PHY2053 PHYSICS
Final Exam

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

Given Information:

$g = 9.8$ m/s^2 $G = 6.67 \times 10^{-11}$ Nm^2/kg^2 1 atmosphere $= 1.01 \times 10^5$ Pa

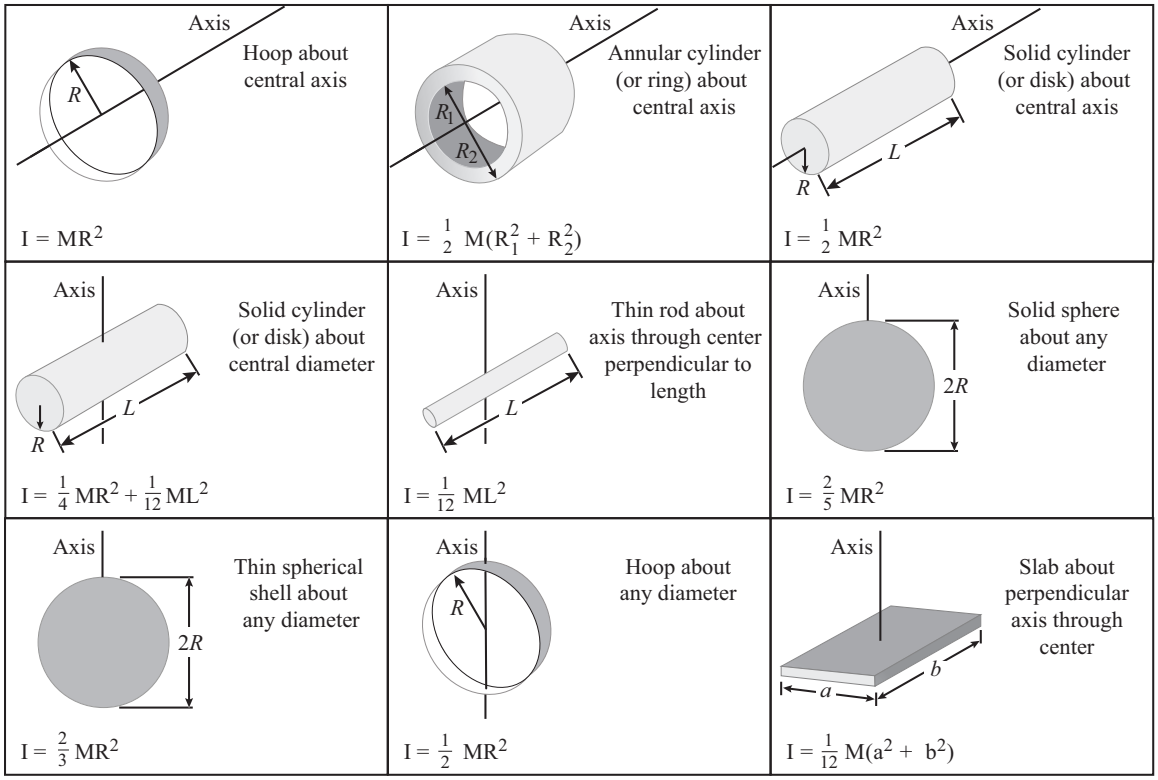
1 m = 100 cm 1 kg = 1000 g 1 inch $= 2.54 \times 10^{-2}$ m 1 foot = 12 inches

1 day = 24 hours 1 hour = 60 minutes 1 minute = 60 seconds

$A = \pi r^2$ $C = 2\pi r$ 1 rev $= 2\pi$ radians π radians $= 180°$

speed of sound in air = 340 m/s density of water = 1000 kg/m^3

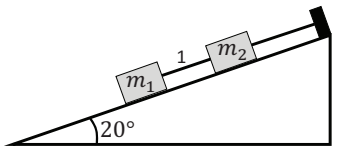
density of steel = 7860 kg/m^3 density of oil = 800 kg/m^3



1. A brick is thrown from the top of a building at an angle 30° downward from the horizontal with an initial speed of 16 m/s. Ignoring air resistance, if the brick is in flight for 2.7 s before it hits the level ground, how tall is the building (in meters)?

(1) 57 (2) 52 (3) 45 (4) 61 (5) 41

2. Two blocks are at rest on a frictionless incline, as shown in the figure. What is the tension in the string number 1 if $m_1 = 3.0$ kg and $m_2 = 1.0$ kg?



(1) 10 N (2) 17 N (3) 23 N (4) 32 N (5) 45 N

3. A bullet of mass 20.0 g moving at 1100 m/s goes through a block of wood of mass 1.00 kg which is at rest on a frictionless surface. The bullet emerges from the block at a speed of 100 m/s. What impulse did the block receive during the collision (in N·s)?

(1) 20 (2) 18 (3) 14 (4) 16 (5) 12

4. Mars completes one orbit around the Sun in 687 days. What is the distance between Mars and the Sun? Assume that the orbit is circular. Mass of the Sun is 1.99×10^{30} kg, mass of Mars is 6.39×10^{23} kg, and $G = 6.67 \times 10^{-11}$ N m^2 kg^2.

(1) 2.28×10^{11} m (2) 1.08×10^{11} m (3) 5.79×10^{10} m (4) 2.15×10^{10} m (5) 3.21×10^{12} m

5. A 0.21 kg, 0.24 m diameter disk is spun on an axle through its center by a motor. The motor supplies 0.059 Nm of torque to take the disk from 0 to 1800 rpm. How long does it take for the disk to reach the final angular velocity? Answer in seconds.

(1) 4.8 (2) 9.7 (3) 16.2 (4) 12.3 (5) 20.1

6. A turntable, with moment of inertia I, starting from rest, has a net torque τ applied to it. After a time t it has a kinetic energy E. The torque applied in terms the other given parameters was:

(1) $\sqrt{\frac{2IE}{t^2}}$ (2) $\sqrt{\frac{IE}{t^2}}$ (3) $\sqrt{\frac{IE}{2t^2}}$ (4) $\sqrt{\frac{4IE}{t^2}}$ (5) $\sqrt{\frac{IE}{4t^2}}$

7. Tom weighs 2/3 what his older brother Ray weighs so balancing on a see-saw is a problem. Not to be deterred, Tom finds a bag of sand that is 1/2 of Ray's weight. With Tom and Ray each a distance L/2 from the pivot point, how far from the pivot point must Tom place the bag of sand for the see-saw to balance?

(1) L/3 (2) L/4 (3) L/5 (4) L/6 (5) L/7

8. A skater with his arms and legs tucked in starts spinning at 3.6 rev/s. The skater's moment of inertia for this tucked-in position is 0.77 kg·m^2. The skater then extends his arms and one of his legs and slows to spinning at 2.9 rev/s. What is the moment of inertia of the skater spinning in this position? Answer in kg·m^2.

(1) 0.96 (2) 1.3 (3) 1.1 (4) 0.62 (5) 0.77

9. A block is attached to a horizontal spring. It takes 1.3 N to pull the block 8.6 cm back from its equilibrium position. When the block is released, it oscillates with a frequency of 0.83 Hz. What is the mass of the block? Answer in kg.

(1) 0.56 (2) 0.15 (3) 0.19 (4) 22 (5) 0.0056

10. A simple pendulum, consisting of a mass on a string of length L, is undergoing small oscillations with amplitude A. The amplitude is doubled. Which of the following is true about the period

(1) The period remains unchanged
(2) The period increases by a factor of 4
(3) The period decreases by a factor of 4
(4) The period doubles
(5) The period is halved

11. While standing at a cross-walk waiting for the light to change, a police car, siren blaring, approaches you with a high constant speed v_P, during which time the siren frequency you hear is 800 Hz. Once the police car goes passed you, while the car is moving away with the same constant speed v_P the siren frequency you hear is 650 Hz. It's a hot day so the speed of sound is v = 350 m/s. The constant speed with which the police car passes you (in m/s) is:

(1) 36.2 (2) 33.6 (3) 38.9 (4) 30.2 (5) 41.4

12. Parasaurolophus is a dinosaur with a long hollow tube in the crest on its head. This tube acts as a resonant chamber for vocalization. If you model the tube as an open-closed system and the first resonant frequency is 53 Hz, what is the length of the tube? Assume the speed of sound in this tube is 330 m/s. Answer in meters.

(1) 1.56 (2) 1.65 (3) 1.50 (4) 1.60 (5) 1.70

13. A solar panel is 15% efficient in converting solar energy into electricity. You need an area of 14.3 m^2 to gather energy at a useful rate. If the sunlight arrives at a rate of 0.84 kW/m^2, for 6 hours at this rate per day on average, and the cost of the array is $8,000.00, how long would you need to operate the panel to recover the cost? Assume that it earns money at the rate of 10 cents per kilowatt-hour. Answer in years.

(1) 20 (2) 19 (3) 18 (4) 21 (5) 17

14. A solid ball of uniform density floats in mercury (ρ = 13.50 g/ml) with 1/4 of its volume below the mercury surface. The volume of mercury displaced is 44 ml. The density of the ball (in g/ml) is:

(1) 3.375 (2) 6.75 (3) 10.13 (4) 5.063 (5) 8.438

15. Water flows into a horizontal, cylindrical pipe with velocity v. The pipe then narrows until its diameter is halved. The pressure difference between the wide and narrow ends of the pipe is 8.0×10^4 Pa. What is the velocity v? Density of water is 1000 kg/m^3

(1) 3.3 m/s (2) 1.6 m/s (3) 2.3 m/s (4) 4.7 m/s (5) 5.6 m/s