

**Assignment-4****Due: 3:00pm on Tuesday, March 27, 2012****Note:** You will receive no credit for late submissions. To learn more, read your instructor's [Grading Policy](#)[\[Switch to Standard Assignment View\]](#)**Problem 25.64**

The region between two concentric conducting spheres with radii  $a$  and  $b$  is filled with a conducting material with resistivity  $\rho$ .

Part A

Find the resistance between the spheres.

**Express your answer in terms of the variables  $\rho$ ,  $a$ ,  $b$  and appropriate constants.**

ANSWER:

$$R = \frac{\rho (b - a)}{4\pi ab}$$

**Correct**

Part B

Derive an expression for the current density as a function of radius, in terms of the potential difference  $V_{ab}$  between the spheres.

**Express your answer in terms of the variables  $\rho$ ,  $a$ ,  $b$ ,  $V_{ab}$ ,  $r$  and appropriate constants.**

ANSWER:

$$J = \frac{(V_{ab}ab)}{\rho(b-a)r^2}$$

**Correct**

Part C

Show that the result in part (a) reduces to the equation  $R = \frac{\rho L}{A}$  when the separation  $L = b - a$  between the spheres is small.

**Essay answers are limited to about 500 words (3800 characters maximum, including spaces).**

ANSWER:

**My Answer:**

since  $4\pi(ab)$  is approximately equal to  $4\pi(a)^2$   $R = (\rho/4\pi)((1/a) - (1/b)) = \rho(b-a)/(4\pi ab) = \rho L/4\pi a^2 = \rho L/A$ , therefore  $L = b - a$

**Problem 25.78**

A toaster using a Nichrome heating element operates on 120 V. When it is switched on at 20 °C, the heating element carries an initial current of 1.35 A. A few seconds later the current reaches the steady value of 1.23 A.

Part A

What is the final temperature of the element? The average value of the temperature coefficient of resistivity for Nichrome over the temperature range is  $4.5 \times 10^{-4} (\text{C}^\circ)^{-1}$ .

Express your answer using two significant figures.

ANSWER:

$$T_f = 240 \text{ } ^\circ\text{C}$$

**Correct**

Part B

What is the power dissipated in the heating element initially?

ANSWER:

$$P_i = 160 \text{ W}$$

**Correct**

Part C

What is the power dissipated in the heating element when the current reaches a steady value?

ANSWER:

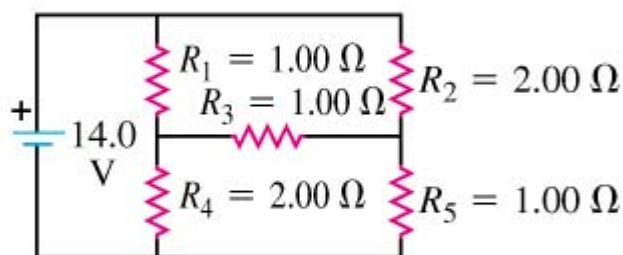
$$P_f = 150 \text{ W}$$

**Correct**

### Problem 26.64

Part A

Find the current through the battery in the circuit shown in the figure .



ANSWER:

$$I = 10.0 \text{ A}$$

*Correct*

Part B

Find the current through the resistor  $R_1$  in the circuit.

ANSWER:

$$I = 6.00 \text{ A}$$

*Correct*

Part C

Find the current through the resistor  $R_2$  in the circuit.

ANSWER:

$$I = 4.00 \text{ A}$$

*Correct*

Part D

Find the current through the resistor  $R_3$  in the circuit.

ANSWER:

$$I = 2.00 \text{ A}$$

*Correct*

Part E

Find the current through the resistor  $R_4$  in the circuit.

ANSWER:

$$I = 4.00 \text{ A}$$

*Correct*

Part F

Find the current through the resistor  $R_5$  in the circuit.

ANSWER:

$$I = 6.00 \text{ A}$$

*Correct*

Part G

What is the equivalent resistance of the resistor network?

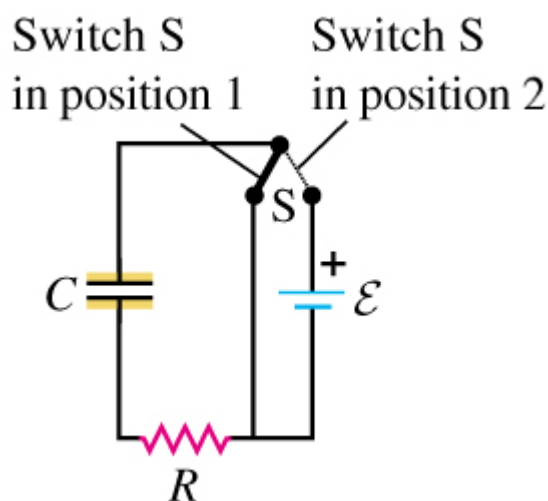
ANSWER:

$$R = 1.40 \text{ } \Omega$$

*Correct*

### Exercise 26.48

In the circuit shown in the figure,  $C = 5.90 \mu\text{F}$ ,  $\mathcal{E} = 28.0 \text{V}$ , and the emf has negligible resistance. Initially the capacitor is uncharged and the switch  $S$  is in position 1. The switch is then moved to position 2, so that the capacitor begins to charge.



Part A

What will be the charge on the capacitor a long time after the switch is moved to position 2?

ANSWER:  $Q = 1.65 \times 10^{-4} \text{ C}$   
*Correct*

Part B

After the switch has been in position 2 for  $3.00 \text{ ms}$ , the charge on the capacitor is measured to be  $110 \mu\text{C}$ . What is the value of the resistance  $R$ ?

ANSWER:  $R = 464 \Omega$   
*Correct*

Part C

How long after the switch is moved to position 2 will the charge on the capacitor be equal to 99.0% of the final value found in part A?

ANSWER:  $t = 1.26 \times 10^{-2} \text{ s}$   
*Correct*

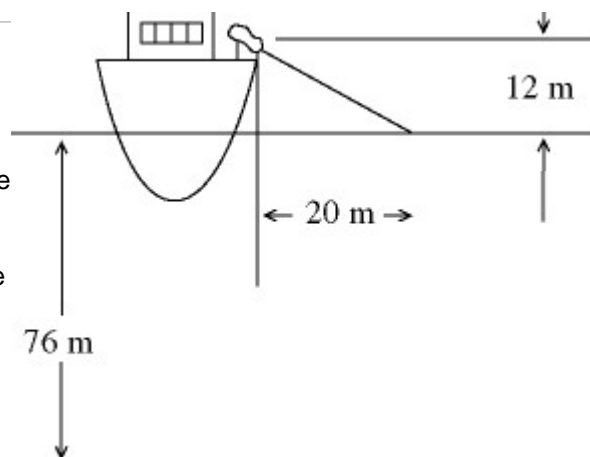
### Multiple Choice Question - 33.13

Part A

Figure 33.3



In Fig. 33.3, a laser positioned on a ship is used to communicate with a small two man research submarine resting on the bottom of a lake. The laser is positioned 12 m above the surface of the water, and it strikes the water 20 m from the side of the ship. The water is 76 m deep and has an index of refraction of 1.33. How far is the submarine from the side of the ship?

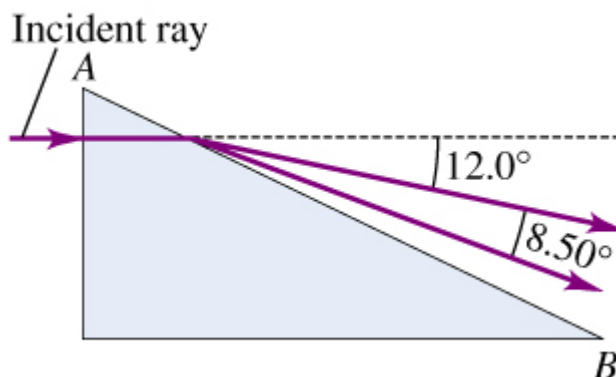


ANSWER:

- 104 m
- 64.1 m
- 84.1 m
- 94.1 m
- 74.1 m

**Correct****Problem 33.42**

A light ray in air strikes the right-angle prism shown in the figure ( $\angle B = 35.0^\circ$ ). This ray consists of two different wavelengths. When it emerges at face  $AB$ , it has been split into two different rays that diverge from each other by  $8.50^\circ$ .



Part A

Find the index of refraction of the prism for each of the two wavelengths.

**Enter your answers in ascending order separated by a comma.**

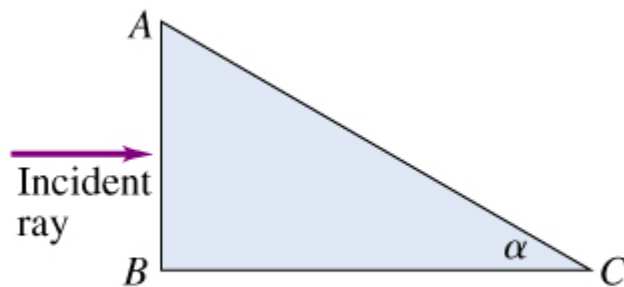
ANSWER:

$$n_1, n_2 = 1.12, 1.18$$

**Correct**

**Exercise 33.22**

Light is incident along the normal on face  $AB$  of a glass prism of refractive index 1.52, as shown in the figure .



Part A

Find the largest value the angle  $\alpha$  can have without any light refracted out of the prism at face AC if the prism is immersed in air.

ANSWER:

$$\alpha = 48.9^\circ$$

**Correct**

Part B

Find the largest value the angle  $\alpha$  can have without any light refracted out of the prism at face AC if the prism is immersed in water.

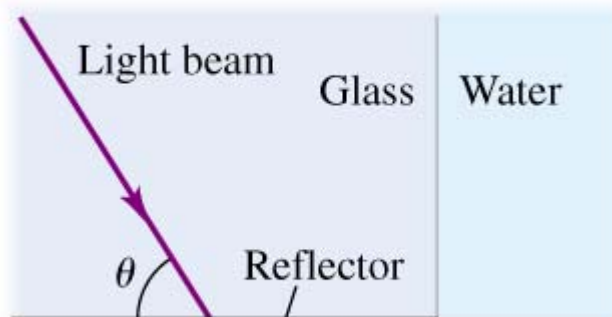
ANSWER:

$$\alpha = 28.7^\circ$$

**Correct**

**Problem 33.54**

A large cube of glass has a metal reflector on one face and water on an adjoining face (the figure ). A light beam strikes the reflector, as shown. You observe that as you gradually increase the angle of the light beam, if  $\theta \geq 59.8^\circ$  no light enters the water.



Part A

What is the speed of light in this glass?

ANSWER:

$$v = 1.94 \times 10^8 \text{ m/s}$$

**Correct**

**Exercise 34.14**A spherical, concave, shaving mirror has a radius of curvature of 31.8 **cm**.

Part A

What is the magnification of a person's face when it is 12.5 **cm** to the left of the vertex of the mirror?

ANSWER:

$$m = 4.68$$

**Correct**

Part B

Where is the image?

ANSWER:

$$s' = -58.5 \text{ cm}$$

**Correct**

Part C

Is the image real or virtual?

ANSWER:

- real
- virtual

**Correct****Problem 34.86**A transparent rod 50.0 **cm** long and a refractive index of 1.54 is cut flat at the right end and rounded to a hemispherical surface with a 14.1 **cm** radius at the left end. An object is placed on the axis of the rod 11.9 **cm** to the left of the vertex of the hemispherical end.

Part A

What is the position of the final image, relative to the far end of the rod?

ANSWER:

$$s' = -54.3 \text{ cm}$$

**Correct**

Part B

What is its magnification?

ANSWER:

$$m = 1.84$$

**Correct**

**Score Summary:**

Your score on this assignment is 99.7%.

You received 99.7 out of a possible total of 100 points.