Physics 30 - Lesson 22A
AC Power

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1) /5

$V_{eff} = 240V$
$R = 3200\Omega$
$I_{max} = ?$

$I_{eff} = \frac{V_{eff}}{R} = \frac{2400V}{3200\Omega} = 0.075A$

$I_{max} = \frac{I_{eff}}{0.707} = \frac{0.075A}{0.707} = \boxed{0.11A}$

2) /4

$V_{max} = 180V$
$R = 220\Omega$

$I_{max} = \frac{V_{max}}{R} = \frac{180V}{220\Omega} = 0.818A$

$I_{eff} = I_{max} \cdot 0.707 = (0.818A)(0.707)$

$\boxed{I_{eff} = 0.578A}$

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3) /3

$V_{Rms} = 120V$
$P = 60W$
$R = ?$

$R = \frac{V^2}{P} = \frac{(120V)^2}{60W} = \boxed{240\Omega}$

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4) /4

$I_{max} = 3.0V$
$P = 1000W$
$V_{Rms} = ?$

$V_{Rms} = \frac{P}{I_{Rms}} = \frac{P}{I_{max}(0.707)} = \frac{1000W}{3.0(0.707)}$

$\boxed{V_{Rms} = 4.7\times10^2 V}$

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5) /2

$P_{Avg} = 100W$
$P_{max} = ?$

$P_{max} = 2\times P_{Avg} = 2(100W)$

$\boxed{P_{max} = 200W}$

6) /6

$R = 15\Omega$
$V_{eff} = 240V$
$P = ?$
$P_{max} = ?$
$P_{min} = ?$

$P_{Avg} = \frac{V^2}{R} = \frac{(240V)^2}{15\Omega} = \boxed{3.8\times10^3 W}$

$P_{max} = 2\times = 3.8\times10^3 = \boxed{7.7kW}$

$\boxed{P_{min} = 0}$

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7) /2

$f = 60Hz$

$vibrations = \frac{60}{s}\times\frac{60s}{\min}\times\frac{60\min}{hr}\times\frac{24hr}{day}$

$vibrations = 5.184\times10^6 Hz = \boxed{5.184MHz}$

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8) /4

$V_{max} = 65V$

$I_{rms} = ?$

$R = 25\Omega$

$$I_{rms} = \frac{V_{rms}}{R} = \frac{V_{max}(0.707)}{R} = \frac{65V(0.707)}{25\Omega}$$

$$\boxed{I_{rms} = 1.8A}$$

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9) /8

$V = 120V$

$I_{BD} = 11A$

$I_{VC} = 4.0A$

$t_{BD} = 0.25h$

$t_{VC} = 0.50h$

a) BD $P_{BD} = V \cdot I_{BD} = 120V(11A)$

$$\boxed{P_{BD} = 1.3kW}$$

b) VC $P_{VC} = V \cdot I_{VC} = 120V(4.0A)$

$$\boxed{P_{VC} = 0.48kW}$$

c) $$\frac{E_{BD}}{E_{VC}} = \frac{P_{BD}(t_{BD})}{P_{VC}(t_{VC})} = \frac{(1.3kW)(0.25h)}{(0.48kW)(0.5h)}$$

$$\boxed{\frac{E_{BD}}{E_{VC}} = \frac{1.4}{1}}$$

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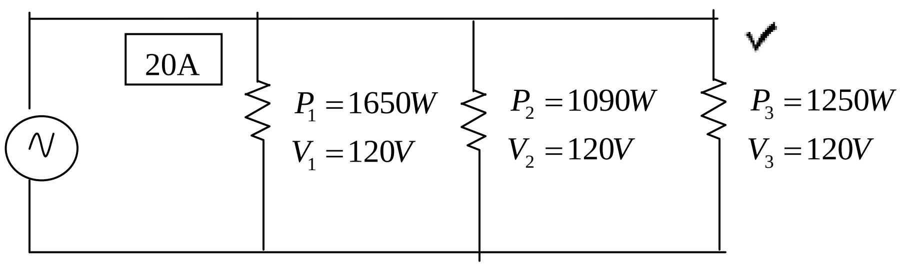
10) /12



a)

Toaster $R = \frac{V^2}{P} = \frac{(120V)^2}{1650W} = 8.73\Omega$

Iron $R = \frac{V^2}{P} = \frac{(120V)^2}{1090W} = 13.2\Omega$

Microwave $R = \frac{V^2}{P} = \frac{(120V)^2}{1250W} = 11.52\Omega$

$$\frac{1}{R_T} = \frac{1}{8.73} + \frac{1}{13.2} + \frac{1}{11.51}$$

$$\boxed{R_T = 3.61\Omega}$$

b)

$$I = \frac{V}{R} = \frac{120V}{3.61\Omega} = \boxed{33.3A}$$

circuit breaker "opens"

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11) $\frac{N_p}{N_s} = \frac{V_p}{V_s}$ ✓

/3

$\frac{13}{1} = \frac{120V}{V_s}$ ✓ $\quad V_s = \frac{120}{13} = \boxed{9.23V}$ ✓

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12) $V_p = 120.0V$ $\quad N_s = \frac{N_p N_s}{V_p}$ ✓ $= \frac{17(4150V)}{120.0V}$ ✓

/4 $V_s = 4150V$ ✓

$N_p = 17$ $\quad \boxed{N_s = 588\ turns}$ ✓

$N_s = ?$

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13) $V_p = 120.0V$ $\quad \frac{N_p}{N_s} = \frac{V_p}{V_s}$ ✓ $= \frac{120V}{10.0V} = \frac{12}{1}$ ✓

/4 $V_s = 10.0V$ ✓

$N_p / N_s = ?$ $\quad \boxed{\text{ratio is 12 to 1}}$ ✓

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14) $I_s = 3.4A$ $\quad \frac{I_s}{I_p} = \frac{N_p}{N_s}$ ✓

$I_p = ?$ ✓

/4 $\frac{N_p}{N_s} = \frac{8}{1}$ $\quad I_p = \frac{I_s N_s}{N_p} = \frac{3.4A(1)}{8}$ ✓

$\boxed{I_p = 0.43A}$ ✓

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15) $I_s = 0.10A$

$V_p = 120V$ ✓

$P = 60.0W$

/7

a) $P = I_s V_s$

$V_s = \frac{P}{I_s}$ ✓ $= \frac{60.0W}{0.10A}$ ✓

$\boxed{V_s = 6.0 \times 10^2 V}$ ✓

b) step up transformer ✓

$\frac{N_p}{N_s} = \frac{V_p}{V_s} = \frac{120V}{600V}$ ✓ $= \frac{1}{5}$ ✓

$\boxed{\text{ratio is 1 to 5}}$

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16)

$$\frac{N_p}{N_s} = \frac{1}{43}$$
$$V_p = 120V$$
$$I_s = 1.5\times10^{-3}A$$
$$P = ?$$

/7

Find V_s or I_p

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$
$$V_s = \frac{N_s}{N_p}\times V_p$$
$$V_s = \frac{43}{1}\times 120V$$
$$V_s = 5.2\times10^{3}V$$
$$P = I_sV_s = 1.5\times10^{-3}\times5.2\times10^{3}$$
$$\boxed{P = 7.7W}$$

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17)

$$P = 1.2\times10^{6}W$$
$$R = 7.0km\times 2lines\times5.0\times10^{-2}\Omega/km$$
$$R = 0.70\Omega$$
$$V = 1200V$$

/12

a)

$$I = \frac{P}{V} = \frac{1.2\times10^{6}W}{1200V}$$
$$I = 1000A$$
$$P_{loss} = RI^2 = 0.70\Omega(1000A)^2$$
$$\boxed{P_{loss} = 7.0\times10^{5}W}$$

b)

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$
$$V_s = \frac{N_sV_p}{N_p} = \frac{100(1200V)}{1} = 120000V$$

$$I = \frac{P}{V} = \frac{1.2\times10^{6}W}{1.2\times10^{5}W}$$
$$I = 10A$$
$$P_{loss} = I^2R = (10A)^2(0.70\Omega)$$
$$\boxed{P_{loss} = 70W}$$

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18)

/3

1. Electrical energy is transmitted much more efficiently with high voltage / low current
2. Transformers can be used to produce the high voltage
3. Transformers work on AC, not DC

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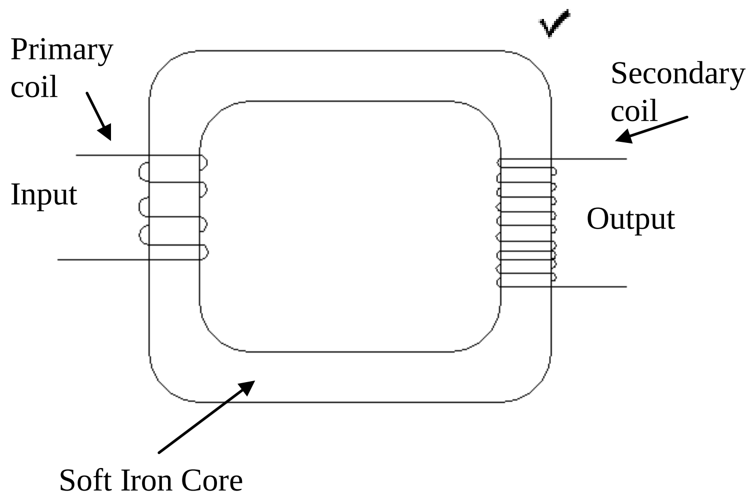
19)



/4

Primary coil ✓
- AC current induces a changing magnetic field

Iron core ✓
- connects the changing magnetic field to the secondary coil

Secondary Coil ✓
- the changing magnetic field induces a new alternating current in the coil

20)

$4KV \rightarrow 240V$ ✓

/1