they collide with object m3. The collision is perfectly inelastic. Object m3 is initially at rest in a vertical position hanging on a 20 m long string. During the collision the protective coating is stripped and as a result the air resistance increases internal energy of the system by 5,000 J during the swing from location 6 to 7.

a) Calculate the height at which the clump of m1m2m3 comes to rest during its first swing to the right (at location 7). **Use the whole integer rounding and assume g = 10 m/s^2**.

2. New ending to previous problem: say, the collision at location 6 is NOT perfectly inelastic.

a) Find the velocity of object m1m2 after the collision, knowing that the object m3 swings up and comes to rest at the point where the string forms an angle of 30^{o} with the vertical. This time **object m3 has a mass of 300 kg**! There is no heat generated this time during the swing from location 6 to 7.

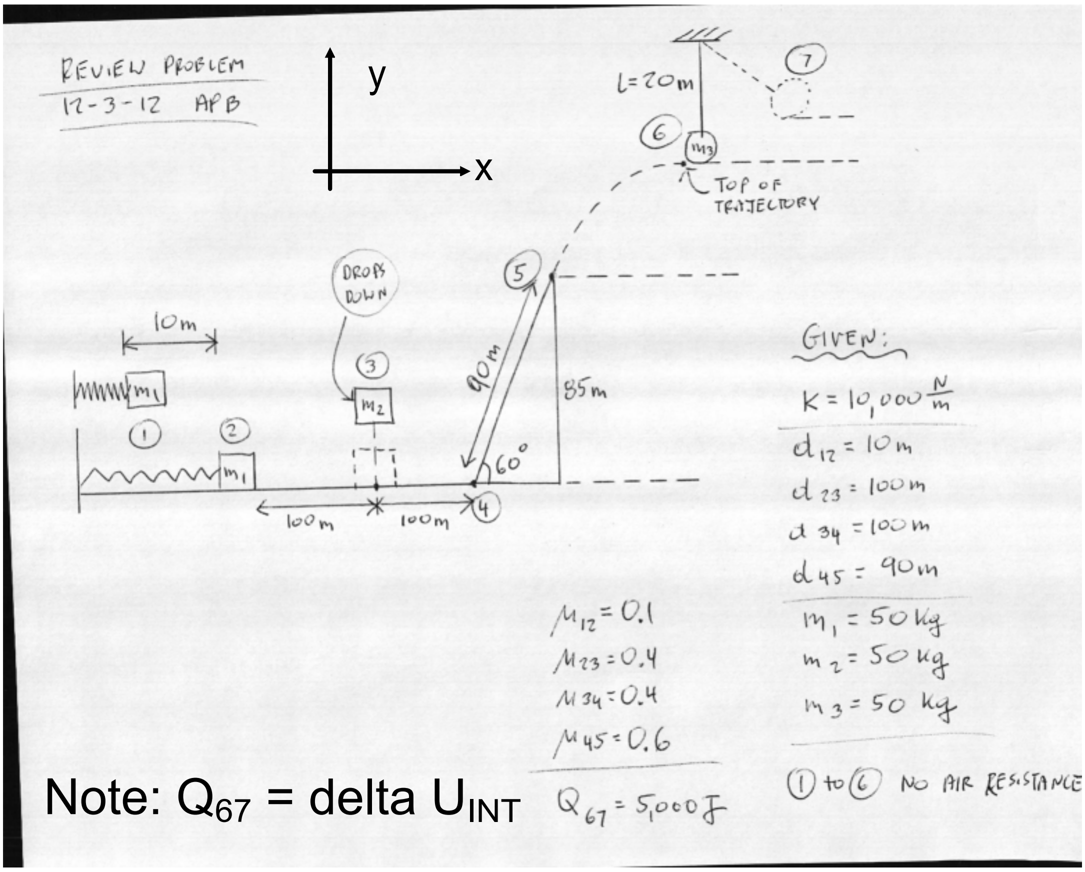
b) Was the collision at location 6 elastic?

c) Calculate the range of object m1m2 after the collision with object m3.

d) If the collision at location 6 lasted 0.2 s, what was the average force of object m3 on object m1m2 during this collision?

e) What was the average force of object m1m2 on object m3 during that collision?

Dec 3-11:09 AM



Dec 3-11:09 AM

Answers.

Note: Q_{67} = delta U_{INT}

1.
Velocity at 2 = 141 m/s
Velocity at 3 before collision = 138 m/s
Velocity at 3 after collision = 69 m/s
Velocity at 4 = 63 m/s
Velocity at 5 = 42 m/s
Projectile: v_{ox} = 21 m/s and v_{oy} = 36 m/s
projectile height = 65 m
Velocity at 6 before collision = 21 m/s (top - only v_{fx}=v_{ox})
Velocity at 6 after collision = 14 m/s
Height of the new pendulum = 6 m above point of equilibrium.

2.
Height of m1m2m3 pendulum after collision = 3 m (from trig.)
Velocity of m1m2m3 pendulum after collision = 8 m/s
Velocity of m1m2 object after collision = 3 m/s left (see sketch)
K_o = 22,500 J
K_F = 10,050 J
It was an inelastic collison.
delta y = 150 m down, so time in the air t = 5 s
delta x = 30 m left from location 6.
$F_{3 \text{ on } 12}$ = 2,400 N left
$F_{12 \text{ on } 3}$ = 2,400 N right.

Dec 3-1:16 PM

HW - momentum - relative motion problem (see Word file).
Problems worth solving from the 2/11/15 Handout:
1,3,6,7,8,11,12,15,16,17,37,38,41,42,62,66,74(approx. graphically only)

Feb 11-8:31 AM