

Instructor(s): *Professor Meisel*

PHYSICS DEPARTMENT

PHY 2020

Mid-Term Exam 2

18 October 2006; 7:30–9:30 pm, BRY 130

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

YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.

- (1) Code your test number on your answer scansheet (use lines 76–80 for the 5-digit number). Code your name and UFID on your answer sheet. **Do not insert a hyphen or space into your UFID.**
- (2) Blacken the circle of your intended answer completely, using a #2 pencil or black pen. Do not make any stray marks, or your sheet may not scan correctly.
- (3) Print your name on this exam paper and sign it after reading the “*Honor Code*” statement.
- (4) Do all scratch work on this exam and on the scratch paper provided. When you finish, place your scratch paper inside this exam paper and return all the materials to the Proctor. No credit will be given unless the scan sheet, exam paper, and scratch paper are all returned.
- (5) Write your test number onto your formula sheet and take it home. It is your record of taking this exam.
- (6) For each problem, choose the answer that is closest to exact. (We suggest you work all problems to at least three significant figures.) Assume that given angles are exact.
- (7) You may have only the following items on your desk:
 - Calculator (graphing calculator is OK);
 - Two sheets of approved notes (8.5 inch \times 11 inch); No other aids are allowed or required;
 - Scratch paper (as provided by proctors);
 - Pen/pencil & eraser;
 - UF Gator-one ID card.
 Other than your calculator and your wristwatch, you may not have any other electronic devices in your sight (no cell phones, PDAs, pagers, iPods, etc.)
- (8) All of the problems will be graded and will be tabulated to generate a final score. Therefore, you should submit work for all of the problems.
- (9) All work must be shown to receive full credit. Work must be clear and unambiguous. Be sure that you hand your completed work to the Proctor.
- (10) Each problem is worth 5 points.
- (11) Following the UF Honor Code, your work on this examination must reflect your own independent effort, and you must not have given, nor received, any unauthorized help or assistance. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “*On my honor, I have neither given nor received unauthorized aid in doing this assignment.*” If true, please initial here: _____

DO NOT OPEN EXAM UNTIL INSTRUCTED

1. In order to receive credit for this problem, you must correctly code (“bubble”) both your 8-digit UFID and your 5-digit test number onto your scan sheet and also select the correct response below. Check right now that both numbers are correctly bubbled. Code your UFID as if it were an ordinary 8-digit number and **do not insert a blank space or hyphen in the middle.**
 - (1) I have correctly bubbled my UFID and test number.
 - (2) I don't think this is important.
 - (3) I bubbled the wrong test number.
 - (4) I don't have time to check.
 - (5) I bubbled the wrong UFID.

2. A raft is constructed of wood having a density of 400 kg/m^3 . Its surface area is 2.5 m^2 and its volume is 0.50 m^3 . When the raft is placed in fresh water of density $1 \times 10^3 \text{ kg/m}^3$, what percentage of it is below water level?
 - (1) 40 %
 - (2) 2 %
 - (3) 11 %
 - (4) 33 %
 - (5) 80 %

3. A wheel of radius 10 cm and moment of inertia of 30 kg m^2 experiences a constant force of 50 N as shown in Figure “Wheel”. What is the angular acceleration?
 - (1) 0.17 rad/s^2
 - (2) 0.33 rad/s^2
 - (3) 0.71 rad/s^2
 - (4) 1.33 rad/s^2
 - (5) 1.50 rad/s^2

4. (CONTINUATION) What is the angular speed of the wheel 4 s after starting from rest?
 - (1) 0.68 rad/s
 - (2) 0.27 rad/s
 - (3) 0.33 rad/s
 - (4) 0.71 rad/s
 - (5) 1.00 rad/s

5. (CONTINUATION) What is the number of revolutions after 4 s when starting from rest?
 - (1) 0.22 rev
 - (2) 0.34 rev
 - (3) 0.71 rev
 - (4) 2.14 rev
 - (5) 3.14 rev

6. Suppose the mass of the earth and the mass of the moon were double their present values, and the distance between them tripled. By what factor would the force of gravity between them change?
 - (1) $\frac{4}{9}$
 - (2) $\frac{4}{3}$
 - (3) $\frac{3}{4}$
 - (4) $\frac{2}{3}$
 - (5) None of these values are correct.

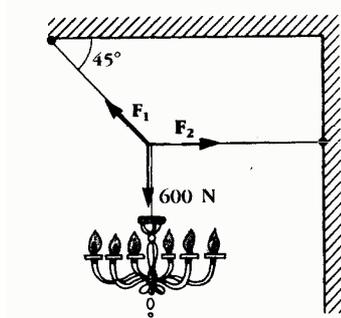
7. A 60 kg soccer player traveling at 5 m/s collides with a 75 kg player who is traveling at 2 m/s in the same direction. Upon collision, they grab and hold onto each other. What is their common speed immediately after the collision?
 - (1) 3.3 m/s
 - (2) zero
 - (3) 1.1 m/s
 - (4) 7.0 m/s
 - (5) Not enough information given to answer.

8. A ball of mass 0.22 kg is moving with a speed of 7.5 m/s in the positive x-direction and collides head-on with a 5.0 kg ball at rest. If the collision is perfectly elastic, what will be the velocities of the two balls after collision? Let the sign designate the positive or negative x-direction, and the velocity of the small ball is listed first.
 - (1) -6.9 m/s and $+0.63 \text{ m/s}$
 - (2) -7.5 m/s and zero
 - (3) -0.33 m/s and -0.63 m/s
 - (4) -0.33 m/s and $+0.63 \text{ m/s}$
 - (5) -6.9 m/s and $+0.02 \text{ m/s}$

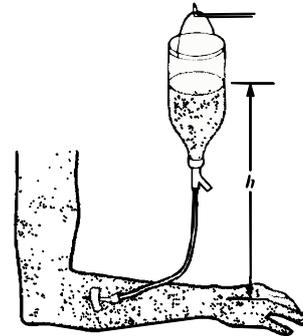
9. A centrifuge rotor has a moment of inertia of $5 \times 10^{-3} \text{ kg m}^2$. How much energy is required to bring it from rest to 10,000 rpm?
 - (1) 2.7 kJ
 - (2) 27 J
 - (3) 270 J
 - (4) 26 J
 - (5) 250 kJ

10. Big John Force needed to tighten a bolt on his funny car. From experience, he knew that 100 N m was needed. His wrench was 25 cm long. How much force did John Force apply to the end of his wrench in order to achieve the torque required?
- (1) 400 N (2) 40 N (3) 4 N (4) 0.4 N (5) This problem is unphysical.
11. Two children balance a seesaw on the playground. Under the conditions of perfectly balanced, the 22 kg child is 2.0 m from the pivot point while the second child is 2.8 m from the pivot point. What is the mass of the second child? Assume the seesaw is perfectly balanced when no children are on it.
- (1) 15.7 kg (2) 31.0 kg (3) 22 kg (4) 17.6 kg (5) More information needed.
12. Find the tension in the two ropes shown in Figure “Chandelier”. For the response, F_1 is listed first and is followed by F_2 .
- (1) None of the choices are correct. (2) 600 N, 845 N (3) 845 N, 845 N (4) 845 N, 426 N (5) 600 N, 426 N
13. Approximately what magnitude of force, F_M , must the upper arm exert on the lower arm to hold a 7.3 kg shotput, see Figure “Arm”. Assume the lower arm has a mass of 2.8 kg and assume its center of gravity (center of mass) is 12 cm from the pivot point.
- (1) 990 N (2) 858 N (3) 727 N (4) 132 N (5) 101 N
14. An object weighs 10 N in air, and it is 1 N when submerged in mercury (Hg) whose density is $\rho_{\text{Hg}} = 1.36 \times 10^4 \text{ kg/m}^3$. Find the density of the object.
- (1) $1.51 \times 10^4 \text{ kg/m}^3$ (2) $1.41 \times 10^4 \text{ kg/m}^3$ (3) $1.27 \times 10^4 \text{ kg/m}^3$ (4) $2.14 \times 10^5 \text{ kg/m}^3$ (5) $1.11 \times 10^3 \text{ kg/m}^3$
15. Intravenous infusions are often made under the influence of gravity as shown in Figure “Intravenous”. Assuming the fluid has a density of 1.25 g/cm^3 , at what height h should the bottle be placed so the liquid pressure is 10 mbar over standard atmospheric pressure? Assume the velocities of the flow are negligible.
- (1) None of the choices is correct. (2) 10 cm (3) 50 cm (4) 1 m (5) 12 m
16. The maximum gauge pressure in a hydraulic lift is 20 bar. What is the largest mass that it can lift if the diameter of the output line is 30 cm?
- (1) $1.4 \times 10^4 \text{ kg}$ (2) $5.8 \times 10^8 \text{ kg}$ (3) 144 g (4) $5.8 \times 10^3 \text{ kg}$ (5) 600 kg
17. A compressed gas cylinder contains Helium gas in a volume of 2.0 m^3 under a pressure of 10 bar at 22°C , which is a comfortable room temperature. What volume will this gas occupy if it is allowed to expand until it reaches 1 bar?
- (1) 20 m^3 (2) 0.2 m^3 (3) 22 cm^3 (4) 440 cm^3 (5) 2.17 m^3
18. Consider a standard X-Y Cartesian grid system, where (x,y) notation provides the locations of different points. A mass of 4 kg is located at (0,2m). A mass of 2 kg is located at (1m,2m). A mass of 2 kg is located at (3m,0). The fourth and final mass of 4 kg is located at (-2m,-2m). What is the (X,Y) coordinates of the center of mass of this arrangement?
- (1) $(0, \frac{1}{3}\text{m})$ (2) (0,0) (3) $(\frac{4}{3}\text{m}, \frac{5}{3}\text{m})$ (4) $(-\frac{1}{3}\text{m}, 0)$ (5) $(-\frac{4}{3}\text{m}, -\frac{5}{3}\text{m})$

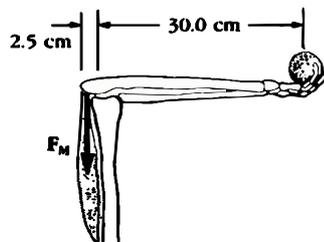
19. A truck of mass 2500 kg is traveling North at 15 m/s and is approaching an intersection. A car of mass 1000 kg is traveling East at 37.5 m/s and is approaching the same intersection. The two vehicles collide inelastically. What is the velocity of the truck-car object immediately after the collision?
- (1) 15.15 m/s, 45° North of East
 - (2) 21.42 m/s, 45° North of East
 - (3) 15.15 m/s, 30° North of East
 - (4) 52.5 m/s, 67° North of East
 - (5) 22.5 m/s, 60° North of East
20. A stiff piece of protein (see Figure “DNA”), with a length of $d = 30$ nm, is pivoted about one end, O. At the other end, a force of magnitude 10 pN is applied as shown in the figure, where the resulting rotation is confined to the plane of the paper and where $\theta = 30^\circ$ and $\phi = 60^\circ$. What is the magnitude of the torque that the DNA experiences about point O?
- (1) 2.6×10^{-19} N m
 - (2) 300 N m
 - (3) 3×10^{-19} N m
 - (4) Cannot answer since the moment of inertia is not given.
 - (5) 0.71×10^{-19} N m



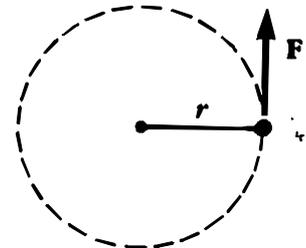
Chandelier



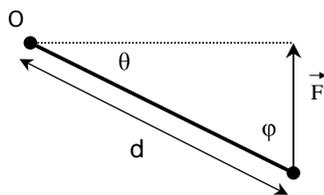
Intravenous



Arm



Wheel



DNA

THE FOLLOWING QUESTIONS, NUMBERED IN THE ORDER OF THEIR APPEARANCE ON THE ABOVE LIST, HAVE BEEN FLAGGED AS CONTINUATION QUESTIONS: 4 5