Instructor: *Profs. Acosta, Hamlin, Muttalib*

PHYSICS DEPARTMENT

PHY 2048 Exam 1 February 10, 2017

Name (PRINT, last, first): _____ Signature: _____

On my honor, I have neither given nor received unauthorized aid on this examination.

YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.

DIRECTIONS

(1) **Code your test number on your answer sheet (use 76–80 for the 5-digit number)**. Code your name on your answer sheet. **DARKEN CIRCLES COMPLETELY**. Code your student number on your answer sheet.
(2) Print your name on this sheet and sign it also.
(3) Do all scratch work anywhere on this exam that you like. At the end of the test, this exam printout is to be turned in. No credit will be given without both answer sheet and printout with scratch work most questions demand.
(4) **Blacken the circle of your intended answer completely, using a #2 pencil or blue or black ink**. Do not make any stray marks or the answer sheet may not read properly.
(5) The answers are rounded off. Choose the closest to exact. There is no penalty for guessing.

>>>>>>>>>**WHEN YOU FINISH** <<<<<<<<<
Hand in the answer sheet separately.

Formula-sheet: Exam 1

- *For constant acceleration $\vec{a}$:*

$$\vec{v} = \vec{v}_0 + \vec{a}t \qquad v_x^2 = v_{x0}^2 + 2a_x(x - x_0)$$
$$\vec{r} = \vec{r}_0 + \vec{v}_0 t + \frac{1}{2}\vec{a}t^2 \qquad v_y^2 = v_{y0}^2 + 2a_y(y - y_0)$$

  Acceleration due to gravity: $g = 9.8\ \mathrm{m/s^2} = 32\ \mathrm{ft/s^2}$ vertically down.

- *For force acting on a body of mass m:* $\vec{F} = m\vec{a}$
- Frictional forces: $f_{s,max} = \mu_s N$; $f_k = \mu_k N$. N : normal force.
- *For uniform circular motion:* centripetal acceleration is $a_c = \dfrac{v^2}{r}$
- Kinetic energy: $K = \dfrac{1}{2}mv^2$
- Work done by a constant force: $W = \vec{F} \cdot \vec{d} = Fd \cos$ (angle between $\vec{F}$ and $\vec{d}$)
- Work-kinetic energy theorem: $W = K_f - K_i$
- Vectors (2d): $\vec{A} = \hat{\imath}A_x + \hat{\jmath}A_y$; $A = \sqrt{A_x^2 + A_y^2}$;

  $A_x = A\cos$(angle between $\vec{A}$ and $\hat{\imath}$); $A_y = A\sin$(angle between $\vec{A}$ and $\hat{\imath}$)

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1. A rocket is accelerating vertically upward at 9.8 m/s^2 near earth's surface. It releases a rock when its velocity is 10 km/s upward. Immediately after release, the velocity v and acceleration a of the rock are

   (1) $v = 10$ km/s up and $a = 9.8$ m/s^2 down
   (2) $v = 0$ and $a = 0$
   (3) $v = 0$ and $a = 9.8$ m/s^2 down
   (4) $v = 0$ and $a = 9.8$ m/s^2 up
   (5) $v = 10$ km/s up and $a = 9.8$ m/s^2 up

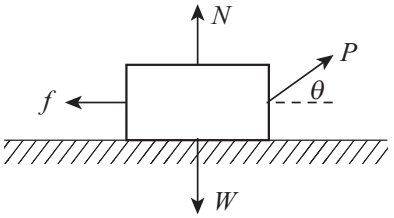
2. A football is kicked with a velocity v_0 at an angle θ_0 above the horizontal, from a point P on the ground. A player starts to run with a uniform velocity at the same time starting from P to catch the ball. The ball will always be exactly above the player until it is caught if the velocity v of the player is

   (1) $v = v_0 \cos\theta_0$ (2) $v = v_0 \sin\theta_0$ (3) $v = v_0 \tan\theta_0$ (4) $v = v_0$ (5) faster than v_0

3. A physics textbook is placed on a spring scale in an elevator. Of the following, the scale shows the <u>*lowest*</u> reading when the elevator:

   (1) moves downward with increasing speed
   (2) moves upward with constant speed
   (3) remains stationary
   (4) moves upward with increasing speed
   (5) moves downward at constant speed

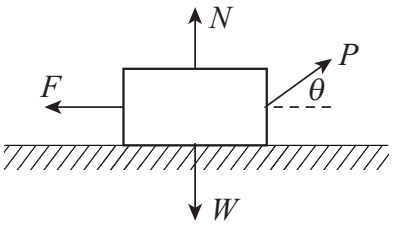
4. A boy pulls a wooden box along a rough horizontal floor at constant speed by means of a force $\vec{P}$ as shown. Here f is the magnitude of the frictional force, N is the magnitude of the normal force, and W is the magnitude of the weight. Which of the following must be true?



   (1) $P > f$ and $N < W$ (2) $P = f$ and $N > W$ (3) $P = f$ and $N = W$ (4) $P > f$ and $N = W$ (5) $P < f$ and $N = W$

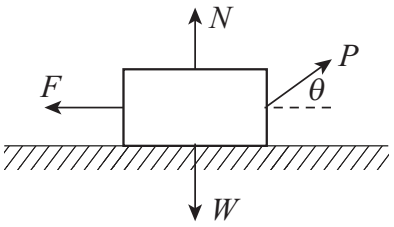
5. Refer to the figure. The block moves horizontally a distance d to the <u>*left*</u> under the action of all forces shown in the figure. Work done by $\vec{F}$, $\vec{P}$ and $\vec{W}$ are, respectively,

   (1) positive, negative, and 0.
   (2) negative, positive and 0.
   (3) negative, 0 and positive.
   (4) positive, 0 and 0.
   (5) positive, positive and negative.



6. Refer to the figure. The block moves horizontally a distance d to the <u>*right*</u> under the action of all forces shown in the figure. Work done by $\vec{F}$, $\vec{P}$ and $\vec{W}$ are, respectively,

   (1) negative, positive and 0.
   (2) positive, negative, and 0.
   (3) negative, 0 and positive.
   (4) positive, 0 and 0.
   (5) positive, positive and negative.



7. A rock is thrown straight up from a height 58.8 m above the ground with an initial velocity 19.6 m/s. How long would it take for the rock to hit the ground?

   (1) 6.0 s (2) 2.0 s (3) 4.0 s (4) 8.0 s (5) 10.5 s

8. A rock is thrown straight down from a height 58.8 m above the ground with an initial velocity 19.6 m/s. How long would it take for the rock to hit the ground?

   (1) 2.0 s (2) 6.0 s (3) 4.0 s (4) 8.0 s (5) 10.5 s

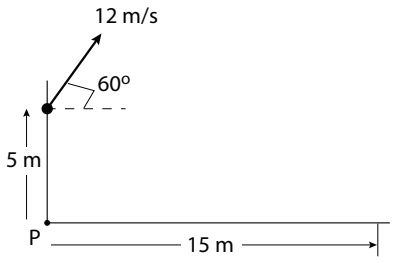
9. A car is moving along a straight line with a velocity v. Applying the brake causes a constant negative acceleration which stops it in 5 s within a distance 50 m. What is the magnitude of the acceleration?

   (1) 4.0 m/s^2 (2) 2.5 m/s^2 (3) 6.0 m/s^2 (4) 8.0 m/s^2 (5) 10.5 m/s^2

10. Two forces acting on a body are given in terms of the unit vectors $\hat{i}$ along the x axis and $\hat{j}$ along the y-axis, with $\vec{F}_1 = 3N\hat{i} + 2N\hat{j}$ and $\vec{F}_2 = 2N\hat{i} - 4N\hat{j}$. The magnitude F and direction (angle θ measured counterclockwise from the x-axis) of the sum of the forces $\vec{F} = \vec{F}_1 + \vec{F}_2$ are

    (1) $F = 5.4\ N$; $\theta = -22°$
    (2) $F = 3.0\ N$; $\theta = -22°$
    (3) $F = 5.4\ N$; $\theta = +22°$
    (4) $F = 3.0\ N$; $\theta = +68°$
    (5) $F = 4.6\ N$; $\theta = +68°$

11. A ball is thrown from a height 5 m above a point P on the ground with an initial velocity 12 m/s at an angle 60° above the horizontal. The ball was caught at a horizontal distance 15 m from P. How high above the ground was the ball caught?



    (1) 0.4 m
    (2) 1.6 m
    (3) 3.8 m
    (4) 5.8 m
    (5) 6.9 m

12. A package is released from a diving plane at a height of 640 m above the ground. Velocity of the plane at the time of release of the package is 80 m/s at an angle 30° below the horizontal. What is the magnitude v and direction θ (angle from the horizontal) of the velocity at the time it hits the ground?

    (1) $v = 138$ m/s; $\theta = -60°$
    (2) $v = 80$ m/s; $\theta = -30°$
    (3) $v = 224$ m/s; $\theta = -84°$
    (4) $v = 112$ m/s; $\theta = -48°$
    (5) $v = 176$ m/s; $\theta = -62°$

13. You throw a ball at a target that is at a horizontal distance d from you and at a height h above the level at which you release the ball. The ball hits the target when it reaches its maximum height. If the time it takes to hit the target is 2 s, what is the height of the target?

    (1) 19.6 m (2) 44.1 m (3) 3.5 m (4) 6.8 m (5) 11.2 m

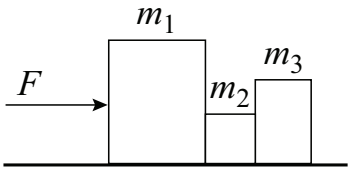
14. An elevator cab with mass 1200 kg moves downward. What is the tension in the cable if the cab's speed is decreasing at a rate 2.2 m/s^2?

(1) 1.44×10^4 N (2) 9.12×10^3 N (3) 1.18×10^4 N (4) 2.64×10^3 N (5) 3.66×10^4 N

15. An elevator cab with mass 1200 kg moves downward. What is the tension in the cable if the cab's speed is increasing at a rate 2.2 m/s^2?

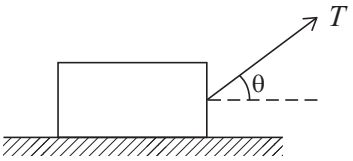
(1) 9.12×10^3 N (2) 1.44×10^4 N (3) 1.18×10^4 N (4) 2.64×10^3 N (5) 3.66×10^4 N

16. Three blocks with masses m_1, m_2 and m_3 are pushed along a horizontal frictionless surface by a horizontal applied force F acting on the mass m_1 from the left as shown. The magnitude of the force of m_1 on m_2 is



(1) $F(m_2 + m_3)/(m_1 + m_2 + m_3)$
(2) $Fm_1/(m_2 + m_3)$
(3) F
(4) $Fm_1/(m_1 + m_2 + m_3)$
(5) $F(m_1 - m_2)/(m_1 + m_2 + m_3)$

17. A block of mass m is pulled along a horizontal floor by an applied force $\vec{T}$ as shown. The normal force exerted on the block by the floor is:

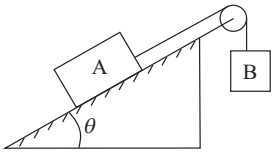


(1) $mg - T\sin\theta$ (2) mg (3) $mg + T\cos\theta$ (4) $mg - T\cos\theta$ (5) $mg + T\sin\theta$

18. A horizontal force of magnitude F pushes a block of weight 6 N against a rough vertical wall. The coefficient of static friction between the wall and the block is 0.50. What is the smallest value of F for which the block does not slide?

(1) 12 N (2) 3 N (3) 6 N (4) 9 N (5) 15 N

19. Block A, with a mass of 10.0 kg, rests on a 30° incline. The coefficient of kinetic friction is 0.20. The attached string is parallel to the incline and passes over a massless, frictionless pulley at the top. Block B, with a mass of 3.0 kg, is attached to the dangling end of the string. The frictional force acting on Block A is:



(1) 17 N (2) 19.6 N (3) 9.8 N (4) 26 N (5) 33 N

20. In the above problem, the acceleration of Block B is

(1) 0.2 m/s^2 (2) 0.69 m/s^2 (3) 2.8 m/s^2 (4) 4.6 m/s^2 (5) 0

21. An iron ball is being swung in a vertical circle at the end of a 2 ft string. How slowly can the ball go through its top position without having the string go slack?

(1) 8 ft/s (2) 4 ft/s (3) 6 ft/s (4) 10 ft/s (5) 12 ft/s

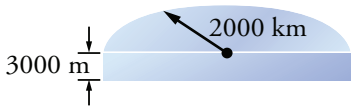
22. If a certain car, going with speed v_1, rounds an unbanked curve with radius R_1, it is just on the verge of skidding. If its speed is now doubled, the radius of the tightest unbanked curve on the same road that it can round without skidding is

(1) $4R_1$ (2) $2R_1$ (3) R_1 (4) $R_1/2$ (5) $R_1/4$

23. If a certain car, going with speed v_1, rounds an unbanked curve with radius R_1, it is just on the verge of skidding. If its speed is now halved, the radius of the tightest unbanked curve on the same road that it can round without skidding is

(1) $R_1/4$ (2) $2R_1$ (3) R_1 (4) $R_1/2$ (5) $4R_1$

24. Antarctica is roughly semicircular, with a radius of 2000 km (see figure). The average thickness of its ice cover is 3000 m. How many cubic centimeters of ice does Antarctica contain? (Ignore the curvature of Earth.)



(1) 1.9×10^{22} cm^3 (2) 1.9×10^{16} cm^3 (3) 1.9×10^{19} cm^3 (4) 6×10^{6} cm^3 (5) 6×10^{11} cm^3

THE FOLLOWING QUESTIONS, NUMBERED IN THE ORDER OF THEIR APPEARANCE ON THE ABOVE LIST, HAVE BEEN FLAGGED AS CONTINUATION QUESTIONS: 20 FOLLOWING GROUPS OF QUESTIONS WILL BE SELECTED AS ONE GROUP FROM EACH TYPE

TYPE 1
Q# S 5
Q# S 6
TYPE 2
Q# S 7
Q# S 8
TYPE 3
Q# S 14
Q# S 15
TYPE 4
Q# S 22
Q# S 23