Physics 295 Prerequisite Test Soln.

5. $x = 6t^2 - t^3$ $v = 12t - 3t^2$ $a = 12 - 6t$
speed is max when $a = 0 \Rightarrow 12 - 6t = 0$, $t = 2$
$x = 6(2)^2 - 2^3 = 16$

6. $v = 32t - 2t^3$ $a = 32 - 6t^2$ $x = x_0 + 16t^2 - t^4/2$
x is max when $v = 0$ $32t - 2t^3 = 0$, $t = 4$
$a = 32 - 6(4)^2 = -64$

7. $x = 15e^{-2t}$ $v = -30e^{-2t}$ $a = 60e^{-2t}$ $a = 60e^{-2} = 8.1\ m/s^2$

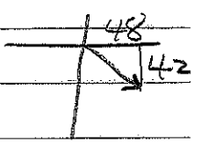
8. $x = v_i t + \frac{1}{2}at^2 = 0 + \frac{1}{2}(2)10^2 = 100\ cm$
$v_f = v_i + at = 0 + 2(10) = 20\ cm/s$
$x_2 = (20)(20) + \frac{1}{2}(-1)(20)^2 = 200\ cm$
$x_{total} = 100\ cm + 200\ cm = 3.0\ m$

9. $v_i = -20\ m/s$ $\Delta y = -60m$ $a = -9.8\ m/s^2$
$\Delta y = v_i t + \frac{1}{2}at^2$ $-60 = -20t - 4.9t^2$
$t = 2.0\ s$

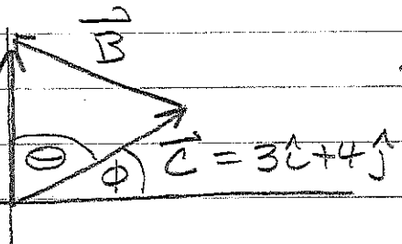
10. $x = 54t - 2t^3$ $v = 54 - 6t^2$ $a = -12t$

13. $\vec{A} = [15\cos 80,\ 15\sin 80]$ $\vec{B} = [12, -16]$
$\vec{A} - \vec{B} = [-9.4,\ 30.8]$ $|\vec{A} - \vec{B}| = \sqrt{(9.4)^2 + (30.8)^2} = 32$

14. $\vec{C} = [2(12) + 24,\ 2(-16) - 10] = [48, -42]$
$\tan\theta = -42/48$ $\theta = -41^\circ$



15
$5 = |\vec{C} + \vec{B}|$



$\tan\phi = 4/3$ $\phi = 53^\circ$ $\theta = 37^\circ$
$|\vec{C}| = \sqrt{3^2 + 4^2} = 5$

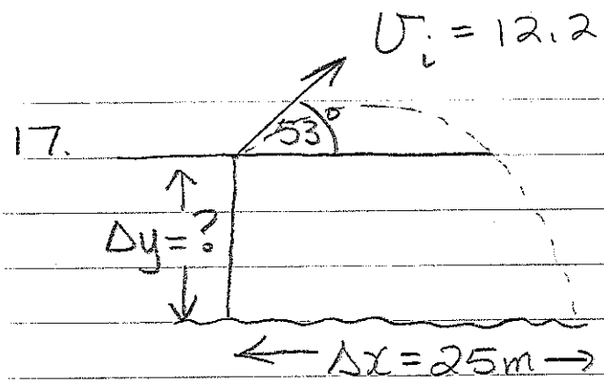
$B^2 = 5^2 + 5^2 - 2(5)(5)\cos 37$ $B = 3.2$

16.

$\hat{i}$	$\hat{j}$
$65\cos 30$	$65\sin 30$
-30	0
$-20\cos 70$	$-20\sin 70$
19.5	13.7

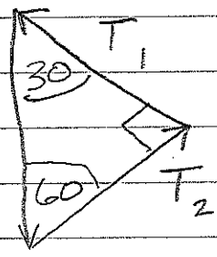
$|\vec{R}| = \sqrt{(19.5)^2 + (13.7)^2}$
$= 23.8$

17.



x	y
$v_i = 12.2\cos 53$	$v_{iy} = 12.2\sin 53$
$v_x = 7.3\ m/s$	$v_y = 9.7\ m/s$
$\Delta x = 25m$	$a = -9.8\ m/s^2$
$t = \frac{25m}{7.3\ m/s}$	$\Delta y = v_i t + \frac{1}{2}at^2$
$= 3.4\ s$	$= 9.7(3.4) - 4.9(3.4)^2$
	$= -23.7m$

18.



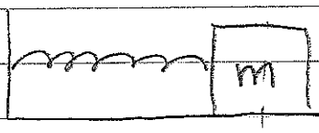
$F_g = mg$
$= 6(9.8)$
$= 58.8N$

$\cos 30 = \frac{T_1}{58.8}$ $\quad T_1 = 51N$

19. $a = F/m$ $\quad x = v_i t + \frac{1}{2}at^2 = \frac{1}{2}(F/m)t^2$

$x \propto F$ if m & t are const. $\Rightarrow \frac{x_2}{x_1} = \frac{F_2}{F_1} = 3$

20.

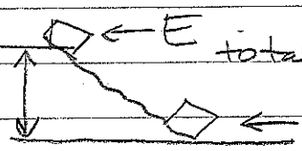


$E_{total} = \frac{1}{2}kx^2 + \frac{1}{2}mv^2$

$x = 0$ $\quad @ x = 0$ $E_{total} = \frac{1}{2}(2)(4)^2 = 16J$

$E_{tot} = 16J = \frac{1}{2}(200)(.2m)^2 + \frac{1}{2}(2)v^2 \Rightarrow v = 3.5\ m/s$

21.



$E_{total} = mgh + \frac{1}{2}mv^2 = 2(9.8)(1.8m)$
$= 35.3J$

$E_{total} = 0 + \frac{1}{2}(2)(5\ m/s)^2 = 25J$

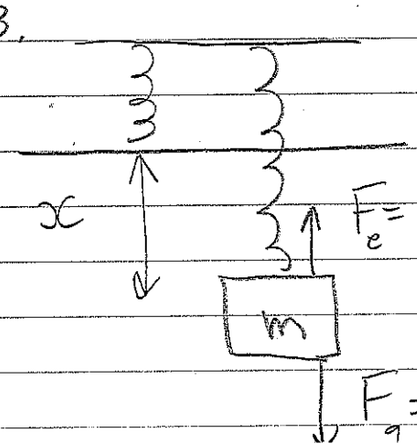
work done by friction $= 25J - 35J = -10J$

22. Cons. of energy $\quad \frac{1}{2}kd^2 = \frac{1}{2}kx^2 + \frac{1}{2}mv^2 + heat$

$heat = F_f \cdot d = \mu mg \cdot d = (.25)(.5)(9.8)(.1) = 0.123J$

$\frac{1}{2}(50)(.1m)^2 = 0 + \frac{1}{2}(0.5)(v^2) + 0.123J \Rightarrow v = 0.71\ m/s$

23.



$kx = mg$

$x = \frac{mg}{k}$

$E_{total} = -mgx + \frac{1}{2}kx^2$
$= -(kx)x + \frac{1}{2}kx^2$
$= -\frac{1}{2}kx^2$
$= -\frac{1}{2}k\left(\frac{mg}{k}\right)^2$ $\quad -\frac{1}{2}$