Instructor(s): *Woodard/Yelton*

PHYSICS DEPARTMENT

PHY 2048 Exam 1 September 27, 2019

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.

(1) **Code your test number on your answer sheet (use lines 76–80 on the answer sheet for the 5-digit number)**. Code your name on your answer sheet. **DARKEN CIRCLES COMPLETELY**. Code your UFID 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. **Circle your answers on the test form.** 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.

(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 some answers may be counted as incorrect.

(5) **The answers are rounded off. Choose the closest to exact. There is no penalty for guessing. If you believe that no listed answer is correct, leave the form blank.**

(6) Hand in the answer sheet (scantron) separately. Only the scantron is graded.

Use $g = 9.80$ m/s^2

PHY2048 Exam 1 Formula Sheet

Vectors

$\vec{a} = a_x\hat{i} + a_y\hat{j} + a_z\hat{k}$ $\vec{b} = b_x\hat{i} + b_y\hat{j} + b_z\hat{k}$ Magnitudes: $|\vec{a}| = \sqrt{a_x^2 + a_y^2 + a_z^2}$ $|\vec{b}| = \sqrt{b_x^2 + b_y^2 + b_z^2}$

Scalar Product: $\vec{a} \cdot \vec{b} = a_x b_x + a_y b_y + a_z b_z$ Magnitude: $\vec{a} \cdot \vec{b} = |\vec{a}||\vec{b}| \cos\theta$ (θ = angle between $\vec{a}$ and $\vec{b}$)

Vector Product: $\vec{a} \times \vec{b} = (a_y b_z - a_z b_y)\hat{i} + (a_z b_x - a_x b_z)\hat{j} + (a_x b_y - a_y b_x)\hat{k}$

Magnitude: $|\vec{a} \times \vec{b}| = |\vec{a}||\vec{b}| \sin\theta$ (θ = angle between $\vec{a}$ and $\vec{b}$)

Motion

Displacement: $\Delta\vec{r} = \vec{r}(t_2) - \vec{r}(t_1)$

Average Velocity: $\vec{v}_{ave} = \dfrac{\Delta\vec{r}}{\Delta t} = \dfrac{\vec{r}(t_2) - \vec{r}(t_1)}{t_2 - t_1}$ Average Speed: s_{ave} = (total distance)/Δt

Instantaneous Velocity: $\vec{v} = \dfrac{d\vec{r}(t)}{dt}$ Relative Velocity: $\vec{v}_{AC} = \vec{v}_{AB} + \vec{v}_{BC}$

Average Acceleration: $\vec{a}_{ave} = \dfrac{\Delta\vec{v}}{\Delta t} = \dfrac{\vec{v}(t_2) - \vec{v}(t_1)}{t_2 - t_1}$ Instantaneous Acceleration: $\vec{a} = \dfrac{d\vec{v}}{dt} = \dfrac{d^2\vec{r}}{dt^2}$

Equations of Motion for Constant Acceleration

$\vec{v} = \vec{v}_0 + \vec{a}t$

$\vec{r} - \vec{r}_0 = \vec{v}_0 t + \frac{1}{2}\vec{a}t^2$

$v_x^2 = v_{x0}^2 + 2a_x(x - x_0)$ (in each of 3 dim)

Newton's Laws

$\vec{F}_{net} = 0 \Leftrightarrow \vec{v}$ is a constant (Newton's First Law)

$\vec{F}_{net} = m\vec{a}$ (Newton's Second Law)

"Action = Reaction" (Newton's Third Law)

Force due to Gravity

Weight (near the surface of the Earth) = mg (**use g=9.8** m/s^2)

Magnitude of the Frictional Force

Static: $f_s \leq \mu_s F_N$ Kinetic: $f_k = \mu_k F_N$

Uniform Circular Motion (Radius R, Tangential Speed $v = R\omega$, Angular Velocity ω)

Centripetal Acceleration: $a = \dfrac{v^2}{R} = R\omega^2$ Period: $T = \dfrac{2\pi R}{v} = \dfrac{2\pi}{\omega}$

Projectile Motion

Range: $R = \dfrac{v_0^2 \sin(2\theta_0)}{g}$

Quadratic Formula

If: $ax^2 + bx + c = 0$ Then: $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

1. On a spending spree in Malaysia, you buy an ox with a weight of 32.1 piculs in the local unit of weights: 1 picul = 100 gins, 1 gin = 16 tahils, 1 tahil = 10 chees, and 1 chee = 10 hoons. The weight of 1 hoon corresponds to a mass of 0.3779 g. When you arrange to ship the ox home to your astonished family, how much mass must you declare on the shipping manifest?

(1) 2000 kg (2) 1700 kg (3) 1500 kg (4) 1200 kg (5) 1000 kg

2. If the position of a particle is given by $x = 29t - 8t^3$, where t is in seconds and x is in meters, when is the particle's velocity zero?

(1) 1.1 s (2) 3.6 s (3) 1.9 s (4) 0 s (5) 2.5 s

3. A ball is thrown vertically downward from the top of a 38.3 m tall building. The ball passes the top of a window that is 15.5 m above the ground 2.00 s after being thrown. What is the speed of the ball as it passes the top of the window?

(1) 21.2 m/s (2) 1.6 m/s (3) 26.9 m/s (4) 9.8 m/s (5) 15.3 m/s

4. A golfer takes three putts to get the ball into the hole. The first putt displaces the ball 3.32 m north, the second 1.57 m southeast, and the third 0.718 m southwest. What is the magnitude of the displacement needed to get the ball into the hole in just one putt?

(1) 1.81 m (2) 0.60 m (3) 1.70 m (4) 4.24 m (5) 3.92 m

5. Two vectors are given by $\vec{a} = 3.6\hat{\imath} + 7.9\hat{\jmath}$ and $\vec{b} = 5.0\hat{\imath} + 1.1\hat{\jmath}$. What is the dot product $\vec{a} \cdot \vec{b}$?

(1) 26.7 (2) 18.0 (3) 8.69 (4) 77.4 (5) 39.5

6. A particle leaves the origin with an initial velocity (in m/s) $\vec{v} = 1.30\hat{\imath}$ and a constant acceleration (in m/s^2) $\vec{a} = -3.35\hat{\imath} - 4.17\hat{\jmath}$. When the particle reaches its maximum x coordinate what is its speed?

(1) 1.62 m/s (2) 1.30 m/s (3) 3.35 m/s (4) 4.17 m/s (5) 5.35 m/s

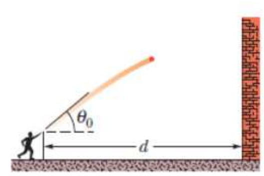
7. In 3.60 h, a balloon drifts 19.6 km north, 9.14 km east, and 2.16 km upward from its release point on the ground. What is the angle (in degrees) its average velocity makes with the horizontal?

(1) 5.70 (2) 25.0 (3) 6.29 (4) 13.3 (5) 10.4

8. A dart is thrown horizontally with an initial speed of 16 m/s toward point P, the bull's-eye on a dart board. It hits at point Q on the rim, vertically below P, 0.19 s later. What is the distance PQ?

(1) 18 cm (2) 36 cm (3) 27 cm (4) 45 cm (5) 9 cm

9. In the figure, you throw a ball toward a wall at speed 36.0 m/s and at angle $\theta_0 =$ 39.0° above the horizontal. The wall is distance $d = 22.0$ m from the release point of the ball. How far above the release point does the ball hit the wall?



(1) 14.8 m (2) 17.8 m (3) 3.03 m (4) 20.8 m (5) 11.9 m

10. A particle moves horizontally in uniform circular motion, over a horizontal xy plane. At one instant, it moves through the point at coordinates (3.60 m, 4.10 m) with a velocity (in m/s) of $\vec{v} = -6.80\hat{\imath}$ and an acceleration (in m/s^2) of $+12.7\hat{\jmath}$. What is the y coordinate of the center of the circular path?

(1) 7.74 m (2) 4.10 m (3) 0.64 m (4) 3.64 m (5) 1.87 m

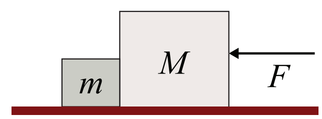
11. A river flows south at a speed $v_1 = 3$ m/s. You swim east at a speed $v_2 = 4$ m/s with respect to the water. The river is 60 m wide. How far down stream will you land from the point directly opposite to your starting point?

(1) 45 m (2) 25 m (3) 30 m (4) 35 m (5) 40 m

12. A block of mass 2 kg moves with a uniform velocity of $v = 2\hat{\imath}$ m/s, while being acted on by 3 forces, $F_1 = 6\hat{\jmath}$ N, $F_2 = 8\hat{\imath}$ N and F_3. What is the magnitude of F_3 in N?

(1) 10 (2) 2 (3) 5 (4) 3 (5) 12

13. Two blocks with masses $m = 1.0$ kg and $M = 4.0$ kg are pushed along a horizontal surface and the coefficient of friction is $\mu_k = 0.4$. The horizontal applied force of $F = 40$ N as shown. What is the magnitude of the force of block m on block M?

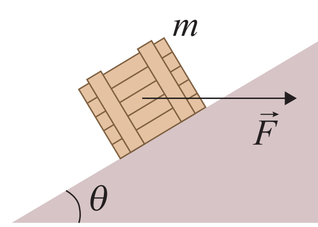


(1) 8 N (2) 4 N (3) 0 N (4) 12 N (5) 32 N

14. You stand on a bathroom scale and it reads 50 kg. You take it into an elevator and during a certain time period it is going down with a speed that changes smoothly from 5 m/s to 3 m/s. During this time the scale will read:

(1) More than 50 kg (2) Less than 50 kg (3) 50 kg (4) There is not enough information (5) 0 kg

15. A crate is pushed at a constant speed of 3 m/s up a frictionless ramp with $\theta = 37°$ by a horizontal force, $F = 20$ N. What is the mass of the crate in kg?



(1) 2.7
(2) 3.4
(3) 0.6
(4) 7.3
(5) 5.6

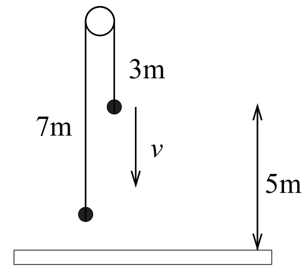
16. A heavy ball hangs from a massless rope which is attached to the ceiling by a hook. The gravitational force (i.e. weight) on the ball pulls down, and we can call this the "action" force. Identify which of the following forces is the "reaction" force paired with this action force by Newton's Third Law.

(1) The gravitational force of the ball pulling the earth.
(2) The tension in the rope pulling the ball up.
(3) The tension of the rope pulling down on the hook.
(4) The force of the hook pulling up on the rope.
(5) The force of the hook pulling the ceiling down.

17. Two blocks, one on top of the other, are on (frictionless) ice. The lower block has a mass of 10 kg, the upper block has a mass of 5 kg. The lower block is pulled to the right with a force of 30 N. The coefficients of friction for the surface between the blocks are $\mu_s = 0.6$ and $\mu_k = 0.5$. What is the magnitude of the force of friction (in Newtons) on the smaller block?

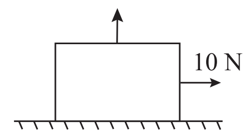
(1) 10 (2) 24.5 (3) 29.4 (4) 0 (5) 58.8

18. Two masses, each of mass 2 kg are on opposite ends of a 10 m long massless string which is hung on a massless frictionless pulley which is 8 m above the ground. Initially one mass, is 5 m above the ground and moving downwards with a speed $v = 5\,\text{m/s}$. What is the tension in the string, in Newtons?



(1) 19.6
(2) 98
(3) 0
(4) 39.2
(5) 9.8

19. A box of mass 5.1 kg rests on a horizontal surface. A person pulls horizontally on it with a force of 10 N and it does not move. To help it start moving, a second person pulls vertically upward on the box. If the coefficient of static friction is 0.4, what is the smallest vertical force for which the box moves?



(1) 25 N (2) 10 N (3) 14 N (4) 4 N (5) 35 N

20. A hot-air balloon starts rising from rest with an acceleration of 2 m/s^2. After 5 seconds of this motion, a man releases a ball over the side of the balloon. One second after the release of the ball, how fast is it moving with respect to the ground, in m/s?

(1) 0.2 (2) 2.2 (3) 10 (4) 19.8 (5) 9.8