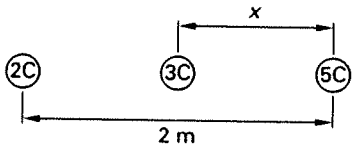
Electrical (9% of morning session questions, 11/120)
FE - type questions

4 hrs / 120 questions = 2 min each. (ave)

1. The net force on the center charge is zero for the system of three colinear charges shown. What is the distance x?



(A) 0.77 m
(B) 1.11 m
(C) 1.17 m
(D) 1.23 m

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*6.33 The electric flux passing out through a closed surface is equal to
a) the line integral of the current around the surface.
b) zero.
c) the flux density at the surface.
d) the total charge enclosed by the surface.

6.36 A point charge of 2×10^{-7} C is located at the origin of coordinates. A spherical shell with center at the origin and radius of 20 cm has a surface charge density 1×10^{-7} C/m^2. The electric flux density at r = 50 cm, in C/m^2, is
a) 3.18×10^{-8} c) 9.55×10^{-8}
b) 7.96×10^{-8} d) 11.14×10^{-8}

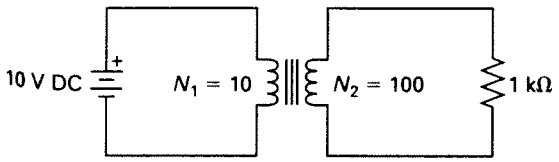
5. A current of 10 A flows through a 1 mm diameter wire. What is the average number of electrons that pass through a cross section of the wire per second?

(A) 1.6×10^{18} e/s
(B) 6.2×10^{18} e/s
(C) 1.6×10^{19} e/s
(D) 6.3×10^{19} e/s

*6.34 The direction of the force acting on a moving charge placed in a magnetic field is
a) perpendicular to the magnetic field.
b) opposite to the direction of motion of the charge.
c) along the direction of the magnetic field.
d) along the direction of motion of the charge.

*6.41 Two long, straight conductors located at (0,3,z) and (0,–3,z) each carry 5 amperes in the same direction (distances are in meters). The magnitude of magnetic field intensity at (4,0,0) is
a) $1/\pi$ b) $2/5\pi$ c) $3/5\pi$ d) $4/5\pi$

14. How much power is dissipated by the 1 kΩ resistor?



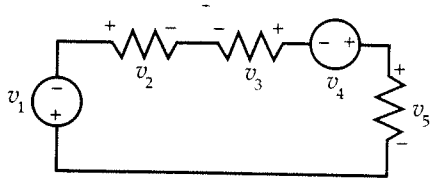
(A) 0 W
(B) 0.1 W
(C) 1 W
(D) 10 W

2. A heating element consists of two wires of different materials connected in series. At 20°C, they have resistances of 600 Ω and 300 Ω, and average temperature coefficients of 0.001 1/°C and 0.004 1/°C, respectively. What is the heating element's total resistance at 50°C?

(A) 900 Ω
(B) 950 Ω
(C) 980 Ω
(D) 990 Ω

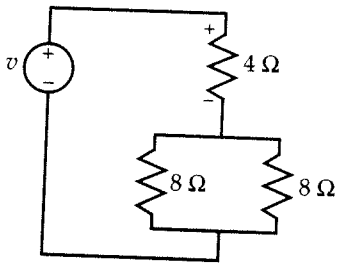
*6.1 For the circuit below, with voltages' polarities as shown, KVL in equation form is

a) $v_1 + v_2 + v_3 - v_4 + v_5 = 0$
b) $-v_1 + v_2 + v_3 - v_4 + v_5 = 0$
c) $v_1 + v_2 - v_3 - v_4 + v_5 = 0$
d) $-v_1 - v_2 - v_3 + v_4 + v_5 = 0$

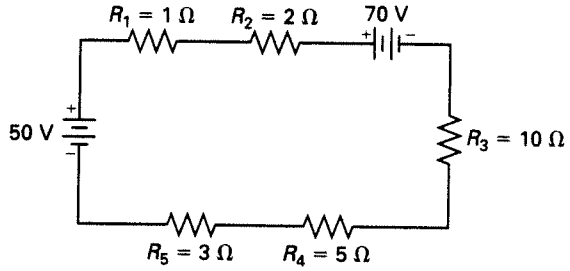


*6.4 For the circuit shown, the voltage across the 4 ohm resistor is, with v = 1 V

a) 1/4
b) 1/2
c) 2/3
d) 2



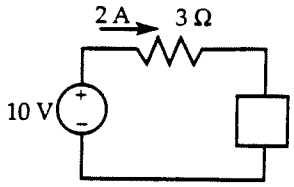
6. What is the voltage across the 10 Ω resistor in the circuit shown?



(A) 9.5 V
(B) 24 V
(C) 33 V
(D) 57 V

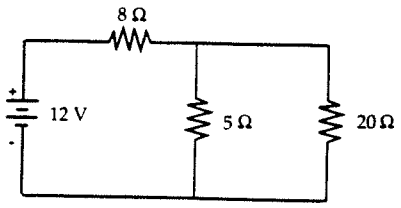
*6.3 Find the magnitude and sign of the power, in watts, absorbed by the circuit element in the box.

a) –20
b) –8
c) 8
d) 12

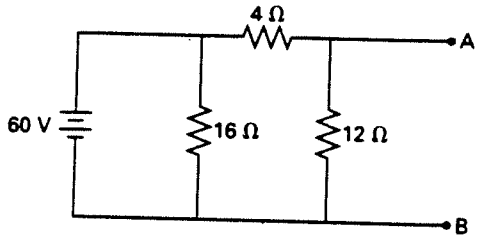


6.7 The power delivered to the 5 ohm resistor is

a) 1.5
b) 2.15
c) 2.85
d) 3.2



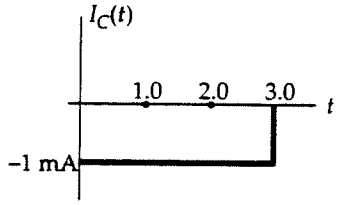
7. What are the Thevenin equivalent resistance and voltage between terminals A and B?



(A) $R_{Th} = 3\ \Omega,\ V_{Th} = 45$ V
(B) $R_{Th} = 7.5\ \Omega,\ V_{Th} = 7.5$ V
(C) $R_{Th} = 7.5\ \Omega,\ V_{Th} = 60$ V
(D) $R_{Th} = 12\ \Omega,\ V_{Th} = 5$ V

6.29 A 100 μF capacitor has $I_C(t)$. The capacitor voltage $V_c(t)$ at $t = 2.5$ seconds $(V(0) = 1.0\ \text{V})$ is most nearly

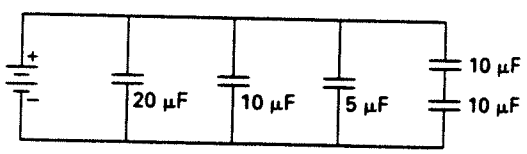
a) –24
b) –25
c) 25
d) 26



6.30 The voltage across a 10 μF capacitor is $50t^2$ V. The time, in seconds, it will take to store 200 J of energy is most nearly

a) 0.15 b) 0.21 c) 1.38 d) 11.25

22. What is the equivalent capacitance seen by the battery for the circuit shown?

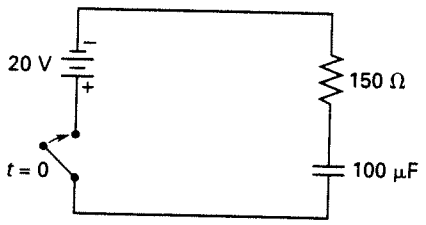


(A) 3 μF
(B) 30 μF
(C) 40 μF
(D) 50 μF

15. A 10-microfarad capacitor has been charged to a potential of 150 volts. A resistor of 25 Ω is then connected across the capacitor through a switch. When the switch is closed for 10 time constants, the total energy dissipated by the resistor is most nearly

(A) 1.0×10^{-7} joules
(B) 1.1×10^{-1} joules
(C) 9.0×10^{1} joules
(D) 9.0×10^{3} joules

28. The switch in the circuit shown is closed at $t = 0$. How long will it take to charge the capacitor to 80% of the battery voltage?



(A) 2.0 ms
(B) 10 ms
(C) 12 ms
(D) 24 ms

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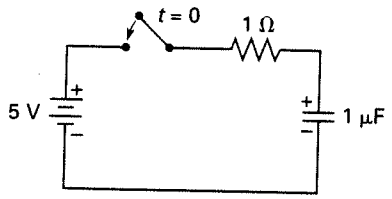
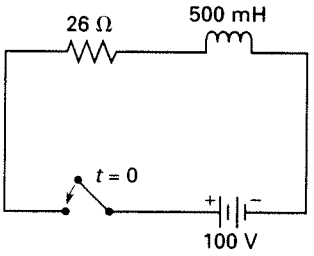
29. The initial voltage across the capacitor is 2.5 V. The switch is closed at $t = 0$. What is the current at $t = 0$ s?



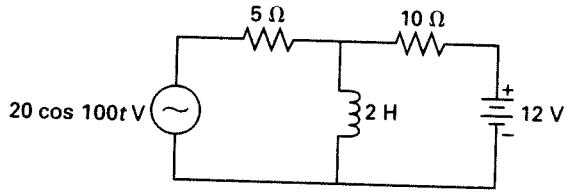
(A) 0.2 A
(B) 0.7 A
(C) 1.0 A
(D) 2.5 A

27. The switch in the circuit shown is closed at $t = 0$. What is the voltage across the inductor at $t = 30$ ms?



(A) 1.0 V
(B) 19 V
(C) 21 V
(D) 48 V

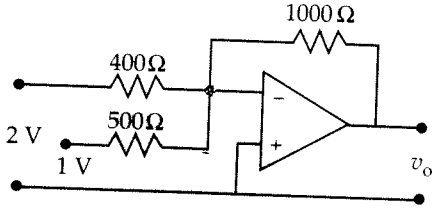
31. What is the average DC current through the inductor?



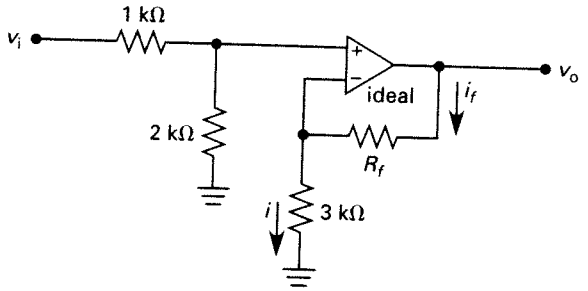
(A) 0 A
(B) 0.8 A
(C) 1.2 A
(D) 3.2 A

6.51 Given the voltages into the following OP-AMP network, the output voltage is

a) –2
b) –4
c) –7
d) –10



4. For the ideal op amp shown, what should be the value of resistor R_f to obtain a gain of 5?



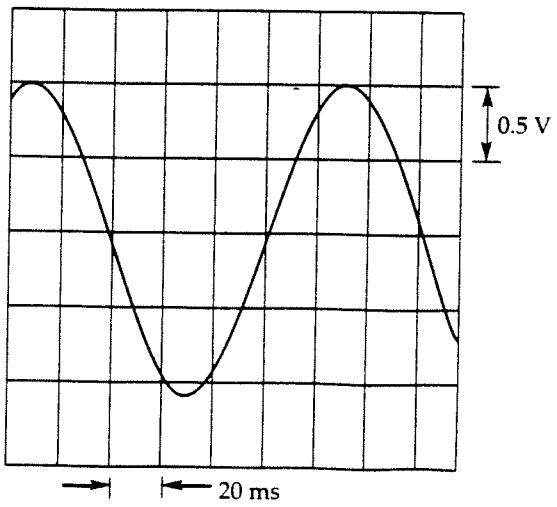
(A) 12.0 kΩ
(B) 19.5 kΩ
(C) 22.5 kΩ
(D) 27.0 kΩ

*6.12 $(2+j2)(3-j4)$ is most nearly

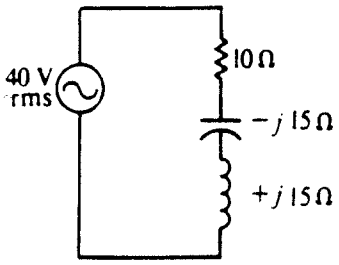
a) $6.0\angle -21.8°$ b) $14.1\angle -21.8°$ c) $14.1\angle -8.1°$ d) $28.0\angle -8.1°$

*6.13 The following sinusoid is displayed on an oscilloscope. The RMS voltage and the radian frequency are most nearly

a) 1, 8.33
b) 0.7071, 52.36
c) 1.4142, 52.36
d) 2, 8.33



26.

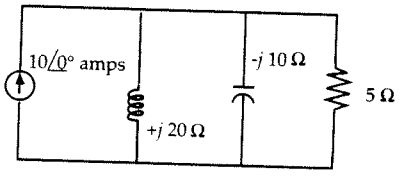


What is the magnitude of the steady-state, root-mean-square voltage across the capacitor in the circuit shown above?

(A) 15 V
(B) 30 V
(C) 45 V
(D) 60 V
(E) 75 V

6.18 The current through the capacitor is

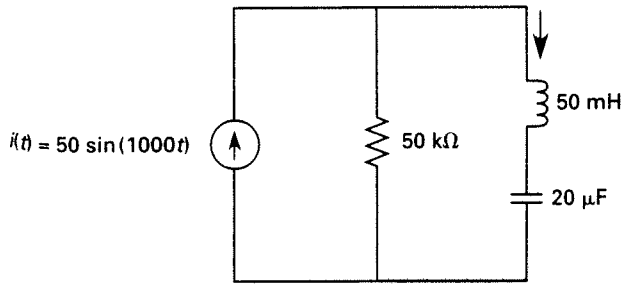
a) 0.21 A
b) 0.57 A
c) 1.0 A
d) 4.85 A



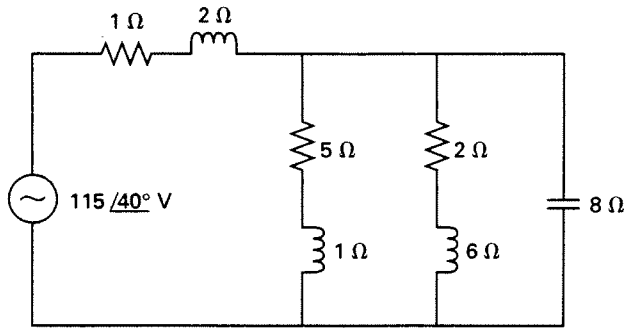
6.19 The voltage across the 5-ohm resistor of Problem 6.18 is

a) 0.50 V
b) 1.61 V
c) 2.06 V
d) 48.5 V

2. What is the current through the LC leg of the following circuit?



(A) 0
(B) $50\sin(1000t)$ A
(C) $50\sin\left(1000t + \frac{\pi}{4}\right)$ A
(D) $70.7\sin\left(1000t - \frac{3\pi}{4}\right)$ A



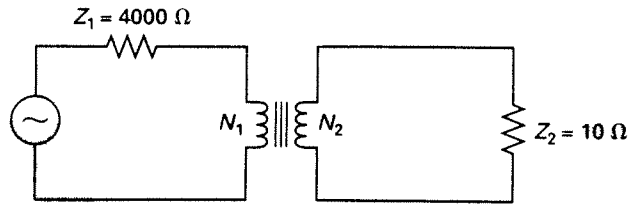
3. What is the average power dissipated by the circuit?

(A) 24 W
(B) 765 W
(C) 910 W
(D) 1970 W

6. A 13.2 kV circuit has a 10 000 kVA load with a 0.85 lagging power factor. How much capacitive reactive power (in kVAR) is needed to correct the power factor to 0.97 lagging?

(A) 2500 kVAR
(B) 3138 kVAR
(C) 4753 kVAR
(D) 5156 kVAR

7. What is the turns ratio ($N_1 : N_2$) for maximum power transfer in the following circuit?



(A) 1:40
(B) 1:20
(C) 20:1
(D) 40:1

Answers

1 D	6.33 d	6.36 b	5 D	6.34 a	6.41 d	14 A	2 B	6.1 c	6.4 b	6 A
6.3 c	6.7 d	7 A	6.29 a	6.30 d	22 c	15 B	28 D	29 D	27 C	31 C
6.51 c	4 B	6.12 c	6.13 b	26 D	6.18 d	6.19 d	2 B	3 d D	6 B	7 C