Exam 3--PHYS 201--F08

Multiple Choice
*Identify the choice that best completes the statement or answers the question. The multiple choice problems are worth 2 points each for a total of 20 points.*

1. A uranium nucleus is at rest and undergoes fission and splits into two fragments, one heavy and one light. Which of these statements is true?
   
   a. the lighter fragment has more momentum than the heavy one  
   b. the lighter and heavier fragments have the same velocity (but in opposite directions)  
   c. the heavier fragment has a higher velocity than the light one  
   d. the lighter and heavier fragments have the same momentum (but in opposite directions)

2. A collection of particles has a total momentum of zero. What can we say about the kinetic energy of the system?
   
   a. the KE is positive  
   b. the KE is zero  
   c. the KE is negative  
   d. the KE is either positive or negative, but not zero  
   e. not enough information

3. An object at rest begins to rotate with a constant angular acceleration. If this object rotates through an angle \( \theta \) in the time \( t \), through what angle did it rotate in the time \( 3t \)?
   
   a. \( 3\theta \)  
   b. \( 0/9 \)  
   c. \( 9\theta \)  
   d. \( 0/3 \)
4. Kaisa sits on the outer rim of a merry-go-round, and Chad sits midway between the rim and center. The merry-go-round makes 1 revolution every 2 seconds. **Chad’s linear or tangential velocity is ...**

   a. same as Kaisa’s  
   b. four times Kaisa’s  
   c. one-half of Kaisa’s  
   d. one-quarter of Kaisa’s  
   e. twice Kaisa’s

5. Two spheres have the same mass. One sphere is made of aluminum, while the other sphere is made of gold. Both are solid. Because gold is more dense, the radius of the gold sphere is smaller than the aluminum sphere. Which has the larger moment of inertia?

   a. aluminum sphere  
   b. gold sphere  
   c. both the same  
   d. not enough information

6. What is the direction of the cross-product \( \mathbf{k} \times \mathbf{j} \)?

   a. \( \mathbf{0} \)  
   b. \( \mathbf{k} \)  
   c. \( \mathbf{i} \)  
   d. \( -\mathbf{i} \)

7. In a swimming pool, assuming the density of water to be 1000 kg/m³, what happens to the buoyant force acting on your body as you descend to deeper depths?

   a. it increases  
   b. it decreases  
   c. it stays the same  
   d. it depends on the volume of your body

8. You squeeze the end of a garden hose to make the cross-sectional area smaller. According to Bernoulli’s principle, what happens to the pressure of the water passing through this smaller area?

   a. the pressure increases  
   b. it depends on the density of the water  
   c. the pressure decreases  
   d. the pressure stays the same
9. Two identical cylinders at the same pressure contain the same gas. If A contains three times as much gas as B, which cylinder has the higher temperature?

   a. Container A       c. both have the same temperature
   b. Container B

10. A steel tape measure is marked such that it gives accurate measurements at room temperature. If the tape measure is used at very low temperatures, how will its length measurements be affected?

   a. measured lengths will be too large  c. measured lengths will be too small
   b. measured lengths will be accurate  d. not enough information
Problem: The four problems are worth a total of 80 points; their individual worth is labeled. Partial credit is given.

11. (25 pts) A uniform sphere that can rotate about its central point in any direction. The sphere has a radius of 1 m and a mass of 3 kilograms and is initially at rest. Starting at time $t=0$, a force of $\vec{F} = 8\hat{i} - 10\hat{k}$ Newtons is applied at the point on the sphere with coordinates (0.5, 0.87, 0) meters.

a) What is the torque applied to the sphere?

b) After 4 seconds, what is the kinetic energy of the sphere?
12. (20 pts) Six children, each of weight 300 N, make a log raft by lashing together logs with volume of 0.1 m$^3$. How many logs will be needed to keep them afloat in fresh water? Assume the density of the logs is 700 kg/m$^3$. The density of water is 1000 kg/m$^3$. 
13. (20 pts) A 200 g copper bowl contains 300 g of water, both at 20°C. A very hot 500 g copper cylinder is dropped into the water, causing the water to boil, with 15 g being converted into steam. Assume the containers are insulated so heat is not lost or gained externally.

   a) What is the final temperature of the system (including water, steam, bowl, and cylinder)?

   b) How much energy is transferred to the water as heat (in calories)?

   c) How much to the bowl?

   d) What is the original temperature of the cylinder?
14. (15 pts) A 4.0 kg mess kit sliding on a frictionless surface explodes in two different sized parts, one has a mass of 3 kg and is moving with velocity $2\hat{i} - 3\hat{j}$ m/s, the other has a mass of 1 kg and is moving at $-5\hat{i} + 10\hat{j}$ m/s. What is the original velocity (in vector notation) of the mess kit?
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Answer Section

MULTIPLE CHOICE

1. ANS: D   PTS: 1
2. ANS: E   PTS: 1
3. ANS: C   PTS: 1
4. ANS: C   PTS: 1
5. ANS: A   PTS: 1
6. ANS: D   PTS: 1
7. ANS: C   PTS: 1
8. ANS: C   PTS: 1
9. ANS: B   PTS: 1
10. ANS: A  PTS: 1

PROBLEM

11. ANS:   
   -   
   PTS: 1
12. ANS:   
   -   
   PTS: 1
13. ANS:   
   -   
   PTS: 1
14. ANS:   
   -   
   PTS: 1