Electricity, Power and Magnetism

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Other Disciplines FE Specifications

Electricity, Power, and Magnetism   7–11 FE exam problems

A. Electrical fundamentals (e.g., charge, current, voltage, resistance, power, energy): 1-6,11

B. Current and voltage laws (Kirchhoff, Ohm): 9-14

C. DC circuits(1-14)

D. Equivalent circuits (series, parallel, Norton's,Thevenin's theorems): 7, 8, 21

E. Capacitance and inductance:15-20

F. AC circuits (e.g., real and imaginary components, complex numbers, power factor, reactance and impedance):15-28

G. Measuring devices (e.g., voltmeter, ammeter, wattmeter): 26-28

NCEES has granted us permission to copy short sections from the FE Handbook to show how to use Handbook information in solving problems. This information will appear in white boxes similar to this one.

1. Two point charges Q_1 and Q_2 , both in Coulombs, are placed r meters apart. The force on Q_2 due to the presence of Q_1 is proportional to:

(A) r (B)1/r (C) r^2 (D) $1/r^2$

2. A charge of *Q* Coulombs is placed between two parallel plates spaced d meters apart. If the voltage across the plates is V volts, the magnitude of the force on the charge *Q*, in Newtons, is:

(A) QV/d (B) Q^2V/d (C) QV/d^2 (D) QV^2/d

3. Two parallel plates in free space are separated by 0.1 mm. The voltage across the plates is 8 volts. How much work would be required to move a point charge of 2 Coulombs from the negative plate to the positive plate? (Hint: first find the force on the 2 C charge)

(A) 16 μJ (B) 40 μJ (C) 2 μJ (D) 16 J

4. If an average of 6 Coulombs pass a given point in a wire in 12 seconds, the average current in the wire in Amperes is:

(A) 0.5 (B) 2 (C) 1/6 (D) 72

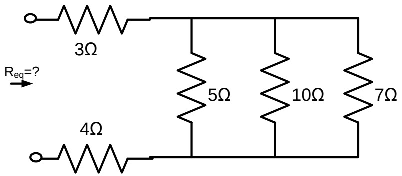
5. When 10 mA flows through a certain resistor, a voltage of 2 volts appears across it. The value of the resistor is most nearly:

(A) 2 kΩ (B) 200 Ω (C) 2 Ω (D) 0.002 Ω

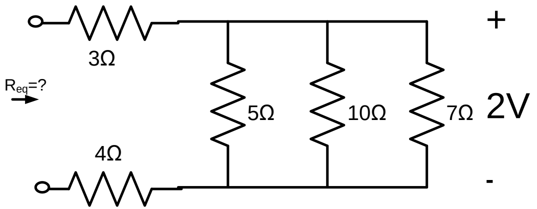
6. A 10 Ω and a 30 Ω resistor are in connected series. If the voltage across the 30 Ω resistor is 60 volts, the voltage across the 10 Ω resistor is most nearly:

(A) 10 V (B) 20 V (C) 60 V (D) 40 V

7. The equivalent resistance, R_{eq} is most nearly:



(A) 8.3 Ω (B) 9.3 Ω (C) 14.3 Ω (D) 16.3 Ω



In Prob 7 we computed the resistance of the 5, 10 and 7 Ω resistors in parallel to be $R_{//}$ = 2.26 Ω

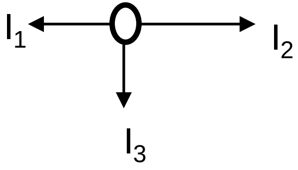
8. In #7 above, if the voltage across the 5Ω resistor is 2 volts, the voltage across the 4Ω resistor is most nearly:

(A) 7 V (B) .28 V (C) 3.5 V (D) 2 V

Node analysis using Kirchoff’s laws

If we assume that I_{in} is a negative I_{out}, we can write the current law as:

$\Sigma\ I_{out} = 0.$ Consider this node(closed surface):

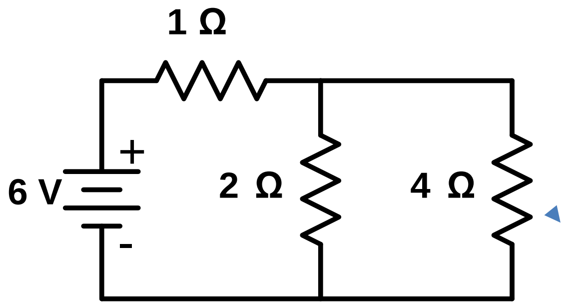


K’s current law states that:

$I_1 + I_2 + I_3 = 0$

So, for example, if $I_1 = 2A$ and $I_2 = 3\ A$, I_3 must be $I_3 = -5A$

9. The current, in amps, through the 2 Ω resistor is most nearly:



(A) 2.4 (B) 2.8 (C) 1.7 (D) 3.4

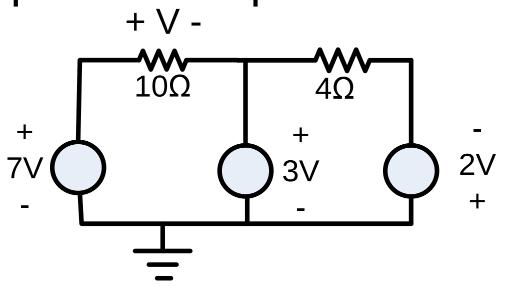
10. A 10 Ω and a 20 Ω resistor are in connected in series. If the voltage across the 20 Ω resistor is 80 volts, the power dissipated in the 10 Ω resistor is most nearly:

(A) 6.4 W (B) 16 W (C) 64 W (D) 160 W

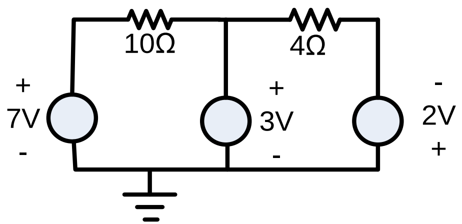
11. A light bulb is rated at 120 V and 100 Watts. What is the resistance of the bulb in Ohms?

(A) 120 (B) 144 (C) 180 (D) 240

12. The power dissipated in the 10 Ω resistor is:



(A) 1.6 W (B)1.8 W (C) 2.0 W (D) 2.2 W

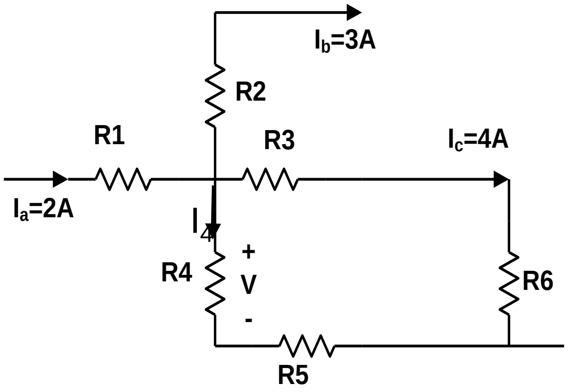


13. The power dissipated in the 4 Ω resistor is about:

(A) 0.25 W (B)1.0 W (C) 6.25 W (D) 20 W

14. The voltage, in Volts, across R4 in the circuit below is:

(A) 9R4 (B) -9R4 (C) 4R4 (D) -5R4



15. A 5 mH inductor and a 10 Ω resistor are connected in series. The voltage across the resistor is 2V. The energy stored in the inductor is most nearly:

(A) 1 μJ (B) 10 μJ (C) 100 μJ (D) 1 mJ

16. A 2 microfarad capacitor is charged to a potential of 100 Volts. A resistor of 50 Ohms is then placed across the capacitor. After 8 time constants, the total energy dissipated in the resistor is most nearly:

(A) 1J (B) 10J (C) 10 mJ (D) 1 mJ

17. A certain voltage is $x(t) = 170 \cos(377t + 20^0)$ volts.

(a) What is the rms value (effective value)?

(b) What is its frequency in Hz?

(c) What is its period?

(d) What is the phasor associated with this voltage?

17. “Continued” $x(t) = 170 \cos(377t + 20^0)$ volts

(e) Express this voltage as a sin function of time

(f) If this voltage is applied to a 100 Ohm resistor, how much power would be dissipated?

(g) If this voltage is applied to a 10 mH inductor, how much power would be dissipated?

(h) If this voltage is applied to a 10 microfarad capacitor, what would be its reactance?

(i) What is the average value of this voltage?

18. What is the maximum amount of energy stored in a 2 µF capacitor when there is a sinusoidal voltage across it of 120 volts rms at 60 Hz?

(A) 0.7 J (B) .07 J (C) .029 J (D) 7.3 mJ

$\sqrt{2}$

19. A capacitor, resistor and inductor are all in series. The magnitudes of the reactance of the capacitor and inductor are 75 Ω and 25 Ω, respectively. The resistance is 20 Ω. First find the impedance of this combination then sketch the impedance diagram.

20. The impedance in Ohms of a 2 μF capacitor, a 6 mH inductance and a 20 Ω resistor in series at 1 kHz is most nearly:

(A) 20 + j42
(B) 20 + j82
(C) 20 - j82
(D) 20 - j42

21. A certain voltage source has an open circuit voltage V_{oc} of 12 volts and a Thevenin equivalent resistance of $R_{eq} = 2\Omega$.

(a)How much power in Watts will be dissipated in a 4Ω load connected to this source

(A)8 (B) 16 (C) 24 (D) 36

(b) The maximum amount of power that can be delivered by this source is most nearly:

(A)18W (B) 16W (C) 12W (D) 8W

22. If $i=\sqrt{-1}$, the quantity $\frac{(1+i)^2}{(1-i)^2}$ is equal to:

(A) $+i$ (B) -1 (C) $-i$ (D) +1

23. If $i = \sqrt{-1}$, the quantity $i-1$ is equal to:

(A) $\sqrt{2}\underline{/\,45^0}$

(B) $\sqrt{2}\underline{/-45^0}$

(C) $\sqrt{2}\underline{/-135^0}$

(D) $\sqrt{2}\underline{/135^0}$

24. A certain source has an short circuit current I_{sc} of 12 Amps and a Norton equivalent resistance of R_{eq} = 60 Ω.

(a)The voltage across a 20 Ω load connected to this source is most nearly:

(A)180V (B)240V (C)360V (D)440V

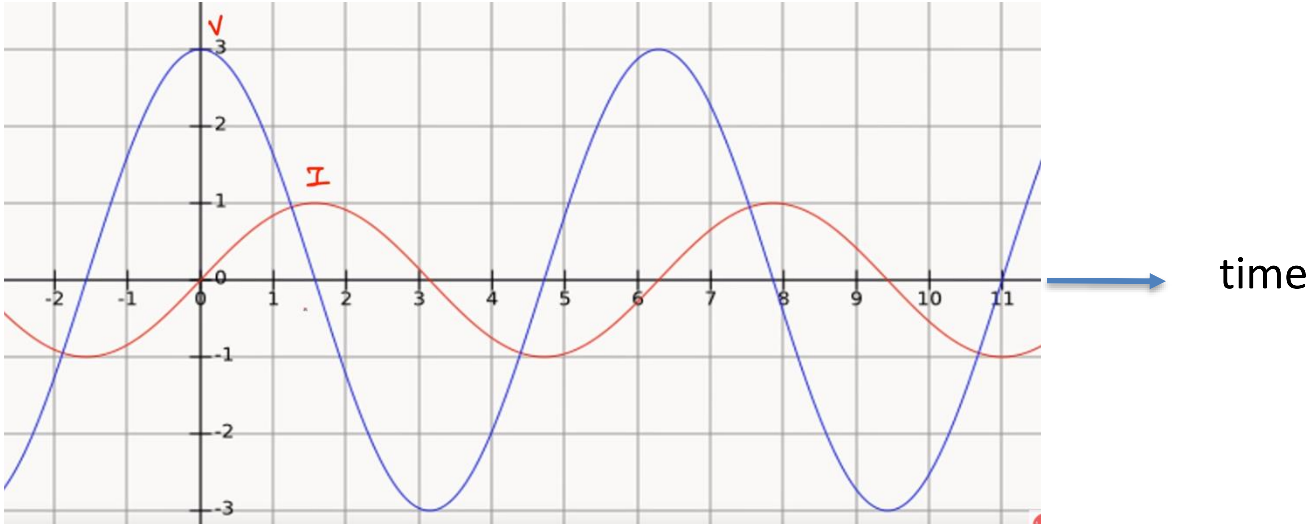
(b) The maximum amount of power that can be delivered by this source is most nearly:

(A)37 kW (B) 32 kW (C)2.2 kW (D) 1.5 kW

25.The voltage across a load is 177 cos($2\pi ft + 35^0$) volts, and the current through the load is 5 cos($2\pi ft + 62^0$) amps. The real power dissipated in the load is most nearly:

(A)197 W (B)442 W (C)788 W (D)885 W

Example of Lagging Power Factor



The peak of the current, I, occurs after the peak of the voltage, V, so the current is said to lag the voltage. A load causing this pattern is called an inductive load and its impedance(and power factor angle) is positive. If the current leads the voltage the load is capacitive and its impedance(and power factor angle) is negative.

26. Concerning voltmeters and ammeters, which of the following statements generally is true?

(A) Both should have low impedance

(B) Both should have high impedance

(C) Voltmeters should have low impedance,
ammeters should have high impedance

(D) Voltmeters should have high impedance,
ammeters should have low impedance

27. A certain AC load, has a rms current through it of I amps and an rms voltage of V volts across it. A wattmeter connected to this load will read (circle all that apply)

(A) Apparent power (B)Real power (C) Reactive power

(D) V x I x sin(power factor angle) (E) I x V

(F) I x V x cos(power factor angle) (G) VARS

28. A certain inductive load consumes 150 watts. The voltage across it is 120 V rms ac and the current through it is 2 A rms. First compute the power factor. Then compute the reactive power which is (in VARS) :

(A)187 (B)207 (C)217 (D)227