B

Phys 111 **Exam 1** **Spring 2011**
NJIT

The exam is closed book and closed notes.

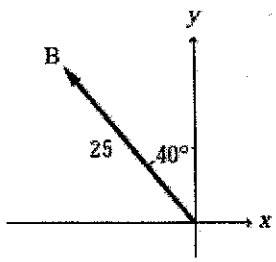
"On my honor, I pledge that I have not violated the provisions of the NJIT Student Honor Code."

Signature_____

Print Name_____

There are a total of 10 multiple choice questions.
Make sure you put your name, section, and ID on the SCANTRON form. **Failure to do so may delay the grading of your exam.** The answers for the multiple choice Questions are to be placed on the SCANTRON form provided. Use a Number 2, HB, pencil to fill in answers on the SCANTRON form. Make sure you give only one (1) answer to each question. **If you erase an answer on the SCANTRON form, make sure all traces are removed. Use the spaces available on the exam sheets to work out the problem**

1) If $\vec{A} = 30\hat{\mathbf{i}} + 11\hat{\mathbf{j}}$ and $\vec{B}$ is as shown, what is the direction of the sum of these two vectors?



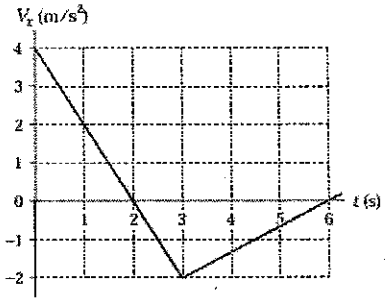
a. 65° b. 59° c. 73° d. 55° e. 42°

2) A particle starts from the origin at $t = 0$ with a velocity of $(16\mathbf{i} - 12\mathbf{j})$ m/s and moves in the xy plane with a constant acceleration of $\mathbf{a} = (3.0\mathbf{i} - 6.0\mathbf{j})$ m/s^2. What is the speed (in m/s) of the particle at $t = 2.0$ s?

a. 52 b. 39 c. 46 d. 33 e. 43

3) V_x is the velocity of a particle moving along the x axis as shown. If $x = 2.0$ m at $t = 1.0$ s, what is the position (in m) of the particle at $t = 6.0$ s? *[Hint: note that initial position is not at origin]*

a . –2.0 b. +2.0 c. +1.0 d. –1.0 e. 6.0

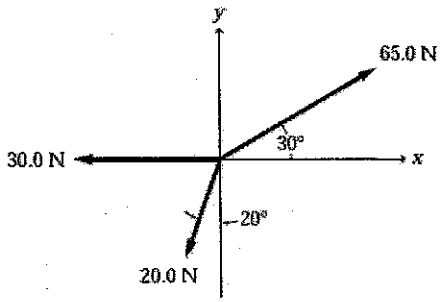


4) An automobile traveling along a straight road increases its speed from 30.0 m/s to 50.0 m/s in a distance of 180 m. If the acceleration is constant, how much time elapses while the auto moves this distance?

a. 6.00 b. 4.50 c. 3.60 d. 4.00 e. 9.00

5) The three forces shown act on a particle. What is the magnitude of the resultant of these three forces (in N)?

a. 27.0 b. 33.0 c. 36.0
d. 24.0 e. 105

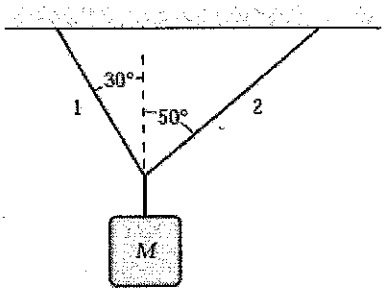


6) A long jumper leaves the ground at an angle of 20.0 above the horizontal and at a speed of 12 m/s. How far does he jump in the horizontal direction?

a. 9.45 b. 4.72 c. 5.02 d. 10.0 e. 0.787

7) In the figure, if the tension in string 1 is 23 N, what is the mass M (in kg) of the object shown?

a. 3.8 **b.** 3.4 **c.** 3.0 **d.** 4.2 **e.** 5.0



8) A baseball is hit at ground level. The ball is observed to reach its maximum height above ground level 3.0 s after being hit. And 2.5 s after reaching this maximum height, the ball is observed to barely clear a fence that is 97.5 m from where it was hit. How high (in m) is the fence?

a. 8.2 b. 15.8 c. 13.4 d. 11.0 e. 4.9

9) A person weighing 0.70 kN rides in an elevator that has an upward acceleration of 1.5 m/s^2. What is the magnitude of the force of the elevator floor on the person?

a. 0.11 b. 0.81 c. 0.70 d. 0.59 e. 0.64

10) A carnival Ferris wheel has a 15-m radius and completes five turns about its horizontal axis every minute. What is the acceleration (in m/s^2) of a passenger at his lowest point during the ride?

a. 5.7 downward b. 4.1 upward c. 14 downward
d. 4.1 downward e. 19 downward

Physics - CR 1
Spring 2011

Version - B

1) $\vec{A} = 30\hat{i} + 11\hat{j}$

$\vec{B} = -16\hat{i} + 19\hat{j}$

$+$

$\vec{A} + \vec{B} = 14\hat{i} + 30\hat{j}$

$\vec{B} = \underbrace{25}_{r}, \underbrace{(40+90)^\circ}_{\theta}$ in polar coordinates

$B_x = 25 \cos 130^\circ$

$= -16.1$

$B_y = 25 \sin 130^\circ$

$= 19.2$

$\tan\theta = \frac{30}{14}$ $\theta = \tan^{-1}\left(\frac{30}{14}\right) = 64.98^\circ$ $\boxed{\theta = 65^\circ}$

2)

$t = 0$ $\vec{v}_0 = 16\hat{i} - 12\hat{j}$ $\frac{m}{s}$; $\vec{a} = 3.0\hat{i} - 6.0\hat{j}$ $\frac{m}{s^2}$

$t = 2.0\,s$ $\vec{v} = ?$

$v_x = v_{0x} + a_x t$

$= 16 + (3.0)(2.0)$

$v_x = 22\ m/s$

$v_y = v_{0y} + a_y t$

$= -12 + (-6.0)(2.0)$

$v_y = -24\ m/s$

$v = \sqrt{v_x^2 + v_y^2}$

$= \sqrt{(22\ m/s)^2 + (-24\ m/s)^2}$

$\boxed{v = 33\ m/s}$

3) $x_0 = 2.0\,m$ @ $t_0 = 1.0\,s$

$x = ?$ @ $t = 6.0\,s$

Δx_{Total} = area under v vs t diagram between $(t - t_0)$

area between $t = 1.0$ and $t = 2.0\,s$

$$\Delta x_I = \left(\frac{1}{2}\right)\left(2 - 0\ \frac{m}{s}\right)(2.0 - 1.0\,s) = +1\,m$$

area between $t = 2.0\,s$ and $t = 3.0\,s$

$$\Delta x_{II} = \left(\frac{1}{2}\right)\left(-2 - 0\ \frac{m}{s}\right)(3.0 - 2.0\,s) = -1\,m$$

area between $t = 3.0\,s$ and $t = 6.0\,s$

$$+\ \Delta x_{III} = \left(\frac{1}{2}\right)\left(-2 - 0\ \frac{m}{s}\right)(6.0 - 3.0\,s) = -3\,m$$

$$\Delta x_{Total} = \Delta x_I + \Delta x_{II} + \Delta x_{III} = -3\,m$$

$$x = x_0 + \Delta x = 2\,m - 3\,m = -1\,m \qquad \boxed{x = -1\,m}$$

4)

Known	Unknown
$v_0 = 30.0\ \frac{m}{s}$	$t = ?$
$v = 50.0\ \frac{m}{s}$	$(a = ?)$
$\Delta x = 180\,m$	

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

$$a = \frac{v^2 - v_0^2}{2\Delta x} = \frac{(50.0\,m/s)^2 - (30.0\ \frac{m}{s})^2}{2(180\,m)}$$

$$a = 4.44\,m/s^2$$

$$v = v_0 + at \qquad t = \frac{v - v_0}{a} = \frac{50.0\,m/s - 30.0\,m/s}{4.44\,m/s^2} = \boxed{t = 4.50\,s}$$

5) $F_1 = 65.0\,N, 30°$

$F_2 = 30.0\,N, 180°$

$F_3 = 20.0\,N, 250°$

$F_{1x} = 65.0\,N \cos 30°$ $\quad F_{1x} = 56.3\,N$

$F_{2x} = 30.0\,N \cos 180°$ $\quad F_{2x} = -30.0\,N$

$F_{3x} = 20.0\,N \cos 250°$ $\quad F_{3x} = -6.84\,N$

$\Sigma F_x = 19.5\,N$

$F_{1y} = 65.0\,N \sin 30°$ $\quad F_{1y} = 32.5\,N$

$F_{2y} = 30.0\,N \sin 180°$ $\quad F_{2y} = 0$

$F_{3y} = 20.0\,N \sin 250°$ $\quad F_{3y} = -18.8\,N$

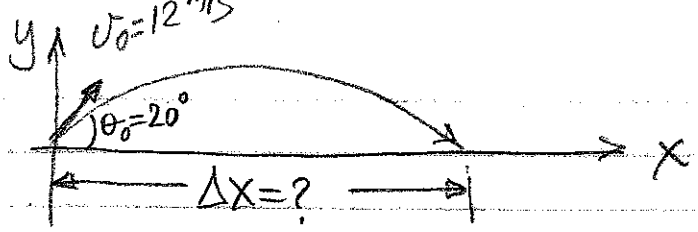
$\Sigma F_y = -18.8\,N$

$$\Sigma F = \sqrt{(\Sigma F_x)^2 + (\Sigma F_y)^2}$$

$$= \sqrt{(19.5N)^2 + (-18.8N)^2}$$

$$\boxed{\Sigma F = 27.0\,N}$$

6)



$v_{0x} = (12\ m/s)(\cos 20°) = 11.3\ m/s = v_x$

$v_{0y} = (12\ m/s)(\sin 20°) = 4.10\ m/s$

$\Delta x = v_{0x} t$

$\Delta y = v_{0y} t - \frac{1}{2} g t^2$

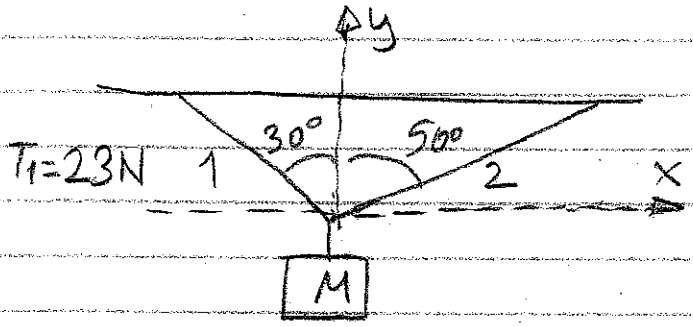
$\Delta y = 0$

$v_{0y} t = \frac{1}{2} g t^2$

$t = \frac{2 v_{0y}}{g} = \frac{2(4.10\ m/s)}{9.80\ m/s^2} = 0.837\ s$

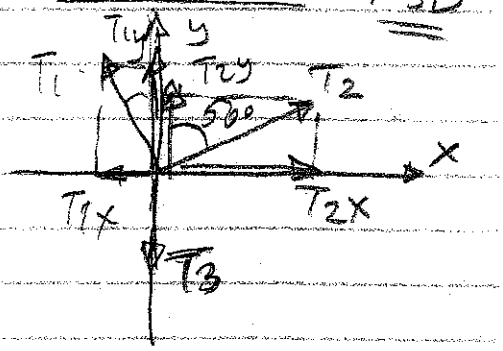
$\Delta x = (11.3\ m/s)(0.837\ s) = \boxed{9.45\ m = \Delta x}$

7)



System: Knot

FBD



$T_{1x} = 23N \sin 30° = 11.5N$

$T_{1y} = 23N \cos 30° = 19.9N$

$T_{2x} = T_2 \sin 50°$

$T_{2y} = T_2 \cos 50°$

Newton's 2nd law for Knot

$\Sigma F_x = ma_x$

$T_{2x} - T_{1x} = 0$

$T_{2x} = T_{1x}$

$= 11.5\ N$

$T_2 \sin 50° = 11.5\ N$

$T_2 = \frac{11.5}{\sin 50°} = 15.0N$

$\Sigma F_y = ma_y$

$T_{1y} + T_{2y} - T_3 = 0$

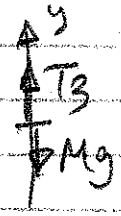
$T_3 = T_{1y} + T_{2y}$

$= T_{1y} + T_2 \cos 50°$

$= 19.9N + 15.0N \cos 50°$

$T_3 = 29.5\ N$

System: Mass



$\Sigma F_y = ma_y$

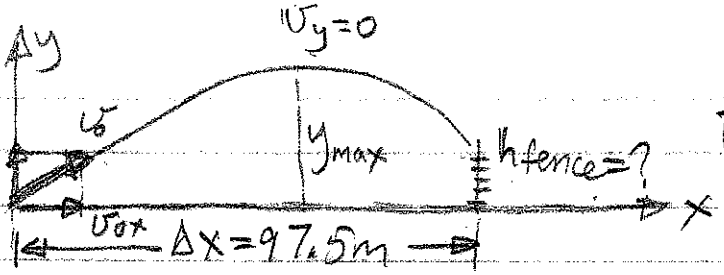
$T_3 - Mg = 0$

$M = \frac{T_3}{g}$

$= \frac{29.5N}{9.80}$

$\boxed{M = 3.0\ kg}$

8)



$t_{ymax} = 3.0\,s$

$t_{fence} - t_{max} = 2.5\,s$

$t_{Total} = 5.5\,s$

Kinematic Eqn for y_{max}

$v_f = v_{oy} - g t_{ymax}$

$0 = v_{oy} - g t_{ymax}$

$v_{oy} = g t_{ymax}$

$= (9.80\,m/s^2)(3.0\,s)$

$v_{oy} = 29.4\,m/s$

for h_{fence}

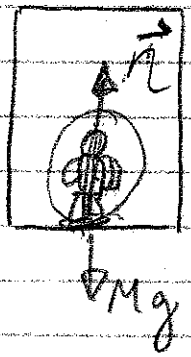
$\Delta y_{fence} = v_{oy} t - \frac{1}{2} g t^2$

$= (29.4\,m/s)(5.5\,s) - \frac{1}{2}(9.80\,m/s^2)(5.5\,s)^2$

$= 161.7 - 148.2$

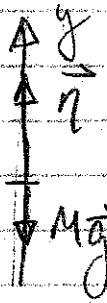
$h_{fence} = 13.5\,m$

9)



$Mg = 0.70 \times 10^3\,N$

$\vec{a}_y = 1.5\,m/s^2$



FBD for person

$\Sigma F_y = m a_y$

$n - Mg = M a_y$

$n = M(a_y + g)$

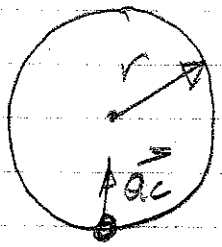
$M = \frac{0.70 \times 10^3\,N}{9.80\,m/s^2}$

$= 71.4\,kg$

$= (71.4\,kg)(1.5\,m/s^2 + 9.80\,m/s^2)$

$= 807\,N \Rightarrow n = 0.81\,kN$

10)



$r = 15m$ $\quad \frac{5 \text{ turns}}{\text{minute}}$

$$v = \frac{5(2\pi r)}{1 \text{ min}} \text{ m} \quad \left[\frac{5 \times \text{circumference}}{\text{time}}\right]$$

$$= \frac{5(2\pi)(15m)}{60 s}$$

$$v = 7.85 m/s$$

$$a_c = \frac{v^2}{r} = \frac{(7.85 m/s)^2}{15m}$$

$$\boxed{a_c = 4.1 \text{ m/s}^2, \text{ upward}}$$ (pointing the center of the circle)