Physics 111 Common Exam 1, Fall 2014

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:

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- 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 18 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:
$\vec{A} = 1\hat{\imath} + 2\hat{\jmath} + 0\hat{k}$ **and** $\vec{B} = 2\hat{\imath} + 2\hat{\jmath} + 0\hat{k}$

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, 18^0
D) 3, 48^0
E) 9, 23^0
Answer 6, 48

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

A) 0
B) $2\hat{j}$
C) $-2\hat{j}$
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

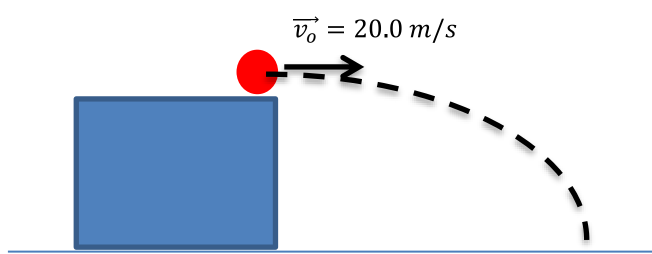
A

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:

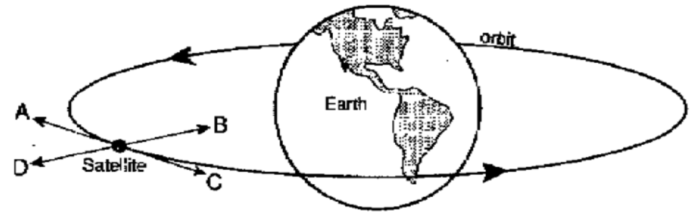
A) $\boldsymbol{\vec{r} = 25\,\hat{\imath} + 75\,\hat{\jmath}}$
B) $\vec{r} = 5\,\hat{\imath} + 25\,\hat{\jmath}$
C) $\vec{r} = 30\,\hat{\imath} + 15\,\hat{\jmath}$
D) $\vec{r} = 20\,\hat{\imath} + 30\,\hat{\jmath}$
E) $\vec{r} = 5\,\hat{\imath} + 25\,\hat{\jmath}$

11. A projectile is fired from the ground with a velocity of 110.0 m/s at an angle of 40.0 degrees above the horizontal. What will be the range (the horizontal displacement) of this projectile?

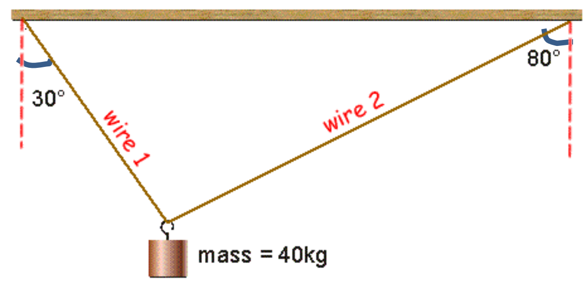
A) 125 m
B) 2350 m
C) 532 m
D) 1215 m
E) 752 m

A

12. The diagram shows a satellite orbiting the earth. The centripetal acceleration and velocity of the satellite, respectively, point to the following letters:
A) A and B
B) B and D
C) A and C
D) B and D
E) B and C

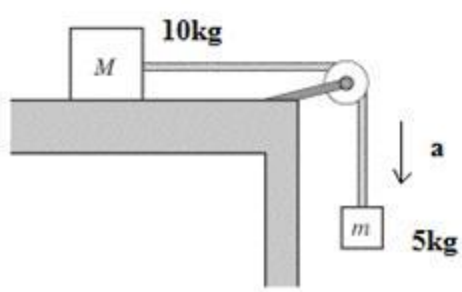


13. A weight of mass 40 kg hangs in equilibrium from two wires as suggested in the Figure. The wires make angles of 30º and 80º with the vertical axis. Find the tensions on both wires (in N):



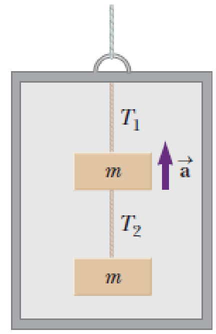
A) T_1 = 119 N and T_2 = 312 N
B) T_1 = 289 N and T_2 = 215 N
C) T_1 = 72 N and T_2 = 453 N
D) T_1 = 103 N and T_2 = 317 N
E) T_1 = 411 N and T_2 = 209 N

14. An object of mass M=10kg placed on a frictionless horizontal table is connected to a string that passes over a pulley and then is fastened to a hanging object of mass m=5kg as shown in the Figure. What is the tension in the string?
A) 62.3 N
B) 42.5 N
C) 32.6 N
D) 21.1 N
E) 11.3 N



A

15. Two blocks, each of mass *m=3.5 kg* are hung from the ceiling of an elevator as in the figure below. The elevator has an upward acceleration *a*=1.6 m/s^2. The strings have negligible mass. Find the tensions T_1 and T_2 in the upper and lower strings.

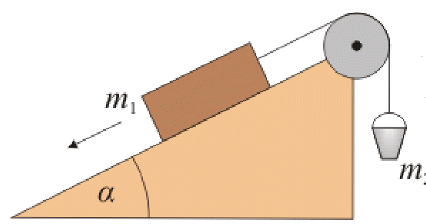


A) T_2 = 40.6 N and T_1 = 100.4 N
B) T_2 = 40.6 N and T_1 = 81.2 N
C) T_2 = 50.6 N and T_1 = 100.4 N
D) T_2 = 62.2 N and T_1 = 120.4 N
E) T_2= 72.5 N and T_1 = 135.5 N

T_2=39.9 N T_1 = 79.8N

16. Two objects of masses m1=6.00 kg and m2=2.0 kg are connected by a light string that passes over a frictionless pulley as shown in the Figure. Assume the incline is frictionless and $\alpha = 55.0^0$. Find the magnitude of the acceleration (in m/s^2) of both masses.

A) 7.32
B) 1.28
C) 2.52
D) 3.57
E) 0.39



17. Two blocks on a frictionless horizontal surface are connected by a string where m1 = 8kg and m2 = 28kg. A force of 80 N is applied to the 28kg block. Determine the tension in the string.

A) 5.3 N
B) 25.3 N
C) 25.3 N
D) 17.7 N
E) 12.5 N

18. A firefighter, a distance d=5 meters from a burning building directs a stream of water from a fire hose at angle $\boldsymbol{\theta = 40^0}$ above the horizontal. If the initial speed of the stream is $\boldsymbol{v_i = 10}$ m/s, at what height h does the water strike the building?

A) 2.1 m
B) 5.1 m
C) 1.2 m
D) 1.7 m
E) 3.4 m

A

FORMULAS – Final Exam

Conversion Factors: 1 inch = 2.54 cm; 1 mi =1609.3 m; 1 cm=10^{-2}m; 1 mm= 10^{-3} m; 1 g=10^{-3} kg;

Physical constants: $g = 9.8$ m/s^2 ; $G = 6.674\times10^{-11}$ N m^2/kg^2 ; $M_{Earth} = 5.97\times10^{24}$ kg ; $R_{Earth} = 6.37\times10^{6}$ m

Math: 360° = 2π radians = 1 revolution. Arc length $s = r\theta$; $V_{sphere} = 4\pi R^3/3$; $A_{sphere} = 4\pi R^2$; $A_{circle} = \pi R^2$

quadratic formula to solve $ax^2 + bx + c = 0$: $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Vectors: $\vec{A} = A_x\hat{i} + A_y\hat{j}$; $A_x = |\vec{A}|\cos(\theta)$; $A_y = |\vec{A}|\sin(\theta)$; $|\vec{A}| = \sqrt{A_x{}^2 + A_y{}^2}$; $\tan\theta = \dfrac{A_y}{A_x}$

$\vec{C} = \vec{A} + \vec{B}$ implies $C_x = A_x + B_x$; $C_y = A_y + B_y$

$\vec{A}\bullet\vec{B} = |\vec{A}||\vec{B}|\cos\theta = A_xB_x + A_yB_y + A_zB_z$; $\hat{\imath}\cdot\hat{\imath} = \hat{\jmath}\cdot\hat{\jmath} = \hat{k}\cdot\hat{k} = 1$; $\hat{\imath}\cdot\hat{\jmath} = \hat{\imath}\cdot\hat{k} = \hat{\jmath}\cdot\hat{k} = 0$

$|\vec{A}\times\vec{B}| = |\vec{A}||\vec{B}|\sin\theta$; $\vec{A}\times\vec{B} = \hat{i}(A_yB_z - A_zB_y) + \hat{j}(A_zB_x - A_xB_z) + \hat{k}(A_xB_y - A_yB_x)$

$\hat{i}\times\hat{i} = \hat{j}\times\hat{j} = \hat{k}\times\hat{k} = 0$; $\hat{i}\times\hat{j} = \hat{k}$; $\hat{j}\times\hat{k} = \hat{i}$; $\hat{k}\times\hat{i} = \hat{j}$

1D and 2D motion:

$v_{avg} = \dfrac{\Delta x}{\Delta t}$; $a_{avg} = \dfrac{\Delta v}{\Delta t}$; $v = \dfrac{dx}{dt}$; $a = \dfrac{dv}{dt} = \dfrac{d^2x}{dt^2}$

$\vec{v}_{avg} = \dfrac{\Delta\vec{r}}{\Delta t}$; $\vec{a}_{avg} = \dfrac{\Delta\vec{v}}{\Delta t}$; $\vec{v} = \dfrac{d\vec{x}}{dt}$; $\vec{a} = \dfrac{d\vec{v}}{dt} = \dfrac{d^2\vec{r}}{dt^2}$

$x = x_i + v_i\,t + \frac{1}{2}at^2$; $v = v_i + at$; $v^2 = v_i^2 + 2a(x - x_i)$; $\vec{r} = \vec{r}_i + \vec{v}_i\,t + \frac{1}{2}\vec{a}t^2$; $\vec{v} = \vec{v}_i + \vec{a}t$

Circular motion: $T = 2\pi R/v$; $T = 2\pi/\omega$; $a_c = v^2/R$

Newton's Laws: $\sum\vec{F} = m\vec{a}$; $\vec{F}_{12} = -\vec{F}_{21}$

Friction: $f_s \le \mu_s N$; $f_k = \mu_k N$

Energies: $K = \frac{1}{2}mv^2$; $U_g = mgy$; $U_s = \frac{1}{2}kx^2$; $W = -\int\vec{F}\bullet d\vec{r} = -\vec{F}\bullet\Delta\vec{r}$

$E_{total} = K + U_g + U_S$; $\Delta E_{mech} = \Delta K + \Delta U_g + \Delta U_s = -f_s d$; $P = dW/dt = \vec{F}\bullet\vec{v}$; $\Delta K = W$

Momentum and Impulse: $\vec{p} = m\vec{v}$; $\vec{I} = \int\vec{F}dt = \Delta\vec{p}$

Center of mass: $\vec{r}_{cm} = \sum_i m_i\vec{r}_i / \sum_i m_i$; $\vec{v}_{cm} = \sum_i m_i\vec{v}_i / \sum_i m_i$

Collisions: $\vec{p}$ = const and E≠ const (inelastic) or $\vec{p}$ = const and E= const (elastic)

Rotational motion: $\omega = 2\pi/T$; $\omega = d\theta/dt$; $\alpha = d\omega/dt$; $v_t = r\omega$; $a_t = r\alpha$ $a_c = a_r = v_t^2/r = \omega^2 r$

$a_{tot}^2 = a_r^2 + a_t^2$; $v_{cm} = r\omega$ (rolling, no slipping) ; $a_{cm} = r\alpha$

$\omega = \omega_o + \alpha t$; $\theta_f = \theta_i + \omega_o t + \alpha t^2/2$; $\omega_f^2 = \omega_i^2 + 2\alpha(\theta_f - \theta_i)$

$I_{point} = MR^2$; $I_{hoop} = MR^2$; $I_{disk} = MR^2/2$; $I_{sphere} = 2MR^2/5$; $I_{shell} = 2MR^2/3$; $I_{rod\,(center)} = ML^2/12$

$I_{rod\,(end)} = ML^2/3$; $I = \sum_i m_i r_i^2$; $I = I_{cm} + Mh^2$; $\vec{\tau} = \vec{r}\times\vec{F}$; $\sum\tau = I\alpha$; $\vec{L} = \vec{r}\times\vec{p}$; $\vec{L} = I\vec{\omega}$

Energy: $K_{rot} = I\omega^2/2$; $K = K_{rot} + K_{cm}$; $\Delta K + \Delta U = 0$; $W = \tau\,\Delta\theta$; $P_{inst} = \tau\omega$

Gravitation: $\vec{F}_g = -\dfrac{Gm_1m_2}{r^2}\hat{r}_{12}$; $g(r) = GM/r^2$; $U = -Gm_1m_2/r$; $T^2 = \dfrac{4\pi^2}{GM}a^3$

Exam 1 Phys 111 Version MK Fall 2014 Section_______________

Name____Score __________

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The exam is closed book and closed notes. Put the answers to these 10 questions on your SCANTRON sheet. Your answer should be **CLOSEST TO THE GIVEN ANSWERS**.

1. A particle moving along the *x* axis has a position given by $x = (24t - 2.0t^3)$ m, where *t* is measured in s. What is the magnitude of the acceleration of the particle at the instant when its velocity is zero?

a. 24 m/s^2
b. zero
c. 12 m/s^2
d. 48 m/s^2
e. 36 m/s^2

2. 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?

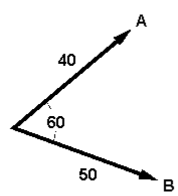
a. 6.00 s
b. 4.50 s
c. 3.60 s
d. 4.00 s
e. 9.00 s

3. 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

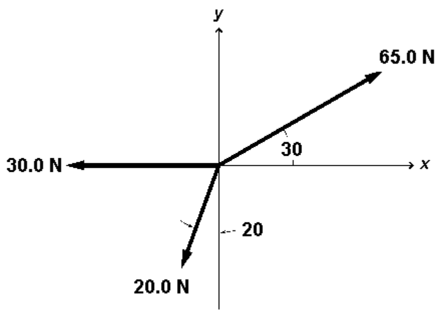
4. John throws a rock straight down with speed 12 m/s from the top of a tower 22 m high. What is the speed of the rock just before it hits the groundr? (air resistance is negligible)
a. 4.8 m
b. 19.6 m
c. 27.5 m
d. 38.4 m
e. 56.0 m

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



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

6. . Find the direction of the net force of three forces shown in the figure below.



a. 35°
b. 45°
c. 65°
d. 55°
e. 85°

7. 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

8. 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

9. A ball is thrown horizontally from the top of a building 35 m high high. The ball strikes the ground at a point 65 m horizontally away from and below the point of release. What is the initial speed of the ball?

a. 43 m/s
b. 24 m/s
c. 39 m/s
d. 36 m/s
e. 14 m/s

10. A cannon ball is shoot with 200 m/s. at an angle of 40^0. If the ball is to strike a target that is at a horizontal distance of 3.0 km from the cannon, what is the time of flight for the ball?

a. **20 s**
b. 31 s
c. 24 s
d. 14 s
e. 19 s

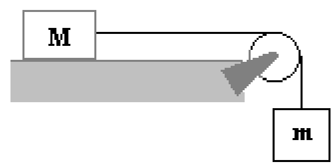
11. A race car moving with a constant speed of 60 m/s completes one lap around a circular track in 50 s. What is the magnitude of the acceleration of the race car?

a. 8.8 m/s^2
b. 7.5 m/s^2
c. 9.4 m/s^2
d. 6.3 m/s^2
e. 5.3 m/s^2

12. A 3.00-kg mass undergoes an acceleration given by **a** = (2**i**+5**j**) m/s^2. The magnitude of the net force is

a. 2.0 N
b. 4.0 N
c. 6.0 N
d. 12.0 N
e. 16.0 N

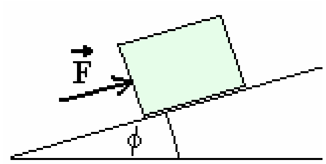
13. A 10-kg block on a horizontal plane is connected by a cord over a massless, frictionless pulley to a second block of mass m. What hanging mass m is needed so that the 10-kg block can move at accelration of 2.8 m/s^2 ?



a. 1 kg
b. 2 kg
c. 3 kg
d. 4 kg
e. 5 kg

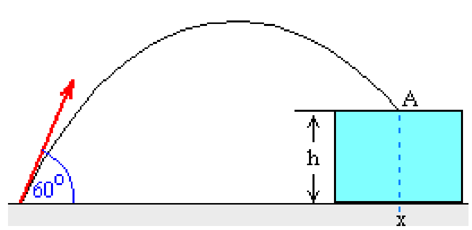
14. A 20 N force **F**, parallel to the incline is required to push a certain crate at acceleration of 1.6 m/s^2 up an incline that is $\phi = 28^0$ above the horizontal. Wwhat is the mass of the crate?

a. 2.31kg
b. 3.49kg
c. 3.22kg
d. 5.84kg
e. 6.04 kg



15. A stone is projected at a cliff of height h =12 m with an initial speed of v_0 directed 60^0 above the horizontal, as shown. Four seconds later the stone strikes the cliff.. What is the initial velocity of the stone?.

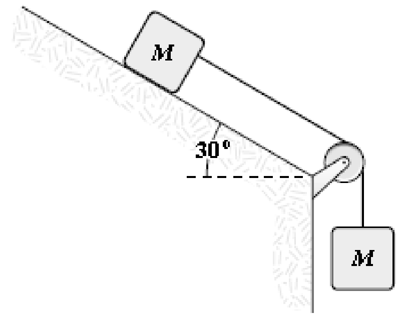
a. 26 m/s
b. 12 m/s
c. 32 m/s
d. 23 m/s
e. 42 m/s



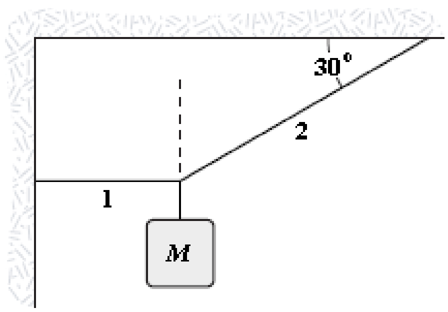
16. If *M* = 2.2 kg, what is the tension in the connecting string? The pulley and all surfaces are frictionless.

a. 2.8 N

b. 12.2 N
c. 9.4 N
d. 5.4 N
e. 1.2 N

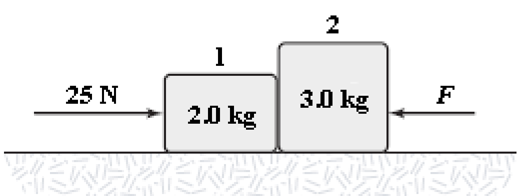


17. If M = 2.0 kg, what is the tension in string 1?



a. 1.2 N
b. 11 N
c. 34 N
d. 3.5 N
e. 40 N

18. If F = 5.0 N, what is the magnitude of the force exerted by block 2 on block 1?



a. 17 N
b. 19 N
c. 21 N
d. 23 N
e. 5.0 N