Exam 2 Problem 1

$m = 1450\ kg$ $\mu = 0.58$

a) 

Vertical $F_N = mg$

Horizontal $f_f = T$

Const speed $\vec{a} = 0 \Rightarrow \vec{F} = 0$

$f_f = \mu F_N = \mu mg = \boxed{8.24 \times 10^3\ N}$

a) $\vec{F} = \boxed{8.24 \times 10^3\ N}$

b) $T = 8.24 \times 10^3\ N$ Const speed $\vec{a} = 0$

c) $f_s = \mu_s mg = \boxed{9.95 \times 10^3\ N}$

Exam 2 Problem 2

a) $P = Fv = Av^2 v = Av^3$

Coast $\vec{v}$ $F_A = F_f$

$P = 300$ Watts $A = 0.08$ kg/m

$v = (P/A)^{1/3} = \left(\frac{300}{0.08}\right)^{1/3} = \boxed{15.5 \text{ m/s}}$

Check $P = Av^3 = 298$ Watts

b) $P = W/t$ $W = F \cdot d = mgh$

$= 100 \cdot 9.8 \cdot 2\text{m} = 1960$ J

$P = 3700$ Watts

$t = W/P$

$= 1960/3700 = \boxed{0.53 \text{ s}}$

c) $t = W/P$ $W = F \cdot d = mgh = 60 \cdot 9.8 \cdot 12$

$= 7056/300$ $= 7056$ J

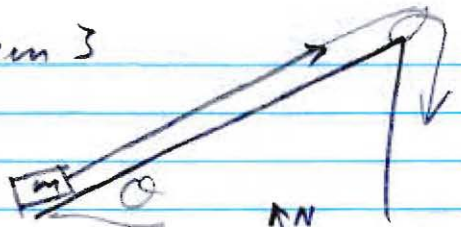
$= \boxed{23.5 \text{ s}}$

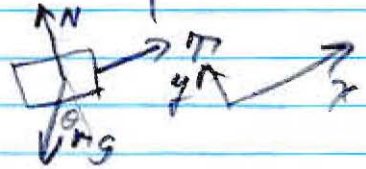
If burst of Power $P = 3700$ Watts

$t = 1.9$ s Not possible?

Experimental Test $\boxed{24 \text{ s}}$

Exam 2 Problem 3





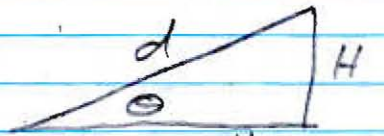
x along T
y along Normal

a) $W = F \cdot d$

$N = mg\cos\theta$

$T = mg\sin\theta$

$W = mg\sin\theta \cdot d$



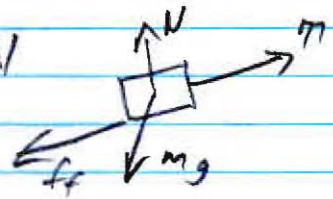
$\sin\theta = \frac{H}{d}$

$d = H/\sin\theta$

$W = mg\sin\theta \cdot \frac{H}{\sin\theta}$

$\boxed{W = mgH}$

b) If friction $F_f = \mu_k N$



$W = F \cdot d$

$T = \mu N + mg\sin\theta$

forces along $x = 0$

$W = \left(\mu_k N + mg\sin\theta\right) \cdot \frac{H}{\sin\theta}$

$= \frac{\mu_k mg\cos\theta H}{\sin\theta} + mgH$

$\boxed{W = mgH\left(\frac{\mu_k}{\tan\theta} + 1\right)}$

Exam 2 Problem 4

$m = 1700\,kg$ $\quad v = 15\,m/s$ $\quad P = 16{,}000\,W$

a) $P = \vec{F}_t \cdot \vec{v}$

$\vec{v}$ const $\quad \vec{F} = \vec{f}_f$

$$\vec{F}_t = \frac{P}{v} = \frac{1.6\times10^4}{15} = \boxed{1.07\times10^3\,N}$$

b) $P = \vec{F} \cdot \vec{v}$

$\vec{F} = mg\sin\theta + F_f$

$=$

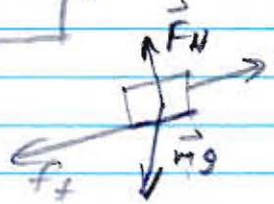
$P = (mg\sin\theta + \vec{F}_f)\cdot v$

$= (2.40\times10^3)\ 15\ m/s$

$= \boxed{36{,}000\ watts} = 48$ horsepower

$\tan\theta = .08$

$\theta = \tan^{-1}.08 = 4.57°$

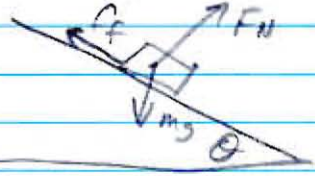


c) $mg\sin\theta - f_f = 0$

$$\sin\theta = \frac{f_f}{mg}$$

$= 0.064$

$\theta = \sin^{-1}0.064 = \boxed{3.68°}$



Const $\vec{v}$

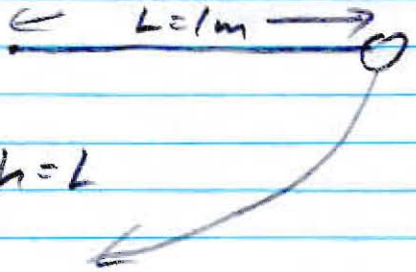
$\vec{a} = 0$

$\vec{F} = 0$

$\tan\theta = .064$

6.4% grade

Exam 2 Problem 5



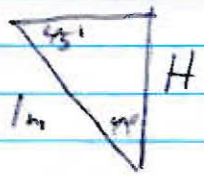
a) $mgh = \frac{1}{2}mv^2$

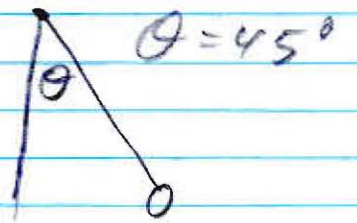
$v = \sqrt{2gh}$

$= \sqrt{2 \cdot 9.8 \cdot 1}$

$\boxed{v = 4.43 \text{ m/s}}$

b)





$\sin 45° = \frac{H}{1m}$

$H = .707 \text{ m}$

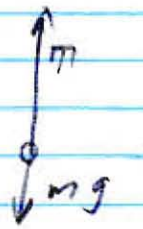
$v = \sqrt{2gH} = \sqrt{2 \cdot 9.8 \cdot 0.707}$

$= \boxed{3.72 \text{ m/s}}$

c) Circular Motion $F_c = \frac{mv^2}{r}$ $r = 1m$ $m = 0.2kg$

1m $F_c = 3.9N$

0.707m $F_c = 2.77 N$



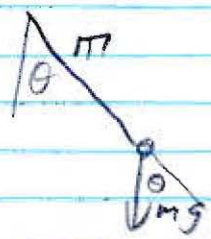
$F_c = T - mg$

$T = F_c + mg$

1m $T = F_c + mg = 3.9 + 1.96$

$\boxed{= 5.86 \text{ N}}$

.707m



$F_c = T - mg\cos\theta$

$T = F_c + mg\cos\theta$

$T = 2.77N + 1.386N$

$\boxed{= 4.16N}$