

Instructor(s): *P. Kumar*PHYSICS DEPARTMENT  
Final Exam

August 7, 2013

Name (print, last first): \_\_\_\_\_ Signature: \_\_\_\_\_

*On my honor, I have neither given nor received unauthorized aid on this examination.***YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.**

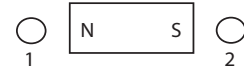
- (1) **Code your test number on your answer sheet (use lines 76–80 on the answer sheet for the 5-digit number).** Code your name on your answer sheet. **DARKEN CIRCLES COMPLETELY.** Code your UFID number on your answer sheet.
- (2) Print your name on this sheet and sign it also.
- (3) Do all scratch work anywhere on this exam that you like. **Circle your answers on the test form.** At the end of the test, this exam printout is to be turned in. No credit will be given without both answer sheet and printout.
- (4) **Blacken the circle of your intended answer completely, using a #2 pencil or blue or black ink.** Do not make any stray marks or some answers may be counted as incorrect.
- (5) **The answers are rounded off. Choose the closest to exact. There is no penalty for guessing. If you believe that no listed answer is correct, leave the form blank.**
- (6) Hand in the answer sheet separately.

## Constants:

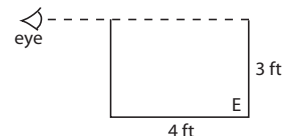
$$e = 1.6 \times 10^{-19} \text{ C} \quad m_p = 1.67 \times 10^{-27} \text{ kg} \quad m_e = 9.1 \times 10^{-31} \text{ kg} \quad g = 9.8 \text{ m/s}^2 \quad \text{micro} = 10^{-6} \quad \text{nano} = 10^{-9}$$

$$\epsilon_o = 8.85 \times 10^{-12} \text{ C}^2/\text{N} \cdot \text{m}^2 \quad k = 1/(4\pi\epsilon_o) = 9 \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2 \quad \mu_o = 4\pi \times 10^{-7} \text{ T} \cdot \text{m}/\text{A} \quad \text{pico} = 10^{-12}$$

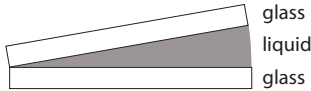
1. The diagram shows two small paramagnetic spheres, one near each end of a bar magnet. Which of the following statements is true?



- (1) The forces on 1 and 2 are both toward the magnet.
  - (2) The force on 1 is away from the magnet and the force on 2 is away from the magnet.
  - (3) The force on 1 is toward the magnet and the force on 2 is away from the magnet.
  - (4) The forces on 1 and 2 are both away from the magnet.
  - (5) The magnet does not exert a force on either sphere.
2. What is the solar radiation pressure in Pascals ( $\text{N}/\text{m}^2$ ) on a dark patch of the Earth's surface (perpendicular to the direction of the overhead sunlight) if the total power produced by the sun is  $3.8 \times 10^{26}$  W and the distance between the sun and the Earth is  $1.5 \times 10^{11}$  m?
- (1)  $4.5 \times 10^{-6}$
  - (2)  $1.3 \times 10^{18}$
  - (3) 1300
  - (4)  $9 \times 10^{-17}$
  - (5)  $1.7 \times 10^4$
3. A 1.2-m radius cylindrical region contains a uniform electric field along the cylinder axis. It is increasing uniformly with time. To obtain a total displacement current of  $2.0 \times 10^{-9}$  A through a cross section of the region, the magnitude of the electric field should change at a rate of:
- (1) 50 V/m·s
  - (2) 12 V/m·s
  - (3) 37 V/m·s
  - (4) 5.0 V/m·s
  - (5)  $4.0 \times 10^7$  V/m·s
4. A ray of light in water (index  $n_1$ ) is incident on its surface (with air) at the critical angle. Some oil (index  $n_2$ ) is now floated on the water. The angle between the ray in the oil and the normal is:
- (1)  $\sin^{-1}(1/n_2)$
  - (2)  $\sin^{-1}(1/n_1)$
  - (3)  $\sin^{-1}(1.00)$
  - (4)  $\sin^{-1}(n_1/n_2)$
  - (5)  $\sin^{-1}(n_2/n_1)$
5. The rectangular metal tank shown is filled with an unknown liquid. The observer, whose eye is level with the top of the tank, can just see corner E. The index of refraction of this liquid is:



- (1) 1.25
- (2) 1.67
- (3) 1.50
- (4) 1.33
- (5) 2.46

6. Two polarizers are oriented in such a way that unpolarized light of intensity  $I_0$  emerges with intensity  $I_0/4$ . At what angle (with respect to the first polarizer) would you insert a third polarizer between the first two, to get the outcoming light of maximum possible intensity?
- (1)  $22.5^\circ$                       (2)  $30^\circ$                       (3)  $45^\circ$                       (4)  $50^\circ$                       (5) none
7. A convex spherical mirror has a focal length of 12 cm. If an object is placed 6 cm in front of it, the image position is:
- (1) 4 cm behind the mirror  
 (2) 4 cm in front of the mirror  
 (3) 12 cm behind the mirror  
 (4) 12 cm in front of the mirror  
 (5) at infinity
8. An object is placed 5 cm from the first of a 2-lens system. The first lens has a focal length of 10 cm. The second lens, located 20 cm from the first, has a focal length of 20 cm. How far from the second lens does the final image form?
- (1) 60 cm                      (2) 30 cm                      (3) 40 cm                      (4) 20 cm                      (5) 50 cm
9. In a Young's double-slit experiment, the slit separation is doubled. This results in:
- (1) a halving of the fringe spacing.  
 (2) a decrease in fringe intensity.  
 (3) a halving of the wavelength.  
 (4) an increase in fringe intensity.  
 (5) a doubling of the fringe spacing.
10. A liquid of refractive index  $n = 4/3$  replaces the air between a fixed wedge formed from two glass plates as shown. As a result, the spacing between adjacent dark bands in the interference pattern:
- 
- (1) decreases to  $3/4$  of its original value.  
 (2) increases by a factor of 3.  
 (3) remains the same.  
 (4) increases by a factor of  $4/3$ .  
 (5) decreases to  $1/3$  of its original value.
11. A diffraction pattern is produced on a viewing screen by illuminating a long narrow slit with light of wavelength  $\lambda$ . If  $\lambda$  is increased and no other changes are made:
- (1) The intensity at the center of the pattern does not change and the pattern expands away from the bright center.  
 (2) The intensity at the center of the pattern increases and the pattern contracts toward the bright center.  
 (3) the intensity at the center of the pattern decreases and the pattern expands away from the bright center.  
 (4) The intensity at the center of the pattern does not change and the pattern contracts toward the bright center.  
 (5) Neither the intensity at the center of the pattern nor the pattern itself change.
12. 13. Monochromatic light is normally incident on a diffraction grating that is 1 cm wide and has 10,000 slits. The first order line is deviated at a  $30^\circ$  angle. What is the wavelength, in nm, of the incident light?
- (1) 500                      (2) 400                      (3) 300                      (4) 600                      (5) 1000
13. Have you filled in your name, UFID and the exam code (top left and right of every page of the exam) in the scantron sheet?
- (1) Yes, I have.    (2) No, I haven't.    (3) Please don't bother me, I am taking an exam.    (4) Why?    (5) Yes, but I lied.