Instructor(s): *Woodard/Yelton*

PHYSICS DEPARTMENT

PHY 2048 Exam 1 September 24, 2018

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 $g = 9.80\ \mathrm{m/s^2}$

PHY2048 Exam 1 Formula Sheet

Vectors

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

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: $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Work (W), Mechanical Energy (E, Kinetic Energy (K)), Potential Energy (U)

Kinetic Energy: $K = \frac{1}{2}mv^2$ Work: $W = \displaystyle\int_{\vec{r}_1}^{\vec{r}_2} \vec{F} \cdot d\vec{r}$ When force is constant $W = \vec{F} \cdot \vec{d}$

Power: $P = \frac{dW}{dt} = \vec{F} \cdot \vec{v}$ Work-Energy Theorem: $K_f = K_i + W$

1. Remembering that there are 2.54 cm in an inch (and knowing that there are 4840 yd^2 in an acre), how many m^2 are in an acre?

(1) 4047 (2) 4428 (3) 5290 (4) 5788 (5) 6326

2. You move 300 m north at 10 m/s, followed by 400 m west at 20 m/s. What is the difference between your average speed and the magnitude of your average velocity?

(1) 4 m/s (2) 0 m/s (3) 5 m/s (4) 2 m/s (5) 3 m/s

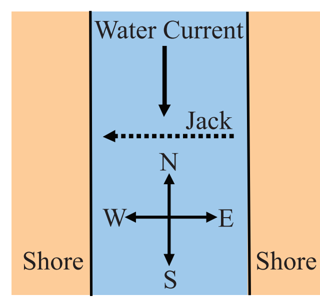
3. The position of a particle as a function of time is given by the following formula: $\vec{r}(t) = (10t^2 - 50)\hat{\imath} + 5t^3\hat{\jmath}$. What is the magnitude of the acceleration at t = 0.5?

(1) 25 (2) 35 (3) 15 (4) 50 (5) 40

4. A remote controlled toy car accelerates from rest at 1.0 m/s^2, under the power of its own wheels, on a horizontal balcony until it shoots off the edge of the balcony 3.0 m from its starting point. If the balcony is 10.0 m high, what is the horizontal distance from the point the car left the balcony to where the car lands on level ground?

(1) 3.5 m (2) 5.0 m (3) 6.5 m (4) 2.1 m (5) 0 m

5. Jack rows across a river taking account of the current so that he actually moves at right angles to the east shore to a point on the west shore, as shown in the figure. The width of the river is 250 m and the current flows from north to south at 0.5 m/s. The trip takes Jack 6 minutes. At what speed (in m/s) with respect to still water would Jack row?

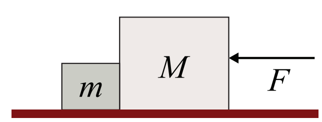


(1) 0.86
(2) 1.16
(3) 0.97
(4) 1.04
(5) 1.72

6. A block of mass $M = 2\,\text{kg}$ moves with a uniform velocity of magnitude $v = 2\,\text{m/s}$, while being acted on by 2 forces one of which is magnitude 2 N. What is the magnitude of the other force?

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

7. Two blocks with masses m = 2.0 kg and M= 5.0 kg are pushed along a horizontal surface and the coefficient of friction is $\mu_k = 0.51$. The horizontal applied force of F = 70 N as shown. What is the magnitude of the force of block M on block m?



(1) 20 N (2) 10 N (3) 5 N (4) 2 N (5) 50 N

8. You kick a ball from ground level, at an angle of 37° to the horizontal and a speed of 20 m/s, towards a wall 10 meters away. How far from the base of the wall does the ball hit the wall?

(1) 5.6 m (2) 6.6 m (3) 5.2 (4) 19.6 (5) 12.7

9. What is the angle (in degrees) between the vectors $5\hat{\imath} + 12\hat{\jmath}$ and $3\hat{\imath} + 4\hat{\jmath}$?

(1) 14 (2) 0.25 (3) 31 (4) 7 (5) 22

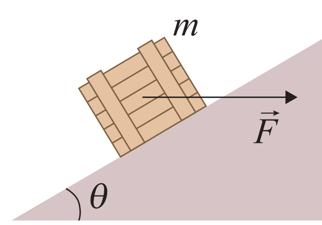
10. An airplane is flying horizontally, 100 meters above the ground, with a varying velocity given by v(t) = (200 + 4t) m/s. At t = 2 seconds, it drops an aid package to the ground. At the moment the package hits the ground, what is the distance (measured only in the horizontal direction) between the package and the plane (in meters)?

(1) 41 (2) 0 (3) 504 (4) 544 (5) 164

11. You are in an elevator and drop a ball from a height of 1.2 meters from the floor of the elevator. You find it hits the elevator floor 0.7 seconds later. What can you conclude about directions of the velocity and acceleraton of the elevator?

(1) v not known, a is down
(2) v is up , a is up
(3) v is up, a is not known
(4) v is not known, a is up
(5) v down, a is down

12. A crate of mass m = 6.0 kg is pushed at constant speed up a frictionless ramp with $\theta = 30°$ by a horizontal force, $\vec{F}$. What is the magnitude $\vec{F}$ in Newtons?



(1) 34
(2) 59
(3) 29
(4) 51
(5) This is not possible with the information given

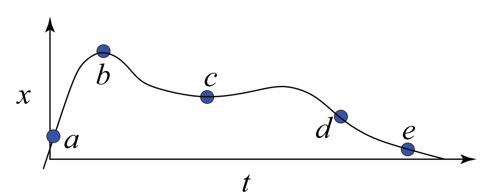
13. A mass of 2 kg is whirled on a string 0.5 meters long in a vertical circle, with a slowly increasing speed. It is found that at a speed of 3 m/s the string breaks. What was the maximum tension in the spring before it broke?

(1) 56 N (2) 36 N (3) 16 N (4) 38 N (5) 19 N

14. A truck of mass 2000 kg has broken down. In order to get it to move, a car of mass 800 kg pushes it from behind. At one moment in time, they are both moving forward with v = 3 m/s and a = 1 m/s^2. At that moment, what is the magnitude of the force the truck imparts on the car (in Newtons)?

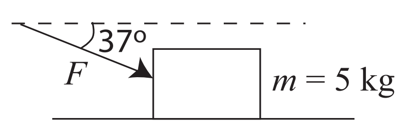
(1) 2000 N (2) 0 (3) 800 N (4) 1200 N (5) 2800 N

15. The position x, as a function of time t, of a person walking along the lecture desk is described by the figure. At which of the labeled points is the magnitude of the velocity of the person greatest?



(1) a (2) b (3) c (4) d (5) e

16. Because of friction, a block of mass 5 kg is stationary on a horizontal table even though force of 10 Newtons is applied to the block at an angle of 37° below the horizontal. The coefficient of static friction between the two is $\mu_s = 0.6$. What is the magnitude of the force of friction?



(1) 8 (2) 33 (3) 29 (4) 24 (5) 12

17. A block A with a mass of 3 kg rests on a horizontal table top. The coefficient of static friction between the surfaces is $\mu_s = 0.8$. You attempt to pull the block using a string pulling at an angle of 40° above the horizontal. What is the magnitude of the force (in Newtons) necessary to put it in motion?

(1) 18.3 (2) 30.5 (3) 90.1 (4) 23.5 (5) 16.7

18. Starting at rest, a particle moves in the positive x direction with an acceleration given by $a(t) = 6 - 2t$, where a is in m/s^2 and t is in seconds. What is the highest value of x (in meters) that it reaches?

(1) 36 (2) infinity (3) 18 (4) 27 (5) 9

19. A boy is in a hot-air balloon that is rising with (taking up to be positive) $v = 4\,m/s$ and $a = 5\,m/s^2$. He throws a ball out of the balloon, horizontally in his reference frame, with a speed of 3 m/s. With what speed does an observer on the ground observe the ball one second after it was thrown.

(1) 6.8 (2) 4.1 (3) 5.0 (4) 15.3 (5) 5.7

20. Two equal masses are on opposite ends of a 10 meter long massless string which is hung on a massless frictionless pulley which is 8 meters above the ground. Initially one mass is 5 meters above the ground and moving downwards with a speed $v = 5\,m/s$. How fast is it moving, in m/s, when it hits the ground?

(1) 5
(2) 10
(3) 15
(4) 20
(5) It never hits the ground