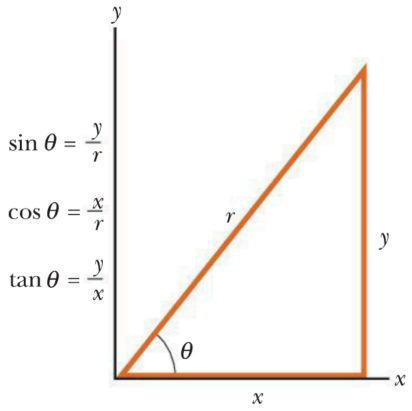
Name: _____ MAKEUP MIDTERM 3, Apr. 15, 2016

Print your name clearly. There are 20 questions on this test, worth 5 points each. There is only one correct answer for each question. Clearly circle your answer.

POTENTIALLY USEFUL INFORMATION (**SOME EQUATIONS ARE ONLY VALID IN SPECIFIC SITUATIONS**):

Conversions: 1 m=3.281 ft 1 mile=1609 m 1 kg=2.2 pounds $g=9.8\ m/s^2$ $\rho_{water}=1000\ kg/m^3$

1 pound=4.45 N 1 hp=746 W $G=6.67 \times 10^{-11}\ N\ m^2/kg^2$ 1 atm=$1.013 \times 10^5\ N/m^2$



$r^2 = x^2 + y^2$

1D or 2D motion:

$$\bar{v} = \frac{\Delta x}{\Delta t} \quad \bar{a} = \frac{\Delta v}{\Delta t} \quad v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} \quad a = \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t}$$

$$x = x_o + \bar{v}t = x_o + v_o t + \frac{1}{2}at^2$$

$$v = v_o + at \quad v^2 = v_o^2 + 2a(x - x_o)$$

Quadratic formula:

$$ax^2 + bx + c = 0 \rightarrow x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$\omega = \omega_i + \alpha t$$

$$\Delta\theta = \omega_i t + \tfrac{1}{2}\alpha t^2$$

$$\omega^2 = \omega_i^2 + 2\alpha\Delta\theta$$

$$v_f - v_i = v_e ln\left(\frac{M_i}{M_f}\right) \quad a_c = \frac{v^2}{r} = r\omega^2 \quad F = G\frac{m_1 m_2}{r^2}$$

$\Delta x = r\Delta\theta$ $\quad v = r\omega$ $\quad a_{tan} = r\alpha$ $\quad F_c = ma_c = m\frac{v^2}{r} = mr\omega^2$

$$x_{cg} = \frac{\sum m_i x_i}{\sum m_i} \qquad I = \Sigma\, m\, R^2 \qquad I_{disk} = \tfrac{1}{2}\, M\, R^2 \qquad L = I\omega$$

$$L_f = I_f\omega_f = L_i = I_i\omega_i$$

$$\tau = rF\sin(\theta) \qquad \tau = I\alpha \qquad \sum\tau = \frac{L_f - L_i}{\Delta t} = \frac{\Delta L}{\Delta t}$$

$$\rho \equiv \frac{m}{V} \qquad P = \frac{F}{A} \qquad \frac{F}{A} = Y\frac{\Delta L}{L_0} \qquad \frac{F}{A} = S\frac{\Delta x}{h} \qquad \Delta P = -B\frac{\Delta V}{V}$$

$$P = P_0 + \rho g h \qquad \frac{F_1}{A_1} = \frac{F_2}{A_2} \qquad A_1 V_1 = A_2 V_2$$

$$P_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = const. \qquad B = \rho_{fluid} \cdot V_{fluid} \cdot g$$

Area of a circle = πr^2 Volume of a circle = $4\pi r^3/3$

The following applies to problems 1 – 3: A large solid cylindrical disk of radius 0.330 m is free to rotate on a frictionless, vertical axle. A constant tangential force of 230 N applied to its edge causes the wheel to have an angular acceleration of 0.830 rad/s^2.

1. What is the moment of inertia of the disk?

a.) 4.23 kg m^2 **b.) 91.4 kg m^2** c.) 914 kg m^2 d.) 1680 kg m^2 e.) 9.8 kg m^2

2. What is the mass of the disk?

a.) 4.23 kg b.) 91.4 kg c.) 914 kg **d.) 1680 kg** e.) 9.8 kg

3. If the disk starts from rest, what is its angular velocity after 5.10 s have elapsed, assuming the force is acting during that time?

a.) 4.23 rad/s b.) 91.4 rad/s c.) 914 rad/s d.) 1680 rad/s e.) 9.8 rad/s

4. If I want to double the final velocity of a rocket when it is starting from rest, but I want to keep the exhaust velocity and final mass constant, by what factor do I need to increase the initial mass (by adding fuel) in order to achieve this?

a.) 2 b.) ln 2 c.) 1/2 **d.) e^2** e.) ln (1/2)

5. If a spinning figure skater decreases her own moment of inertia by 1/2 by pulling her arms closer to her body, her new angular velocity will be

a.) 1/2 her original angular velocity **b.) 2x her original angular velocity**

c.) 4x her original angular velocity d.) unknown, need to know her mass

6. For the skater in question 5, her new kinetic energy will be

a.) 1/2 her original kinetic energy **b.) 2x her original kinetic energy**

c.) 4x her original kinetic energy d.) unknown, need to know her mass

7. If a particular horse on a merry-go-round starts from rest at an angle of 10° relative to the ticket stand, and undergoes a constant angular acceleration of $6.0^{\circ}/s^2$ in a direction such that it moves farther away from the stand, what will its angle be relative to the stand after 5.0 s?

a.) 40° b.) 65° c.) 75° **d.) 85°** e.) 95°

8. A speeding driver exits a highway onto an exit ramp going at 50 m/s. The exit ramp is in the shape of a full circle with a diameter of 100 m. Keeping his speed constant, how long does it take him to drive the full length of the exit ramp?

a.) 0.5 s b.) 2.0 c.) 3.1 s **d.) 2.0π s** e.) 8.4 s

9. For the driver in problem 8, if his mass is 100 kg, and he is pressed sideways against the driver's side door while he is on the exit ramp, how much normal force must the door exert to keep him inside the car?

a.) 1000 N b.) 3200 N **c.) 5000 N** d.) 5980 N e.) 9800 N

10. What is the gravitational acceleration of the Moon due to the Earth? The mass of the Earth is 6×10^{24} kg, the mass of the Moon is 7×10^{22} kg, and the distance between them is 4×10^{8} m.

a.) 0.0025 m/s² b.) 0.025 m/s² c.) 0.25 m/s² d.) 1.6 m/s² e.) 9.8 m/s²

11. If a 100 kg astronaut is on the Moon, what is her acceleration due to the Earth?

a.) 0.0025 m/s² b.) 0.025 m/s² c.) 0.25 m/s² d.) 1.6 m/s² e.) 9.8 m/s²

12. If a 10 kg disk rolls with a linear velocity of 2 m/s, its total kinetic energy is

a.) 0 J b.) 10 J c.) 20 J **d.) 30 J** e.) 40 J

13. answer is b

13. For round objects rolling on an incline, the faster objects are generally those with the
    a. greatest rotational inertia compared with mass.
    b. lowest rotational inertia compared with mass.
    c. most streamlining.
    d. highest center of gravity.

14. If a fisherman holds his fishing rod at an angle of 20.0° with the horizontal, and the rod is 2.02 m long, what is the magnitude of the torque exerted by the fish about an axis perpendicular to the rod and passing through the fisherman's hand, if the fish pulls on the fishing line with a force F = 108 N at an angle 37.0° below the horizontal?

a.) 12 N m b.) 98 N m **c.) 183 N m** d.) 356 N m e.) 1296 N m

15. Two different kinds of chairs of the same volume are thrown into a swimming pool. One floats and one sinks. Which one (if either) has the greater buoyance force acting on it?

a) floating chair b) chair that sank c) both the same d) impossible to know

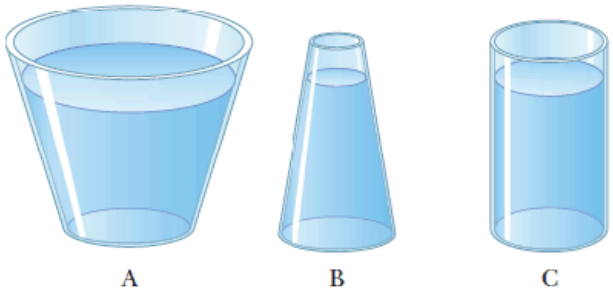
15. answer is b

16. A meter stick is found to balance at the 49.7-cm mark when placed on a fulcrum. When a 56.5-gram mass is attached at the 17.0-cm mark, the fulcrum must be moved to the 39.2-cm mark for balance. What is the mass of the meter stick?

a.) 13 g **b.) 119 g** c.) 276 g d.) 1.2 kg e.) 10.1 kg

17. The three containers shown below are filled to the same height with the same stationary liquid. Which one has the greatest pressure at the bottom of the container?

a) A b) B c) C d) all the same



17. answer is a

18. If the radius of a circular panel on the left side of an hydraulic press (a fluid enclosed by moving panels on either end) is twice as large as the radius of a circular panel on the right, the force exerted on the left will be how many times as large as the force on the right?

a.) ¼x b.) ½x c.) 2x **d.) 4x**

19. The largest spider ever observed by scientists weighed 241 kg! If each of his 8 legs each had a radius of 5 cm (assume circular area of πr^2), approximatedly what pressure does the spider apply to the ground? Actually, this spider broke its legs due to this pressure.

a) 0.038 Pa b) 38 Pa c) 380 Pa d) 3800 Pa e) 38000 Pa

20. A 4.7 kg solid sphere, made of metal whose density is 4000 kg/m^3, is suspended by a string in water. The density of water is 1000 kg/m^3. What is the tension in the string when the sphere is completely immersed?

a) 10.6 N b) 34.5 N c) 44.9 N d) 46.1 N e) 138 N

19. answer is e

20. answer is b