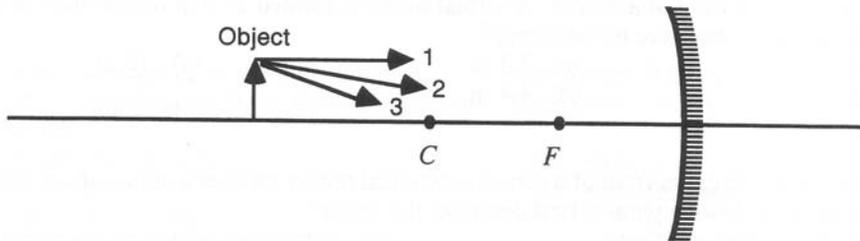


**Purdue University**  
**PHYS221**  
**EXAM II Solutions are marked with a \*) 10/31/02**

(All questions are worth 5 points unless otherwise stated. There is no penalty for guessing. Attempt all questions to maximize you score. Remember to write your name and SSN on your bubble sheet and sign the sheet.)

1. Which one of the following phrases most accurately describes the term *wave front*?
- (a) the surface of a plane mirror
  - (b) the surface of a convex mirror
  - (c) a surface upon which a wave is incident
  - (d) a surface of constant phase within a wave (\*)
  - (e) a surface that is parallel to the direction of wave propagation.

2. An object is placed in front of a concave spherical mirror as shown below. The three rays **1**, **2** and **3**, leave the top of the object and, after reflection, converge at a point on the top of the image. Ray **1** is parallel to the principal axis, ray **2** passes through  $F$ , and ray **3** passes through  $C$ .



Which ray(s) will pass through  $F$  after reflection?

- (a) 1 only(\*)
  - (b) 2 only
  - (c) 3 only
  - (d) both 1 and 2
  - (e) 1, 2, and 3
3. Which one of the following statements concerning electromagnetic waves is false?
- (a) Electromagnetic waves are longitudinal waves. (\*)
  - (b) Electromagnetic waves transfer energy through space.
  - (c) The existence of electromagnetic waves was predicted by Maxwell.
  - (d) Electromagnetic waves can propagate through a material substance.
  - (e) Electromagnetic waves do not require a physical medium for propagation.

4. Which one of the following types of wave is intrinsically different from the other four?

- (a) radio waves            (c) gamma rays            (e) visible light  
(b) sound waves(\*)        (d) ultraviolet radiation

5. Which one of the following statements concerning the energy carried by an electromagnetic wave is true?

- (a) The energy is carried only by the electric field.  
(b) More energy is carried by the electric field than by the magnetic field.  
(c) The energy is carried equally by the electric and magnetic fields. (\*)  
(d) More energy is carried by the magnetic field than by the electric field.  
(e) The energy is carried only by the magnetic field.

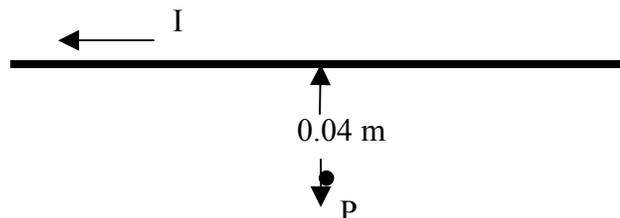
6. The average intensity of sunlight at the top of the Earth's atmosphere is  $1390 \text{ W/m}^2$ . Assuming that all sunlight that falls on a solar panel could be collected, what is the maximum energy that a  $25\text{m} \times 45\text{m}$  solar cell could collect in one hour in this sunlight? (10 points)

- (a)  $4.2 \times 10^9 \text{ J}$   
(b)  $3.7 \times 10^9 \text{ J}$   
(c)  $5.1 \times 10^9 \text{ J}$   
(d)  $5.6 \times 10^9 \text{ J}$  (\*)  
(e)  $8.4 \times 10^9 \text{ J}$

7. A solenoid of length  $0.25\text{m}$  and radius  $0.02\text{m}$  is comprised of 120 turns of wire. Determine the magnitude of the magnetic field at the center of the solenoid when it carries a current of  $15\text{A}$ . (10 points)

- (a)  $2.26 \times 10^{-3} \text{ T}$             (d)  $7.50 \times 10^{-3} \text{ T}$   
(b)  $4.52 \times 10^{-3} \text{ T}$             (e) zero tesla  
(c)  $9.05 \times 10^{-3} \text{ T}$  (\*)

8. A long, straight wire is carrying a current of  $5\text{A}$  in the direction shown in the figure. The point **P** is  $0.04\text{m}$  from the wire.

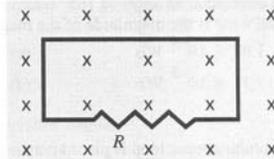


What is the direction of the magnetic field at point **P** due to the current in the wire?

- (a) to the right of the page
- (b) to the left of the page
- (c) toward the bottom of the page
- (d) into the plane of the page
- (e) out of the plane of the page(\*)

9. The figure shows a uniform magnetic field that is normal to the plane of conducting loop, which has a resistance  $R$ . Which one of the following changes will cause an induced current to flow through the resistor?

- (a) decreasing the area of the loop
- (b) decreasing the magnitude of the magnetic field
- © increasing the magnitude of the magnetic field
- (d) rotation the loop through  $90^\circ$  into the plane of the paper
- (e) all of the above (\*)



10. A transformer changes 120 V across the primary to 1200 V across the secondary. If the secondary coil has 800 turns, how many turns does the primary coil have?

- (a) 40
- (b) 80 (\*)
- (c) 100
- (d) 400
- (e) 4000

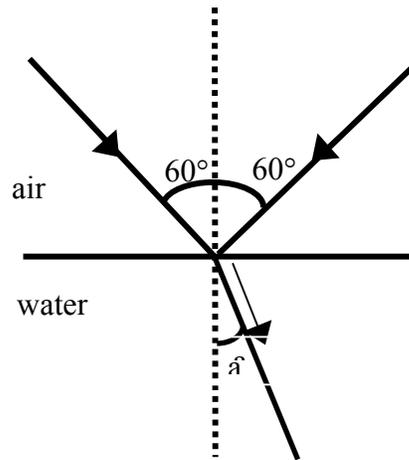
11. Three  $4.0\text{-}\mu\text{F}$  capacitors are connected in parallel across the terminals of a 120-Hz generator. What is the capacitive reactance of the circuit?

- (a)  $39\ \Omega$
- (b)  $110\ \Omega$  (\*)
- (c)  $330\ \Omega$
- (d)  $720\ \Omega$
- (e)  $1.0 \times 10^3\ \Omega$

12. A ray of light traveling through the air ( $n=1$ ) is incident on water ( $n=1.33$ ). Part of the beam is reflected at an angle of sixty degrees relative to the normal to the surface of the water. What angle,  $a$ , does the refracted beam, i.e the part of the beam that passes through the water make with the normal?

- (a)  $60.0^{\circ}$
- (c)  $39.5^{\circ}$
- (d)  $40.6^{\circ}$  (\*)
- (e)  $0^{\circ}$

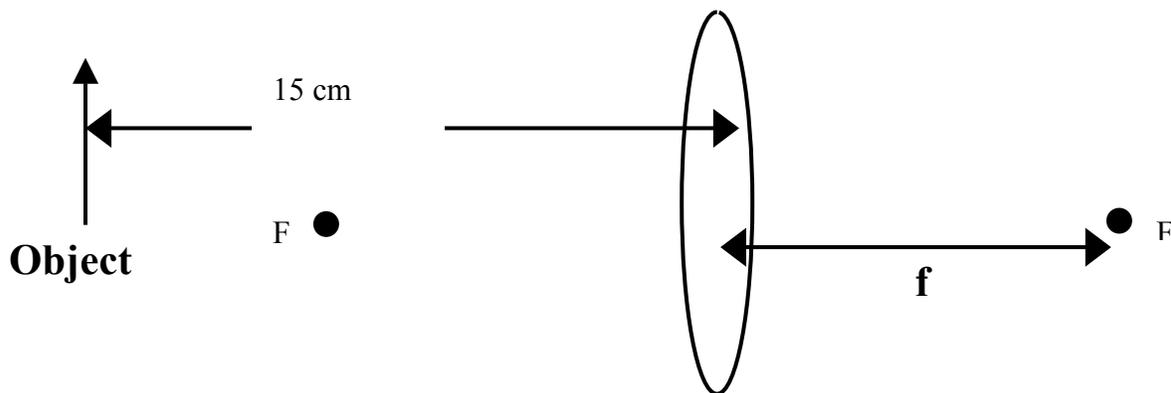
(b)  $41.0^{\circ}$



13. An object is placed 15 cm in front of a converging lens which has a focal length,  $f$ , of 10 cm.. Which of the following describes the image.

- (a) Image is real, inverted, 15 cm from the lens and enlarged
- (b) Image is real, upright, 15cm form the lens and enlarged
- (c) Image is real, upright, 30cm from the lens and is enlarged
- (d) Image is real, inverted, 30cm from the lens and diminished
- (e) Image is real, inverted, 30cm from the lens, and enlarged (\*)

10 points



14. In a Young's double slits experiment two slits are 0.158 mm apart. A mixture of red light (wavelength 665 nm) and yellow-green light (wavelength=565 nm) falls on the slits. A flat observation screen is located 2.24 m away. What is the distance on the screen between the third order (bright) red fringe and the third order (bright) yellow-green fringe? (10 points)

- (a)  $2.3 \times 10^{-3} \text{ m}$
- (b)  $3.6 \times 10^{-3} \text{ m}$
- (c)  $4.3 \times 10^{-3} \text{ m}$  (\*)
- (d)  $5.4 \times 10^{-3} \text{ m}$
- (e)  $6.9 \times 10^{-3} \text{ m}$

15. You are standing one meter front of a short flat mirror which is placed too high, so you can see above your head, but only down to your knees. To see your shoes you must:

- (a) move 0.5 m closer to the mirror
- (b) move so close to the mirror you are almost touching it.
- (c) move further from the mirror by 0.5 m
- (d) move a long way further from the mirror
- (e) changing distance does not change what you see of yourself (\*)

16. Ghost images are formed in a TV picture when the electromagnetic wave from the broadcasting antenna reflects from a building or other large object and arrives at the TV set shortly after the wave coming directly from the broadcasting antenna. If the reflected wave arrives  $5.0 \times 10^{-7} \text{ s}$  after the direct wave, what is the difference in the distances traveled by the two waves?

- (a)  $0.6 \times 10^{15} \text{ m}$
- (b)  $1.67 \times 10^{-15} \text{ m}$
- (c)  $0.06 \times 10^{-1} \text{ m}$  (\*)
- (d) 150m
- (e) 300m