Mid term

Collin O'Driscoll

1) C: $1.0\ g\ cm^{-3}$

2) C: 10.0 hours

3) D: $90\ km\ hr^{-1}$

4) C: $1/6\ km\ hr^{-1}\ s^{-1}$

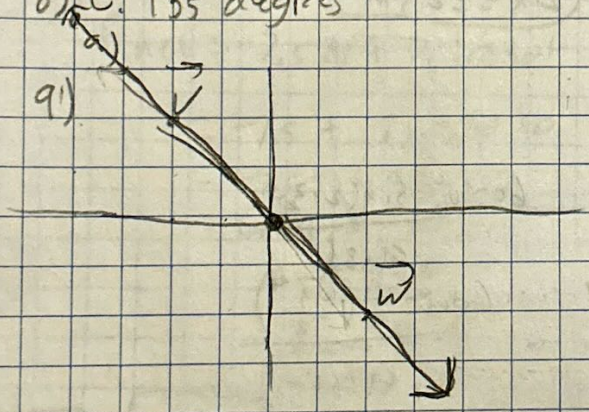
5) A: $5000\ m^2$

6) C: 4×10^3

7) D: -7.1 and -7.1 km/hr

8) C: 135 degrees

9)



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

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

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

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

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

$-4 - 4$

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

Unit 2: Kinematics II and III

1) a) $v(t) = at + v_i$

$(3)(4) + (15)$

$v_f = 27\ ms^{-1}$

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

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

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

$3/2\ (16)m + 60m = 84m$

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

$v_2 = \frac{2400 - 1500\ m}{30 - 20s} = \frac{1400m}{10s} = 140\ ms^{-1}$

b) Positive Acceleration
$65\ ms^{-1} \rightarrow 140\ ms^{-1}$

3) $v_0 = 0\ m/s$
$v_f = 6\ m/s$
$a = 0.8\ m/s^2$

$v_f = v_0 + at$

$t = \frac{v_f - v_0}{a} = \frac{6 - 0}{0.8} = \boxed{7.5s}$

$v_f^2 = v_0^2 + 2a\Delta x$

$\frac{v_f^2 - v_0^2}{2a} = \Delta x$

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

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

4) 60m
Velocity $= 26\ ms^{-1}$

$T = \frac{2u\sin\theta}{g}$

$T = \frac{2(26)\sin 30}{9.81}$

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

$60 = \frac{v_2^2 \sin(2 \cdot 30)}{9.81}$

$60m = \frac{v_0^2\left(\frac{\sqrt{3}}{2}\right)}{9.81}$

$v_0^2 = \frac{60 \times 9.81}{\sqrt{3}/2} = \frac{588.6}{0.86} = 678.5$

$\sqrt{v_0^2} = \sqrt{678.5}$

$\boxed{v_0 = 26\ ms^{-1}}$

5)

Unit 2: Forces I and II

1) a) $T = \frac{F_\perp}{\sin(\theta)} = \frac{1000}{\sin(7)} = \frac{1000}{0.122} = \boxed{8205\ N}$

b) $F_{net} = ma \qquad a = \frac{F_{net}}{m} \qquad a = \frac{7763.55}{9.00} + 0 \approx 863\ m/s^2$

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

$a = \frac{0 - (333)^2}{2 \cdot 100} = \frac{-1111.11}{200} = \boxed{-5.56\ m/s^2}$

b) $F = ma$

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

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

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

$= -7.5 + 6.93 + 7.07$

$= 6.49\ N = ma$

$m = 6.49\ N$ / $50\ kg$

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

$F_{net} = 10\sin 45 - 8\sin 30$

$= 3.07 N$

$\frac{3.07}{50}$

$\boxed{a = 0.06\ m/s}$

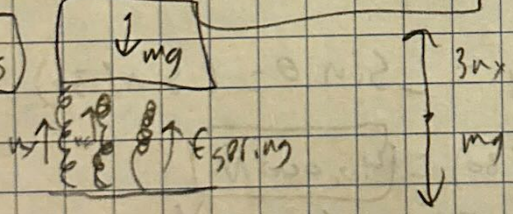
$F = \sqrt{6.49^2 + 3.07^2}$

$F = 7.18 N$

$a = \frac{7.18\ N}{60\ kg} = \boxed{0.4\ m/s^2}$

Unit 3 forces

4)



$F_{xnet} = 3n_x - mg = 0$

$\rightarrow mg = 3n_x$

$x = \frac{mg}{3n}$

x and n are inversely proportional as $n \to 0$ so the bottom gets infinitely greater + more x small

5) $v_t = \sqrt{\frac{2 \cdot 60 \cdot 9.81}{1.2 \cdot 1.6 \cdot 0.25 \cdot 0.5}} = \sqrt{\frac{1177.2}{0.15}} = \sqrt{7848} \approx 88.59$ m/s

b) $A_{new} = 100 \times 0.25 = 25\ m^2$ $v_t = \sqrt{\frac{2 \cdot 60 \cdot 9.81}{1.2 \cdot 25 \cdot 0.5}} = v_t = \sqrt{\frac{1177.2}{15}}$

$= \sqrt{7848}$

$= 6.86$ m/s

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

$\Delta L = \frac{10,000 \cdot 10}{0.0314 \cdot 45 \times 10^9} = \frac{100,000}{1.413 \times 10^9}$ $\Delta L = 7.09 \times 10^{-5}$ m

b) $\Delta L_{new} = \frac{F \cdot L_0}{\Delta E \cdot A_{new}} = \frac{10,000 \cdot 10}{0.0314 \cdot 22.4 \times 10^9} = 1.415 \times 10^{-4}$ m

Unit 3 forces

1) $a = g(\sin\theta - \mu\cos\theta) = \frac{F_{net}}{m}$

b) $m = 0$

$a = g \sin\theta$

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

$a = 9.81(\sin 10 - 0.05\cos 10)$

$a = 9.81(0.1736 - 0.04924) =$ $a \approx 1.22\ m/s^2$

b) $d = v_0 t + \frac{1}{2} a t^2$

$d = 0 \cdot 30 \cdot \frac{1}{2} 1.22 \cdot 30^2$

$= 0 + 0.06 \cdot 900 = 549$ m

$1.22(30) =$ 36.6 m/s

Unit 3: Forces III IV

3) $F_{centripetal} = L_{horizontal} = L \sin\theta = L \sin(30)$

$F_{centripetal} = 80,000 \sin(30) =$ 40,000 N

$F_{cent} = \frac{mv^2}{r} \Rightarrow r = \frac{mv^2}{F_{cent}} = \frac{(6000 kg)(166.667\ m/s)^2}{40,000 N}$

$C = 2\pi r$ distance total $= \pi r$

$= 4166.68$ m $= 4.17$ km

$\frac{(4166.68 m)\pi}{166.667\ m/s} =$ $t = 78.54$ s