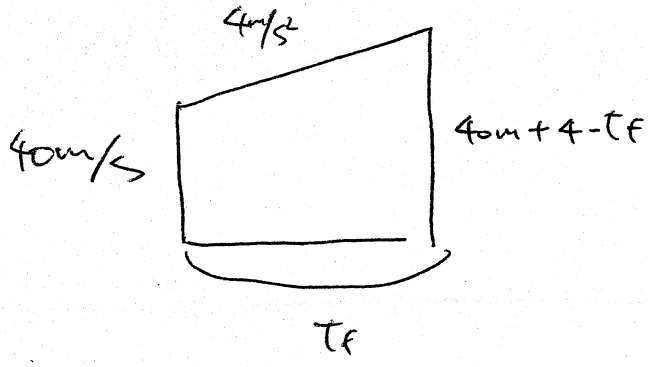
2048H FALL 2008 **SOLUTION KEY** EXAM 1

PROBLEM 1



$$500m = \frac{t_f}{2} \cdot (40m + 40 + 4t_f)$$

$$500 = \frac{80t_f + 4t_f^2}{2} = 40t_f + 2t_f^2$$

$$250 = 20t_f + t_f^2$$

$$0 = t_f^2 + 20t_f - 250$$

$$t_f = \frac{-20 \pm \sqrt{400 + 4 \cdot 250}}{2} = \frac{-20 \pm \sqrt{1400}}{2}$$

$$t_f = (-10 \pm 5\sqrt{14})\,\text{sec}$$

OR

$$(-10 + 5\sqrt{14})\,\text{sec}$$

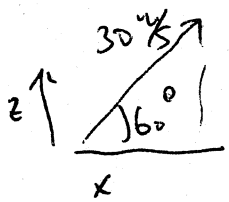
OR

$$8.71\,\text{sec}$$

~~PROBLEM 2~~

$$V_F = 40 + 4 \cdot (-10 + 5\sqrt{14})\ sec = \boxed{74.83\ m/s}$$

PROBLEM 1b



VELOCITY

$$x: \quad 30 \cos 60° = 15\ m/s$$

$$Y: \quad 30 \sin 60° = 15\sqrt{3}\ m/s$$

POSITON

$$x = 15 \cdot t$$

$$Y = 15\sqrt{3}\,t - 4.9t^2$$

GETS TO THE STRUCTURE AT $t = 1sec$

$$Y(1) = 15\sqrt{3} - 4.9$$

$$= 15 \cdot 1.7 - 4.9$$

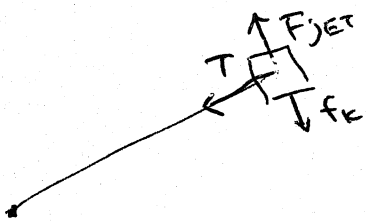
$$\approx 25.5 - 4.9 = 20.6\ m$$

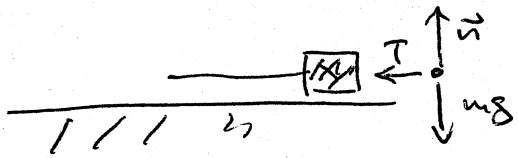
$$\therefore \boxed{\text{CLEARS}}$$

15
1.7
10.5
15
25.5

PROBLEM 2

a) RADIAL





b) ACCELERATION = $a_c = \frac{V^2}{r} = \frac{900}{100} = 9\ m/s^2$

INWARD ALONG THE ROPE

c) $F_{JET} = f_k = 0.3 \cdot (1100) \cdot 9.8 \cong$ ~~333N~~ ~~294N~~

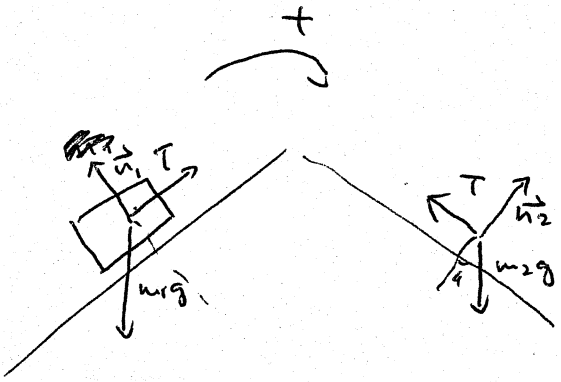
OR

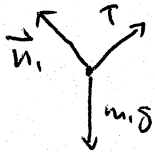
EXACTLY 294N

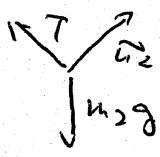
d) $T = \frac{mV^2}{r} = \frac{\cancel{100} \cdot 30^2}{\cancel{100}} = 900N$

PROBLEM 3

a)







b) $m_1 a = T - m_1 g \sin 30^\circ$

$+ \quad m_2 a = m_2 g \sin 45^\circ - T$

$(m_1 + m_2)\, a = m_2 g \sin 45^\circ - m_1 g \sin 30^\circ$

$$20\, a = 98 \left(\frac{\sqrt{2} - 1}{2} \right)$$

$$a = \frac{49}{20} (0.41) = 2.45 \cdot 0.41$$

$$\begin{array}{r} 0.41 \\ \hline 245 \\ 9^1 8^2 0 \\ \hline 10\ 0.45 \end{array}$$

$$= 1 \text{ m/s}^2$$

c)

$$m \cdot a = T - m \cdot g \sin\theta$$

$$10a = = T - \frac{10 \cdot 9.8}{2}$$

$$10 = T - 49 \Rightarrow T = \underline{59\,N}$$