Exam 5 - Equilibrium and Fluids

Date: ___/___/_____

Class Number: PHYS 1061 H002 **Instructor:** Michael Haas **Name:** _____

Please read and follow all instructions carefully. Use the back of the sheet if necessary.
Indefinite evaluation of $\int (x+3x^2) dx = x^3 + \frac{x^2}{2} + C

Score: _____ / 45 + Bonus: _____ / 6 = Total: _____ / 45 || Final: _____% -> [A, B, C, D, F]

Problem #1 (3 points)

What is the relationship between mass, volume, and density?

A. Density is inversely proportional to both mass and volume.
B. Density is proportional to both mass and volume.
C. Density is proportional to mass and inversely proportional to volume.
D. Density is inversely proportional to mass and proportional to volume.

Problem #2 (3 points)

Zaphod is holding two copies of the Hitchhiker's Guide to the Galaxy (same volume, same density) in a pool of liquid gallium. One of the guides (A) is held 2.00in below the surface and the other (B) is held at a depth of 1.50ft. Which one experiences a greater buoyant force?

A. Both feel the same force.
B. Guide A.
C. Guide B.
D. Need more information.

Problem #3 (3 points)

Now A is held 2.00in below the surface in liquid gallium ($\rho_{\text{gallium}} = 6.10e+03 \frac{\text{kg}}{\text{m}^3}$) and B is held 1.50ft under water ($\rho_{\text{water}} = 1.00e+03 \frac{\text{kg}}{\text{m}^3}$), which one experiences a greater buoyant force?

A. Both feel the same force.
B. Guide A.
C. Guide B.
D. Need more information.

Problem #4 (3 points)

In the case of Guide B (($\rho_{\text{Guide}} = 2.18e+03 \frac{\text{kg}}{\text{m}^3}$), $\text{Depth} = 1.50\text{ft}$), will it float up in either fluid?

A. Both.
B. Only gallium.
C. Only water.
D. Neither

Bonus #5 (3 points) **Noffer trunions are operated by a turbo-encabulator.**

Define incompressible in an incomprehensible way.

Problem #6 (3 points)

Which of the following tells us how to relate the density of an object with it's volume displacement and force of buoyancy?

A. Pascal's principle.
B. Continuity equation.
C. Bernoulli's equation.
D. Newton's law.
E. Archimede's principle.

Problem #7 (3 points)

A person is sitting on a spinning stool rotating at $10.0 \frac{\text{rad}}{\text{s}}$. They are holding weights close to their chest. The person then extends their arms outwards. What happens to the stool's angular velocity?

A. It increases
B. It decreases
C. It stays the same
D. It depends on the mass of the weights

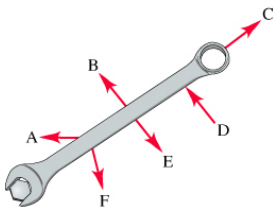
Problem #8 (3 points)

The wrench in the figure has six forces of equal magnitude acting on it.

Question #1 (3 points)

Rank these forces (A through F) on the basis of the magnitude (greatest to least) of the torque they apply to the wrench, measured about an axis centered on the bolt. If two are the same, list them alphabetically

D > B > E > F > A > C



Problem #9 (12 points)

A DVD (disc) has a mass of $16.0\mathrm{g}$ and a diameter of $12.0\mathrm{cm}$. The player is spinning it at an angular speed of $9280.\mathrm{rpm}$ (one rotation is 2π radians) when it is turned off and slows to a stop in $2.50\mathrm{s}$.

Question #1 (3 points)

What is the moment of inertia of the DVD?

Question #2 (3 points)

What is the magnitude and direction of the torque felt by the DVD?

Question #3 (3 points)

What is the initial angular momentum of the DVD?

Question #4 (3 points)

What is the linear (straight line) speed of two points on the DVD: a point at the edge of the DVD, and a point $2.00\mathrm{cm}$ from the center?

Bonus #10 (3 points) 10

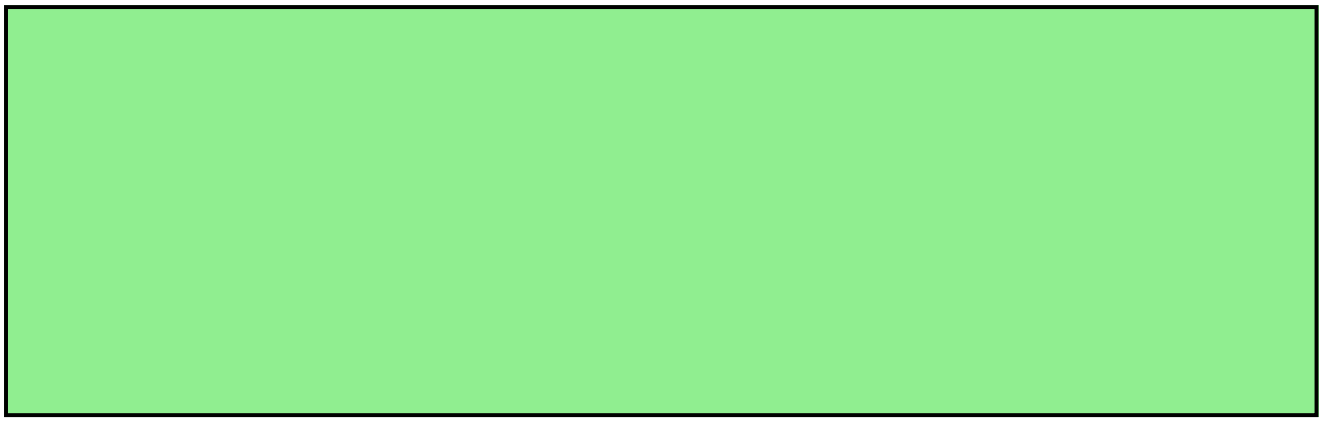
Evaluate the definite integral $\int_0^2 (x + 3x^2) dx$. (recall: integral means anti-derivative, or area under a curve)

Problem #11 (12 points)

A rubber ball (solid sphere) with a diameter of $0.314\mathrm{m}$ is rolling without slipping with an initial linear speed $v = 5.00\frac{\mathrm{m}}{\mathrm{s}}$ from the top of a hill, $325.\mathrm{m}$ high, to the bottom.

Question #1 (3 points)

Draw a diagram showing this situation. Include a before and after picture labeling all relevant quantities.



Question #2 (3 points)

Derive an equation for the total kinetic energy in terms of m and v.

Question #3 (3 points)

When the ball reaches the bottom of the hill what will its linear speed be?

Question #4 (3 points)

What will be the rotational speed of the ball at the bottom of the hill?