Appendix B

Answers to Problems

Notes

Answers to Problems
Chapter 2

Problem 1

A) Determine circuit voltage. This may be accomplished by noting the power source output voltage or by connecting the volt-ohm meter across the power source.

ANSWER: 100 V

B) Determine total circuit current (I). Solve Ohm's Law: R = V / I for I. Although you have information on the other two variables (R & V), the two resistor values must be reduced to one value to use the equation. Hence, you must determine R_{eq}.

1. Determine R_{eq}.

ANSWER: $R_{eq} = R_1 + R_2 = 20 + 30 = 50$ ohms

Now you have the equivalent resistance value and the circuit voltage.

2. Solve for circuit current.

ANSWER: $R = V / I \rightarrow I = V / R = 100 / 50 = 2$ amps

C) Determine voltage dissipated across each resistor. Use Ohm's law.

1. Determine resistor voltages

ANSWER: $V_{R1} = R_1 \times I = 20 \times 2 = 40$ V
$V_{R2} = R_2 \times I = 30 \times 2 = 60$ V

2. What is the sum of the resistors voltage?

ANSWER: 100 V

3. What circuit variable is this value equal to?

ANSWER: Applied circuit voltage

D) Determine current through each resistor. Use Ohm's law. (Remember, you have voltage and resistance values for each resistor).

ANSWER: $I_1 = V_1 / R_1 = 40 / 20 = 2$ amps

$I_2 = V_2 / R_2 = 60 / 30 = 2$ amps

Problem 2

A) Determine circuit total voltage. This may be accomplished by noting the power supply voltage or by connecting a volt-ohm meter across the power supply.

ANSWER: 100 V

B) Determine total circuit current (I). Solve Ohm's Law: R = V / I for I. Although you have information on the other two variables (R & V), the two resistor values must be reduced to one value to use the equation. Hence, you must determine R_{eq}. (Remember to use a different formula to determine R_{eq} in a parallel circuit).

1. Determine R_{eq}

ANSWER: $R_{eq} = 1 / (1/20 + 1/30)$ or $(20 \times 30) / (20 + 30) = 12$ ohms

Now you have a circuit resistance value and a circuit voltage value.

2. Solve for circuit total current.

ANSWER: $R = V / I \rightarrow I = V / R = 100 / 12 = 8.3$ amps

C) Determine current through each resistor. Use Ohm's Law.

1. Determine resistor currents

ANSWER: $R = V / I \rightarrow I = V / R$

$I_1 = V / R_1 = 100 / 20 = 5$ amps

$I_2 = V / R_2 = 100 / 30 = 3.3$ amps

2. What is the sum of the resistor currents?

ANSWER: 5 + 3.3 = 8.3 amps

3. What circuit variable is this value equal to?

ANSWER: total circuit current

D) Determine voltage dissipated across each resistor. Use Ohm's Law. (Remember, you have current and resistance values for each resistor).

ANSWER: $V_{R1} = R_1 \times I_1 = 20 \times 5 = 100$ V

$V_{R2} = R_2 \times I_2 = 30 \times 3.3 \sim 100$ V

Problem 3

A) Calculate equivalent resistance

ANSWER: $R_{eq} = 60 + 20 = 80$ ohms

B) Calculate circuit current

ANSWER: $I = V / R = 160 / 80 = 2$ amps

Problem 4

A) choose the proper circuit diagram:

ANSWER: **A**; A parallel circuit is used since the running light and spot light should work independently. For example, you probably would not want your running lights to always go off when your spotlight is turned off or malfunctions.

B) Calculate the equivalent resistance.

ANSWER: $R_{eq} = (12 \times 4)/(12 + 4)$ or $1/(1/12+1/4) = 3$ ohms

C) Calculate circuit current

ANSWER: $I = 12V / 3\Omega = 4$ amps

Problem 5

A) Choose the correct circuit diagram.

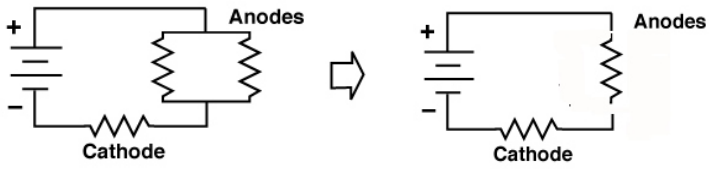
ANSWER: **B**; the anodes are wired in parallel

B) Calculate circuit current

1. First, calculate R_{eq} for the anode

$R_{eq\ anode} = (75 \times 50) / (75 + 50) = 30$ ohms

This changes the circuit from:



2. Now calculate R_{eq} for the entire circuit.

ANSWER: $R_{eq\ circuit} = 10 + 30 = 40$ ohms

3. Calculate circuit total current.

ANSWER: $I = V / R_{eq} = 200V/ 40\Omega = 5$ amps

Problem 6

Solve problem 3 for power

ANSWER: $P = (I)^2 \times R$
$= (2)^2 \times 80$
$= 320$ watts
or

$P = V \times I = 160V \times 2 \text{ amps} = 320 \text{ watts}$

or

$P = (V)^2 / R = (160)^2 / 80 = 320 \text{ watts}$

Problem 7

A) Solve problem 4 for power

ANSWER: $P = (I)^2 \times R = (4)^2 \times 3 = 48$ watts

B) Which takes the greater power, the spotlight or the running light?

ANSWER: The spotlight

$P_{spotlight} = (I_{spotlight})^2 \times R_{spotlight} = (3)^2 \times 4\ \Omega = 36$ watts
$P_{running\ light} = (I_{running\ light})^2 \times R_{running\ light} = (1)^2 \times 12\ \Omega = 12$ watts

Problem 8

A) Solve problem 5 for power

ANSWER: $P = (I)^2 \times R = (5)^2 \times 40 = 1000$ watts

B) Convert your answer to horsepower
(746 watts = one horsepower)

ANSWER:
Horsepower = 1000 watts × 1 horsepower / 746 watts
= 1.34 horsepower

Problem 9

A) Calculate the Duty cycle of this setting.

ANSWER: PW = 5 ms = 0.005 seconds

$f = 1 / T$; $T = 1 / f = 1 / 50 = 0.02$ seconds

Duty cycle = $(PW / T) \times 100 = 0.005 / 0.02 \times 100 = 25\%$

B) Calculate the average voltage.

ANSWER: $V_{ave} = V_{DC} \times$ Duty cycle = 160 V × 25% = 40 V

C) Calculate the average power requirement.

ANSWER: PDC P_{ave} = DC Power × Duty cycle
PDC P_{ave} = 320 watts × 25% = 80 watts

Problem 10

A) Calculate V_p.

ANSWER: $V_p = V_{rms} / 0.707 = 120 / 0.707 \sim 170$ V

B) Calculate V_{p-p}.

ANSWER: $V_{p-p} = 2 \times V_p = 2 \times 170 = 340$ V

C) Calculate the period.

ANSWER: 60 HZ = 60 pulses per second

T = 1 / f = 1 / 60 = 16.7 ms

Problem 11

A) Is the strict AC and PDC comparison valid?

ANSWER: No

Fish respond to peak voltages, not average voltages.

B) Why or why not?

1) Calculate DC V_p.

ANSWER: $V_p = V_{ave}$ / Duty cycle = 100 / 0.5 = 200 V_p

2. Calculate AC V_{p-p}

ANSWER: $V_p = V_{rms} / 0.707 = 100 / 0.707 \sim 141$ V_p

$V_{p-p} = 2 \times V_p = 2 \times 141 = 282$ V_{p-p}

3. Compare voltages.

ANSWER: Peak voltages are unequal between the waveforms and the V_{p-p} is 41% greater than PDC V_p!

Problem 12

A) Calculate input AC power.

ANSWER: $P_{ave} = V_{rms} \times I_{rms} = 240 \times 10 = 2400$ watts

B) Calculate output RMS voltage (remember $V_2 / V_1 = N_2 / N_1$).

ANSWER: $V_2 = V_1 \times N_2 / N_1 = 240 \times 20 / 10 = 480$ volts

C) Calculate output RMS current (remember $I_2 / I_1 = N_1 / N_2$).

ANSWER: $I_2 = I_1 \times N_1 / N_2 = 10 \times 10 / 20 = 5$ amps

D) Calculate the output AC power.

ANSWER: $P_{ave} = 480$ V $\times$ 5 amps = 2400 watts

Problem 13

A) By what PCF factor must the total power applied to this circuit be increased to dissipate 360 watts in the load resistor (R_L)?

ANSWER: Enter the PCF graph with a ratio of two (i.e., load/internal = 20 / 10 = 2) and read PCF = 1.13 (estimate).

B) How much total power will now be used by the circuit in order to have 360 watts dissipated in the load?

ANSWER: Total power = 1.13 × 480 = 542 watts (estimate)

Problem 14

Determine PCF for the previous problem using the PCF equation.

ANSWER: $q = 20 / 10 = 2$

$PCF = (1 + 2)^2 / 4(2) = 1.125$

Answers to Quiz Questions (Chapter 2)

1. 2
2. 2
3. 1
4. 2
5. 5
6. 4
7. 2
8. 4
9. 2
10. 3
11. 3
12. 2
13. 4