Instructor(s): *Rinzler/Qiu*

PHYSICS DEPARTMENT

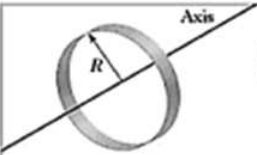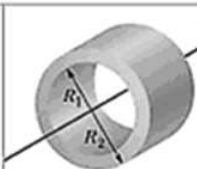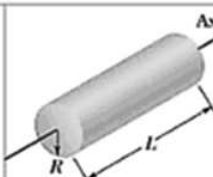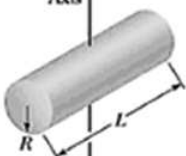PHY2053   Final Exam   April 23, 2011

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.
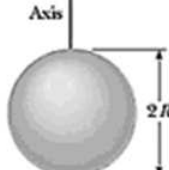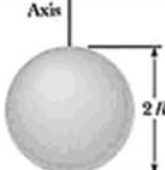(2) Print your name on this sheet and sign it also.
(3) Do all scratch work anywhere on this exam that you like. **Circle your answers on the test form.** At the end of the test, this exam printout is to be turned in. No credit will be given without both answer sheet and printout.
(4) **Blacken the circle of your intended answer completely, using a #2 pencil or <u>blue</u> or <u>black</u> 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.**
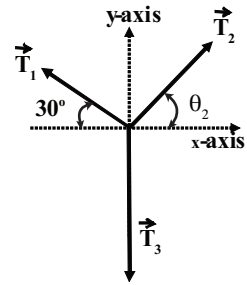(6) Hand in the answer sheet separately.

Use $g = 9.80$ m/s^2

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1. A dolphin at Seaworld is to jump through a hoop held in the air by a trainer. The dolphin leaves the water at an angle of θ relative to the water and travels a horizontal distance of 5.0 m while in the air. If the dolphin reaches a maximum height of 10 m above the water, at what speed did the dolphin leave the water?

(1) 14.1 m/s   (2) 10.1 m/s   (3) 8.0 m/s   (4) 12.4 m/s   (5) need to know θ

2. The system shown in the figure is in equilibrium (*i.e.*, the sum of all forces acting at the origin are zero). If the magnitude of the tension T_3 is twice the magnitude of the tension T_1, what is the angle θ_2?
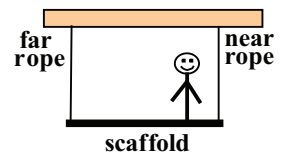
(1) 60°
(2) 30°
(3) 45°
(4) 50°
(5) 90°

3. A 0.5-kg rubber ball is dropped from rest a height of 18.6 m above the surface of the Earth. It strikes the sidewalk below and rebounds up to a maximum height H. If the magnitude of the impulse due to the collision with the sidewalk is 16.73 N·s, what is the height H (in meters)?

(1) 10.5   (2) 4.9   (3) 2.4   (4) 12.6   (5) 19.6

4. A billboard worker with a weight of 700 N stands on a uniform scaffold with length $L = 5$ m. The scaffold is supported by vertical ropes at each end as shown in the figure. If the scaffold weighs 500 N and the worker stands 1.0 m from one end, what is the tension (in N) in the rope farthest from the worker?

(1) 390   (2) 810   (3) 730   (4) 1200   (5) 250

5. A toy merry-go-round consists of a uniform disk of mass M and radius R that rotates freely in a horizontal plane about its center. A mouse of the same mass, M, as the disk starts at the rim of the disk. Initially the mouse and disk rotate together with an angular velocity of ω. If the mouse walks to a new position a distance r from the center of the disk, the new angular velocity of the mouse-disk system is 2ω. What is the new distance r?

(1) $r = R/2$ (2) $r = R/4$ (3) $r = 3R/4$ (4) $r = R/3$ (5) $r = 0$

6. The atmospheric pressure is 1.01×10^5 Pa. An airtight box, having a lid of area 80 cm^2, is partially evacuated to a pressure that is one-half atmospheric pressure. What is the minimum force (in N) required to pull the lid off of the box?

(1) 404   (2) 202   (3) 808   (4) 101   (5) 40.4

7. A water rocket, launched from the ground, rises vertically with acceleration of 19.6 m/s^2 for 2 seconds before it runs out of "fuel". Disregarding air resistance, how high will the rocket rise (in m)?

(1) 39.2   (2) 9.8   (3) 29.4   (4) 19.6   (5) 58.8

8. Two identical billiard balls roll toward each other on the x-axis as shown in the figure. The one on the left (ball 1) is moving at +4 m/s while the one on the right (ball 2) is moving at −2 m/s. If they undergo an elastic collision, what is the velocity of ball 1 after they collide?
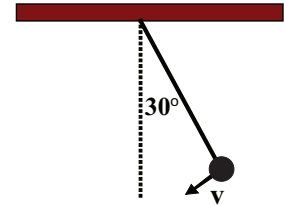
(1) −2 m/s   (2) zero   (3) −4 m/s   (4) 2 m/s   (5) −3 m/s

9. The gravitational acceleration at the surface of the Earth is g. If a planet has 3 times the radius of the Earth, but has the same density as the Earth, what is the gravitational acceleration at the surface of the planet?
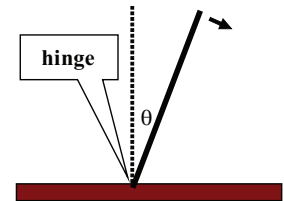
(1) 3g　　　　　　　(2) 9g　　　　　　　(3) g　　　　　　　(4) g/3　　　　　　　(5) g/9

10. A ball of mass M is connected to a thin string with negligible mass and 2.0 m in length. It is released by a push when the string is at an angle of 30° from the vertical as shown in the figure. If the initial tangential speed of the suspended mass is 2.5 m/s when at the release point, to what maximum angle will the string make with the vertical during its swing?

(1) 45°　　　　　　　(2) 30°　　　　　　　(3) 60°　　　　　　　(4) 90°　　　　　　　(5) 35°

11. A thin stick with mass M, length L, and moment of inertia $ML^2/3$ is hinged at its lower end and allowed to fall from a vertical position as shown in the figure. If its length $L = 1$ m, with what angular speed does it hit the table?

(1) 5.42 rad/s　　　　　(2) 2.71 rad/s　　　　　(3) 1.22 rad/s　　　　　(4) 7.67 rad/s　　　　　(5) 3.96 rad/s

12. A uniform disk with mass M, radius $R = 0.50$ m, and moment of inertia $I = MR^2/2$ rolls without slipping along the floor at 2 revolutions per second when it encounters a long ramp angled upwards at 45° with respect to the horizontal. How high above its original level will the center of the disk get (in meters)?

(1) 3.0　　　　　　　(2) 1.9　　　　　　　(3) 2.3　　　　　　　(4) 3.7　　　　　　　(5) 4.1

13. An object having a density of 1.0 g/cm^3 floats in the salt rich (dense) waters of the Dead Sea. If it floats with 1/3 of its volume above the water line, what is the density of the Dead Sea water (in g/cm^3)?

(1) 1.5　　　　　　　(2) 0.95　　　　　　　(3) 1.2　　　　　　　(4) 1.7　　　　　　　(5) 1.9

14. A projectile hits the ground at an angle of 30° with respect to the vertical at a speed of 30 m/s. The horizontal component of its velocity at launch (in m/s) was:

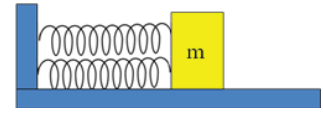(1) 15　　　　　　　(2) 26　　　　　　　(3) 11　　　　　　　(4) 18　　　　　　　(5) 22

15. A simple pendulum consists of a bob of mass 3 kg on the end of a long string with length L. It is pulled to one side 6° from the vertical and on being let go, the frequency of its oscillation is measured to be f_0. Nearby a second simple pendulum has the same length string but its bob has a mass of 4 kg. It is displaced the same amount and let go. The frequency with which the second pendulum oscillates is:

(1) f_0　　　　　　　(2) $0.75f_0$　　　　　　　(3) $1.25f_0$　　　　　　　(4) $1.15f_0$　　　　　　　(5) $0.87f_0$

16. A transverse wave on a taught string has amplitude A, wavelength λ and speed v. A point on the string only moves in the transverse direction. If its maximum transverse speed is v_{Tmax}, what is the ratio v_{Tmax}/v?

(1) $2\pi A/\lambda$　　　　　(2) $2\pi\lambda/A$　　　　　(3) $A/(2\pi\lambda)$　　　　　(4) $\lambda/(2\pi A)$　　　　　(5) $2\pi\lambda A$

17. Each of the two springs in the figure has force constant k and the surface is frictionless. What is the frequency of simple harmonic oscillation of the mass m?

(1) $\dfrac{1}{2\pi}\sqrt{\dfrac{2k}{m}}$
(2) $\dfrac{1}{2\pi}\sqrt{\dfrac{k}{m}}$
(3) $\dfrac{1}{2\pi}\sqrt{\dfrac{k}{2m}}$
(4) $\dfrac{1}{\pi}\sqrt{\dfrac{2k}{m}}$
(5) $\dfrac{1}{4\pi}\sqrt{\dfrac{k}{m}}$

18. At one point in a hanger a jet testing its engines produces a sound intensity of 0.800 W/m^2. The decibel sound level at that point is:

(1) 119 dB
(2) 117 dB
(3) 118 dB
(4) 120 dB
(5) 121 dB

19. The average power emitted by a point source of sound is 0.25 W. At a distance of 90 meters a parabolic reflector intercepts 2.0 square meters of the the passing sound waves. How much of the radiated power is captured by the reflector (in Watts)?

(1) 4.9×10^{-6}
(2) 5.9×10^{-4}
(3) 6.3×10^{-5}
(4) 5.1×10^{-7}
(5) 3.3×10^{-6}

20. An ambulance moving at a constant speed of 20 m/s with its siren on overtakes a car moving at a constant speed of 10 m/s in the same direction as the ambulance. As the ambulance approaches the car the driver of the car perceives the siren to have a frequency of 1200 Hz. What frequency does the driver of the car perceive after the ambulance has passed? This takes place on a cold night in Alaska where the speed of sound is 320 m/s.

(1) 1127 Hz
(2) 995 Hz
(3) 1059 Hz
(4) 1091 Hz
(5) 1161 Hz