Calc Based Midterm

*Unit 0

1) $\boxed{C: 11.0 g/cm^3}$

2) $\frac{600km}{60km/h} = 10h$ $\boxed{C: 10hrs}$

3) $25\left(\frac{3600s}{1hr}\right)\left(\frac{1km}{1000m}\right) = 90\frac{km}{h}$ $\boxed{D: 90 kmhr}$

4) $\frac{10km/h - 0km/h}{60s} = \frac{1}{6}\frac{km/h}{s}$ $\boxed{C: \frac{1}{6}\frac{km/h}{s}}$

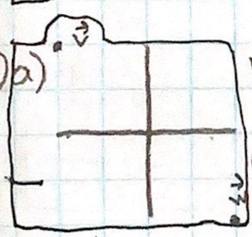
5) $\boxed{C: 500m^2}$

6) $\frac{2000cm^3}{.5cm^3} = 4000$ $\boxed{C: 4 \times 10^3}$

7) $V_x = V_y = 10 \times \cos(45°) = 10 \times \frac{\sqrt{2}}{2} = 7.1 km/h$ $\boxed{D: -7.1 \ \& -7.1 km/h}$

8) $\boxed{A: 225°}$

9) a)



b) $\vec{v} + \vec{w} = (-2\hat{i} + 2\hat{j}) + (2\hat{i} - 2\hat{j}) = 0$

$\boxed{\vec{v} + \vec{w} = 0}$

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

$\boxed{\vec{v} - \vec{w} = -4\hat{i} + 4\hat{j}}$

d) $\vec{v} + \vec{w}$ is at the origin
$\vec{v} - \vec{w}$ is at the top left

e) $\vec{v} \cdot \vec{w} = (-2)(2) + (2)(-2) = \boxed{-8}$

*Unit 1

1) a) $V = V_0 + at$
$= 15 m/s + (3 m/s^2)(4s)$
$\boxed{V = 27 m/s}$

b) $S = V_0 t + \frac{1}{2}at^2$
$= (15 m/s)(4s) + \frac{1}{2}(3 m/s^2)(4s)^2$
$\boxed{S = 84m}$

c) $V_{avg} = \frac{V_0 + V_f}{2} = \frac{15 + 27}{2} = 21 m/s$
$V_{inst} = t = 0, V_0 = 15 m/s$
$V_{inst} = t = 4, V = 27 m/s$
$\boxed{\text{they are different}}$

2) a) $P = \frac{600m}{10s} = \boxed{60 m/s}$
$Q = \frac{2138m}{25s} = \boxed{85.52 m/s}$

b) $\boxed{\text{positive}, \sim 2m/s}$

3) a) $V_f^2 = V_0^2 + 2as$
$6^2 m/s = 0 + 2(.8 m/s^2)s$
$36 = 1.6s$
$\boxed{S = 22.5m}$

b) $V_f = V_0 + at$
$6 m/s = 0 + (.8 m/s^2)t$
$\boxed{t = 7.5s}$

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

$\theta = 45°$

$\sin(2\theta) = \sin(90) = 1$

$V_0^2 = 60 \cdot 9.81$

$V_0 = \sqrt{588.6}$

$\boxed{V_0 = 24.3 \text{ m/s}}$

$T = \frac{2V_0 \sin\theta}{g}$ → $\frac{2(24.3)\sin 45}{9.81}$

$\boxed{T = 3.5 s}$

5) $T = 2\pi\sqrt{\frac{L}{g}}$ → $g = \frac{4\pi^2 L}{T^2}$

$L = 1m$

$T \approx 2s$

$g = \frac{4\pi^2(1.0)}{2.0^2} = 9.87 \text{ m/s}^2$

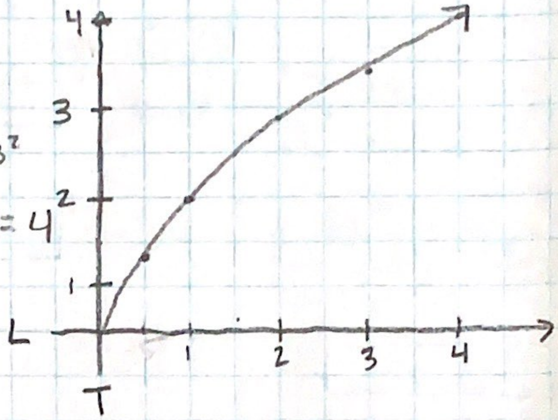
$T = 2\pi\sqrt{.5/9.87} \approx 1.41$

$T = 2\pi\sqrt{1/9.87} \approx 2$

$T = 2\pi\sqrt{2/9.87} \approx 2.8$

$T = 2\pi\sqrt{3/9.87} \approx 3.46$

$T = 2\pi\sqrt{4/9.87} = 4$



★ Unit 2

1) a) $F_\perp = T\sin\theta$ → $T = \frac{F_\perp}{\sin\theta}$ $\frac{1000N}{\sin(7°)}$

$\boxed{T = 8203N}$

b) $F_f = \mu_k \cdot m \cdot g = 0.05 \cdot 900 \cdot 9.81 = 441.45N$

$F_{net} = F_\perp - F_f = 1000 - 441.45 = 558.55N$

$a = \frac{F_{net}}{m} = \frac{558.55N}{900} \approx \boxed{0.621 \text{ m/s}^2}$

2) a) $V_f^2 = V_0^2 + 2ad$

$0 = (33.33)^2 + 2a(100)$

$\boxed{a = -5.56 \text{ m/s}^2}$

b) $F = m \cdot a$

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

3) F_1: $F_{1x} = 10\cos(45°) = 7.07N$

$F_{1y} = 10\sin(45°) = 7.07N$

F_2: $F_{2x} = 8\cos(30°) = 6.93N$

$F_{2y} = 8\sin(30°) = 4.00N$

$F_{net} = F_{1x} + F_{2x} - F$

$= 7.07 + 6.93 - 7.5$

$= 6.5N$

$F_{net} = m \cdot a$

$a = \frac{6.5}{50}$

$\boxed{a = 0.13 \text{ m/s}^2}$

★ Unit 3

1) a) $F_{net} = mg\sin\theta - f$

$= mg\sin\theta - \mu(mg\cos\theta)$

$ma = mg\sin\theta - \mu mg(\cos\theta)$

$\boxed{a = g(\sin\theta - \mu\cos\theta)}$

b) theres no friction:

$\boxed{a = g\sin\theta}$

2) a) $a = g(\sin\theta - \mu\cos\theta)$

$a = 9.81(0.1736 - 0.05(0.9848))$

$\boxed{a = 1.22 \text{ m/s}^2}$

b) $d = V_0 t + \frac{1}{2}at^2$

$d = 0.61 \cdot 900 = \boxed{549m}$

$V = V_0 + at = 0 + 1.22 \cdot 30 = \boxed{36.6 \text{ m/s}}$

3) a) $F_c = F_L \sin(\theta)$

$F_c = 80{,}000 \sin(30)$

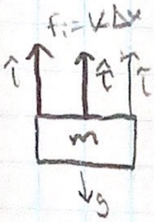
$\boxed{F_c = 40{,}000N}$

b) $F_c = \frac{mv^2}{r} \rightarrow \frac{6000(166.67)^2}{40{,}000} \rightarrow \boxed{4166.67m}$

c) $C = 2\pi r \quad \frac{C}{2} = \pi r = \pi(4166.67) \approx 13{,}094.4m$

$t = \frac{d}{v} = \frac{13{,}094.4}{166.67} \approx \boxed{78.57 \text{ seconds}}$

4)



b) $F_{total} = 3k\Delta x$

$mg = 3k\Delta x$

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

c) $k \to \infty$ $\quad$ the mass would barely move

$\lim_{k\to\infty} \Delta x = \lim_{k\to\infty} \frac{mg}{3k} = 0$

5) $V_t = \sqrt{2mg/C\rho A}$

$V_t = \sqrt{\frac{2 \cdot 60 \cdot 9.81}{0.5 \cdot 1.2 \cdot 0.25}} = \sqrt{7848} = \boxed{88.6 m/s}$

b) $A' = 100 \cdot 0.25 = 25m^2$

$V_t' = \sqrt{\frac{2mg}{C\rho A}} = \sqrt{\frac{2 \cdot 60 \cdot 9.81}{0.5 \cdot 1.2 \cdot 25}}$

$V_t' = \sqrt{\frac{1177.2}{15}} \quad \sqrt{78.48} \approx \boxed{8.86 m/s}$

6) $\Delta L = \frac{FL}{AY}$ $\quad \Delta L = \frac{10000 \cdot 10}{0.0314 \cdot 45 \cdot 10^9}$

$\Delta L = \frac{100000}{1.413 \times 10^9} = \boxed{7.08 \times 10^{-5} m}$

b) $Y' = 22.5 \times 10^9 N/m^2$

$\Delta L' = \frac{10000 \times 10}{0.0314 \times 22.5 \times 10^9} \quad \Delta L' = \frac{100000}{.707 \times 10^9}$

$\boxed{\Delta L' = 1.41 \times 10^{-4}}$