AP® Physics B
2003 Sample Student Responses

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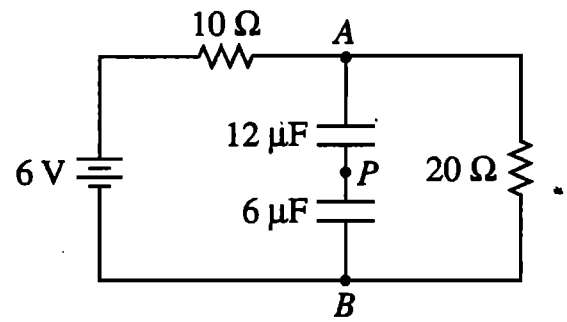
F1



2. (15 points)
A circuit contains two resistors (10 Ω and 20 Ω) and two capacitors (12 μF and 6 μF) connected to a 6 V battery, as shown in the diagram above. The circuit has been connected for a long time.

(a) Calculate the total capacitance of the circuit.

$C_1 = 12\ \mu F \quad C_2 = 6\ \mu F$

$$C_T = \left(\frac{1}{C_1} + \frac{1}{C_2}\right)^{-1}$$

$$= \left(\frac{1}{12\ \mu F} + \frac{1}{6\ \mu F}\right)^{-1}$$

$$= \left(\frac{3}{12\ \mu F}\right)^{-1}$$

$$= 4\ \mu F$$

(b) Calculate the current in the 10 Ω resistor.

$R_1 = 10\ \Omega \quad R_2 = 20\ \Omega$

$$R_T = R_1 + R_2$$

$$= 30\ \Omega$$

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

$$= \frac{6\ V}{30\ \Omega} = 0.20\ A$$

(c) Calculate the potential difference between points *A* and *B*.

$$V_1 = R_1 I$$

$$= 10\ \Omega \cdot 0.20\ A$$

$$= 2\ V$$

$V_{point\ A}$

$= V_T - V_1$

$= 6\ V - 2\ V$

$= 4\ V$

$$\Delta V_{BA} = V_B - V_A$$

$$= 0\ V - 4\ V$$

$$= -4\ V$$

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F2

(d) Calculate the charge stored on one plate of the 6 μF capacitor.

$$V_2 = IR_2$$
$$= 0.20A \cdot 20\Omega$$
$$= 4V$$

Q is the same in series

$$Q = C_T V \qquad C_1 = 4\mu F$$
$$= 4 \times 10^{-6} \frac{C}{V} \cdot 4V$$
$$= 1.6 \times 10^{-5} C$$

(e) The wire is cut at point P. Will the potential difference between points A and B increase, decrease, or remain the same?

____ increase ____ decrease ___✓ remain the same

Justify your answer.

Since the wire with the two capacitors and the wire with a 20 Ω resistor are in parallel with each other, the votage passes each wire would have the same value. which is 4 V. At point A, there is a voltage drop of 2 V after the 10 Ω resistor. At point B, the circuit would need experiences the total of 6 V voltage drop since that is the total voltage of the battery. Thus even if the wire is cut at point P, the potential difference between point A and B would remain the same

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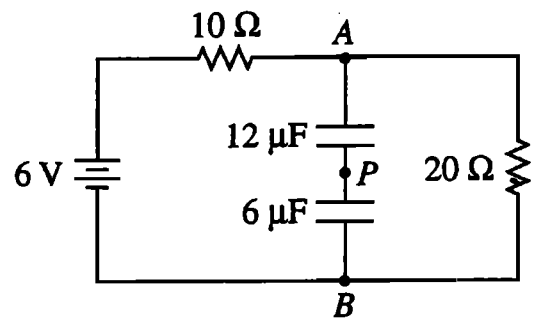
G1



2. (15 points)
A circuit contains two resistors (10 Ω and 20 Ω) and two capacitors (12 μF and 6 μF) connected to a 6 V battery, as shown in the diagram above. The circuit has been connected for a long time.

(a) Calculate the total capacitance of the circuit.

Capacitors in series $\frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{C_{tot}}$

$\frac{1}{\frac{1}{12E^{-6}} + \frac{1}{6E^{-6}}} =$ [illegible]

$4E^{-6}$

4 μF

(b) Calculate the current in the 10 Ω resistor.

$V = IR$ $\quad R = 10 + 20\ \Omega$

$6 = I(30)$

$I = 0.2\ A$

(c) Calculate the potential difference between points *A* and *B*.

$V = IR$ $\quad V = \left(\frac{1}{5}\right)(20)$

voltage in parallel paths is equal

$V = 4$

4V

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G2

(d) Calculate the charge stored on one plate of the 6 μF capacitor.

$$C = \frac{Q}{V}$$

$$6\,\mu F = \frac{Q}{6V} = 1\,\mu C$$

(e) The wire is cut at point P. Will the potential difference between points A and B increase, decrease, or remain the same?

____ increase ____ decrease ✓ remain the same

Justify your answer.

The was no current running through the capacitors after they were charged, so after the wire is cut there will still be no current, so the voltage from A to B will not change

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