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PHYSICS DEPARTMENT  
Final exam

December 8, 2007

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 green answer sheet (use 76–80 for the 5-digit number). Code your name on your answer sheet. Darken circles completely. Code your UF ID number on your answer sheet.
- (2) Print your name on this sheet and sign it also.
- (3) Do all scratch work on this exam to the right of the questions, and anywhere else 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 the answer sheet and printout, with the scratch work which most questions demand of anyone.
- (4) You will receive one point for each correct answer and zero points for an incorrect answer or no answer.
- (5) Use a number 2 pencil on the answer sheet. Do not make any stray marks, or the answer sheet may not be read properly.

>>>>>>> **BEFORE YOU FINISH** <<<<<<<<

Fold the exam so that your name is on top, include any figure sheet inside the printout. Hand in the answer sheet separately.

**Possibly Useful Equations:**

$\vec{A} \cdot \vec{B} = A_x B_x + A_y B_y + A_z B_z$	$\vec{A} \cdot \vec{B} =  \vec{A}  \vec{B}  \cos \theta$	$ \vec{A} \times \vec{B}  =  \vec{A}  \vec{B}  \sin \theta$	$\vec{F} = m\vec{a}$
$\vec{x} - \vec{x}_0 = \vec{v}_0 t + \frac{1}{2} \vec{a} t^2$	$\vec{v} = \vec{v}_0 + \vec{a} t$	$\vec{V}_{AC} = \vec{V}_{AB} + \vec{V}_{BC}$	$g = 9.8 \text{ m/s}^2$
$\frac{1}{2} (v^2 - v_0^2) = \vec{a} \cdot (\vec{x} - \vec{x}_0)$	$v = \sqrt{2ax}$	$f_k = \mu_k N$	$f_s \leq \mu_s N$
$\sin(A \pm B) = \sin(A) \cos(B) \pm \sin(B) \cos(A)$	$\vec{v}_{avg} = \frac{\vec{r}_f - \vec{r}_i}{\Delta t}$	$\vec{a}_{avg} = \frac{\vec{v}_f - \vec{v}_i}{\Delta t}$	(f = final, i = initial)

Rotational kinematics ( $\alpha$  constant):

$\theta = \theta_0 + \omega_0 t + \frac{1}{2} \alpha t^2, \quad \omega = \omega_0 + \alpha t$

translation  $\leftrightarrow$  rotation

$s = r\theta, \quad v = r\omega, \quad a = r\alpha$

$\omega = \frac{d\theta}{dt}$

$\alpha = \frac{d\omega}{dt} = \frac{d^2\theta}{dt^2}$

$K_{Rot} = \frac{1}{2} I \omega^2$

$F_G = G \frac{M_1 M_2}{R^2}$

$\frac{F}{A} = E \frac{\Delta L}{L}$

$\omega = 2\pi f$

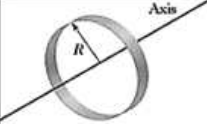
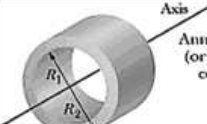
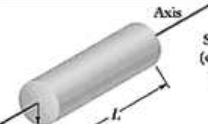

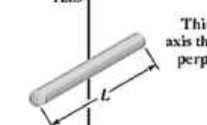
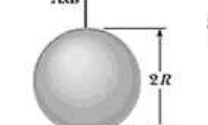
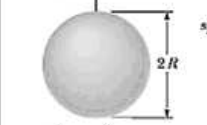


$f = \frac{1}{T}$

SHO:  $\omega = \sqrt{\frac{k}{m}}$

$f' = f \frac{v \pm v_D}{v \pm v_S}$

$v = \sqrt{\frac{\tau}{\mu}}$

Interference — constructive:  $\frac{\Delta L}{\lambda} = 0, 1, 2, \dots$       destructive:  $\frac{\Delta L}{\lambda} = 0.5, 1.5, 2.5, \dots$

 <p>Hoop about central axis</p> <p><math>I = MR^2</math>      (a)</p>	 <p>Annular cylinder (or ring) about central axis</p> <p><math>I = \frac{1}{2} M (R_1^2 + R_2^2)</math>      (b)</p>	 <p>Solid cylinder (or disk) about central axis</p> <p><math>I = \frac{1}{2} MR^2</math>      (c)</p>
 <p>Solid cylinder (or disk) about central diameter</p> <p><math>I = \frac{1}{4} MR^2 + \frac{1}{12} ML^2</math>      (d)</p>	 <p>Thin rod about axis through center perpendicular to length</p> <p><math>I = \frac{1}{12} ML^2</math>      (e)</p>	 <p>Solid sphere about any diameter</p> <p><math>I = \frac{2}{5} MR^2</math>      (f)</p>
 <p>Thin spherical shell about any diameter</p> <p><math>I = \frac{2}{3} MR^2</math>      (g)</p>	 <p>Hoop about any diameter</p> <p><math>I = \frac{1}{2} MR^2</math>      (h)</p>	 <p>Slab about perpendicular axis through center</p> <p><math>I = \frac{1}{12} M(a^2 + b^2)</math>      (i)</p>

1. An object with an initial velocity of 12 m/s west experiences a constant acceleration of 4 m/s<sup>2</sup> west for 3 seconds. During this time the object travels a distance of:  
(1) 54 m                      (2) 24 m                      (3) 36 m                      (4) 12 m                      (5) 144 m
2. Two vectors lie with their tails at the same point. When the angle between them is increased by 20° the magnitude of their vector product doubles. The original angle between them was about:  
(1) 18°                      (2) 0                      (3) 25°                      (4) 45°                      (5) 90°
3. An object is moving on a circular path of radius  $\pi$  meters at a constant speed of 4.0m/s. The time required for one revolution is:  
(1)  $\pi^2/2$  s                      (2)  $2/\pi^2$  s                      (3)  $\pi/2$  s                      (4)  $\pi^2/4$  s                      (5)  $2/\pi$  s
4. A massless rope passes over a massless pulley suspended from the ceiling. A 4-kg block is attached to one end and a 5-kg block is attached to the other end. The acceleration of the 5-kg block is:  
(1) g/9                      (2) 5g/9                      (3) 4g/9                      (4) g/5                      (5) g/4
5. A box rests on a rough board 10 meters long. When one end of the board is slowly raised to a height of 6 meters above the other end, the box begins to slide. The coefficient of static friction is:  
(1) 0.75                      (2) 0.25                      (3) 0.4                      (4) 0.6                      (5) 0.8
6. A particle starts from rest at time  $t = 0$  and moves along the x axis. If the net force on it is proportional to  $t$ , its kinetic energy is proportional to:  
(1)  $t^4$                       (2)  $t^2$                       (3)  $t$                       (4)  $1/t^2$                       (5) none of the above
7. A 0.5-kg block slides along a horizontal frictionless surface at 2m/s. It is brought to rest by compressing a very long spring of spring constant 800 N/m. The maximum spring compression is:  
(1) 5 cm                      (2) 3 cm                      (3) 0                      (4) 80 cm                      (5) 80 m
8. A 2.5-kg stone is released from rest and falls toward Earth. After 4.0 s, the magnitude of its momentum is:  
(1) 98 kg·m/s                      (2) 78 kg·m/s                      (3) 39 kg·m/s                      (4) 24 kg·m/s                      (5) zero
9. A pulley with a radius of 3.0 cm and a rotational inertia of  $4.5 \times 10^{-3}$  kg·m<sup>2</sup> is suspended from the ceiling. A rope passes over it with a 2.0-kg block attached to one end and a 4.0-kg block attached to the other. The rope does not slip on the pulley. At any instant after the blocks start moving, the object with the greatest kinetic energy is:  
(1) the pulley  
(2) the lighter block  
(3) the heavier block  
(4) either block (the two blocks have the same kinetic energy)  
(5) none (all three objects have the same kinetic energy)

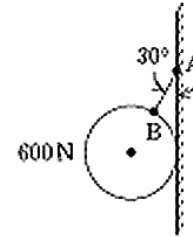
10. Two uniform circular disks having the same mass and the same thickness but different radii are made from different materials. The disk with the smaller rotational inertia is:

- (1) the one made from the more dense material
- (2) the one made from the less dense material
- (3) neither — both rotational inertias are the same
- (4) the disk with the larger angular velocity
- (5) the disk with the larger torque

11. A 15-g paper clip is attached to the rim of a phonograph record with a radius of 30 cm, spinning at 3.5 rad/s. The magnitude of its angular momentum is:

- (1)  $4.7 \times 10^{-3} \text{ kg}\cdot\text{m}^2/\text{s}$     (2)  $1.4 \times 10^{-3} \text{ kg}\cdot\text{m}^2/\text{s}$     (3)  $1.6 \times 10^{-2} \text{ kg}\cdot\text{m}^2/\text{s}$     (4)  $3.2 \times 10^{-1} \text{ kg}\cdot\text{m}^2/\text{s}$     (5)  $1.1 \text{ kg}\cdot\text{m}^2/\text{s}$

12. The 600-N ball shown is suspended on a string AB and rests against a frictionless vertical wall. The string makes an angle of  $30^\circ$  with the wall. The magnitude of the tension force of the string is:



- (1) 690N                      (2) 1200N                      (3) 2100N                      (4) 2400N                      (5) none of these

13. The mass of a hypothetical planet is 1/100 that of Earth and its radius is 1/4 that of Earth. If a person weighs 600N on Earth, what would he weigh on this planet?

- (1) 96N                      (2) 48N                      (3) 24N                      (4) 192N                      (5) 600N

14. The approximate value of  $g$  at an altitude above Earth equal to one Earth diameter is:

- (1)  $1.1 \text{ m/s}^2$                       (2)  $4.9 \text{ m/s}^2$                       (3)  $2.5 \text{ m/s}^2$                       (4)  $1.9 \text{ m/s}^2$                       (5)  $9.8 \text{ m/s}^2$

15. A hydraulic press has one piston of diameter 2.0 cm and the other piston of diameter 8.0 cm. What force must be applied to the smaller piston to obtain a force of 1600N at the larger piston?

- (1) 100N                      (2) 25N                      (3) 6.25N                      (4) 400N                      (5) 1600N

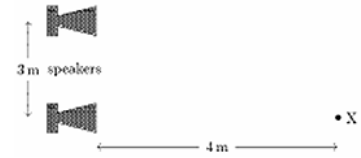
16. A 0.20-kg object attached to a spring whose spring constant is 500N/m executes simple harmonic motion. If its maximum speed is 5.0m/s, the amplitude of its oscillation is:

- (1) 0.10m                      (2) 0.0020m                      (3) 0.20m                      (4) 25m                      (5) 250m

17. A string carries a sinusoidal wave with an amplitude of 2.0 cm and a frequency of 100Hz. The maximum speed of any point on the string is:

- (1) 13m/s                      (2) 4.0m/s                      (3) 6.3m/s                      (4) 2.0m/s                      (5) unknown (not enough information is given)

18. Two small identical speakers are connected (in phase) to the same source. The speakers are 3m apart and at ear level. An observer stands at X, 4m in front of one speaker as shown. If the amplitudes are not changed, the sound he hears will be least intense if the wavelength is:



- (1) 2m                      (2) 1m                      (3) 3m                      (4) 4m                      (5) 5m
19. If the length of a piano wire (of given density) is increased by 5%, what approximate change in tension is necessary to keep its fundamental frequency unchanged?
- (1) Increase of 10%      (2) Decrease of 5%      (3) Decrease of 10%      (4) Increase of 5%      (5) Increase of 20%
20. In each of the following two situations a source emits sound with a frequency of 1000 Hz. In situation I the source is moving at 100m/s toward an observer at rest. In situation II the observer is moving at 100m/s toward the source, which is stationary. The speed of sound is 340m/s. The frequencies heard by the observers in the two situations are:
- (1) I: 1417 Hz; II: 1294Hz  
 (2) I: 1417 Hz; II: 1417Hz  
 (3) I: 1294 Hz; II: 1294Hz  
 (4) I: 773Hz; II: 706 Hz  
 (5) I: 773Hz; II: 773 Hz