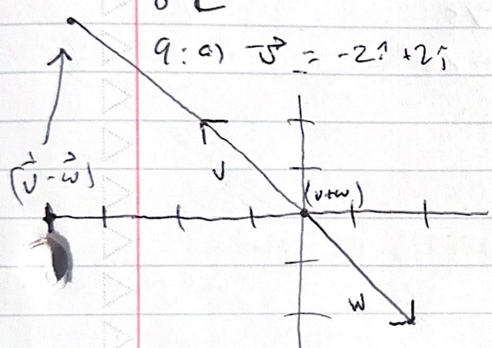
Algebra Based physics Midterm

1. C
2. C
3. D
4. C
5. A
6. C
7. D
8. C

9: a) $\vec{v} = -2\hat{i} + 2\hat{j}$ $\vec{w} = 2\hat{i} - 2\hat{j}$



$\vec{v} + \vec{w} = (-2, 2)i + (2 + -2)j$

$\vec{v} + \vec{w} = 0i + 0j$

b) $\vec{v} + \vec{w} = 0i + 0j$

c) $\vec{v} - \vec{w} = -4i + 4j$

$\vec{v} - \vec{w} = (-2 - 2)i + (2 - -2)j$

D) ok

E) $\vec{v} \cdot \vec{w} = (-2)(2) + (2)(-2)$ $\vec{v} - \vec{w} = -4i + 4j$

$-4 \quad -4$

$\vec{v} \cdot \vec{w} = -8$

Unit 1: Kinematics II and III

1.

a) $V(t) = at + V_i = (3)(4) + (15) = 12 + 15 = \underline{V_f = 27 ms^{-1}}$

b) $x(t) = \frac{1}{2}at^2 + V_i t + x_i$

$\Delta x = \frac{1}{2} 3ms^{-2} (4s)^2 + 15ms^{-1}(4s)$

$= \frac{3}{2}(16)m + 60m = \boxed{84m}$

C) Yes they are

2.

a) $V_p = \frac{988 - 338m}{15 - 5s} = \frac{650}{10s} = \boxed{65 ms^{-1}}$

$V_Q = \frac{2900 - 1500m}{30 - 20s} = \frac{1400m}{10s} = \boxed{140 ms^{-1}}$

b) positive acceleration because it goes $65 ms^{-1}$ to $140 ms^{-1}$

3. $V_f^2 = V_0^2 + 2a\Delta x$

a)

$V_0 = 0 m/s$
$V_f = 6 m/s$
$a = 0.8 m/s^2$

$\frac{V_f^2 - V_0^2}{2a} = \Delta x$

$\Delta x = \frac{6^2 - 0^2}{2(0.8)}$

$\boxed{\Delta x = 22.5m}$

b) $V_f = V_0 + at$

$t = \frac{V_f - V_0}{a} = \frac{6 - 0}{0.8} = \boxed{7.5s}$

4. Range = 60m
launch angle =
Initial velocity =
time of flight =

$R = \frac{V_0^2 \sin(2\theta)}{g}$

$60m = \frac{V_0^2 \sin(2 \cdot 30)}{9.81}$

$60m = \frac{V_0^2 \left(\frac{\sqrt{3}}{2}\right)}{9.81}$

$V_0^2 = \frac{60 \times 9.81}{\sqrt{3}/2} = \frac{588.6}{0.866} = 678.5$

$V_0 = \sqrt{678.5}$

$V_0 = 26 ms^{-1}$

$T = 2v_0 \sin\theta$

$T = \frac{2(26) \sin 30°}{9.81}$

$T = \frac{26}{9.81} = 2.65s$

3 Unit 2: Forces I and II

1.

a) $T = \frac{F\perp}{\sin(Q)} = \frac{1000}{\sin(7)} = \frac{1000}{.12187} \approx 8205N$

b) $F_{net} = m \cdot a \quad a = \frac{F_{net}}{m} \quad a = \frac{7763.51}{900}$

$\boxed{a \approx 8.63 m/s^2}$

2.

a) $V_F^2 = V_0^2 + 2ad \qquad a = \frac{V_F^2 - V_0^2}{2d}$

$a = \frac{0-(33.33)^2}{2 \cdot 100} = \frac{-1111.11}{200} = \boxed{-5.56 m/s^2}$

b) $F = ma$

$F = 20{,}000\ (-5.56) = \boxed{111{,}200N}$

3.

50 kg child-sled system

• friction is negative

$F_{x net} = -7.5N + F_2 \cos(30) + F_1 \cos(45)$

$= -7.5 + 8\cos(30) + 10\cos(45)$

$= -7.5 + 6.9282 + 7.07$

$= +6.49927N = ma$

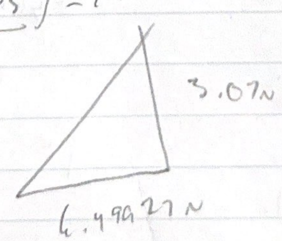
$F_{y net} = 10\sin(45) - 8\sin(30) \qquad m = \frac{+6.49927N}{50 kg}$

$= 3.07N$

X direction $= a + 0.13 m/s^2 \rightarrow$ X direction

$a = F/m \quad a = \frac{3.07}{50}$

$\boxed{a = 0.0614 m/s^2}$ - Y direction



$F = \sqrt{6.49927^2 + 3.07^2}$

$F = 7.18N = ma$

$a = \frac{7.18N}{50 kg}$

$a = 0.14 m/s^2$

4 Unit 3 forces III and IV

1. a) $g(\sin\theta - M\cos\theta) = \frac{k\Delta x}{m}$

b) $M = 0$

$a = g\sin\theta$

2.

a) $a = g(\sin\theta - M\cos\theta)$

$a = 9.8/(\sin 10^\circ - 0.05\cos 10^\circ)$

$a = 9.81 (0.1736 - 0.04924 = 9.81 \cdot 12436$

$a \approx 1.22\ m/s^2$

b) $d = v_0 t + \frac{1}{2}at^2$ $\quad d = 0 + 0\ 61.900 = 549m$

$a = 0 \cdot 30 + \frac{1}{2} \cdot 1.22 \cdot 30^2$ $\quad v = v_0 + at = 1.22(30) = 36.6\ m/s$

3.

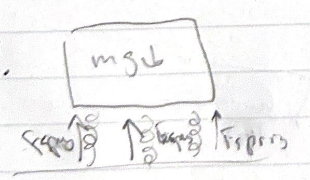
a) $F_{centripetal} = L_{horizontal} = L\sin\theta = L\sin(30)$ $\quad 600\frac{km}{h}\left(\frac{1000m}{1km}\right)\left(\frac{1h}{60min}\right)\left(\frac{1min}{}\right)$

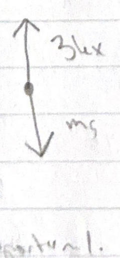
$F_{cent} = 80{,}000\sin(30) \boxed{= 40{,}000N}$ $\quad = 166.667\ m/s$

B) $F_{cent} = \frac{mv^2}{r} \rightarrow r = \frac{mv^2}{F_{cent}} = \frac{(6000kg)(166.667m/s)^2}{40{,}000N} \boxed{= 4166.68m = 4.17km}$

C) $C = 2\pi r$, d plane path $= \pi r$

$v = \frac{d}{t} \rightarrow t = \frac{d}{v} = \frac{\pi r}{166.667} = \frac{(4166.68m)\pi}{166.667m/s}$ $\boxed{t = 78.54s}$

4. 



$F_{y\,net} = 3kx - mg = 0$

$\Rightarrow mg = 3kx$

$\boxed{x = \frac{mg}{3k}}$

X and k are inversely proportional.
As k gets close to infinity, x gets smaller.

5.

a) $V_t = \sqrt{\frac{2\cdot 60\cdot 9.81}{1.2\cdot 0.25\cdot 0.5}} = \sqrt{\frac{177.2}{0.15}} = \sqrt{7848} \approx 88.57$ m/s

b) $A_{new} = 100 \times 0.25 = 25 m^2$

$V_t = \sqrt{\frac{2\cdot 60\cdot 9.81}{1.2\cdot 25\cdot 0.5}} = V_t\sqrt{\frac{1177.2}{15}} = \sqrt{78.48}$ $\boxed{\approx 8.86 \text{ m/s}}$

6. a) $A = \pi\cdot\left(\frac{0.2}{2}\right)^2 = \pi\cdot(0.1)^2 = \pi(0.01) m^2 \approx 0.0314 m^2$

$\Delta L = \frac{10,000\cdot 10}{0.0314\cdot 4.5\times10^{9}} = \frac{100,000}{1.413\times10^{9}}$

$\boxed{\Delta L = 7.08\times10^{-3} m}$

b) $\Delta L_{new} = \frac{F\cdot L_0}{A E_{new}} = \frac{10,000\cdot 10}{0.0314\cdot 22.5\times10^{9}}$

$= \frac{100,000}{0.7065\times10^{9}} \approx 1.415\times10^{-4}$ m

5. (Design problem #2)

T= 2.6 seconds

M= 1.00 kg

L= 0.75 m

$F = 2\pi\sqrt{L/g}$

$2.6^2 = 2\pi\sqrt{0.75g}^2$

$6.76 = 2\pi\, 0.75g^2$

$6.76 = 4.73g^2$

$g^2 = 1.636$

$g = 1.279$