FIRST YEAR BLOCK WEEK SOLUTIONS.

1/ (a) $(0{\cdot}1)(10) = \underline{\underline{1N}}$.

total mass.

(b) $(0{\cdot}2)(10) - F_f = (1).(0{\cdot}5)$

$F_f = 2 - 0{\cdot}5 = \underline{\underline{1{\cdot}5N}}$.

(c) $F_{f\,dynamic}$ remains constant $= \underline{\underline{1{\cdot}5N}}$.

(d) $\mu_{static} = \dfrac{F_{f\,max}}{F_N} = \dfrac{2}{8} = 0{\cdot}25$.

total mass.

$\therefore F_{f\,max} = \mu_{static} . F_N = (0{\cdot}25)(1{\cdot}2)(10)$
$= 3N$

$\therefore 3 = mg$

$m = 3/10 = \underline{300 \text{ grams}}$

2/ (a) $\Delta\vec{p}_{10} = (10)(7) - (10)(5) = 20Ns$.

(b) $\Delta\vec{p}_{20} = -20Ns$.

(c) E_k before $= \frac{1}{2}(20)(10)^2 + \frac{1}{2}(10)(5)^2$
$= 1000 + 125$
$= 1125 J$

E_k after $= \frac{1}{2}(10)(7)^2 + \frac{1}{2}(20)(9)^2$
$= 245 + 810$
$= 1055 J$

$-20 = 20.v - 20.(10)$

$180 = 20.v$

$v = 9ms^{-1}$

$\therefore \Delta E_k = 1055 - 1125$
$= \underline{\underline{-70J}}$.

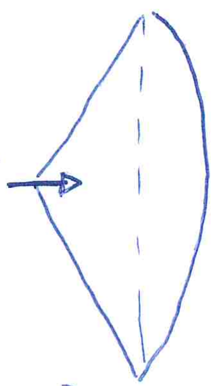
2 d/ Both equal + opposite.

(e) Area = +20 Ns.

$\therefore \quad 20 = \frac{1}{2} \times 0.1 \times F_{max}$

$\therefore \quad F_{max} = \underline{\underline{400N}}$.

3/

(a) F 

(b) $\vec{F}_{AV} = \frac{100+0}{2} = 50N$.

$\therefore a = \frac{50}{0.05} = 1000 ms^{-2}$

(c) $v^2 = u^2 + 2as$

$v^2 = 2(1000)(0.2)$

$v = \underline{\underline{20 ms^{-1}}}$.

<u>OR</u>

Area = Work

$\therefore$ Work = $\frac{1}{2}(0.2)(100)$

= 10 Joules.

$10 = \Delta E_k = \frac{1}{2}mv^2 - 0$.

$10 = \frac{1}{2}(0.05)v^2$

$v = \sqrt{20/0.05} = \underline{\underline{20 ms^{-1}}}$

(d) Power = $\frac{\text{Work}}{\text{time}}$

$= \frac{10}{0.02}$ = 500 watts

OR

Power = $\bar{F} \cdot \bar{v}$

$= (50) \cdot \left(\frac{20}{2}\right)$

= 500 watts.

$v = u + a\Delta t$

$\frac{20}{1000} = t = 0.02$

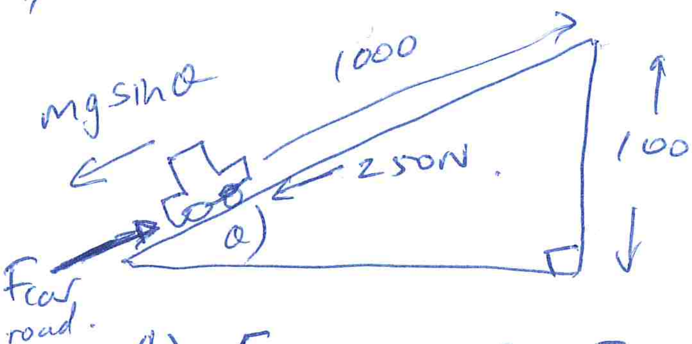
3 (e) $W = \Delta E_k$

$= 0 - \frac{1}{2}(0.05)(20)^2$

$= -10$ Joules ✓✓

$\therefore$ ~~$\vec{F} = -10/0.05 = -200N$~~ .

4/ (a) $F_{net} = ma = (500)(2) = \underline{\underline{1000N}}$



$\sin\theta = \frac{1\cancel{0}\cancel{0}}{1\cancel{0}\cancel{0}\cancel{0}}$

$\sin\theta = 0.1$

(b) $F_c - mg\sin\theta - F_f = ma$

$F_c - (500)(10)(0.1) - 250 = 500(2)$

$F_c = 1000 + 750$

$= \underline{\underline{1750N}}$.

b/ Car also exerts a normal force.

$mg\cos\theta = 5000\cos 6^\circ$

$= \underline{\underline{4970N}}$

(c) $P_{car} = \bar{F}_c \cdot \bar{v}$

$= (1750)(32)$

$= \underline{\underline{55kW}}$

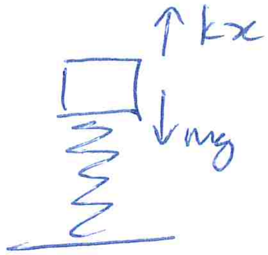
$v^2 = u^2 + 2as$

$v^2 = 0 + 2(2)(1000)$

$v = 63ms^{-1}$ (very fast)

$\bar{v} = 32ms^{-1}$

5/ (a)

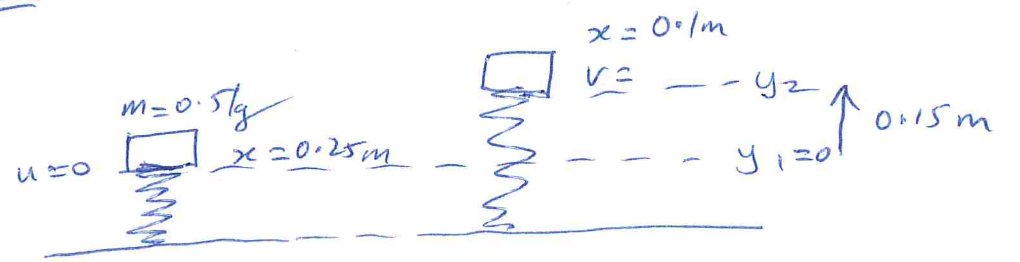


$mg = kx$

$(0.5)(10) = k(0.1)$

$k = \underline{\underline{50\,Nm^{-1}}}$.

(b) max speed occurs when mass passes through equilibrium as beyond that point net force is <u>down</u>.



$\Delta E = 0$

$\Delta U_E + \Delta U_g + \Delta E_k = 0$.

$\left[\frac{1}{2}(50)(0.1)^2 - \frac{1}{2}(50)(0.25)^2\right] + \left[(0.5)(9.8)(0.15) - 0\right] + \left[\frac{1}{2}(0.5)v^2\right] = 0$

$\left[0.25 - 1.56\right] + \left[0.75\right] + \left[0.25v^2\right] = 0$.

$0.25v^2 = 0.56$

$v \cong \underline{\underline{1.5\,ms^{-1}}}$

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ignoring gravity.

w/o gravity

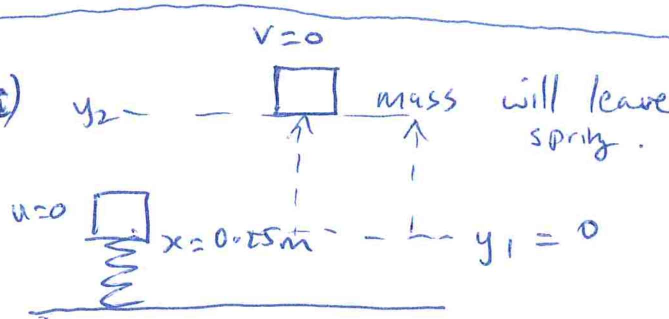
(ie: take $x=0$ to be at <u>20cm</u>.)

$\frac{1}{2}mv^2 = \frac{1}{2}kx^2 \leftarrow$ relative to eqm.

$v^2 = \frac{50(0.15)^2}{0.5} = 100(0.15)^2$

$v = 10(0.15) = \underline{\underline{1.5\,ms^{-1}}}$.

(c)



$\underbrace{\Delta U_E}_{\text{zero}} + \Delta U_g + \Delta E_k = 0$.

$\left(0 - \frac{1}{2}(50)(0.25)^2\right) + \left((0.5)(10)y_2\right) + 0 = 0$

$y_2 = \frac{1.56}{5}$

$= \underline{\underline{30cm}}$ above y_1