Instructor(s): *Field/Hirschfeld*

PHYSICS DEPARTMENT

PHY 2048 Final Exam April 26, 2008

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

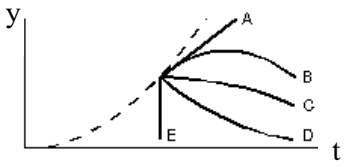
On my honor, I have neither given nor received unauthorized aid on this examination.

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.
(6) **Hand in the answer sheet separately.**

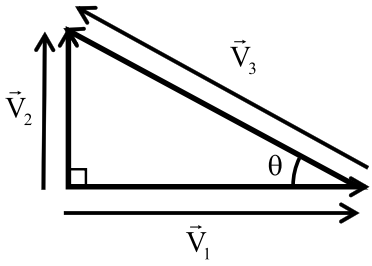
Where needed use $g = 9.80$ m/s^2

1. An elevator is moving upward with constant acceleration. The dashed curve shows the position y of the ceiling of the elevator as a function of the time t. At the instant indicated by the intersection of the solid lines, a bolt breaks loose and drops from the ceiling. Which curve best represents the position of the bolt as a function of time?



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

2. Three vectors are arranged to form the right triangle as shown in the diagram (they are also shown separated from the triangle to make clear their directions). The vector $\vec{V}_3$ is equal to:

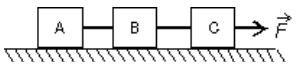


(1) $\vec{V}_2 - \vec{V}_1$ (2) $\vec{V}_1 - \vec{V}_2$ (3) $\vec{V}_1 + \vec{V}_2$ (4) $\vec{V}_1 \cos\theta$ (5) $\frac{\vec{V}_1}{\cos\theta}$

3. A man rides a Ferris wheel with a radius of 8.0m that makes 1 revolution every 20 s. When he is at the top, one diameter above the ground, he releases a ball. How far from the point on the ground directly under the release point does the ball land?

(1) 4.5 m (2) zero m (3) 0.8 m (4) 1.8 m (5) 3.8 m

4. Three blocks (A,B,C), each having mass M, are connected by strings as shown. Block C is pulled to the right by a force of magnitude F that causes the entire system to accelerate. Neglecting friction, the net force magnitude acting on block B is:



(1) F/3 (2) F/2 (3) 2F/3 (4) zero (5) F

5. A student in a physics lab is measuring the acceleration of an object that is sliding down an incline having an of angle 30 degrees with the horizontal. He finds that the object accelerates at half of what is calculated under the assumption of no friction. What is the value of the coefficient of kinetic friction?

   (1) 0.289 (2) 0.577 (3) 0.866 (4) 1.20 (5) 1.37

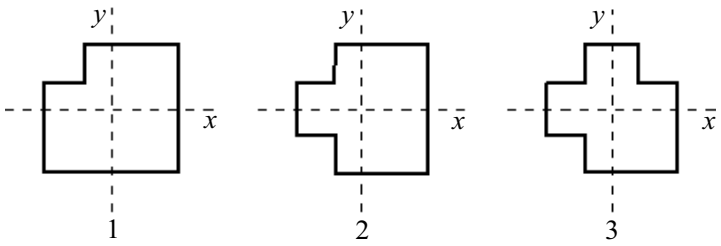
6. A spring made out of a new material is found to obey a non-Hookian force law, $F = 4x^3$ N, with x measured in meters and F in Newtons. The spring lies on a horizontal frictionless surface with one end attached to a rigid wall. A 2 kg block of wood is pressed against the other end of the spring such that the spring is compressed from its equilibrium length by 0.1m. The block is then released, sliding along the frictionless surface, accelerated by the spring force. At some point the block loses contact with the spring and continues on with a constant speed that is (HINT: consider the formal definition of work in the compression of the spring):

   (1) 1 cm/s (2) 8.0 cm/s (3) 22 cm/s (4) 2.2 cm/s (5) 80 cm/s

7. A projectile of mass 0.50 kg is fired with an initial speed of 10 m/s at an angle of 60° above the horizontal. The potential energy of the projectile-Earth system when the projectile is at its highest point (relative to the potential energy when the projectile is at ground level) is:

   (1) 18.75 J (2) 6.25 J (3) 12.5 J (4) 22.6 J (5) 27.4 J

8. A machinist starts with three identical square plates but cuts one corner from one of them, two corners from the second, and three corners from the third, as indicated in the figure. Rank the three plates according to the absolute value of the x coordinates of their centers of mass, from smallest to largest. The origin of coordinates for each plate is at the intersection of the associated dotted coordinate axes.

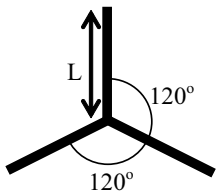


   (1) 1 & 3 tie then 2 (2) 1 and 2 tie, then 3 (3) 1, 2, 3 (4) 1, 3, 2 (5) 3, 2, 1

9. Two bodies, A and B, have equal kinetic energies. The mass of A is nine times that of B. The ratio of the momentum of A to that of B is

   (1) 3:1 (2) 1:3 (3) 9:1 (4) 1:9 (5) 1:1

10. The rotational inertia of a thin rod about its center of mass is $(1/12)ML^2$, where M is the rods mass and L its length. Three such rods lying in a common plane are joined at one end with angles of 120° between them. What is the rotational inertia of the three rods for rotation about an axis oriented perpendicular to their common plane going through the point at which the rods are joined (axis in and out of the page in the figure)?

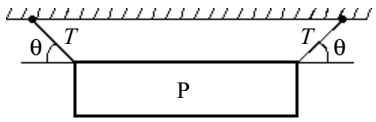


    (1) ML^2 (2) $(3/12)ML^2$ (3) $(1/3)ML^2$ (4) $27ML^2$ (5) $9ML^2$

11. A single force acts on a particle situated on the positive x axis. The torque about the origin is in the negative z direction. The force might be:

    (1) in the negative y direction
    (2) in the positive y direction
    (3) in the positive x direction
    (4) in the negative x direction
    (5) in the positive z direction

12. A picture P of weight W is hung by two strings as shown. The magnitude of the tension force of each string is T. The total upward pull of the strings on the picture is:



(1) $2T\sin\theta$ (2) $2W\cos\theta$ (3) $2T\cos\theta$ (4) $T\cos\theta$ (5) $2W\sin\theta$

13. A spaceship is returning to Earth with its engine turned off. Consider only the gravitational field of Earth and let M be the mass of Earth, m be the mass of the spaceship, and r be the distance from the center of Earth. In moving from position 1 to position 2 the kinetic energy of the spaceship increases by:

(1) $GMm\left[\frac{1}{r_2}-\frac{1}{r_1}\right]$ (2) $GMm\left[\frac{1}{r_1}-\frac{1}{r_2}\right]$ (3) $GMm\left[\frac{1}{r_1^2}-\frac{1}{r_2^2}\right]$ (4) $GMm\left[\frac{1}{r_2^2}-\frac{1}{r_1^2}\right]$ (5) $GMm\left[\frac{r_1-r_2}{r_2^2}\right]$

14. An object hangs from a spring balance. The balance indicates 30 N in air, 20 N when the object is submerged in water. What does the balance indicate when the object is submerged in liquid with a density that is half of water?

(1) 25 N (2) 35 N (3) 15 N (4) zero (5) 45 N

15. A 3-kg block, attached to a spring, executes simple harmonic motion according to the equation $x = 2\cos(50t)$ where x is in meters and t is in seconds. The spring constant of the spring is:

(1) 7500 N/m (2) 100 N/m (3) 4.0 N/m (4) 150 N/m (5) 75 N/m

16. The displacement of a string carrying a traveling sinusoidal wave is given by $y(x,t) = y_m\sin(kx-\omega t-\phi)$. At time $t = 0$ the point at $x = 0$ has a displacement of 0 and is moving in the positive y direction. The phase constant ϕ is:

(1) 180° (2) 90° (3) 45° (4) 270° (5) 135°

17. The mathematical forms for the three sinusoidal traveling waves are gives by
wave 1: $y(x,t)$ =(2 cm) sin $(3x-6t)$
wave 2: $y(x,t)$ =(3 cm) sin $(4x-12t)$
wave 3: $y(x,t)$ =(4 cm) sin $(5x-11t)$
where x is in meters and t is in seconds. Of these waves:

(1) wave 2 has the greatest wave speed and wave 3 has the greatest maximum transverse string speed
(2) wave 1 has the greatest wave speed and also the greatest maximum transverse string speed
(3) wave 2 has the greatest wave speed and wave 1 has the greatest maximum transverse string speed
(4) wave 3 has the greatest wave speed and also the greatest maximum transverse string speed
(5) wave 3 has the greatest wave speed and wave 2 has the greatest maximum transverse string speed

18. A fire whistle emits a tone of 170 Hz. Take the speed of sound in air to be 343 m/s. The wavelength of this sound is about:

(1) 2 m (2) 0.5 m (3) 1 m (4) 241 m (5) (1/241) m

19. The sound intensity 5.0 m from an isotropically radiating point source is 0.50 W/m^2. The power output of the source is:

(1) 160 W (2) 39 W (3) 266 W (4) 320 W (5) 2.5 W

20. A source emits sound with a frequency of 1000 Hz. It and an observer are moving toward each other, each with a speed of 100 m/s. If the speed of sound is 343 m/s, the observer hears sound with a frequency of:

(1) 1823 Hz (2) 708 Hz (3) 1412 Hz (4) 549 Hz (5) 1224 Hz

77777