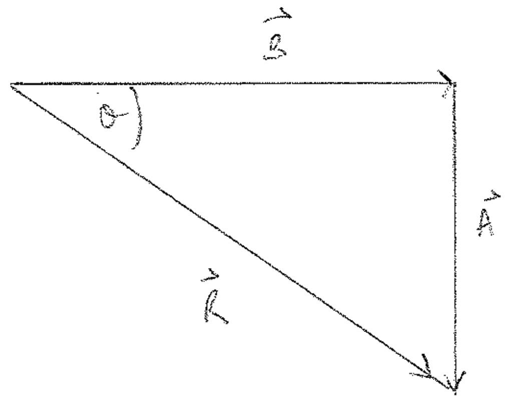
Exam Review - Problem #1 - Calculating $\vec{R}$

$\vec{A}$ = 28.9 m/s^2, S and $\vec{B}$ = 37.1 m/s^2, E. Calculate $\vec{R}$.



$$R^2 = A^2 + B^2$$

$$R = \sqrt{A^2 + B^2}$$

$$R = \sqrt{(28.9)^2 + (37.1)^2}$$

$$R = 47.0 \text{ m/s}$$

$$\tan\theta = \frac{A}{B}$$

$$\tan\theta = \frac{28.9}{37.1}$$

$$\theta = 37.9^\circ$$

$\vec{R}$ = 47.0 m/s, 37.9° S of E or [E 37.9° S]

R = 47.0 m/s^2, 37.9° S of E or 52.1° E of S

Exam Review - Problem #2 - General Kinematic Problem

A car moving with a velocity of 3.45 m/s [W] accelerates uniformly for 5.21 s over a distance of 110 m. Determine the final velocity of the car.

$\vec{v}_i = -3.45 \text{ m/s}$

$t = 5.21 \text{ s}$

$\vec{d} = -110 \text{ m}$

$\vec{v}_f = ?$

$$2\vec{d} = \left[\frac{1}{2}(\vec{v}_i + \vec{v}_f)t\right]2$$

$$2\vec{d} = (\vec{v}_i + \vec{v}_f)t$$

$$\frac{2\vec{d}}{t} = \vec{v}_i + \vec{v}_f$$

$$\vec{v}_f = \frac{2\vec{d}}{t} - \vec{v}_i$$

$$\vec{v}_f = \frac{2(-110)}{5.21} - (-3.45)$$

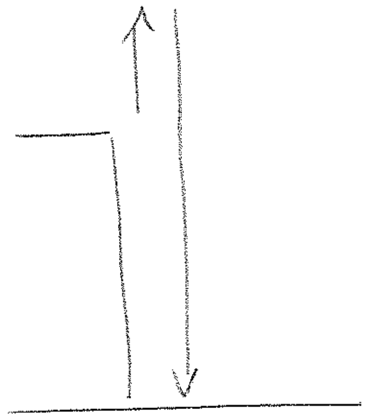
$$\vec{v}_f = -38.8 \text{ m/s}$$

The final velocity of the car was 38.8 m/s [W]

38.8 m/s [W]

Exam Review - Problem #3 - Freely Falling Body

A cliff diver begins her dive by jumping vertically upward. What was the diver's initial velocity if it takes her 5.4 s to hit the water 112 m below?



$\vec{a} = -9.80\,m/s^2$

$t = 5.4\,s$

$\vec{d} = -112\,m$

$\vec{v}_i = ?$

$$\vec{d} = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$$

$$\vec{d} - \frac{1}{2}\vec{a}t^2 = \vec{v}_i t$$

$$\vec{v}_i = \frac{\vec{d} - \frac{1}{2}\vec{a}t^2}{t}$$

$$\vec{v}_i = \frac{(-112) - \frac{1}{2}(-9.80)(5.4)^2}{5.4}$$

$$\vec{v}_i = +5.7\,m/s.$$

The diver's initial velocity was 5.7 m/s, up.

5.7 m/s, up

Exam Review - Problem #4 - 1st Law Problem

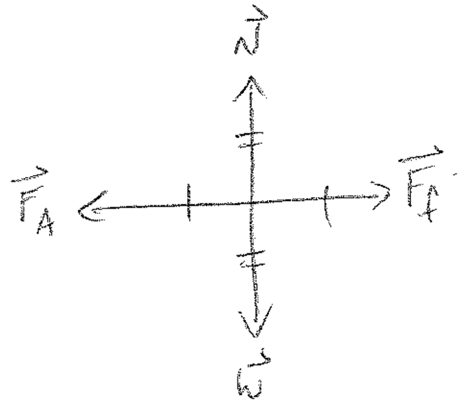
→ $\vec{v} = 0$ m/s
→ $\vec{v}$ is constant

A box of mass 15.32 kg is being pulled to the left across a horizontal surface by an applied force of 58 N. The box is moving at constant speed. What is the coefficient of kinetic friction? Include an FBD for the box.

$m = 15.32$ kg

$F_A = 58$ N

$\mu = ?$



$F_A = F_f$ $F_f = \mu N$

$N = W$ $W = mg$

$F_f = \mu N$

$F_A = \mu N$

$F_A = \mu W$

$F_A = \mu mg$

$\mu = \dfrac{F_A}{mg}$

$\mu = 0.39$

The coefficient of kinetic friction is 0.39.

0.39

Exam Review - Problem #5 - 2nd Law Problem

Type II

A 75 kg bobsled is pushed along a horizontal surface by two athletes. After the bobsled is pushed distance of 4.5 m starting from rest, its speed is 6.0 m/s. Find the magnitude of the net force on the bobsled.

Kinematic	force
$\vec{d} = +4.5\,m$	$m = 75\,kg$
$\vec{v}_i = 0\,m/s$	$\vec{F}_{net} = ?$
$\vec{v}_f = +6.0\,m/s$	* State F_{net} only in WS.
$\vec{a} = ?$	

No FBD

* we don't have individual forces.

① $\vec{v}_f^{\,2} = \vec{v}_i^{\,2} + 2\vec{a}\vec{d}$

$\vec{a} = \frac{\vec{v}_f^{\,2}}{2\vec{d}}$

$\vec{a} = \frac{(6.0)^2}{2(4.5)}$

$\vec{a} = +4.00\,m/s^2$

② $\vec{F}_{net} = m\vec{a}$

$\vec{F}_{net} = (75)(4.00)$

$\vec{F}_{net} = +3.0 \times 10^2\,N$

The magnitude of the net force is $3.0 \times 10^2\,N$.

3.0×10^2 N

Exam Review - Problem #6 - 2nd Law Problem

Type III

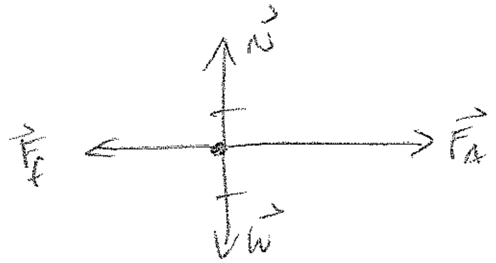
In a physics lab, Amanda applies a 34.5 N rightward force to a cart to accelerate it across a horizontal surface at a rate of 1.28 m/s². The coefficient of friction between the cart and surface is 0.648. Determine the mass of the cart. * include an FBD for the cart.

$F_A = 34.5\ N$

$a = 1.28\ m/s^2$

$\mu = 0.648$

$m = ?$



$F_A \neq F_f$ $\quad W = mg$

$N = W$ $\quad F_f = \mu N$

$\vec{F}_{net} = m\vec{a}$

$\vec{F}_{net} = m\vec{a}$

$+F_A - F_f = m(+a)$

$F_A - \mu N = ma$

$F_A - \mu W = ma$

$F_A - \mu mg = ma$

$F_A = ma + \mu mg$

$F_A = m(a + \mu g)$

$m = \dfrac{F_A}{a + \mu g}$

$m = \dfrac{34.5}{1.28 + (0.648)(9.80)}$

$m = 4.52\ kg$

The mass of the cart is 4.52 kg.

4.52 kg

Exam Review - Problem #7 - Impulse-Momentum Theorem

A 2250 kg car is traveling to the west with a speed of 20.0 m/s. How long does it take a car to obtain a momentum of 1.125×10^4 kgm/s, east if an eastward force of 8450 N acts on the car?

$m = 2250\ kg$

$\vec{v}_i = -20.0\ m/s$

$\vec{p}_f = +1.125\times10^4\ kgm/s$

$\vec{F} = +8450\ N$

$t = ?$

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

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

$\vec{F}t = \vec{p}_f - \vec{p}_i$

$\vec{F}t = \vec{p}_f - m\vec{v}_i$

$$t = \frac{\vec{p}_f - m\vec{v}_i}{\vec{F}}$$

$$t = \frac{(1.125\times10^4) - (2250)(-20.0)}{8450}$$

$t = 6.66\ s$

It would take 6.66 s for the car to obtain a momentum of 1.125×10^4 kgm/s [E].

6.66 s

Exam Review - Problem #8 - Work-Energy Theorem

* This is a work-gravitational potential theorem prob.

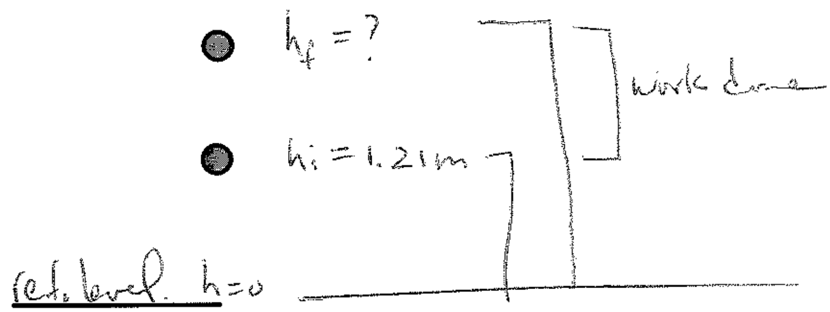
You lift an 0.170 kg apple 1.21 m above the ground. If you do another 1.2 J of work on the apple, what will be the height of the apple relative to the ground?

$m = 0.170$ kg

$h_i = 1.21$ m

$W = 1.2$ J

$h_f = ?$



$W = Fd = \Delta E_g$

$W = \Delta E_g$

$W = E_{gf} - E_{gi}$

$W = mgh_f - mgh_i$

$W + mgh_i = mgh_f$

$h_f = \frac{W + mgh_i}{mg}$

$h_f = \frac{1.2 + (0.170)(9.80)(1.21)}{(0.170)(9.80)}$

$h_f = 1.9$ m

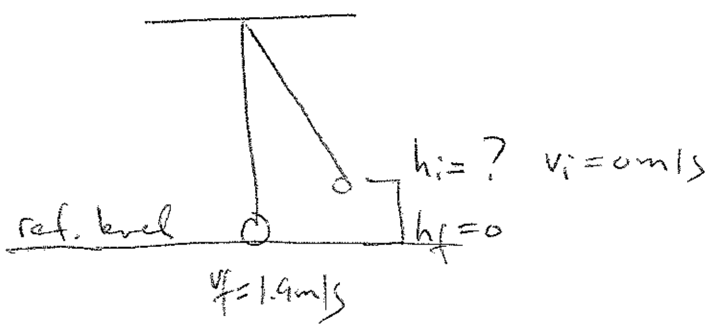
The apple will be 1.9 m from the ground.

1.9 m

Note: There will also be a work-kinetic energy theorem problem on the final exam.

Exam Review - Problem #9 - Conservation of Energy

A pendulum bob is released from some initial height such that the speed of the bob at the bottom of the swing is 1.9 m/s. What is the initial height of the bob? Assume energy is conserved.



* No mass is provided so you should expect m's to divide out.

$$E_{k_i} + E_{g_i} + E_{e_i} = E_{k_f} + E_{g_f} + E_{e_f}$$

$$mgh_i = \frac{1}{2}mv_f^2$$

$$h_i = \frac{v_f^2}{2g}$$

$$h_i = \frac{(1.9)^2}{2(9.81)}$$

$$h_i = 0.18\,m$$

The initial height of the bob is 0.18m.

0.18m