KWAME NKRUMAH
UNIVERSITY OF SCIENCE AND TECHNOLOGY
SCHOOL OF ENGINEERING

B.Sc. (Engineering) Examination, 2004
First Year

EE 151 APPLIED ELECTRICITY

DECEMBER, 2006 THREE HOURS

Each question is followed by four options lettered A to D. Find out the correct option and circle without ambiguity the letter for the option you have chosen.

Index No……..Dept…….……Circle Your Year: *1, 2, 3 or 4.*

1. Which of the following statements are true?
   I A passive element, which dissipates electrical energy it absorbs, will be represented by resistance.
   II The voltage-current relationship for a resistance is given by $i = C\frac{dv}{dt}$ if i is shown to be entering the negative terminal.
   III Certain passive elements can deliver energy to a source.

   A I and II only
   B I and III only
   C II and III only
   D I, II and III

2. If the current $i(t) = 1.5t^2$ flows through a 2-H inductor, find the voltage across the inductor at $t = 4s$ .in volts
   A 3.0
   B 20
   C 40
   D 60

3. Which of the following statements are true?
   I Kirchoff's Laws apply to both linear and nonlinear networks.
   II Reciprocity Theorem applies to both single- and multi-source networks.
   III Superposition Theorem applies to both linear and nonlinear networks.

   A I only
   B II only
   C III only
   D I and II only

4. Calculate the total resistance between terminals A and B of the circuit shown in Fig. 1 in kΩ. All resistances are in kΩ.

A 42
B 32
C 22
D 12

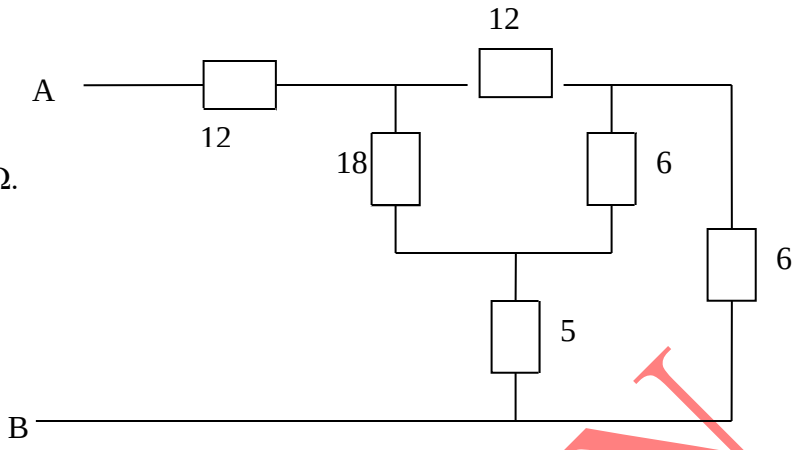

Fig. 1

Use the circuit in Fig. 2 to answer questions 5 and 6.

5. Find the current in the 6-ohm resistor in amps.
A 3.5
B 2.5
C 1.5
D 1.0

6. Find the voltage across the 6-ohm resistor in volts if a 4.8-ohm resistor is connected in parallel with it.
A. 10
B. 6
C. 3
D. 1

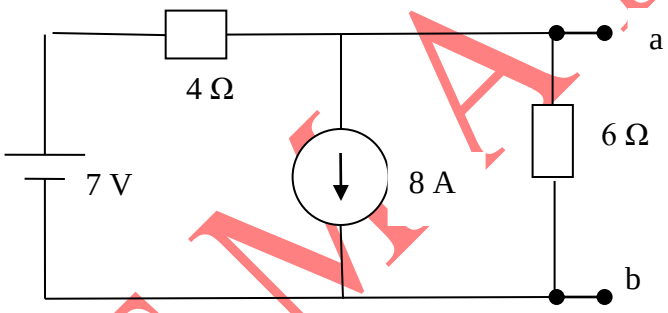

Fig. 2

7. In the circuit shown in Fig. 3, find the value for R in kΩ such that the current in the 1-kΩ resistor is 1 mA. E_1 = 40 V, E_2 = 30 V, E_3 = 20 V and E_4 = 10 V
A 102
B 100
C 98
D 96

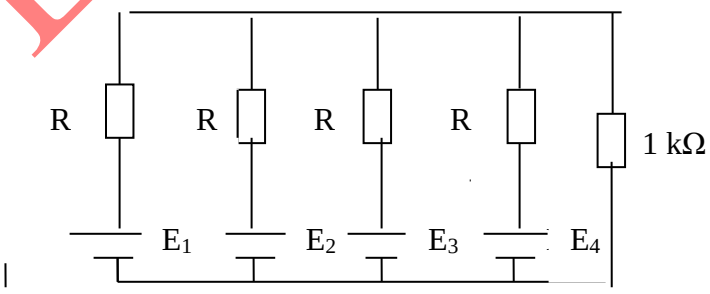

Fig. 3

8. A practical current source with a 1-A short-circuit current and 100-ohm internal resistance is to be used to deliver 1/12 A to a 100-ohm load. Determine an external resistance that can be placed across the source terminals, to achieve this result. Express the answer in ohms.
A 14
B 10
C 6
D 2

9. Given that $V_o = 6$ V and $R_1 = R_2 = 3$ kΩ in the circuit in Fig. 4, find V_S in volts.
   A 9
   B 7
   C 5
   D 3

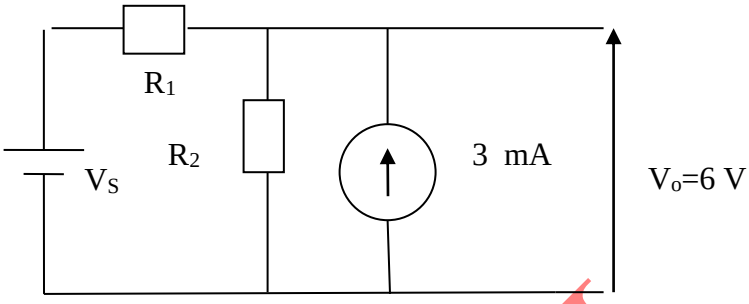

Fig. 4

Use the information below to answer questions 10 and 11:

A practical source supplies I_L =2 A to a 10-ohm load and I_L =1 A to a 50-ohm load.

10. Determine its Thevenin parameter V_{TH} in volts
    A 80
    B 75
    C 70
    D 65

11. Determine its Thevenin parameter R_{TH} in ohms.
    A. 40
    B. 35
    C. 30
    D. 25

Use the circuit in Fig. 5 to answer questions 12 to 14.

12. Find the current I in amps if E_2 is deactivated and E_1 = 24 V.
    A 6
    B 5
    C 4
    D 3

13. Find the current I in amps if E_1 is deactivated and E_2 = 24 V
    A. 6
    B. 5
    C. 3
    D. 1

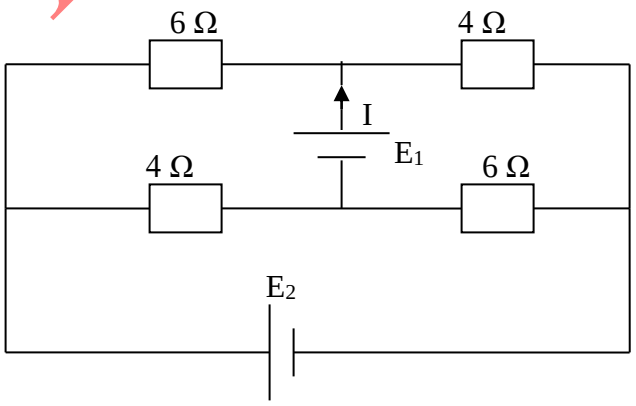

Fig. 5

14. Find the current I in amps if E_1 = 24 V and E_2 = 12 V and both sources are in circuit.
    A 5.5
    B 4.5
    C 3.5
    D 2.5

15. Three resistors of 4 ohms, 5 ohms and 10 ohms are connected in parallel. A further resistor of 20 ohms is connected in series with this parallel circuit. If the voltage across the 4-ohm resistor is 20 V, what is the supply voltage across the whole circuit in volts?.
    A 240
    B 220
    C 200
    D 180

16. Calculate the r.m.s. value of the waveform in Fig. 6
    A 4.0
    B 3.0
    C 2.0
    D 1.0

17. Calculate the average value of the waveform in Fig. 6.
    A 6.0
    B 4.5
    C 3.0
    D 1.5

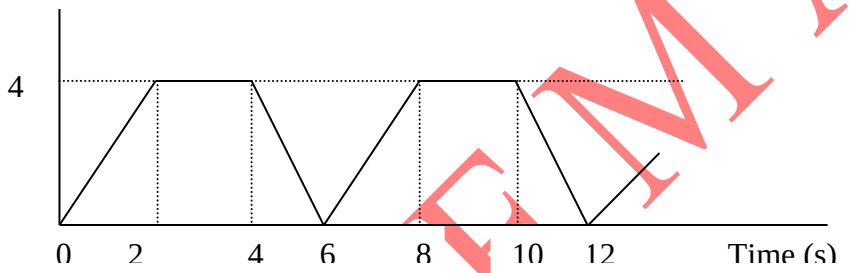

Fig. 6

18. Four conductors meet at a junction, as shown in Fig. 9. The currents are $i_1 = 5\sin \omega t$, $i_2 = 3\sin(\omega t + 90^o)$ and $i_3 = 2\sin(\omega t - 90^o)$.
    Calculate the r.m.s. value of the current i_4.
    A 7.5
    B 6.3
    C 5.0
    D None of the above.

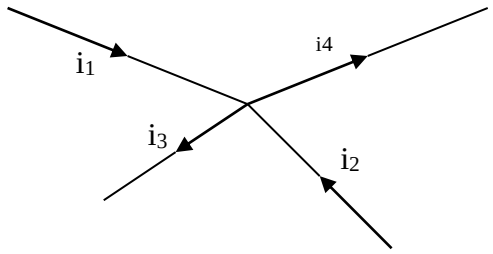

Fig. 9

19. An alternating current is represented by $i = 3 + 4\sqrt{2}\sin \omega t + 5\sqrt{2}\sin 3\omega t$. Calculate its average value.
    A 12.0
    B 9.0
    C 6.0
    D 3.0

20. Calculate the r.m.s. value of the current given in problem 19.
    A 9.57
    B 7.07
    C 5.67
    D 3.02

21. An inductor having inductance of $3/\pi$ H is connected in series with an 8-ohm resistor. A 28-V, 1-Hz supply is connected across this series circuit. Determine the voltage across the resistor in volts.
    A 22.4
    B 16.8
    C 16.0
    D 12.0

Use the information below to answer questions 22 to 24.

When a series circuit, containing inductance and resistance, was connected across a 240-V, 50-Hz supply, the current was 4 A and the power taken was 400 W.

22. Calculate the power factor of the circuit, when connected across the a.c. supply.
    A 0.912
    B 0.615
    C 0.417
    D 0.312

23. Calculate the value of the resistance in ohms
    A 55.0
    B 46.7
    C 34.5
    D 25.0

24. Calculate the inductance in henries.
    A 0.515
    B 0.437
    C 0.256
    D 0.174

Use the information below to answer questions 25 and 26.

A coil of resistance 30 Ω and inductance 20 mH is connected in parallel with 8 μF capacitor across a supply of 25 V and frequency $1000/\pi$ *Hz.*

25. Calculate the total supply current in amps.
    A 0.53
    B 0.30
    C 0.10
    D 0.05

26. Calculate the total power taken from the supply in watts.
    A 11.2
    B 9.4
    C 8.3
    D 7.5

27. A circuit has two parallel paths and their impedances are $Z_1 = 10 + j20$ ohm; $Z_2 = -j12.5$ ohm. Calculate the combined impedance.
    A $10 - j20$
    B $15 - j15$
    C $21 - j18$
    D $10 + j8$

28. A circuit draws a current of $5\angle 30^o$ amps when the applied voltage is $200\angle -30^o$ volts. Calculate the complex apparent power drawn by the circuit in voltamperes.
    A $866 + j500$
    B $500 - j866$
    C $866 - j500$
    D $1000 + j0$

Use the information below to answer questions 29 and 30.

A single-phase motor connected to a 200-V, 50-Hz supply is developing 5 kW with an efficiency of 80 per cent and a power factor of 0.6 lagging.

29. Calculate the input apparent power in kilovoltamperes.
    A 6.25
    B 9.30
    C 10.42
    D 12.32

30. Calculate the reactive power drawn by the motor in kilovars.
    A 5.85
    B 7.65
    C 8.33
    D 10.75

Use the information below to answer questions 31 to 33.

The load taken from a 200-V single-phase a.c. supply consists of:
i. a fluorescent lighting load of 800 W at 0.8 power factor lagging
ii. a motor load of 3 kVA at power factor of 0.6 lagging.

31. Find the total power in kW.
    A 2.44
    B 2.60
    C 3.80
    D None of the above.

32. Find the total reactive power in kVAr
    A 2.0
    B 3.0
    C 4.0
    D 5.0

33. Find the total current in amps if the total power and reactive power are assumed to be 1.6 kW and 1.2 kVAr respectively.
    A 4.0
    B 6.0
    C 10.0
    D 14.0

34. A circuit consists of an impedance of $24 + j8$ ohm in series with two impedances of $0 + j6$ ohm and $0 - j8$ ohm which are parallel. Calculate the total impedance in ohms.
    A $28\angle 90^o$
    B $40\angle 53.1^o$
    C $51\angle 36.9^o$
    D None of the above.

Use the information below to answer questions 35 and 36.

A $250\sqrt{3}$-V, 50-Hz, 3-phase supply delivers 3.75 kVA to a balanced load which has a power factor of 0.6 lagging.

35. Calculate the line current in amps.
    A 8.0
    B 7.0
    C 6.0
    D 5.0

36. Calculate the value of the inductance per phase in henries assuming the load to be star connected.
    A 0.127
    B 0.321
    C 0.567
    D 0.814

Use the information below to answer questions 37 and 38.

In a 3-phase, 4-wire system, the line voltage is 400 V and pure resistive loads of 5, 4 and 2.5 kW are connected between the three line conductors respectively and the neutral point.

37. Calculate the current in the line to which the 5-kW load is connected in amps.
    A 10.21
    B 21.65
    C 32.74
    D 53.66

38. Calculate the current in the neutral conductor in amps.
    A 9.5
    B 8.4
    C 7.3
    D 6.7

Use the information below to answer questions 39 and 40.

Three similar coils, each having a resistance 5 ohm and inductance $66/\pi$ *mH, are connected in star to a* $250\sqrt{3}$ *-V, 3-phase, 50-Hz source.*

39. Calculate the line current in amps.
    A 51.8
    B 45.7
    C 30.2
    D 20.6

40. Calculate the total power absorbed in kilowatts.
    A 19.5
    B 18.8
    C 15.6
    D 13.7