Practice Exam, Physics 111 Common Exam 1

Name (Print): ______________________________ 4 Digit ID:________ Section: ______

Honors Code Pledge: For ethical and fairness reasons all students are pledged to comply with the provisions of the NJIT Academic Honor Code. You must answer the quiz questions entirely by yourself. **Turn off all cell phones, pagers, or other communication devices**.

Instructions:

- First, write your name and section number on **both** the Scantron card and this exam sheet.
- Use the formula sheet (last exam booklet page) and no other materials.
- Budget your time. There are 16 multiple choice problems (1 pt each).
- Answer each question on the Scantron card using #2 pencil. Also circle your answers on question papers.
- Do not hesitate to ask for clarification of any exam question, if needed, from your proctor or Professor.

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1. 2 mm^3 is equivalent to:

A) $2 \cdot 10^{-3}$ m^3
B) $2 \cdot 10^{-6}$ m^3
C) $2 \cdot 10^{-9}$ m^3
D) $2 \cdot 10^{-12}$ m^3
E) $2 \cdot 10^{-15}$ m^3

For the following 3 problems use the vectors:
$\vec{\mathbf{A}} = 1\hat{\imath} + 2\hat{\jmath} + 0\hat{k}$ **and** $\vec{\mathbf{B}} = 2\hat{\imath} + 2\hat{\jmath} + 0\hat{k}$

2. Find the magnitude of $\vec{A} + \vec{B}$. Select the closest answer.

A) 1
B) 2
C) 3
D) 4
E) **5**

3. Find the dot product $\vec{A} \cdot \vec{B}$ and the angle between vectors:
A) 4, 33^0
B) 12, 38^0
C) 6, 48^0
D) 3, 48^0
E) 9, 23^0

4. Find the vector (cross) product $\vec{A} \times \vec{B}$:

A) 0
B) $2\hat{\jmath}$
C) $-2\hat{\jmath}$
D) $-2\hat{k}$
E) $2\hat{k}$

5. A body is projected vertically upward from the surface of the earth with a speed of 10.0 m/s. What is its speed (in m/s) when it is at ½ of its maximum height?

A) 0
B) 2.5
C) 5.0
D) 7.0
E) 10.0

6. A body moves from A to B along a straight line a distance of 100 m in 10 sec. Stops at B for 20 sec. and then returns to A at an average speed of 5 m/s. The average speed (in m/s) from A to B is:

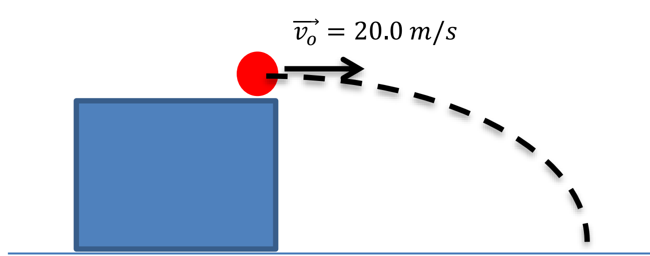
A) 0
B) -2
C) 3
D) 4
E) 5

7. An Apache helicopter during vertical takeoff releases a package when it is at 39.2 m high and its speed is 9.80 m/s. How long (in seconds) does it take the package to read the ground?

A) 1
B) 2.8
C) 3
D) 4
E) 5.2

8. The displacement of a body $x(t) = 10\ (m) + 20\ \left(\frac{m}{s}\right) t - 5 \left(\frac{m}{s^2}\right) t^2$. Find the average velocity for the period between t=0 and t=5s.
A) 0
B) -1
C) 1
D) -2
E) -5

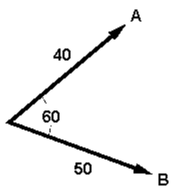
9. A ball is thrown off a 100 meters high cliff with an initial horizontal velocity of 20 m/s. How long does it take for it to hit the ground?
A) 4.5 s
B) 20.0
C) 2.0 s
D) 3.2 s
E) 12 s



10. A particle starts from the origin with velocity $5\hat{\imath}$ m/s and t=0 and moves in the xy plane with a constant acceleration of $6\hat{\jmath}$. Determine the position of the particle after 5 s:

A) $\vec{r} = 25\,\hat{\imath} + 75\,\hat{\jmath}$
B) $\vec{r} = 5\,\hat{\imath} + 25\,\hat{\jmath}$
C) $\vec{r} = 30\,\hat{\imath} + 15\,\hat{\jmath}$
D) $\vec{r} = 20\,\hat{\imath} + 30\,\hat{\jmath}$
E) $\vec{r} = 5\,\hat{\imath} + 25\,\hat{\jmath}$

11. Vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are shown. What is the magnitude of a vector $\vec{\mathbf{C}} = \vec{\mathbf{A}} - \vec{\mathbf{B}}$?



a. 46
b. 10
c. 30
d. 78
e. 90

12. A marathon is 26.2188 miles long. An expert marathon runner finishes the race in 2 hours. What was her average speed in SI units?

A) 3.17 m/s
B) 10.1 m/s
C) 4.92 m/s
D) 5.86 m/s
E) 7.44 m/s

13. At $t = 0$, a particle leaves the origin with a velocity of 8 m/s in the positive y direction and moves in the xy plane with a constant acceleration of $\left(-2.0\hat{\mathbf{i}} + 4.0\hat{\mathbf{j}}\right)$ m/s^2. How far from the origin is the particle 10 sec later

a. 100 m
b. 210 m
c. 297 m
d. 424 m
e. 345 m

14. The position of an object is given by $x = (24t - 2.0t^3)$ where t is in seconds. At t = 2.0 s, what is the magnitude of the particle's acceleration?
a. 0 m/s^2
b. 2.0 m/s^2
c. 17 m/s^2
d. 36 m/s^2
e. 24 m/s^2

15. The initial speed of a cannon ball is 200 m/s. If the ball is to strike a target that is at a horizontal distance of 3.0 km from the cannon, what is the minimum time of flight for the ball?
a. **16 s**
b. 21 s
c. 24 s
d. 14 s
e. 19 s

16. A bird, accelerating from rest at a constant rate, experiences a displacement of 28 m in 17 s. What is the final velocity after 11 s?

a. 0.19 m/s
b. 1.6 m/s
c. 3.3 m/s
d. 2.1 m/s
e. 5.1 m/s

Constants and units: $g = 9.8\,\mathrm{m/s^2}$, $1\,\mathrm{mm} = 10^{-3}\mathrm{m}$, $1\,\mathrm{cm} = 10^{-2}\,\mathrm{m}$, $1\,\mathrm{km} = 10^3\,\mathrm{m}$, $1\,\mathrm{in} = 2.54\,\mathrm{cm}$, $1\,\mathrm{mi} = 1609\,\mathrm{m}$; $1\,\mathrm{N}$ (newton) $= \mathrm{kg}\cdot\mathrm{m/s^2}$, $1\,\mathrm{J}$ (joule) $= \mathrm{N}\cdot\mathrm{m} = \mathrm{kg}\cdot\mathrm{m^2/s^2}$, $1\,\mathrm{W}$ (watt)=J/s. density=mass/volume.
Volumes. Cylinder: $\pi R^2 h$, sphere: $\frac{4}{3}\pi R^3$, cone: $\frac{1}{3}\pi R^2 h$
Quadratic equation. $ax^2 + bx + c = 0\,,\ x = \left(-b \pm \sqrt{b^2 - 4ac}\right)/(2a)$
Derivatives/integrals. $\frac{d}{dt}t^n = nt^{n-1}\,,\ \int r^n\,dr = \frac{1}{n+1}r^{n+1}$
Vectors. If $\vec{c} = \vec{a}+\vec{b}$, then $c_x = a_x+b_x\,,\ c_y = a_y+b_y\,,\ c_z = a_z+b_z$ and $c = \sqrt{c_x^2 + c_y^2 + c_z^2}$. Dot product: $\vec{a}\cdot\vec{b} = a_x b_x + a_y b_y + a_z b_z = ab\cos\alpha$. Cross product: $\hat{i}\times\hat{j} = \hat{k}\,,\ \hat{j}\times\hat{k} = \hat{i}\,,\ \hat{k}\times\hat{i} = \hat{j}$.
Kinematics: $v = dx/dt\,,\ a = dv/dt = d^2x/dt^2$. Constant a: $v - v_0 = at$, $x - x_0 = \frac{v_0+v}{2}t = v_0 t + \frac{1}{2}at^2 = \frac{v^2-v_0^2}{2a}$. Projectile: $v_x = const\,,\ x - x_0 = v_x t\,,\ v_y = v_{0y} - gt\,,\ y - y_0 = v_{0y}t - \frac{1}{2}gt^2 = (v_{0y}^2 - v_y^2)/(2g)$. Range: $\left(v_0^2/g\right) * \sin(2\theta)$
Circular motion with constant speed: $\omega = v/R$, $a_c = v^2/R = \omega^2 R$, towards center.
The three Laws of motion: (1) If $\vec{F}_{net} = 0$ then $\vec{v} = const$; (2) $\vec{F}_{net} = m\vec{a}$; (3) $\vec{F}_{21} = -\vec{F}_{12}$
Specific forces. Gravity: $m\vec{g}$ (down). Normal $\vec{N}$ - perpendicular to surface; tension T - constant along the string. Spring force: $F = -kx$ (k is spring constant).
Friction - parallel to surface; kinetic: $f_k = \mu_k N$; static: $f_s \le \mu_s N$ with $N = mg$ (horizontal plane) or $N = mg\cos\theta$ (inclined plane).
Inclined plane. Components of gravity: $mg\sin\theta$ (parallel to plane, downhill) and $mg\cos\theta$ (perpendicular to plane). Kinetic friction: $\mu_k mg\cos\theta$ (parallel to plane, opposite to direction of motion).
Centripetal motion: $F_{net} = mv^2/R$; direction of $\vec{F}_{net}$ - towards center of revolution.
Work and power. Constant force $W = \vec{F}\cdot(\vec{r}_2 - \vec{r}_1) = F_x\Delta x + F_y\Delta y + F_z\Delta z$ (or, $W = F\Delta r\cos\alpha$); general: $W_{AB} = \int_A^B \vec{F}\cdot d\vec{r}$. Power: $P = W/\Delta t = \vec{F}\cdot\vec{v}$. Work by specific forces: gravity: $W_g = -mg\Delta y$ (and Δx does not matter); normal: $W_N = 0$; kinetic friction: $W_f = -fL$; spring $W_s = \frac{1}{2}k\left(x_i^2 - x_f^2\right)$
Kinetic energy and work-energy theorem: $K = \frac{1}{2}mv^2\,,\ \Delta K = W$ where W is the *net* work (i.e. work by all forces).
Potential energy. For conservative forces (with path-independent work) introduce $U(\vec{r})$ so that $W_{AB} = U_A - U_B = -\Delta U$. For specific forces: gravity: $U_g = mgh$; spring: $U_s = \frac{1}{2}kx^2$. If *only* conservative forces, then energy conservation: $K + U = const$. If also non-conservative forces (e.g., friction) with work $W_{non-cons}$, then $\Delta(K+U) = W_{non-cons}$