B Physics 111 – Fall 2012 Exam#1 NAME (PRINT): [redacted] 8

As a student at NJIT I (sign) [redacted], will conduct myself in a professional manner and will comply with the provisions of the NJIT Academic Honor Code. I also understand that I must subscribe to the following pledge on major work submitted for credit as described in the NJIT Academic Honor code: On my honor, I pledge that I have not violated the provisions of the NJIT Academic Honor Code. **Except calculators, no cell phones, computers or other electronic devices are allowed.**

The exam is closed book and closed notes. You are required to show all of your work. NO WORK MEANS NO CREDIT even if your answer is correct. Your work must be legible and logical. If the grader can not follow and understand your work, it is wrong.

1. Which of the following quantities has the same units as velocity?

a. Mass/Acceleration

b. Force/Distance

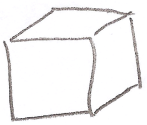
c. (Tension/Mass per unit length)$^{1/2}$

d. (Distance/Acceleration)^3

e. None of the above

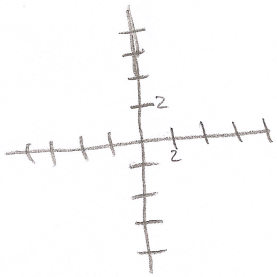
2. A cubic box with an edge (distance between sides) of exactly 10 cm has a volume of:

a. 10^{-6} m^3
b. 10^{-3} m^3
c. 10^{3} m^3
d. 10^{6} m^3
e. 10^{-8} m^3



3. A particle moves in the *xy* plane with a constant acceleration given by $\vec{a} = -4.0\hat{j}$ m/s^2. At $t = 0$, its position and velocity are $10\hat{i}$ m and $(-2.0\hat{i} + 8.0\hat{j})$ m/s, respectively. What is the distance from the origin to the particle at $t = 2.0$ s?

a. 6.4 m
b. 10 m
c. 7.0 m
d. 2.0 m
e. 6.2 m



4. In the diagram, the vector $\vec{A}$ has a magnitude of 12 m and the vector $\vec{B}$ has a magnitude of 8.0 m. The y-component of the vector $\vec{A} + \vec{B}$ is approximately

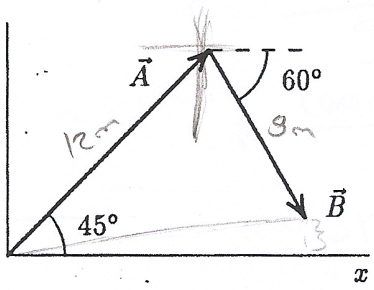
a. 17 m
b. 1.6 m
c. 14 m
d. 20 m
e. 3.6 m

$\vec{A} = \langle 12\cos 45\hat{i} + 12\sin 45\hat{j} \rangle$

$\vec{B} = \langle 8\cos 60\hat{i} - 8\sin 60\hat{j} \rangle$

$= 1.55\text{ m}$

$\approx 1.6\text{ m}$



5. A ball is thrown upward from a point on a roof 30 m above the ground with an initial velocity of 25 m/s. The average velocity of the ball during the first 4.0 s is closest to:

a. 2.6 m/s
b. 5.4 m/s
c. 13 m/s
d. –5.1 m/s
e. –14 m/s

$V_0 = 25\text{m/s}$

$V_{avg} = \frac{V_f + V_0}{2}$ $\quad -14.2\frac{m}{s} + 25\text{m/s}$ / 2

$V_f = V_0 + at$

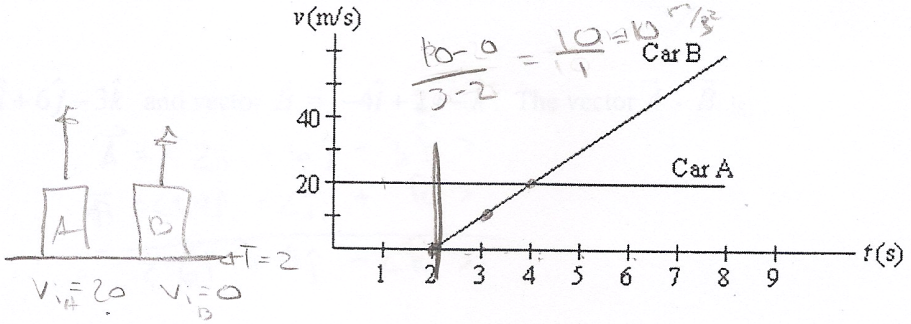
$V_f = 25 - g(4)$

$V_f = -14.2\text{m/s}$

$h = 30\text{m}$

6. Driver A is cruising along enjoying the fall colors. Driver B starts her car at the instant he passes her. Their velocities are shown as functions of time in the graph below. At what instants in time on the graph are drivers A and B side by side?

a. 0 s, 2 s
b. 0 s, 4 s
c. 2 s, 4 s
d. 2 s, 6 s
e. 4 s, 6 s



$\frac{20-0}{3-2} = \frac{10}{1} = 10\frac{m}{s^2}$

$x_{f_A} = 0 + V_{i_A}(t) =$

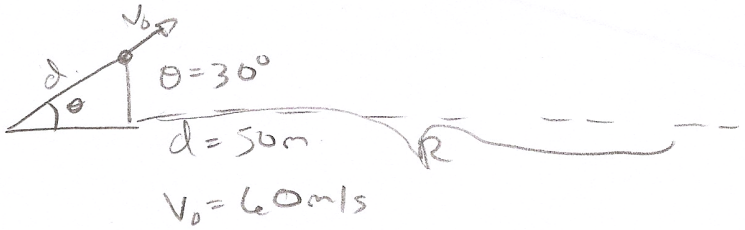
$x_{f_B} = 0 + V_{i_B}(t) + \frac{1}{2}at^2$

$x_{f_A} = 20(4) = 80\text{m}$ $\quad x_{f_A} = 20(2) = 40$

$x_{f_B} = \frac{1}{2}(10)(4)^2 = 80\text{m}$ $\quad x_{f_B} = \frac{1}{2}(10)(2)^2 = 20$

7. A motorcycle daredevil rides up a ramp 50.0-m long which is set 30.0° to the horizontal. If the speed at the instant when he leaves the ramp is 60.0 m/s, what is the horizontal distance between the edge of the ramp and his landing point.

a. 81
b. 320
c. 334
d. 357
e. 404



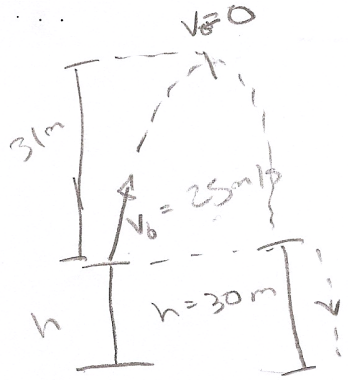
$$R = \frac{V_i^2 \sin 2\theta}{g}$$

$$R = \frac{(60m/s)^2 \sin[2(30°)]}{9.8m/s^2}$$

$$R = 318$$

8. If the ball in **problem 5** above is launched at t = 2 .0s, what is the time reading when it hits the ground?

a. 6s
b. 7s
c. 8 s
d. 20 s
e. 31 s



$t_{up} + t_{down} = t_{total}$

$0 = V_i - gt$

$\frac{-25 = -gt}{-g}$

$t_{up} = 2.55s$

$t_{up} = t_{down}$

$x_f = 0 + 0 + \frac{1}{2}gt^2$

$31 = \frac{1}{2}5t^2$

$V_f = 25 - (9.8)(5.1s)$

$V_f = -25 m/s$

$30 =$

9. Consider vector $\vec{A} = 2\hat{i} + 6\hat{j} - 3\hat{k}$ and vector $\vec{B} = -4\hat{i} + 2\hat{j} - \hat{k}$. The vector $\vec{A}$ - $\vec{B}$ is:

a. $6\hat{i} + 4\hat{j} - 2\hat{k}$
b. $-2\hat{i} + 8\hat{j} - 4\hat{k}$
c. $5\hat{i} + 2\hat{j} + \hat{k}$
d. $-6\hat{i} - 4\hat{j} + 2\hat{k}$
e. $-3\hat{i} + 14\hat{j} - 5\hat{k}$

$\vec{A} = \langle 2\hat{i} + 6\hat{j} - 3\hat{k} \rangle$

$\vec{B} = \langle +4\hat{i} - 2\hat{j} + \hat{k} \rangle$

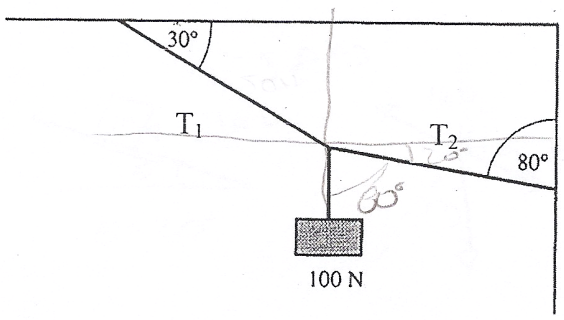
$\langle 6\hat{i} + 4\hat{j} - 2\hat{k} \rangle$

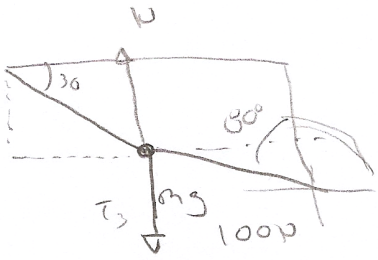
10. The speed of a particle moving in a circle 2.0 m in radius increases at the constant rate of 4.4 m/s^2. At an instant when the magnitude of the total acceleration is 6.0 m/s^2, what is the speed of the particle?

a. 3.9 m/s
b. 2.9 m/s
c. 3.5 m/s
d. 3.0 m/s
e. 1.4 m/s

11. For the weight cable system below, find the tension T_2 in the cable to the left of the suspended weight (closest value).

a. 70 N
b. 320 N
c. 253 N
d. 170 N
e. 150 N





$T_1 + T_2 - T_3 = 0$

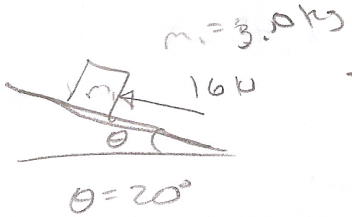
$T_1 = T_2$

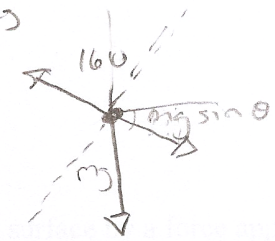
12. An object of mass M sits on a flat table. The Earth pulls on this object with force Mg, which we will call the action force. What is the reaction force?

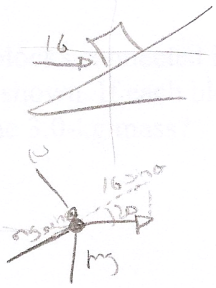
a. The table pushing up on the object with force *Mg*.
b. The object pushing down on the table with force *Mg*.
c. The table pushing down on the floor with force *Mg*.
d. The object pulling upward on the Earth with force *Mg*.
e. The table pulling upward on the Earth with force *Mg*.

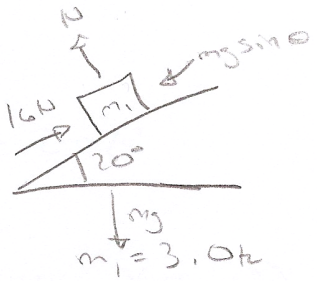
13. A 3.0-kg block slides on a frictionless 20° inclined plane. A force of 16 N acting parallel to the incline and up the incline is applied to the block. What is the acceleration of the block?

a. 2.0 m/s^2 down the incline
b. 5.3 m/s^2 up the incline
c. 2.0 m/s^2 up the incline
d. 3.9 m/s^2 down the incline
e. 3.9 m/s^2 up the incline









$F_{net} = 16N - mg\sin\theta$

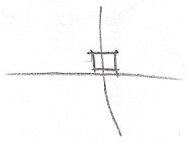
$16N - 10.1N = 5.9N$

$5.9N = 3.0kg\,a$

$(3.0kg)(9.8m/s^2)\sin 20° = 10.1N$

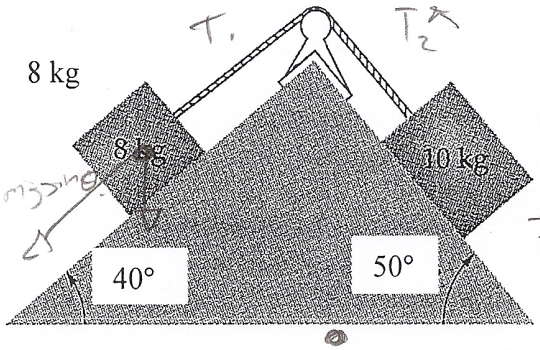
$F_{net} = 16N - 10.1N$

$5.9N = 3.0a$



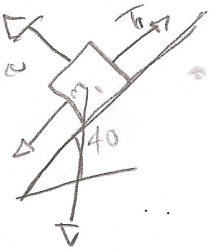
14. Two blocks of mass 8.0 kg and 10 kg are connected by a rope and massless pulley. To a non symmetric wedge as shown in the picture. If there is no friction on the surfaces, the acceleration of the two masses when released from rest will be approximately:

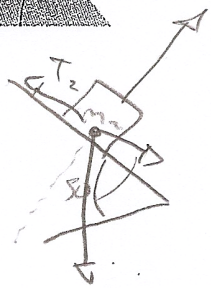
a. 5.8 m/s^2
b. 4.0 m/s^2
c. 2.9 m/s^2
d. 4.9 m/s^2
e. 1.4 m/s^2



$T_1 = T_2$

T_1 T_2 8 kg 10 kg $m_1 g \sin\theta$ $m_2 g \sin\theta$ 500 N 750 N





$750 - 500 = 250$

$F = ma$

$250 = (m_1 + m_2)a$

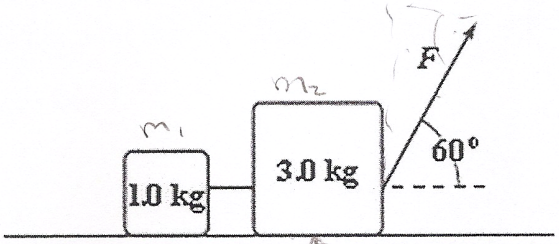
$250 = 18a$

$13.89\ m/s^2 = a$

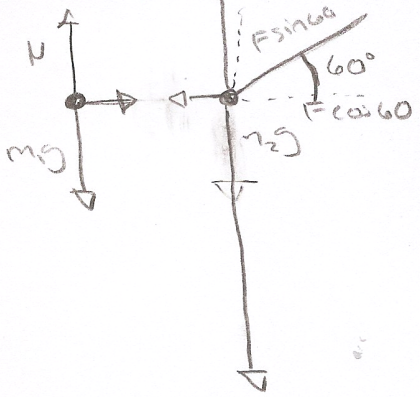
$1.4 \approx a$

15. Two blocks connected by a string are pulled across a horizontal surface by a force applied to one of the blocks, as shown. If each block has an acceleration of 2.0 m/s^2 to the right, what is the magnitude of the normal force on the 3.0-kg mass?

a. 16 N
b. 29 N
c. 9.8 N
d. 14 N
e. 39 N



$a = 2\ m/s^2$



$F\sin\theta = (4\ kg)(2\ m/s^2)$

$-8N + (9.8)(3\ kg) = 37.4N$

Problem 10, Exam B. A particle moves at a constant speed around the circle shown below (neglecting gravity). When it is at point A (see figure) the coordinates are x = 0 m and y = 2 m and its velocity is $-4\hat{i}$ m/s. When it is at point B (see figure) its **velocity and acceleration** are:

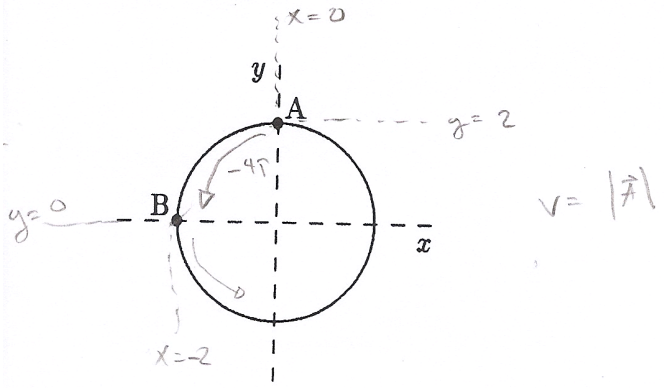
a. $-4\hat{j}$ m/s and $8\hat{i}$ m/s^2

b. $4\hat{i}$ m/s and $-8\hat{i}$ m/s^2

c. $4\hat{j}$ m/s and $8\hat{i}$ m/s^2

d. $4\hat{j}$ m/s and $8\hat{i}$ m/s^2

e. ~~$4\hat{j}$ m/s and 0 m/s^2~~ acceleration is change in direction too



$v = |\vec{v}|$