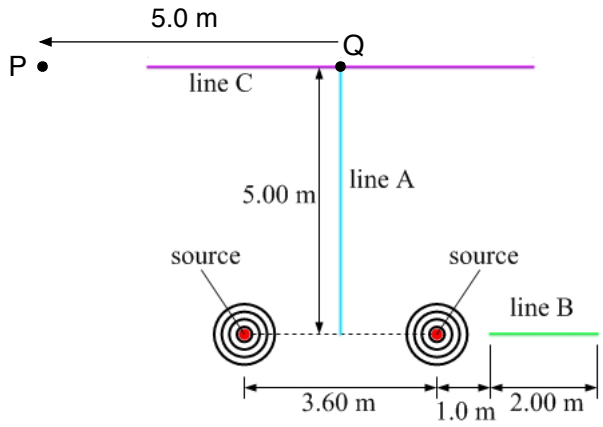
Physics 1520, Spring 2014
Quiz 2A, Form: A

Name: _____

Date: _____

Section 1. Multiple Choice

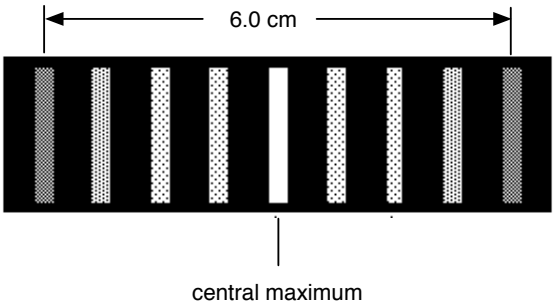
Questions 1–3: Two point sources of waves emit radio waves of wavelength 0.5 m as shown below.



Point Q is on line C and on the perpendicular bisector of the two sources. Point P is 5 m from Point Q, along line C.

1. What is the path difference between the two sources at Point P?
   - (a) 1.4 m
   - (b) 1.8 m
   - (c) 2.5 m
   - (d) 2.9 m
   - (e) 3.6 m
2. At Point P,
   - (a) total destructive interference occurs.
   - (b) total constructive interference occurs.
   - (c) the interference of the two sources is not totally constructive nor totally destructive.
3. At Point Q,
   - (a) total destructive interference occurs.
   - (b) total constructive interference occurs.
   - (c) the interference of the two sources is not totally constructive nor totally destructive.

Questions 4–5: A fringe pattern due to double-slit interference is shown below.



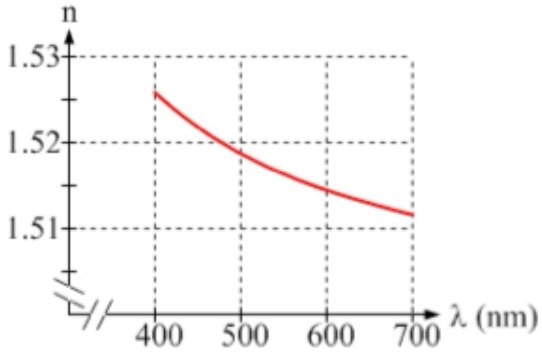
4. What is the distance between adjacent fringes, Δy?

   (a) 1.5 cm
   (b) 0.67 cm
   (c) 0.86 cm
   (d) 0.60 cm
   (e) 0.75 cm

5. If you *increase* the distance between the slits, the distance between adjacent fringes will

   (a) stay the same.
   (b) increase.
   (c) decrease.

6. The index of refraction of the medium depends slightly on the wavelength of light. (This is why water separates white light into a rainbow. This effect is called dispersion.)



   Suppose that you shine light from a red laser through water and then you shine light from a green laser through water. Which color travels fastest in the water?

   (a) red light
   (b) green light
   (c) Neither, they will travel the same speed in water.

7. Light of wavelength λ in air strikes an anti-reflection film that coats a lens made of glass with index of refraction $n_{glass} = 1.6$. The film has thickness t and index of refraction 1.3. For which one of the following conditions will there be no reflection for light incident perpendicular to the film?

   (a) $2t = \frac{\lambda}{1.33}$

   (b) $2t = \frac{1}{2}\frac{\lambda}{1.6}$

   (c) $2t = \frac{\lambda}{2}$

   (d) $2t = \frac{\lambda}{1.6}$

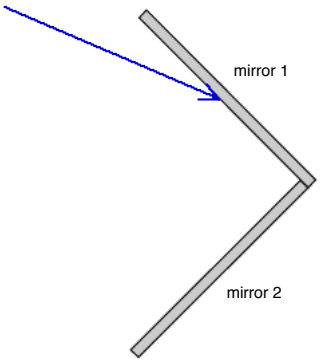
   (e) $2t = \frac{1}{2}\frac{\lambda}{1.3}$

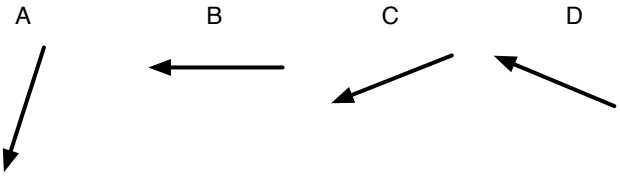
8. When light traveling in soap reflects off an interface with air on the other side, the reflected light

   (a) is phase shifted 180°.

   (b) is not phase shifted.

9. Two mirrors are perpendicular to each other. A ray hits mirror 1 at the angle shown below.





Which arrow points in the direction of the ray after it reflects from mirror 2?

   (a) A

   (b) B

   (c) C

   (d) D

   (e) none of the above

10. If a person has a near point of 30 cm (meaning that she cannot focus on anything closer than 30 cm away), what is the closest distance that she can stand away from a flat mirror and see herself clearly?

    (a) 20 cm

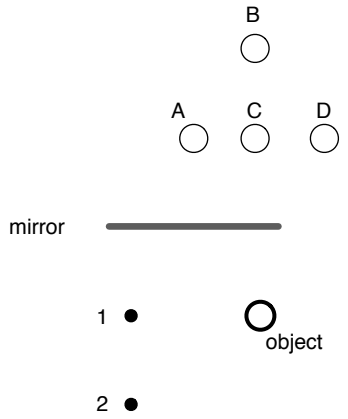
    (b) 10 cm

    (c) 60 cm

    (d) 30 cm

    (e) 15 cm

11. A basketball is in front of a mirror as shown below. Points A – D are different points behind the mirror. Points 1 and 2 are the locations of two different people looking in the mirror at an image of the basketball.



    Which of the following statements is true?

    (a) Person 1 and Person 2 will agree that the image is located at A.

    (b) Person 1 and Person 2 will agree that the image is located at B.

    (c) Person 1 and Person 2 will agree that the image is located at C.

    (d) Person 1 and Person 2 will agree that the image is located at D.

    (e) Persons 1 and 2 will NOT agree on the location of the image.

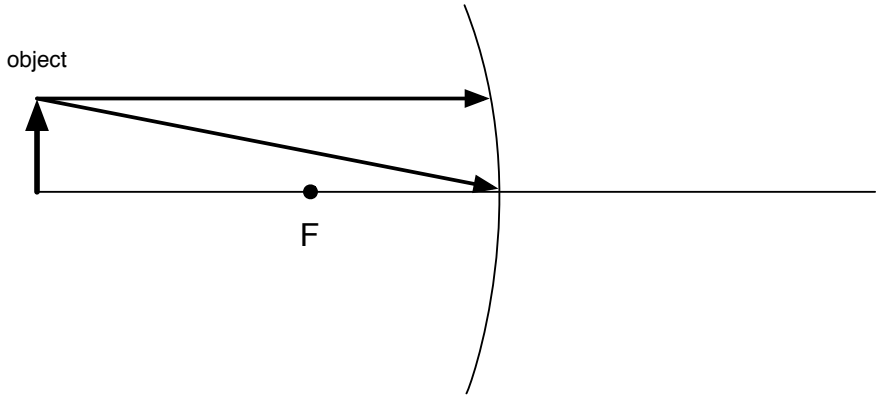
12. A concave mirror used for a telescope has a radius of curvature of 4 m. What is the focal length of the mirror?

    (a) 0.25 m
    (b) 0.5 m
    (c) 2 m
    (d) 4 m
    (e) 8 m

13. A concave mirror in an amusement park has a focal length of 1.5 m. A child stands in front of the mirror so that the image is upright and appears 2.5 times taller than her actual height. How far is she standing from the mirror?

    (a) 2.5 m
    (b) 0.40 m
    (c) 0.55 m
    (d) 1.0 m
    (e) 0.90 m

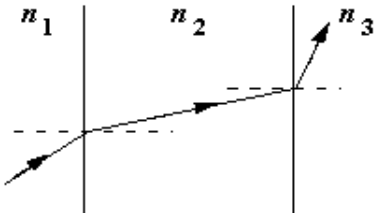
14. An object is in front of a spherical concave mirror at the location shown below. Two of the "easy rays" (as I like to call them) are shown. Trace the rays to find the location of the image.



    The image is

    (a) to the left of the object.
    (b) between the object and F.
    (c) exactly at F.
    (d) between F and the mirror.
    (e) to the right of the mirror.

15. The figure below shows the path of a ray of light as it is transmitted through three different materials.



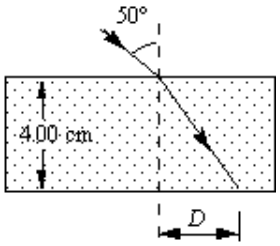
(a) $n_1 > n_2$ and $n_2 > n_3$

(b) $n_1 > n_2$ and $n_3 > n_2$

(c) $n_2 > n_1$ and $n_3 > n_2$

(d) $n_2 > n_1$ and $n_2 > n_3$

16. A ray of light passes from air into a block of glass with an index of refraction of 1.50 as shown in the figure. *Note that the angle of the refracted ray is not accurately drawn.* What is the value of the distance D?



(a) 2.14 cm

(b) 1.42 cm

(c) 1.90 cm

(d) 2.38 cm

(e) 1.66 cm

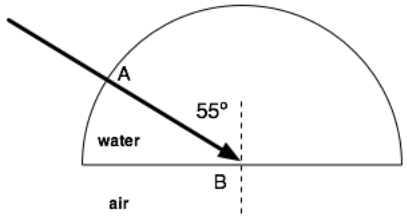
17. If you replace the glass in the previous question with water of index 1.33 and repeat the experiment, then D will be

(a) larger.

(b) smaller.

(c) the same.

Questions 18–19: You shine a laser into a semi-circular chamber of water ($n = 1.33$) in the direction shown so that it strikes the water-air surface at point B at the center of the circle.



18. At point A, what is the angle of incidence (which is always measured between the ray and the normal to the surface)?

    (a) 55°

    (b) 35°

    (c) 0°

    (d) 90°

    (e) between 35°and 55°

19. Calculate the critical angle for the water-air interface. Considering the result, what happens at point B?

    (a) Light is reflected into the water at 55°, and light is transmitted into the air at an angle greater than 55°.

    (b) Light is reflected into the water at 55°, and light is transmitted into the air at an angle less than 55°.

    (c) No light is reflected into the water. All of the light is transmitted into the air at an angle greater than 55°.

    (d) No light is reflected into the water. All of the light is transmitted into the air at an angle less than 55°.

    (e) All of the light is reflected into the water at 55°. No light is transmitted into the air.

Questions 20–21: A convex lens is used to focus light from a small bulb onto the page of a book. The lens has a focal length of 10.0 cm and is located 40.0 cm from the book.

20. Determine the distance from the lens to the bulb.

    (a) 13 cm

    (b) 20 cm

    (c) 30 cm

    (d) 50 cm

    (e) 8.6 cm

21. The image of the bulb is

    (a) virtual and upright.

    (b) virtual and inverted.

    (c) real and upright.

    (d) real and inverted.

Questions 22–25:

22. Joe's eyes are focused on the tree. If he now shifts his focus to the mountain, the muscles in his eyes must _____ the radius of curvature of the lens (of the eye) resulting in a(n) _____ focal length for the lens (of the eye).

(a) increase/increased
(b) increase/decreased
(c) decrease/increased
(d) decrease/decreased

23. Now, Joe turns his attention to the squirrel sitting on a nearby rock and finds that he cannot bring the squirrel into focus. This is because Joe is

(a) nearsighted.
(b) farsighted.

24. In order to correct his vision, Joe needs to obtain contact lenses which contain

(a) convex (i.e. converging) lenses
(b) concave (i.e. diverging) lenses

25. Joe backs up and finds that the closest distance he can stand away from the squirrel and focus on it clearly is 140 cm. In order to correct his vision so that he can stand 25 cm away from the squirrel and see it clearly, Joe needs to obtain contact lenses with a power of

(a) +0.71 D
(b) –0.71 D
(c) +3.3 D
(d) –3.3 D
(e) +4.7 D