Physics 12   Name:

Ultimate Electric Circuits Review Assignment
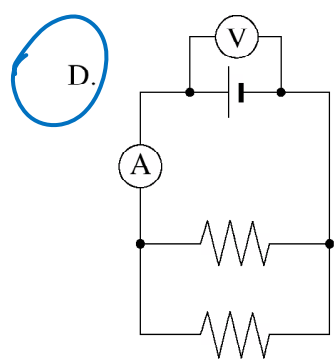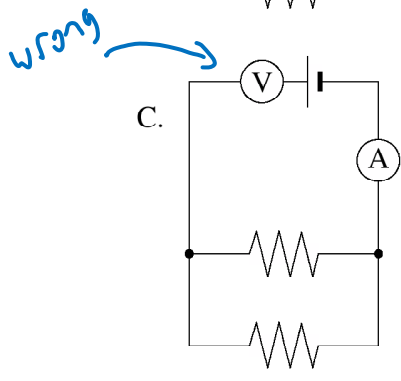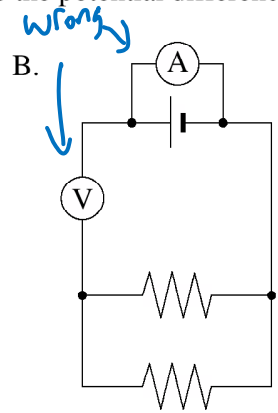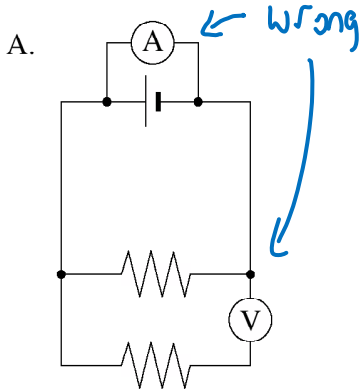
Key Formulae:

$$I = \frac{Q}{\Delta t} \qquad\qquad V = IR \qquad\qquad V_{terminal} = \varepsilon \pm Ir \qquad\qquad P = VI$$

0108

1.
Which of the following diagrams shows an ammeter correctly placed to measure the circuit current and a voltmeter correctly placed to measure the potential difference across the battery?
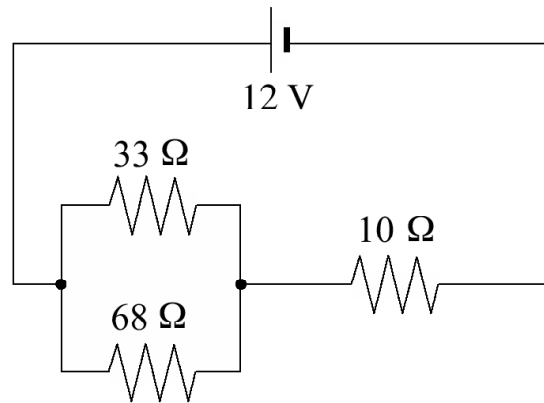
A. *wrong*

B. *wrong*

C. *wrong*

D. *(circled)*

2.

What is the current through the 10 Ω resistor in the circuit shown below?

$$\frac{1}{R_{//}} = \frac{1}{33} + \frac{1}{68}$$

$R_{//} = 22.2$

$R_{total} = 10 + 22.2 = 32.2$

12 V

33 Ω

10 Ω

68 Ω

A. 0.11 A
B. 0.37 A
C. 1.2 A
D. 1.7 A

$V_T = I_T R_T$

$$I_T = \frac{V}{R} = \frac{12}{32.2} = 0.37 \text{ A}$$

3.

Transformers are commonly used in which electrical device?

A. toaster
B. television set
C. electric kettle
D. incandescent bulb

0106
4.

Current is a measure of

A. the number of charges stored in a cell.
B. the amount of energy given to a charged object.
C. the charge passing a point in a circuit in a given time.
D. the resistance to the flow of charged particles in a circuit.

0108

5. A 12 V battery transfers 33 C of charge to an external circuit in 7.5 s.

a) What current flows through the circuit? **(2 marks)**

$$I = \frac{Q}{t} = \frac{33}{7.5}$$

$$I = 4.41 \ A$$

b) What is the resistance of the circuit? **(2 marks)**

$$R = \frac{V}{I} = \frac{12}{4.4} = 2.73 \ \Omega$$

c) What is the power output of the battery? **(2 marks)**
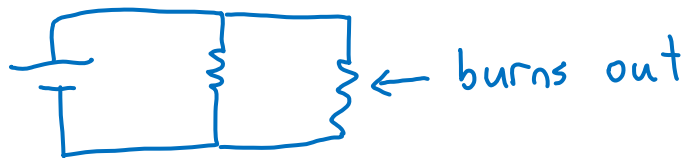
$$P = VI = (12)(4.4) = 52.8 \ W$$

d) The external circuit is most likely to consist of: (circle the correct response)

i. a bulb　　　　ii. a kettle　　　　iii. a calculator　　　　**(1 mark)**

← burns out

6.

Two identical light bulbs, wired in parallel to a battery, are equally bright. When one of the bulbs burns out, however, the other bulb is observed to glow brighter. Using principles of physics, explain why the battery causes the remaining bulb to glow more brightly. **(4 marks)**
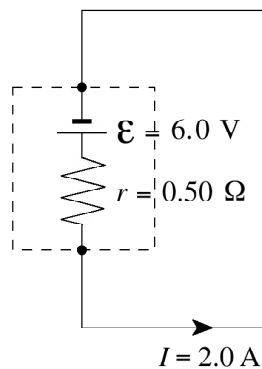
Since bulb burns out, no current flows through that junction. This means the current in the remaining bulb increases from $I/2$ to I total. Since brightness equals Power, and $P = I^2 R$, and I has

increased, P has increased.

0106

7.

The battery in the diagram below is delivering a current of 2.0 A.

$V_{AB} = \mathcal{E} - Ir$

$= 6 - 2(.5)$

$= 5$ V

$\mathcal{E} = 6.0$ V

$r = 0.50\ \Omega$

$I = 2.0$ A

What will be the reading on a voltmeter connected to the battery terminals?
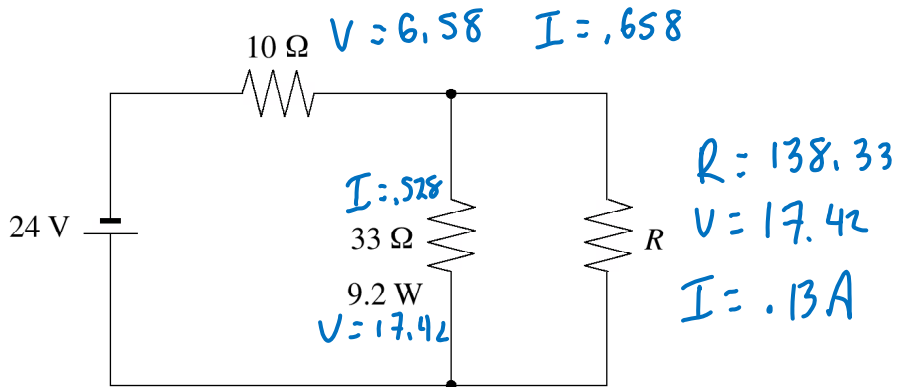
A. 1.0 V
B. 5.0 V
C. 6.0 V
D. 7.0 V

8.

What is the total power dissipated by the three resistors in the circuit shown below?
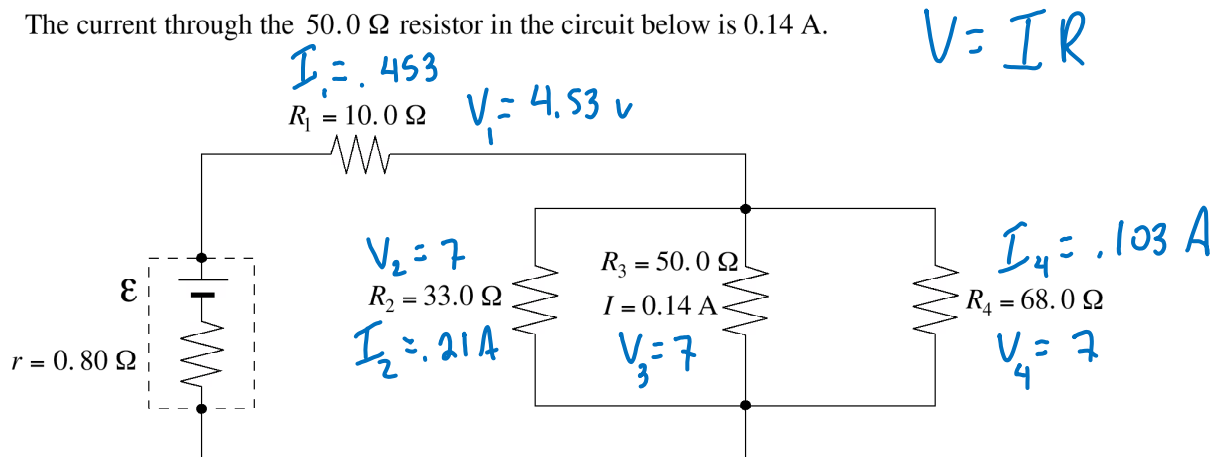
$P = I^2R$

$I = \sqrt{\dfrac{P}{R}}$

Circuit diagram annotations:

10 Ω $V = 6.58$ $I = .658$

24 V

$I = .528$

33 Ω $R = 138.33$

9.2 W R — $V = 17.42$
$V = 17.42$ $I = .13 A$

A. 12 W
B. 16 W (circled)
C. 23 W
D. 30 W

$(.658^2)(10) + (.528)^2(33) + (.13)^2(138.33)$

$= 15.8 \ W$

9.

The current through the 50.0 Ω resistor in the circuit below is 0.14 A. $V = IR$

$I_1 = .453$

$R_1 = 10.0 \ \Omega$ $V_1 = 4.53 \ v$

ε

$r = 0.80 \ \Omega$

$V_2 = 7$
$R_2 = 33.0 \ \Omega$
$I_2 = .21 A$

$R_3 = 50.0 \ \Omega$
$I = 0.14 \ A$
$V_3 = 7$

$I_4 = .103 \ A$
$R_4 = 68.0 \ \Omega$
$V_4 = 7$

a) Determine the emf of the battery.   **(5 marks)**

$V_{AB} = \varepsilon - I r_{Total}$

$I_T = .103 + .14 + .21 = .453 A$

$V_{AB} = 4.53 + 7 = 11.53 \ v$

$\varepsilon = V_{AB} + Ir = 11.53 + (.453)(.8) = 11.9 \ v$

b) Determine the power dissipated in the battery's internal resistance. **(2 marks)**

$$P = I^2 R = (.453)^2 (.8) = 0.16 \text{ W}$$
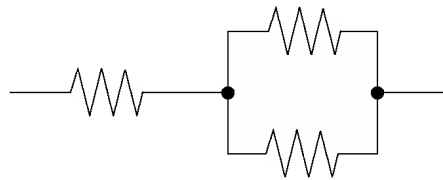
0101

10.

Which of the following combinations of three identical resistors has the least equivalent resistance?
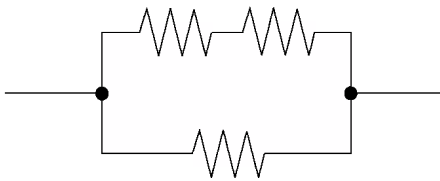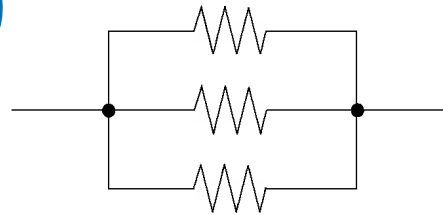
A.

B.

C.

D.

11.

An electrical device with a constant resistance draws 0.75 A when connected to a 4.8 V source. What are the current and power for this device when it is connected to a 6.0 V source?

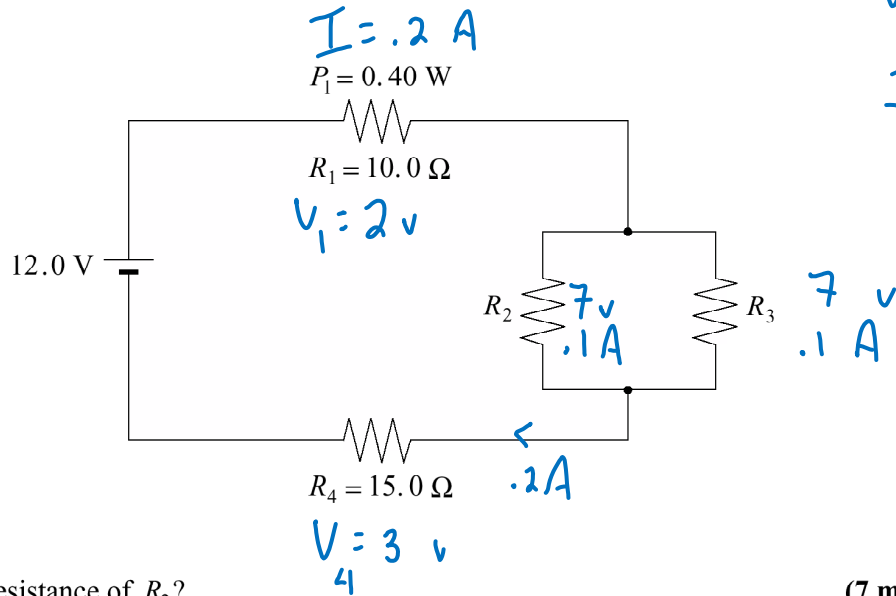|	CURRENT (A)	POWER (W)
A.	0.75 ✗	3.6 ✗
B.	0.75 ✗	5.6 ✓
C.	0.94 ✓	3.6 ✗
D.	0.94 ✓	5.6 ✓

$$V = I R$$

$$R = \frac{4.8}{.75} = 6.4 \ \Omega$$

$$I_{New} = \frac{V_{new}}{R} = \frac{6}{6.4} = .937 \text{ A}$$

$$P = VI = (6)(.937) = 5.6 \text{ W}$$

12.

In the circuit below, resistor R_1 dissipates 0.40 W. Resistors R_2 and R_3 are identical.

$$P = I^2 R$$

$$V = IR$$

$$I = \sqrt{\frac{P}{R}}$$

$I = .2$ A

$P_1 = 0.40$ W

$R_1 = 10.0 \, \Omega$

$V_1 = 2$ v

12.0 V

R_2 7 v   .1 A R_3 7 v   .1 A

$R_4 = 15.0 \, \Omega$ .2 A

$V_4 = 3$ v
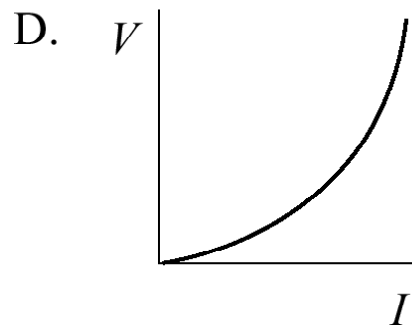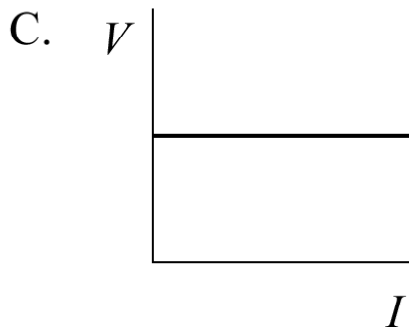
What is the resistance of R_2?   **(7 marks)**
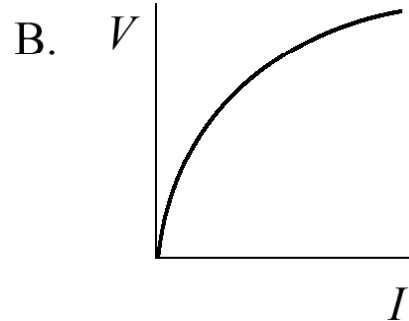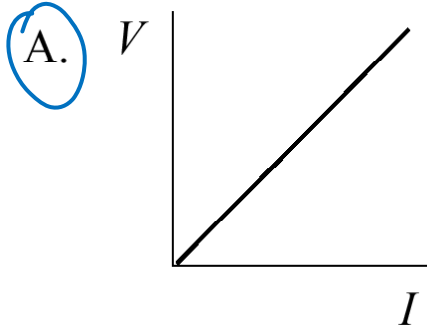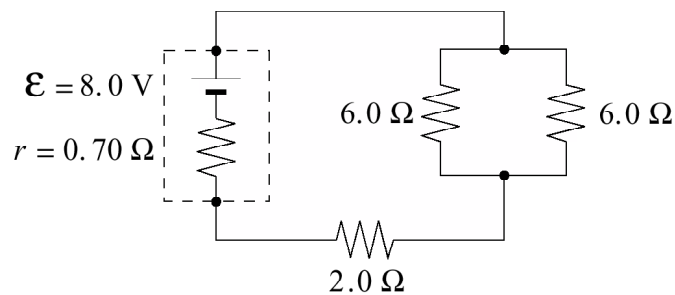
$$R_2 = \frac{V_2}{I_2} = \frac{7}{.1} = 70 \, \Omega$$

0008

13.

Which of the following graphs illustrates Ohm's law?

A. V vs I — straight line through origin (circled)

B. V vs I — concave down curve

C. V vs I — horizontal line

D. V vs I — concave up curve

14.

In the following circuit, what is the terminal voltage of the battery?

$\varepsilon = 8.0$ V

$r = 0.70\ \Omega$

$6.0\ \Omega$ $6.0\ \Omega$

$2.0\ \Omega$

A. 6.9 V
B. 7.0 V
C. 8.0 V
D. 9.0 V
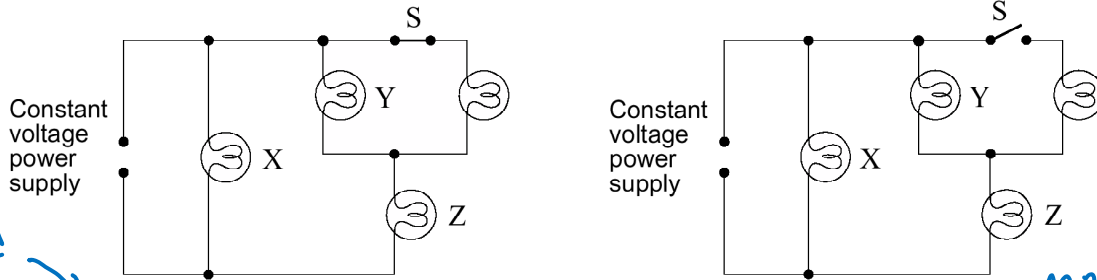
$\dfrac{1}{R_{//}} = \dfrac{1}{6} + \dfrac{1}{6}$

$R_{//} = 3\ \Omega$

$R_{total} = 3 + 2 + .7 = 5.7$

$I_T = \dfrac{V_T}{R_T} = \dfrac{8}{5.7} = 1.40\ A$

$V_{AB} = \varepsilon - I r = 8 - (1.4)(.7) = 7.0\ v$

15.

If switch S is opened, how does the brightness of each bulb (X, Y, and Z) compare to the situation when the switch was closed?

(handwritten annotations, left): voltage drop and resistance (constant) are constant x. So bulb x is constant

(handwritten annotations, right): more current goes through Y, so brighter.

	BULB X	BULB Y	BULB Z
A.	same ✓	same ✗	same
B.	same ✓	dimmer ✗	brighter
C.	same ✓	brighter ✓	dimmer ✓
D.	dimmer ✗	dimmer ✗	dimmer

(C. is circled)

16.

What is the power dissipated in the $8.0\ \Omega$ resistor in the circuit as shown?   **(7 marks)**

Circuit labels:
80.0 V
$R_1 = 12.0\ \Omega$
$I_1 = 2.985$ $V_1 = 35.8$
$R_3 = 12.0\ \Omega$ $V = 14.35$
$R_2 = 10.0\ \Omega$ $I_2 = 2.985$ $V_2 = 29.85$
$V_4 = 14.35$
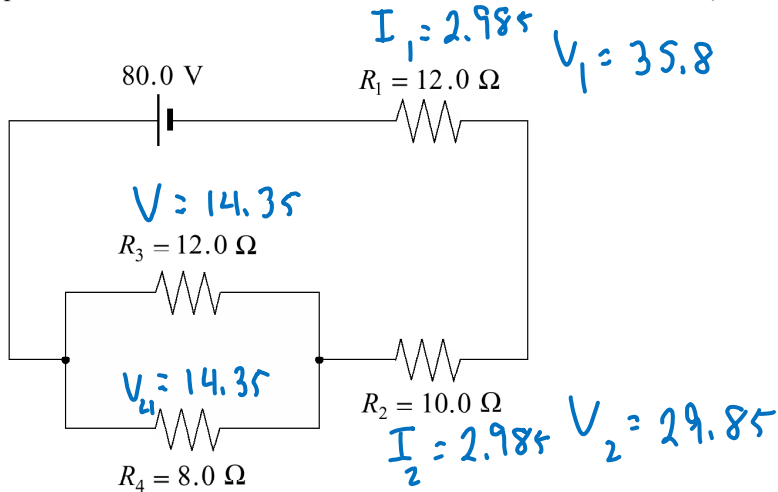$R_4 = 8.0\ \Omega$

(handwritten work):

$$\frac{1}{R_{\parallel}} = \frac{1}{12} + \frac{1}{8}$$

$$R_{\parallel} = 4.8\ \Omega$$

$$R_T = 4.8 + 10 + 12$$
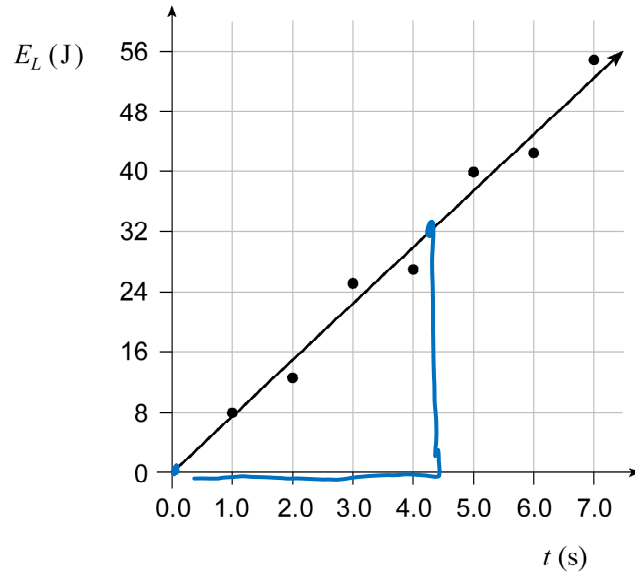
$$R_{total} = 26.8\ \Omega$$

$$I_{total} = \frac{V_T}{R_T} = \frac{80}{26.8} = 2.985\ A$$

$$P_4 = \frac{(V_4)^2}{R_4} = 25.7\ W = 26\ W$$

17.

The graph shows the light energy E_L emitted by a bulb versus time t.

E_L (J)

56
48
40
32
24
16
8
0

0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0

t (s)

a) Find the power output of the bulb.   **(2 marks)**

$$P = \frac{E}{t} = \frac{32}{4.3} \approx 7.4 \ W$$

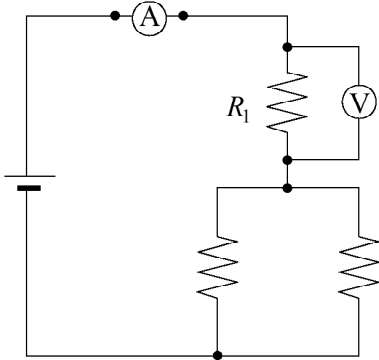b) If this bulb is 20% efficient, find the power delivered to the bulb.   **(3 marks)**

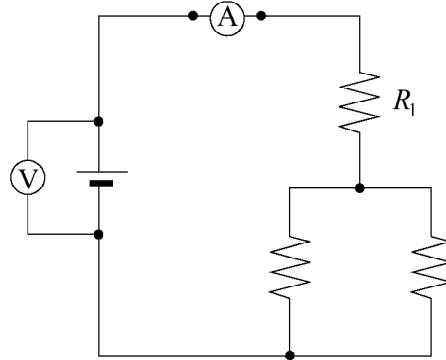$$.2 = \frac{7.4}{P_{in}} \rightarrow P_{in} = \frac{7.4}{.2} = 37 \ W$$

18.

Which one of the following shows the correct placement of an ammeter and a voltmeter to determine the power output of resistor R_1?
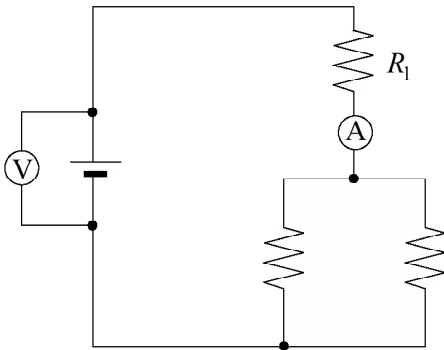
A.

B.

C.

D.
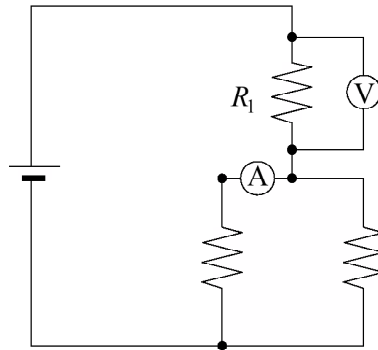
19.

What is the terminal voltage of the battery in the circuit shown below?

0.50 Ω   6.00 V

4.00 Ω
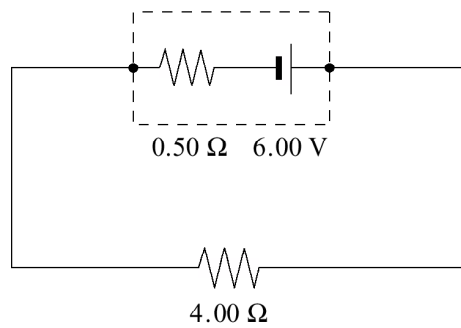
A.   5.25 V
B.   5.33 V
C.   6.00 V
D.   6.67 V

$$I_T = \frac{V_T}{R_T}$$

$$I_T = \frac{6}{4.5} = 1.33 \, A$$

$$V_{AB} = \mathcal{E} - I_r$$

$$= 6 - (1.33)(.5) = 5.33 \quad v$$

20.

In circuit one, resistors and voltmeters are connected as shown. In circuit two, an additional resistor R_4 is placed in parallel with resistor R_2.

Circuit One
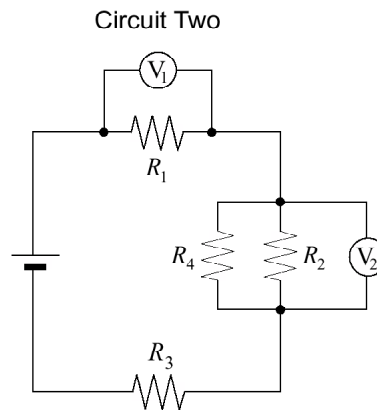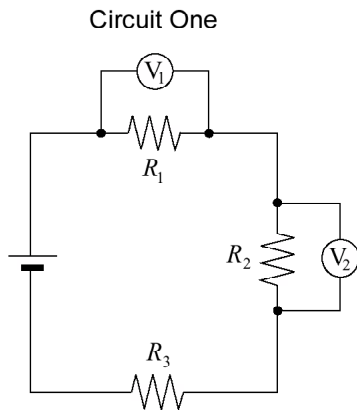
Circuit Two

adding R_4 lowers overall resistance, which increases overall current.

How have the values of V_1 and V_2 in circuit two changed compared to those in circuit one?

	V_1	V_2
A.	no change ✗	decreased ✓
B.	decreased ✗	increased ✗
C.	increased ✓	decreased ✓
D.	increased ✓	no change ✗

∴ V_1 will increase

However, less current will go through R_2, so V_2 will decrease.

21.

A current of 1.50 A flows through the 40.0 Ω resistor.

$I_1 = 7.5\ A$ $V_1 = 45\ v$

$R_1 = 6.0\ \Omega$

$V_2 = 60\ v$

$I_3 = 1.50\ A$

$V_3 = 60\ v$

V

$R_2 = 10.0\ \Omega$

$R_3 = 40.0\ \Omega$

$I_2 = 6A$

$R_4 = 4.0\ \Omega$

$I_4 = 7.5\ A$ $V_4 = 30\ v$
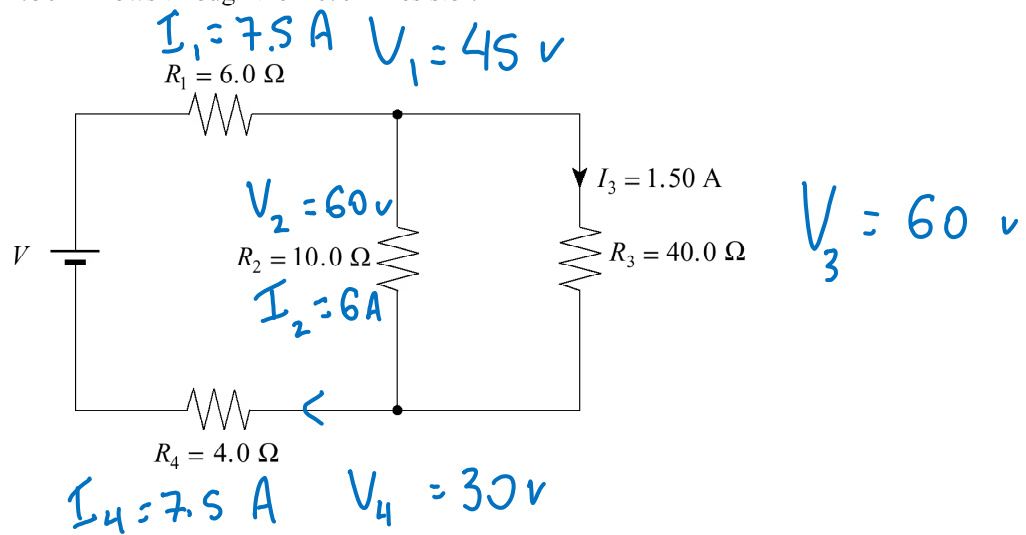
What is the potential difference of the power supply? **(7 marks)**
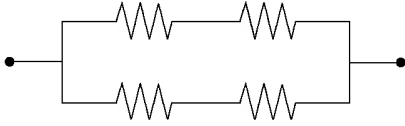
$$V = V_1 + V_2 + V_4 = 45 + 60 + 30$$

$$V = 135\ v$$

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22.

Biggest current means smallest R.

Which of the following arrangements would draw the largest current when connected to the same potential difference? All resistors have the same value.

A.

B.
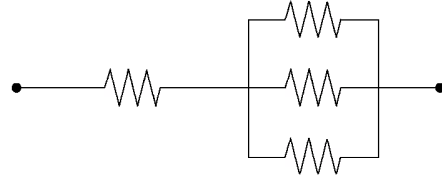
C.
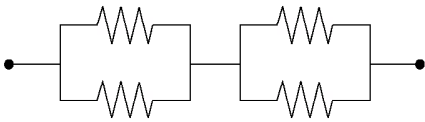
D.
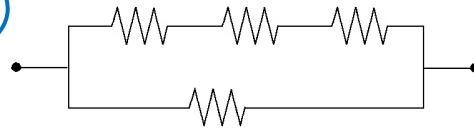
23.

What is the power dissipated by the 5.0 Ω resistor in the following circuit?

10 Ω

25 V

30 Ω   30 Ω

5.0 Ω
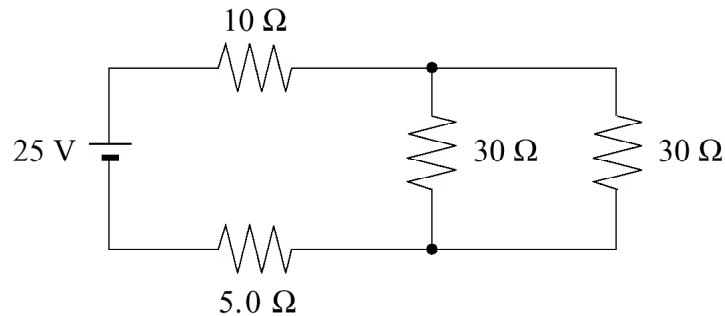
A. 0.56 W
B. 3.5 W
C. 6.2 W
D. 130 W

$$\frac{1}{R_{\parallel}} = \frac{1}{30} + \frac{1}{30} \qquad R_{\parallel} = 15 \ \Omega$$

$$R_T = 10 + 15 + 5 = 30$$

$$I_T = \frac{V}{R} = \frac{25}{30} = \frac{5}{6} \ A$$

$$P = I^2 R = \left(\frac{5}{6}\right)^2 (5) = 3.5 \ W$$

$P = VI$

24.

The circuit shown consists of an 8.00 V battery and two light bulbs. Each light bulb dissipates 5.0 W. Assume that the light bulbs have a constant resistance. Switch S is open.

Lamp A $5W$ $I_A = 1.5$ A $V_A = 3.33$

$\mathcal{E} = 8.00$ V

r

S

Lamp B $5W$ $I_B \approx 1.5$ A $V_B = 3.33$

$I = 1.50$ A
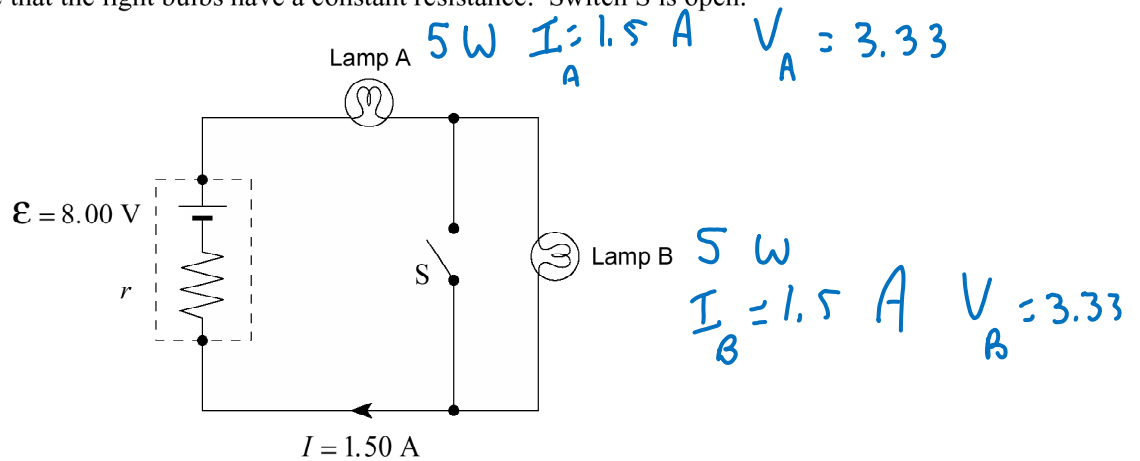
a) If a current of 1.50 A flows in the circuit, what is the internal resistance r of the battery?

(4 marks)

$8 = 1.5r + 3.33 + 3.33$

$1.33 = 1.5r$

$r = \dfrac{1.33}{1.5} = 0.89 \ \Omega$

9908

25.

Electricity is transmitted at high potential to

A. operate heavy equipment.
B. maximize current in the transmission lines.
C. minimize the energy lost as heat in the transmission lines.
D. produce alternating currents because they always require high voltages.

26.

Find the current flowing through resistor R_2 in the circuit shown below.

$$V = 21 \text{ V}$$
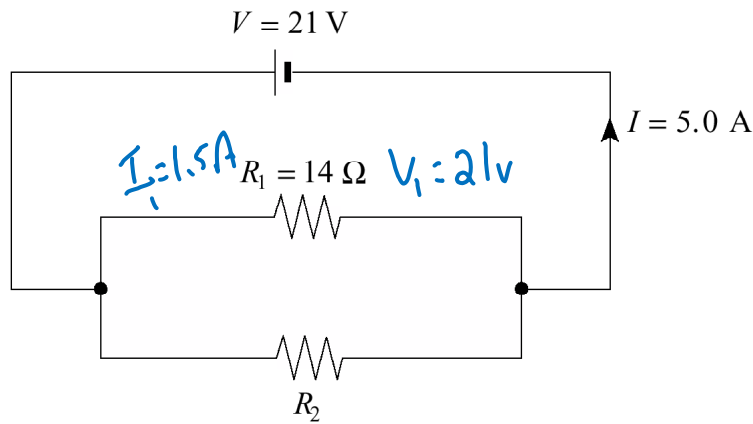
$I = 5.0$ A

$I = 1.5 A$ $R_1 = 14\ \Omega$ $V_1 = 21v$

R_2

A. 1.5 A
B. 2.5 A
C. 3.5 A
D. 5.0 A

$V_2 = 21\ v$

$I_2 = 5 - 1.5 = 3.5\ A$

27.

Bad
Question

A cell has an internal resistance of $0.50\ \Omega$. It has a terminal voltage of 1.4 V when connected to a $5.0\ \Omega$ external resistance. What will its terminal voltage be if the $5.0\ \Omega$ resistor is replaced by a $10.0\ \Omega$ resistor?

A. 0.70 V
B. 1.4 V
C. 1.5 V
D. 2.8 V

$\mathcal{E} = V_{AB} + Ir$

Need $I \rightarrow I_T = \dfrac{V_T}{R_T} = \dfrac{1.4}{5.0} = 0.28\ A$

$\mathcal{E} = 1.4 + (0.28)(.5) = 1.54$ ✓

new current: $I_T = \dfrac{V_T}{R_T} = \dfrac{1.54}{10.5} = 0.14\overline{6}$

$V_{AB} = \mathcal{E} - Ir$
$= (1.54) - (.14\overline{6})(.5)$

$V_{AB} = 1.47\ v$

28.

a) Find the value of resistor R_2. **(5 marks)**

$R_3 = 5.0\ \Omega$ $V_3 = 9\ v$

$I = 1.8\ A$

$R_4 = 10.0\ \Omega$

$I = 2.40\ A$

$V_4 = (10)(2.4) = 24\ v$

$R_1 = 6.0\ \Omega$ R_2

$I_1 = 0.60\ A$
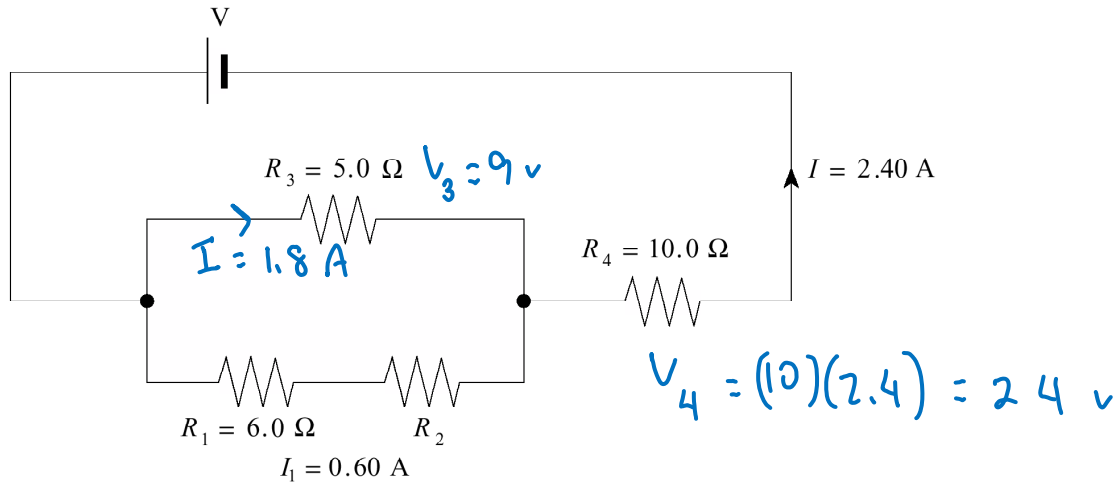
b) Find the potential difference of the power supply, V. **(2 marks)**

I did (b) first

b) $V = 9 + 24 = 33\ v$

a) Both branches must be 9 v, so...

$9 = (.6)(6) + .6(R_2)$

$R_2 = 9\ \Omega$

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29.

The circuit shown below includes two ammeters and two voltmeters. Identify the correct placement of these meters.
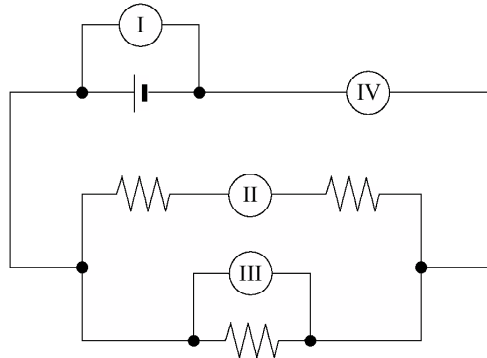

	AMMETERS	VOLTMETERS
A.	I, II ✗	III, IV
B.	I, III ✗	II, IV
C.	II, IV ✔	I, III
D.	III, IV ✗	I, II

30.

A 120 V supply is connected to a heater of resistance 15 Ω. What must the resistance of another heater be in order to produce the same power output when connected to a 240 V supply?

A. 3.8 Ω
B. 7.5 Ω
C. 30 Ω
D. 60 Ω

$$P = \frac{V^2}{R} = \frac{120^2}{15}$$

$$P = 960 \text{ W}$$
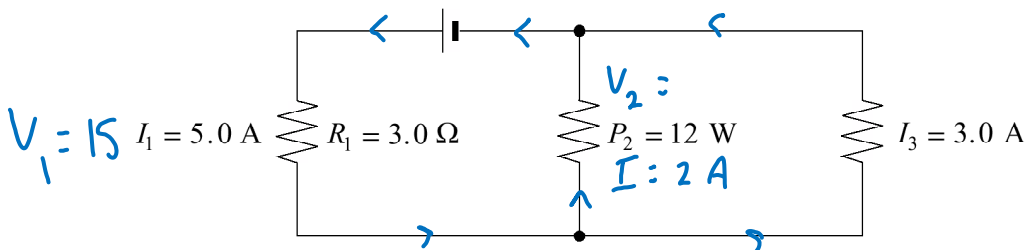
$$P = \frac{V^2}{R}$$

$$R = \frac{V^2}{P} = \frac{240^2}{960} = 60 \ \Omega$$

31.

What is the voltage of the power supply shown in the diagram?
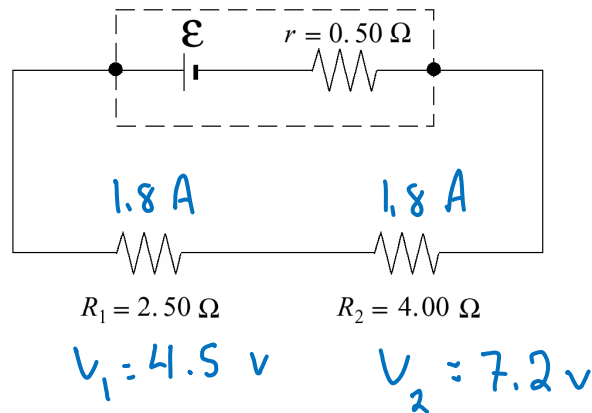

$V_1 = 15$ $I_1 = 5.0 \text{ A}$ $R_1 = 3.0 \ \Omega$ $V_2 =$ $P_2 = 12 \text{ W}$ $I = 2 \text{ A}$ $I_3 = 3.0 \text{ A}$

A. 12 V
B. 19 V
C. 21 V
D. 27 V

$$P = VI$$

$$V_2 = \frac{P_2}{I_2} = \frac{12}{2} = 6 \text{ v}$$

32.

The cell shown in the diagram supplies a 1.80 A current to the resistors R_1 and R_2.

$$\mathcal{E} \qquad r = 0.50\ \Omega$$

1.8 A   1.8 A

$R_1 = 2.50\ \Omega$ $R_2 = 4.00\ \Omega$

$V_1 = 4.5\ v$ $V_2 = 7.2\ v$

a) What is the terminal voltage of the cell?   **(3 marks)**

b) What is the emf of the cell?   **(4 marks)**

a) $V_{AB} = 4.5\ v + 7.2\ v = 11.7\ v$

b) $V_{AB} = \mathcal{E} - Ir$

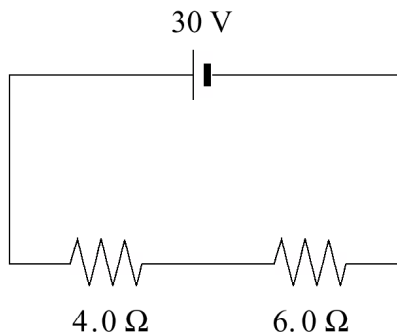$\mathcal{E} = V_{AB} + Ir = 11.7 + (1.8)(.5) = 12.6\ v$

9901

33.

Which household electrical appliance consumes the least energy in a typical month?

A. Stove
B. Dryer
C. Clock
D. Refrigerator

34.

What is the power output of the $6.0 \, \Omega$ resistor in the diagram?

$$I_T = \frac{V_T}{R_T}$$

$$I_T = \frac{30}{10} = 3 \, A$$

30 V

4.0 Ω   6.0 Ω

A. 36 W
B. 54 W
C. 90 W
D. 150 W

$$P = I^2 R = (3)^2 (6) = 54 \, W$$

35.

A $12 \, V$ power supply is connected to an $8.0 \, \Omega$ resistor for $50 \, s$. How much charge passes through the resistor?

$$I = \frac{Q}{t} \rightarrow Q = I \cdot t \qquad \text{need } I$$
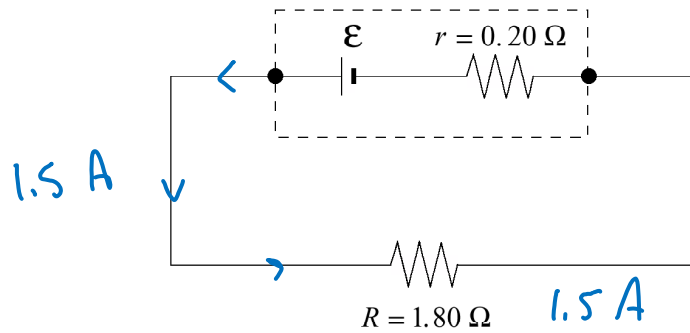
A. 1.9 C
B. 75 C
C. 900 C
D. 4 800 C

$$V = IR$$

$$I = \frac{V}{R} = \frac{12}{8} = 1.5 \, A$$

$$Q = (1.5)(50) = 75 \, C$$

36.

The cell shown delivers a 1.50 A current to the external circuit and has a terminal voltage of 2.70 V.

$$\mathcal{E} \qquad r = 0.20\ \Omega$$

1.5 A

$R = 1.80\ \Omega$ 1.5 A

a) What is the emf of the cell? $V = 2.7\ v$ **(4 marks)**

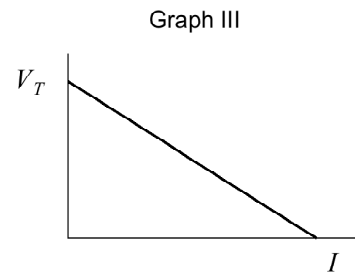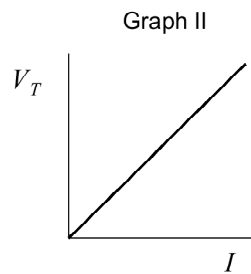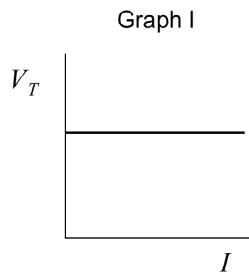$V_{AB} = 2.7\ v$

$V_{AB} = \mathcal{E} - I_r \Rightarrow \mathcal{E} = V_{AB} + I_r$

$\mathcal{E} = 2.7 + 1.5\,(.2) = 3.0\ v$

$$V_{AB} = \varepsilon - Ir$$

b) The $1.80\ \Omega$ external resistance is replaced by other resistors and the current and terminal voltage are measured in each case. Which graph best represents terminal voltage V_T versus current I as these resistors are changed? **(2 marks)**

Graph I   Graph II   Graph III

V_T V_T V_T

(Check one response.)

- Graph I
- Graph II
- ☑ Graph III

c) Using principles of physics, explain your answer to b). **(3 marks)**

$$V_{AB} = \varepsilon - Ir \ . \ \text{As } I \text{ increases,}$$

$$Ir \text{ increases } (\varepsilon \text{ is constant}), \text{ and}$$

$$V_{AB} \text{ decreases.}$$

9806

37.

In which of the following circuits is the voltmeter placed correctly to measure the terminal voltage of the battery, and the ammeter placed correctly to measure the current through the light bulb (⊗) ?

A.
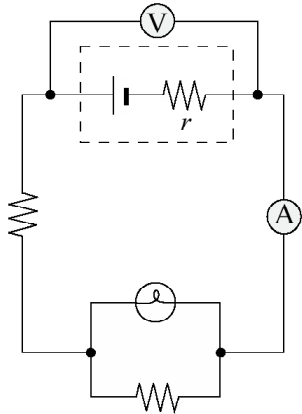
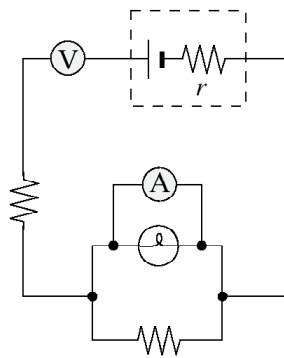B.
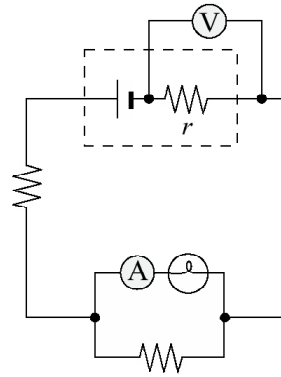
C.

D.
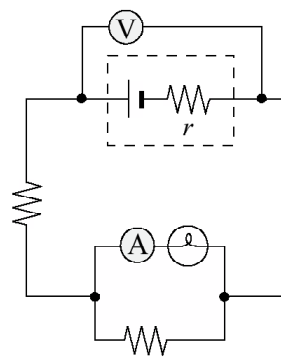
38.

What is the current leaving the battery in the circuit below?

$P_1 = 60$ W

120 V

$P_2 = 60$ W

$P_3 = 60$ W
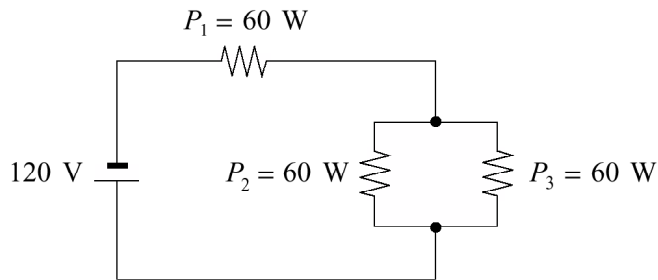
A. 1.3 A

B. 1.5 A

C. 2.0 A

D. 4.0 A

$P = VI \Rightarrow \dfrac{P}{V} = I$

$\dfrac{180}{120} \approx 1.5\ A$

39.

The circuit shown in the diagram below consists of a 9.00 V battery and a 3.50 W light bulb.

$P = VI$

$I = .4$

P = 3.50 W

$V = 8.75$ v

r

$\mathcal{E} = 9.00$ V
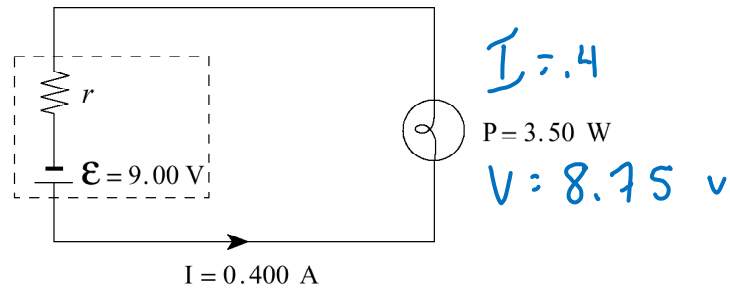
I = 0.400 A

a) If a current of 0.400 A leaves the battery, what is the internal resistance, r, of the battery? **(5 marks)**

voltage drop across internal resistor must be .25 v

$V = Ir$

$.25 = (.4)r \Rightarrow r = \frac{.25}{.4} = .63 \,\Omega$

b) The light bulb is now replaced by a lower resistance (brighter) light bulb. The terminal voltage will now be

☒ less than before.

☐ the same as before.

☐ greater than before.

(Check one response.) **(1 mark)**

c) Using principles of physics, explain your answer to b). **(3 marks)**

lower resistance means lower total resistance. This means total current will increase. Since

$$V_{AB} = \varepsilon - I r \qquad (\varepsilon \text{ and } r \text{ are constant}), \text{ if}$$

I, increases, V_{AB} decreases.

9801

40.

Which of the following statements provides valid reasoning for the transmission of electric energy at high potential?

A) At high potential there will be low current resulting in low power loss.

B. At high potential there will be high current resulting in high power loss.

C. At high potential there will be low line resistance resulting in low power loss.

D. At high potential there will be high line resistance resulting in high power loss.

41.

What is the terminal voltage of the battery in the circuit shown in the diagram?

$V_T = I_T R_T$

$\mathcal{E} = 6.0$ V

$r = 0.20\ \Omega$

$R = 2.5\ \Omega$

$I_T = \dfrac{6}{2.7} = 2.22$ A
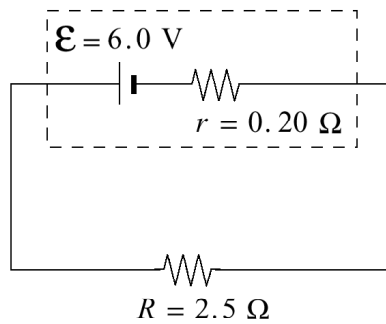
A. 0.44 V
B. 5.6 V
C. 6.0 V
D. 6.4 V

$V_{AB} = \mathcal{E} - I r = 6 - (2.22)(.2)$

$V_{AB} = 5.6$ v

42.

What is the power dissipated in the unknown resistor R_x in the circuit below?

$V = 5.80$ V

R_x

$R_1 = 5.0\ \Omega$

$R_2 = 10.0\ \Omega$

$I_2 = 0.10$ A

$V_x = 4.8$ v

$V = 1$ v

$R_1 = 5.0\ \Omega$

$I = \dfrac{V}{R}$

$I = \dfrac{1}{5} = .2$ A

$V = 1$ v
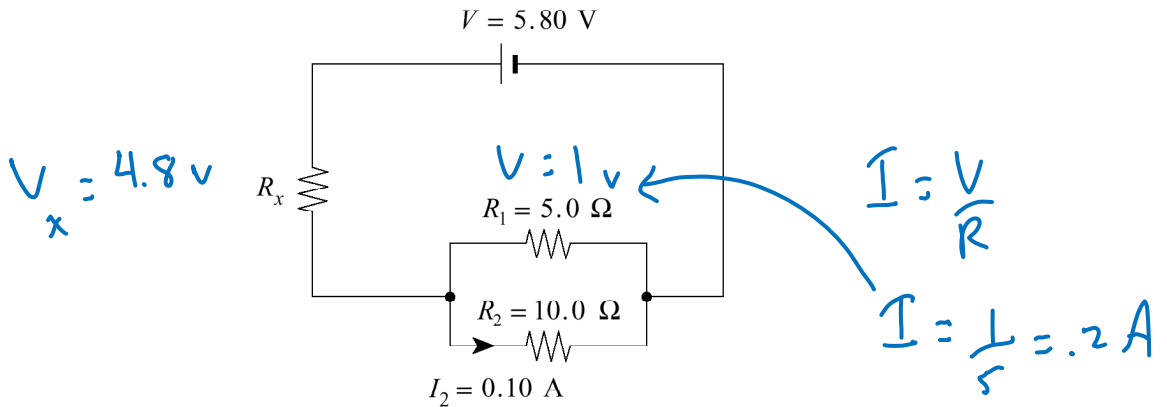
A. 0.30 W
B. 1.4 W
C. 1.7 W
D. 2.0 W

$I_{total} = .3$ A

$P = VI = (4.8)(.3) = 1.44$ W

43.

Consider the circuit shown below.

$\frac{1}{R_{\text{II}}} = \frac{1}{10} + \frac{1}{17}$

R_1

.53 A

5.0 Ω

↑ V=2.65v

6.0 V

10.0 Ω
3.35v

7.0 Ω

10.0 Ω
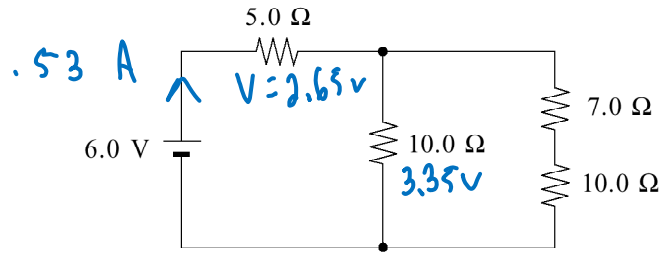
$R_{\text{II}} = 6.3 \, \Omega$

$R_{total} = 11.3 \, \Omega$

a) What is the current through the 7.0 Ω resistor?   **(5 marks)**

b) How much charge flows through the 7.0Ω resistor in a 30 s interval?   **(2 marks)**

$I_T = \frac{V_T}{R_T} = \frac{6}{11.3} = .53 \text{ A}$

The current in the 10Ω resistor is $I = \frac{V}{R} = \frac{3.35}{10} = .335 A$

The current in the 7Ω is $.53 - .335 = .20 A$

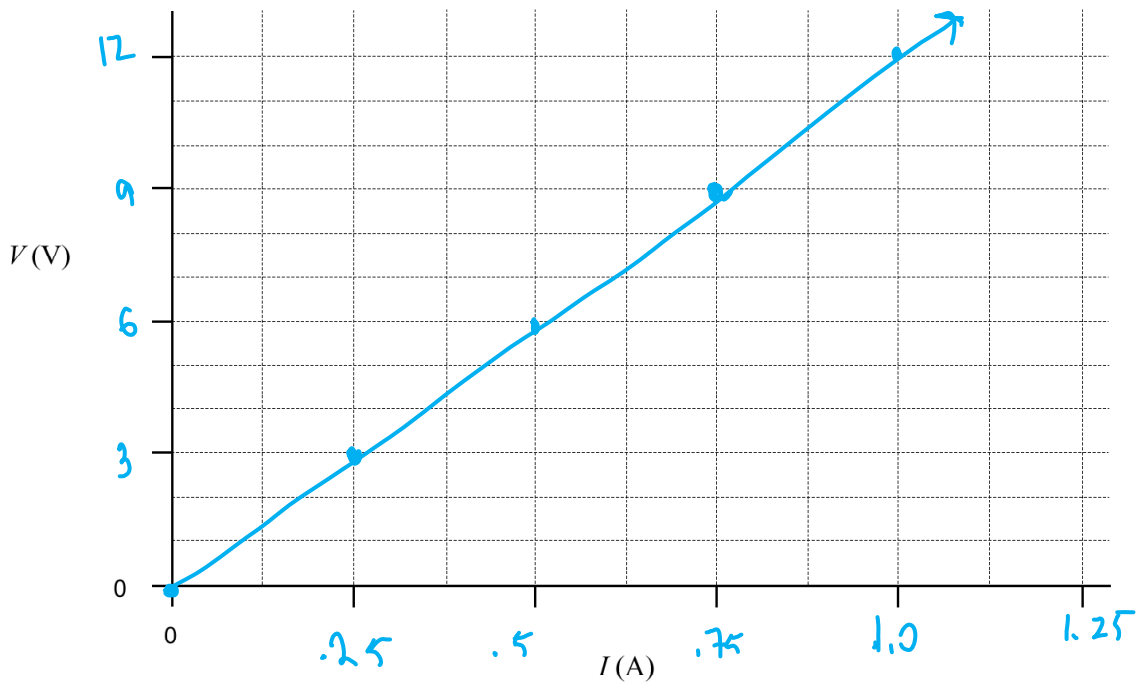b) $I = \frac{Q}{t} \Rightarrow Q = It = (.20)(30) = 6.0 \text{ C}$

44.

A student connects a power supply to a circuit and measures the potential difference V at its terminals and the current I delivered to the circuit.

V (V)	0.0	3.0	6.0	9.0	12.0
I (A)	0.00	0.25	0.50	0.75	1.00

a) Plot a graph of V versus I on the axes below. **(2 marks)**

$V = IR$

$\frac{V}{I} = R$

b) Calculate the slope of the line, expressing your answer in appropriate units. **(2 marks)**

$$\frac{12 \text{ V}}{1 \text{ A}} = 12 \ \Omega$$
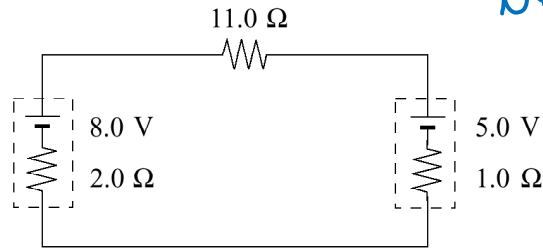
c) What does the slope of the line represent? **(1 mark)**

resistance in the circuit

9708
45.

What current flows through the 11.0 Ω resistor?

Net voltage = 3v

11.0 Ω

8.0 V
2.0 Ω

5.0 V
1.0 Ω

A. 0.21 A
B. 0.27 A
C. 0.93 A
D. 1.2 A

$I_T = \dfrac{V_T}{R_T} = \dfrac{3}{14} = 0.21\ A$

46.

Calculate the current through the 6.0 Ω resistor in the circuit shown.

16 v
4.0 Ω

4A

40.0 V

12v 6.0 Ω   10.0 Ω   15.0 Ω

3.0 Ω *12v*
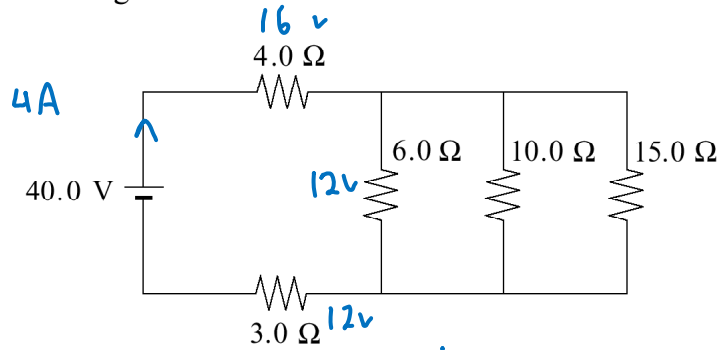
A. 1.1 A
B. 2.0 A
C. 4.0 A
D. 6.7 A

$\dfrac{1}{R_{||}} = \dfrac{1}{6} + \dfrac{1}{10} + \dfrac{1}{15}$ $R_{||} = 3\ \Omega$

$I_T = \dfrac{V_T}{R_T} = \dfrac{40}{4+3+3} = 4\ A$

$I_6 = \dfrac{V_6}{6\Omega} = \dfrac{12}{6} = 2\ A$

47.

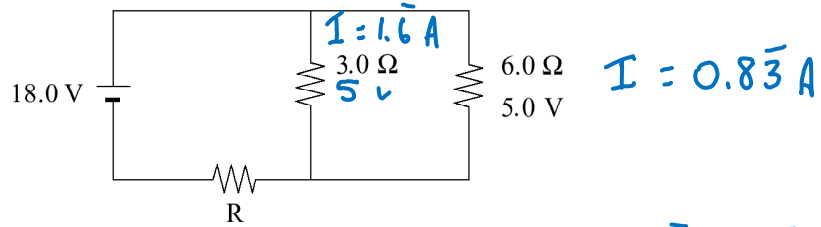In the following circuit, determine the value of resistor R.

$I = 1.6 A$

18.0 V

3.0 Ω
$5v$
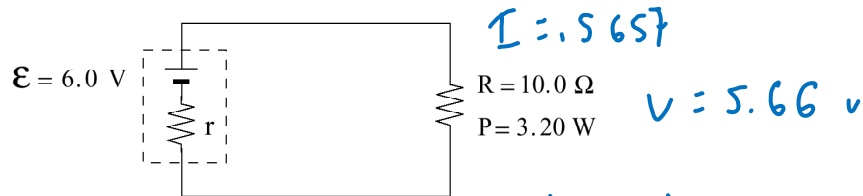
6.0 Ω
5.0 V

$I = 0.83 A$

R

A. 3.2 Ω
B. 5.2 Ω
C. 9.0 Ω
D. 23 Ω

$13v$
$I = 2.5A$

$I_T = .83 + 1.6 = 2.5A$

$R = \dfrac{V}{I} = \dfrac{13}{2.5} = 5.2\ \Omega$

48.

A battery provides 3.20 W of power to an external resistance. What power is dissipated as heat by the internal resistance within the battery?

$\varepsilon = 6.0\ V$

r

R = 10.0 Ω
P = 3.20 W

$I = .5657$

$V = 5.66v$

A. 0.19 W
B. 3.4 W
C. 3.6 W
D. 60 W

$P = I^2 R$

$I = \sqrt{\dfrac{P}{R}} = .5657 A$

Internal

$V = 6 - 5.65 = 0.34v$

$P = VI = (.34)(.5657) = .19 W$

9808
49.

Which of the following household electrical appliances has the greatest rate of energy consumption?

$P = VI$

|	ITEM	VOLTAGE	CURRENT
A.	Video Camera	6.0 V	1.6 A
B.	Radio	4.5 V	0.45 A
C.	Cassette Recorder	6.0 V	2.2 A
D.	Ghetto Blaster	12 V	1.4 A

← biggest

50.

Which of the following correctly labels arrows 1 and 2 and polarities X and Y in the circuit below?
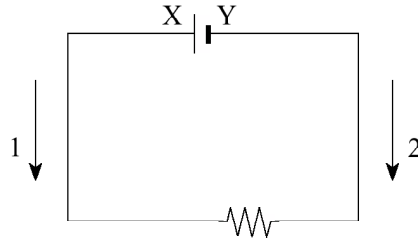
|	ARROW 1	ARROW 2	POLARITY X	POLARITY Y
A.	Electron Flow ✗	Conventional Current ✗	Positive ✓	Negative ✓
B.	Electron Flow ✗	Conventional Current ✗	Negative ✗	Positive ✗
C.	Conventional Current ✓	Electron Flow ✓	Positive ✓	Negative ✓
D.	Conventional Current ✓	Electron Flow ✓	Negative ✗	Positive ✗

51.

Switch S is originally open as shown in the circuit below.
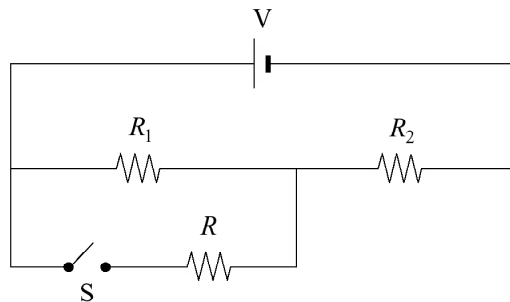
How does the current through resistors R_1 and R_2 change when switch S is closed?

	CURRENT THROUGH R_1	CURRENT THROUGH R_2
A.	increases ✗	increases ✓
B.	increases ✗	decreases ✗
C.	decreases ✓	increases ✓
D.	decreases ✓	decreases ✗

52.

What is the power dissipated in the 33 Ω resistor in the circuit shown below?   **(7 marks)**

Need I

10 Ω

.24A↑   2.4v

12 V   100 Ω   10 Ω

.24A   2.4v   33 Ω
       10 Ω
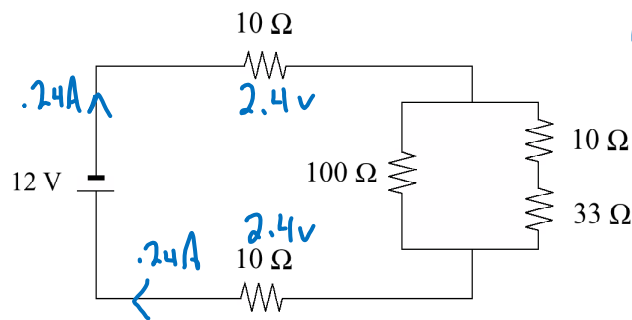
$$\frac{1}{R_{\parallel}} = \frac{1}{100} + \frac{1}{43} \Rightarrow R_{\parallel} = 30.07 \ \Omega$$

$$R_{total} = 10 + 30.07 + 10 = 50.07 \ \Omega$$
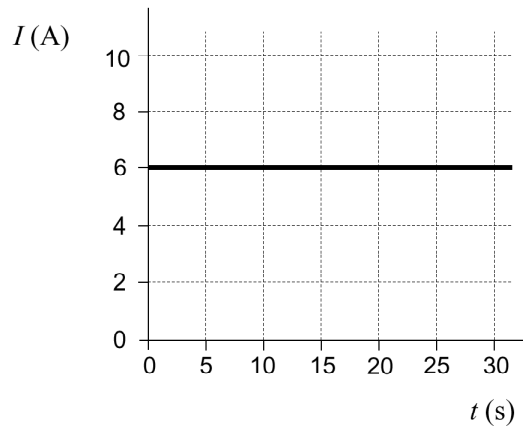
$$I_T = \frac{12}{50.07} = 0.24 A$$

$$V_{in \ 100\Omega} = 12 - 2.4 - 2.4 = 7.2v \qquad I_{in \ 100} = \frac{7.2}{100} = .072$$

∴ current in 33Ω is 0.24 - .072 = .168 A

$$P = I^2 R = (.168)^2 (33) = 0.93 \ W$$

53.

A power supply was connected to a resistor and a student plotted the graph of current, I, flowing through the resistor versus time, t, as shown below.

I (A)

[graph: horizontal line at $I = 6$ from $t = 0$ to $t = 30$; y-axis 0–10, x-axis 0–30]

t (s)

a) Calculate the area under the graph between $t = 0$ s and $t = 30$ s. **(2 marks)**

$$A = lw = (30)(6) = 180 \ A \cdot s$$
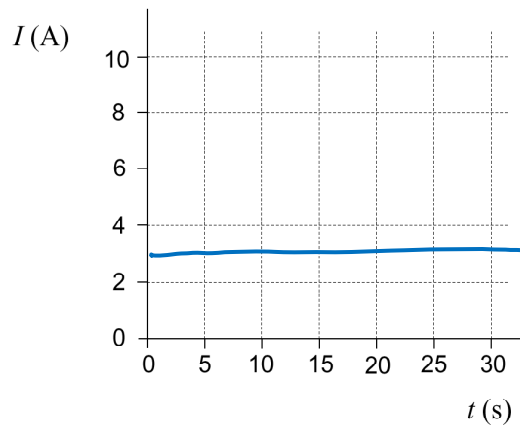
b) What does the area represent? **(1 mark)**

$$I = \frac{Q}{t} \rightarrow Q = It \quad \therefore \text{ areas is charge}$$

c) The same power supply is connected to a resistor of greater resistance. For this new set-up, sketch a possible graph on the axes below and label it c). **(2 marks)**

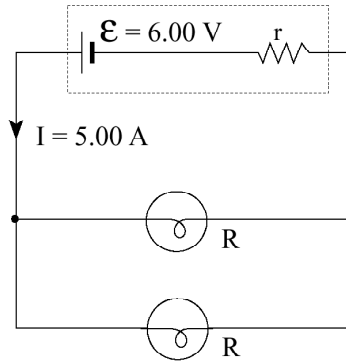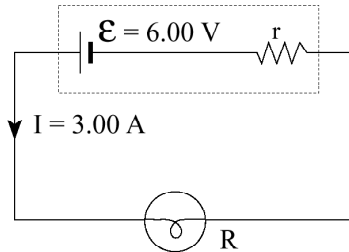same voltage

R increases

$\therefore$ I decreases

I (A)

[graph: horizontal line at $I = 3$ from $t = 0$ to $t = 30$, labelled c); y-axis 0–10, x-axis 0–30]

← possible graph

t (s)

54.

When a power supply whose emf is 6.00 V is connected to a light bulb, it delivers a 3.00 A current.
When the same supply is connected to two identical bulbs wired in parallel, the current from the
supply is 5.00 A.

$\varepsilon = 6.00$ V   r

I = 3.00 A

R

$\varepsilon = 6.00$ V   r

I = 5.00 A

R

R

Find the internal resistance of the supply.   **(10 marks)**

$$\frac{1}{R_{//}} = \frac{1}{R} + \frac{1}{R}$$

$$\frac{1}{R_{//}} = \frac{2}{R}$$

$$R_{//} = R/2$$

In circuit 1, $V_T = I_T R_T$

$$R_T = \frac{6}{3} = 2 \, \Omega \quad \therefore \boxed{r + R = 2}$$

In circuit 2, $R_T = \frac{6}{5} = 1.2 \, \Omega \quad \therefore \boxed{\frac{R}{2} + r = 1.2}$

① $r + R = 2$ ⎱ this is a system/ mult equation ②
② $r + \frac{R}{2} = 1.2$ ⎰ by -2.

① $r + R = 2$ Now add.
② $-2r - R = -2.4$

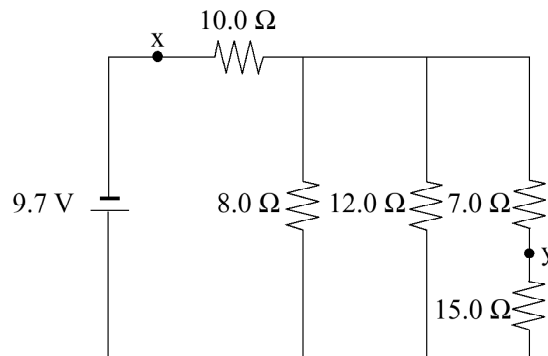$-r \quad\quad = -.4$ $\boxed{r = 0.40 \, \Omega}$

9508
55.
The diagram below shows an electrical circuit.

Find the potential difference between points **x** and **y**.   **(12 marks)**

$$\frac{1}{R_{//}} = \frac{1}{8} + \frac{1}{12} + \frac{1}{22} \qquad R_{//} = 3.94 \ \Omega$$

$$R_T = 10 + 3.94 = 13.94 \ \Omega$$

$$I_T = \frac{V_T}{R_T} = \frac{9.7}{13.94} = 0.696 \ A \qquad \therefore V_{10\Omega} = (.696)(10) = 6.96 \ V$$

$$\therefore V_{in \ parallel} = 9.7 - 6.96 = 2.74 \ V$$

current y $\rightarrow$ $I_y = \frac{V}{R} = \frac{2.74}{22} = 0.124 \ S$

$$V_{7\Omega} = (0.124)(7) = 0.87 \ V$$

Total Drop: $6.96 + .87 = 7.8 \ V$

Answers:

1. D
2. B
3. B
4. C
5. a) 4.4 A b) 2.7 Ω c) 53 W d) (i)
6. see solution key
7. B
8. B
9. a) 12 v b) 0.16 W
10. D
11. D
12. 70 Ω
13. A
14. B
15. C
16. 26 W
17. a) 7.6 W b) 38 W
18. A
19. B
20. C
21. 135 v
22. D
23. B
24. a) 0.89 Ω
25. C
26. C
27. C
28. a) 9 Ω b) 33.0 v
29. C
30. D
31. C
32. a) 11.7 v b) 12.6 v
33. C
34. B
35. B

36. a) ε=3.00 v b) Graph III
    c) If R is increased in value, the total resistance of the circuit increases, and the total current I decreases. There is then a smaller potential difference across *r* so that the terminal voltage is higher.
37. D
38. B
39. a) r= 0.63 Ω b) less than before
    c) The total resistance of the circuit will decrease, therefore the current through the battery will increase. More potential will be dropped across the internal resistance, therefore the terminal voltage will decrease.
40. A
41. B
42. B
43. a) 0.20 A b) 6.0 C
44. b) 12 Ω c) resistance of the circuit
45. A
46. B
47. B
48. A
49. D
50. C
51. C
52. 0.95 W
53. a) 180 C b) the charge delivered
    c) see solution key
54. r= 0.40 Ω
55. 7.9 v