ELECTRICAL ENGINEERING

PAPER-I

1. Match List I (Components) with list II (Transfer functions) and select the correct answer:

List I

A. ac servo motor

B. Field controlled dc servo motor

C. Tacho generator

D. Integrating gyro

List II

1. $\frac{K}{s(1+s\tau_m)}$

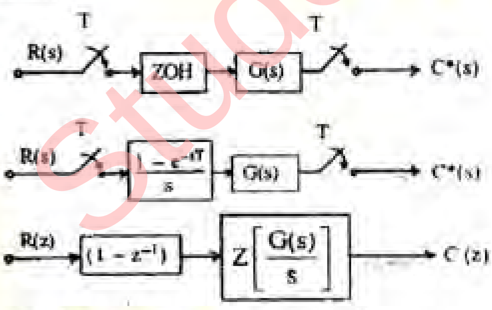
2. $\frac{K}{s(1+s\tau_m)(1+s\tau_m)}$

3. Ks

4. $\frac{K}{1+s\tau}$

	A	B	C	D
a.	1	2	3	4
b.	1	2	4	3
c.	2	1	3	4
d.	2	1	4	3

2. Consider the following sampled data systems:



1.

2.

3.

Which of these systems are similar?

a. 1 and 2

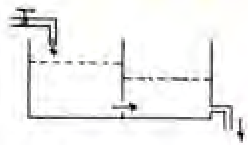
b. 1 and 3

c. 2 and 3

d. 1, 2 and 3

3. A two-tank system is shown in Figure — 1. The electrical equivalent of this system is

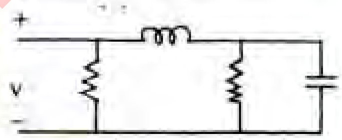
Figure – I



a.

b.

c.



d.

4. For the system + axx ± bx = 0, the equation for the phase-plane isocline of slope m is

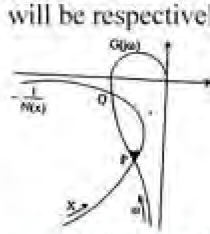
a. $m^2 + am + b = 0$

b. $m = -ax - \frac{bx}{x}$

c. $m = ax + \frac{bx}{x}$

d. $m^2 + axm + b = 0$

5. For the determination of stability of a nonlinear control system by the Describing Function method, the plots of C (jω) and — 1 / N(x) are drawn as shown in the given figure for an input x = X sin ωt. The types of limit cycles at the points P and Q will be respectively

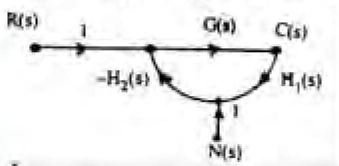


a. stable and stable

b. stable and unstable

c. unstable and stable
d. unstable and unstable

6. A closed-loop system is shown in the given figure. The noise transfer function C(s) / N(s) [$C_n(s)$ = output corresponding to noise input N(s) is approximately



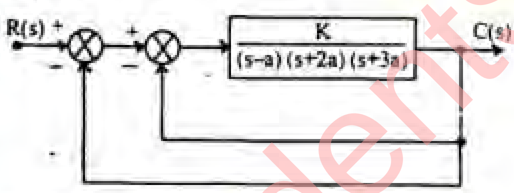
a. $\frac{1}{G(s)\,H_1(s)}$ for $|G_1(s)\,H_1(s)\,H_2(s)| << 1$

b. $-\frac{1}{H_1(s)}$ for $G_1(s)\,H_1(s)\,H_2(s)| >> 1$

c. $-\frac{1}{H_1(s)H_2(s)}$ for $|G_1(s)\,H_1(s)\,H_2(s)|>>1$

d. $\frac{1}{G(s)H_1(s)H_2(s)}$ for $|G_1(s)\,H_1(s)\,H_2(s)| << 1$

7. For the block diagram shown in the given figure, the limiting values of K for stability of inner loop is found to be X < K < Y. The overall system will be stable if and only if

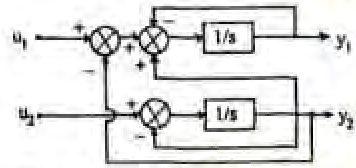


a. 4X < K < 4Y
b. 2X < K < 2Y
c. X < K < Y
d. X/2 < K < Y/2

8. A signal flow graph is shown in the given figure. The number of forward paths M and the number of individual loops P for this signal flow graph would be

a. M = 4 and P = 4
b. M = 6 and P = 4
c. M = 4 and P = 6
d. M = 6 and P = 6

9. The control system shown in the given figure is represented by the equation $\begin{bmatrix} y_1 \\ y_2 \end{bmatrix}$ = [matrix 'G'] $\begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$



The matrix 'G' of the system is

a.
$$\begin{bmatrix} 1/s & -1/s^2 \\ 0 & 1/s \end{bmatrix}$$

b.
$$\begin{bmatrix} 1/s & -1/s^2 \\ 0 & 1/s \end{bmatrix}$$

c.
$$\begin{bmatrix} \frac{1}{(s+1)} & -\frac{1}{(s+1)^2} \\ 0 & \frac{1}{(s+1)} \end{bmatrix}$$

d.
$$\begin{bmatrix} \frac{1}{(s+1)} & \frac{1}{(s+1)^2} \\ 0 & -\frac{1}{(s+1)} \end{bmatrix}$$

10. A system with transfer function G (s) = $\frac{1}{(1+s)}$ is subjected to a sinusoidal input r(t) = sin ωt. In steady–state, the phase angle of the output relative to the input at ω = 0 and ω = ∞ will be respectively
a. 0° and -90°
b. 0^0 and 0^0
c. 90° and 0°
d. 90° and -90°

11. A system has fourteen poles and two zeros. The slope of its highest frequency asymptote in its magnitude plot is
a. –40 dB/decade
b. –240 dB/decade
c. –280 dB/decade
d. –320 dB/decade

12. The open-loop transfer function of a feedback control system is

$\dfrac{K}{s(s^2+2s+6)}$. The break-away point(s) of its root locus plot

a. exist at $(-1 \pm j1)$

b. exist at $(-3/2 \pm \sqrt{15/16})$

c. exists at origin

d. do not exist

13. $[-a \pm jb]$ are the complex conjugate roots of the characteristic equation of a second order system. Its damping coefficient and natural frequency will be respectively

a. $\dfrac{b}{\sqrt{a^2+b^2}}$ and $\sqrt{a^2+b^2}$

b. $\dfrac{b}{\sqrt{a^2+b^2}}$ and a^2+b^2

c. $\dfrac{a}{\sqrt{a^2+b^2}}$ and $\sqrt{a^2+b^2}$

d. $\dfrac{a}{\sqrt{a^2+b^2}}$ and $\sqrt{a^2+b^2}$

14. A unity feedback control system has a forward, path transfer function

$$G(s)=\frac{10(1+4s)}{s^2(1+s)}$$

If the system is subjected to an input $r(t) = 1 + t + \dfrac{t^2}{2} (t \geq 0)$, the steady-state error of the system will be

a. zero

b. 0.1

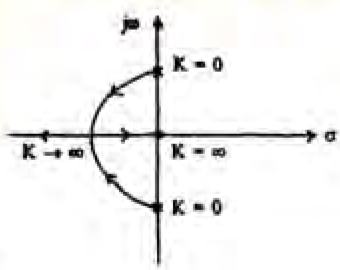
c. 10

d. infinity

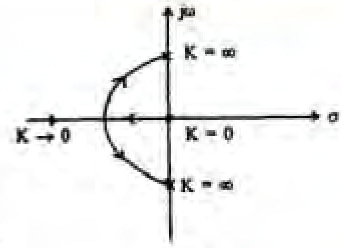
15. The characteristic equation of a linear control system is

$$s^2 + 5Ks + 10 = 0$$

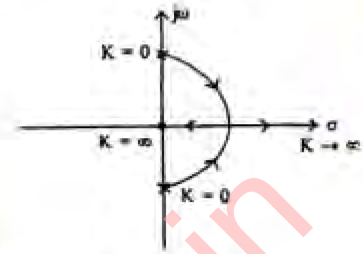
The root-loci of the system for $0 < K < \infty$ is



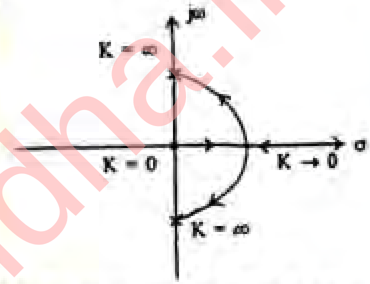
a.



b.

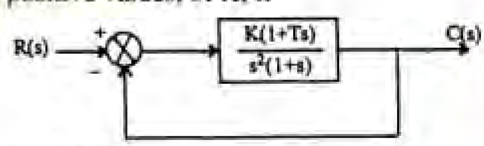


c.



d.

16. A feedback control system is shown in the given figure. The system is stable for all positive values, of K, if



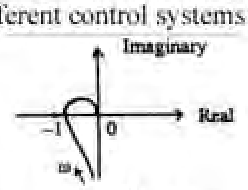
a. $T = 0$

b. $T < 0$

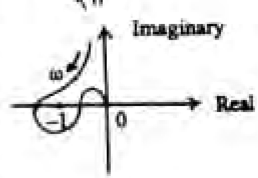
c. $T > 1$

d. $0 < T < 1$

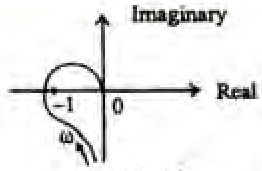
17. Consider the following Nyquist plots of different control systems :

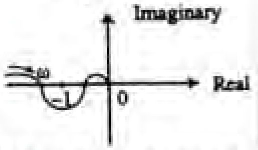


1.



2.

3. 



Which of these plot(s) represent(s) a stable system?

a. 1 alone
b. 2, 3 and 4
c. 1, 3 and 4
d. 1, 2 and 4

18. The state diagram of a system is shown in the given figure :

The system is

a. controllable and observable
b. controllable but not observable
c. observable but not controllable
d. neither controllable nor observable

19. For the function $X(s) = \dfrac{1}{s(s+1)^3(s+2)}$, the residues associated with the simple poles at s = 0 and s = –2 are respectively

a. 1/2 and 1/2
b. 1 and 1
c. —1 and —1
d. —1/2 and 1/2

20. Match List I (Matrix) with List II (Dimensions) for the state equations : X(t) = PX(t) + QU(t) and Y(t) = RX(t) + SU(t) and select the correct answer :

List I

A. P
B. Q
C. R
D. S

List II

1. (n × p)
2. (q × n)
3. (n × n)
4. (q × p)

	A	B	C	D
a.	1	3	4	2
b.	1	3	2	4
c.	3	1	4	2
d.	3	1	2	4

21. The state-variable description of a linear autonomous system is X = AX where X is a state vector and

$$A = \begin{bmatrix} 0 & 2 \\ 2 & 0 \end{bmatrix}$$

The poles of the system are located at

a. –2 and +2
b. –2j and +2j
c. –2 and –2
d. +2 and +2

22. Consider the state transition matrix:

$$\phi(s) = \begin{bmatrix} \dfrac{s+6}{s^2+6s+5} & \dfrac{-1}{s^2+6s+5} \\ \dfrac{-5}{s^2+6s+5} & \dfrac{s}{s^2+6s+5} \end{bmatrix}$$

The eigen values of the system are

a. 0 and –6
b. 0 and +6
c. 1 and –5
d. –1 and –5

23. The frequency spectrum of a signal lies within the band $f_0 \le f \le f_1$ Hz. To sample the signal properly, the sampling period should be

a. $> 1/2 f_0$
b. $< 2/f_0$
c. $< 1/2 f_1$
d. $> 2/f_1$

24. For insulators, the forbidden gap is of the order of

a. 5ev
b. 1 ev
c. 0.1 ev
d. zero

25. Which one of the following materials does not have a covalent bond?

a. Metal
b. Silicon
c. Organic polymers
d. Diamond

26. Match List I (Type of polarization) with List II (Signal frequency) and select the correct answer :

List I

A. Electronic polarisation
B. Ionic polarisation
C. Orientational polarisation
D. Space charge polarisation

List II

1. 10^2 Hz
2. 10^{14} Hz
3. 10^6 Hz
4. 10^{12} Hz

	A	B	C	D
a.	2	1	3	4
b.	3	4	2	1
c.	2	4	3	1
d.	3	1	2	4

27. Piezoelectric effect is generally observed in
a. Insulators
b. insulators and semiconductors
c. conductors and superconductors
d. conductors and semiconductors

28. The conductivity of material 'A' is half that of material 'B'. The ratio of relaxation time of 'A' to that of 'B' is
a. 0.5
b. 1
c. 2
d. 4.1

29. According to the BCS theory, a material goes into superconducting state when electron-pairs participate in the following events:
1. Lattice distorts as a free electron A attracts a lattice ion Temperature is decreased
2. Energy of electron B is lowered and it forms a pair with electron A
3. A phonon is created which interacts with electron B

The correct sequence of occurrence of these events is :
a. 2, 1, 3, 4
b. 1, 2, 3, 4
c. 2, 1, 4, 3
d. 1, 2, 4, 3

30. Match List I (Magnetic parameters) with list II (Electric parameters) on the basis of analogy in definition and select the correct answer :

List I

A. Magnetic field
B. Flux density
C. Magnetization

List II

1. Electric dipole moment per unit volume
2. Electric force per unit positive charge
3. Dielectric density

	A	B	C
a.	2	3	1
b.	3	1	2
c.	1	3	2
d.	1	2	3

31. High frequency transformer cores are generally made of
a. cast iron
b. mu-metal
c. ferrite
d. graphite

32. A current of 50 A is passed through a metal strip which is subjected to a magnetic flux density of 1.2 Wb/m^2. The magnetic field is directed at right angles to the current direction. Thickness of the strip in the direction of the magnetic field is 0.5 mm. If the Hall voltage is found to be 150 V, the number of conduction electrons per m^3 in the metal is
a. 5×10^{27}
b. 0.5×10^{27}
c. 50×10^{27}
d. 5×10^{26}

33. In the optical fibre used for communication, the core and cladding material used are respectively
a. pure silica and Ge-doped silica
b. P-doped silica and Ge-doped silica
c. Ge-doped silica and P-doped silica
d. Ge-doped silica and pure silica

34. Match List I (Materials) with List II (Applications) and select the correct answer:

List I

A. Tantalum
B. Graphite
C. Refractory metal
D. Polysilicon

List II

1. Schottky gate
2. Cryotron
3. IC -technology
4. Furnace

	A	B	C	D
a.	2	3	1	4
b.	1	4	2	3
c.	1	3	2	4
d.	2	4	1	3

35. The band-gap of a semiconductor is 1.43 ev. Its cut-off wavelength is
a. 1 mm
b. 0.81 mm
c. 0.56 mm
d. 0.27 mm

36. Match List I (Semiconductor parameters) with List II (Physical processes) and select the correct answer :

List I
A. Impurity concentration
B. Carrier mobility
C. Carrier life time
D. Intrinsic carrier concentration

List II
1. Recombination
2. Band to band transition
3. Scattering
4. Ion implantation

	A	B	C	D
a.	3	4	2	1
b.	4	3	2	1
c.	3	4	1	2
d.	4	3	1	2

37. Match List I (Materials) with List II (Thermal conductivity) and select the correct answer :

List I
A. Constantan
B. Carbon
C. iron
D. Quartz

List II
1. 4.2 W m^{-1} deg^{-1}
2. 12.6 W m^{-1} deg^{-1}
3. 22.5 W m^{-1} deg^{-1}
4. 67.0 W m^{-1} deg^{-1}

	A	B	C	D
a.	3	4	1	2
b.	2	1	4	3
c.	3	1	4	2
d.	2	4	1	3

38. Consider the following statements:
In the case of paramagnetic materials, there
1. is no permanent dipole moment.
2. are permanent dipole moments.
3. is no alignment of dipoles in the absence of magnetic field.
4. is no interaction among the dipoles.

Which of these statement(s) is/are correct?
a. 1 alone
b. 3 and 4
c. 2 and 4
d. 2, 3 and 4

39. Consider the following statements:
There will be no spontaneous polarization, if
1. there is no hysteresis loop in a plot of polarization against field
2. there is a hysteresis loop in a plot of polarization against field
3. the material is below the Curie temperature
4. the material is above the Curie temperature

Which of these statements are correct ?
a. 1 and 3
b. 1 and 4
c. 2 and 3
d. 2 and 4

40. Consider the following types of semiconductors :
1. n-type
2. p-type
3. Intrinsic
4. Extrinsic

Which of these statements are correct ?
a. 1 and 3
b. 2 and 4
c. 1 and 4
d. 2 and 3

41. Consider the following properties:
1. Perfect diamagnetism
2. Ionic conductivity
3. Magnetic field causes an increase in transition temperature

4. Loss of superconductivity in long circular wire by large currents

Which of these properties are exhibited by a superconductor?

a. 1, 2 and 3
b. 2, 3 and 4
c. 1, 3 and 4
d. 1, 2 and 4

42. Assertion (A) : The basic principle of operation of a Q-meter is based on the property of a series-resonant circuit.

Reason (R) : If a fixed voltage is applied to a series resonant circuit, the voltage developed across its capacitor is Q times the applied voltage.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

43. Assertion (A) : In a good quality, cassette audio tape recorder, ac bias is provided for recording purposes to improve the quality.

Reason (R) : The ac bias provided for recording in an audio tape recorder takes care of the non-linearity of the recording head.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

44. Assertion (A) : A spectrum analyzer is an instrument which displays the spectrum of the input waveform with respect to the frequency.

Reason (R) : A spectrum analyzer consists of an internal sweep voltage generator connected to the X-deflecting plate of the CRT.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

45. Assertion (A) : The opening of the secondary circuit of a current transfer results in a very high voltage in the secondary winding with consequent severe strain on the insulation and danger to the operator.

Reason (R) : The high magnetic forces acting on the core, if suddenly removed, may leave behind considerable residual magnetism in the core.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

46. Assertion (A) : The stability of a closed-loop system can be obtained from the open-loop transfer function $G(j\omega)\ H(j\omega)$ plot with respect to the critical point $(-1, j0)$ in $G(j\omega)\ H(j\omega)$ plane.

Reason (R) : The origin of $1 + G(j\omega)\ H(j\omega)$ corresponds to $(-1, j0)$ point in $G(j\omega)\ H(j\omega)$ plane.

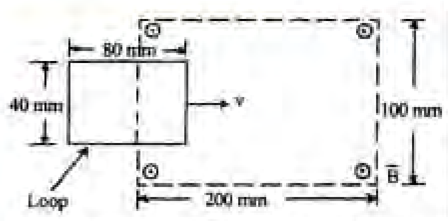
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

47. Assertion (A) : The closed-loop system $\frac{C(s)}{R(s)} = \frac{5}{(s+1)(s+5)}$ for a step input can be approximated by a system $\frac{C_1(s)}{R(s)} = \frac{1}{s+1}$ for $R(s) = \frac{1}{s}$.

Reason (R) : Both $\frac{C(s)}{R(s)}$ and $\frac{C_1(s)}{R(s)}$ have approximately the same transient response.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

48. In the given figure, a single-turn rectangular loop moves with uniform velocity 'v' through a region of uniform magnetic flux density $\overline{B}$, the direction of $\overline{B}$ being perpendicular to the plane of the loop.



Assertion (A) : The emf induced in the loop is maximum during the interval the loop is fully inside the region of $\overline{B}$.

Reason (R) : Induced emf = $-\partial / \partial t$ (flux linkage).

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

49. Assertion (A): Low frequencies are more suitable than high frequencies for underwater communication and for communication with underwater objects.

Reason (R): Electric and magnetic fields in the underwater objects are out of phase by 45°.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

50. Assertion (A): Storage of energy in a dielectric is due to shift in relative positions of internal charges against normal atomic and molecular forms.

Reason (R): All dielectrics are characterised by the presence of molecules having permanent displacement between the centres of gravity of the positive and negative charges.

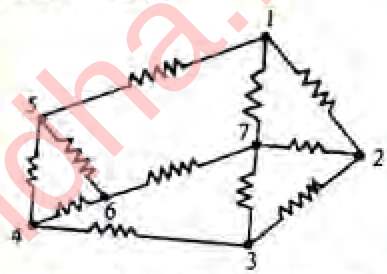
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

51. Assertion (A) : dc resistance of ferrites is much higher than that of dia-, para- or ferro- magnetic materials.

Reason (R) : Ferrites are obtained by replacing divalent ferrous ion in ferrimagnetic magnite by another divalent metal such as Mg, Zn etc., but the exchange interactions are antiferromagnetic type.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

52. Assertion (A) : In the circuit shown in the figure, five current equations are required to calculate the independent branch currents and four voltage equations are required to determine the independent branch voltages.



Reason (R): The number of current equations is b – n + 1 and the number of voltage equations is n – 1 where b is the number of branches and n is the number of nodes for a circuit.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

53. Assertion (A) : A driving - point function should have its poles and zeros to the left half of s - plane.

Reason (R) : Only a positive real function can be realized in network form.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

54. Assertion (A) : If the impulse response of a network is available, the response to any arbitrary input can be derived.

Reason (R) : The Laplace transform of unit impulse is unity.

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is NOT the correct explanation of A
c. A is true but R is false
d. A is false but R is true

55. Consider the following functions:

1. $\frac{s^3+3s}{2(s^2+1)}$
2. $\frac{s^4+3s+1}{5(s^2+1)}$
3. $\frac{s^2+1}{3s}$
4. $\frac{3(s^3+7s/2)}{s^4+14s^2+30}$

Which of these are valid driving- point impedance functions?
a. 1, 2 and 3
b. 1, 3 and 4
c. 1, 2 and 4
d. 2, 3 and 4

56. Consider the following driving -point functions :

$$F_1 = \frac{(s^2+1)(s^2+3)}{s(s^2+4)},$$

$$F_2 = \frac{(s^2+1)(s^2+3)}{(s^2+2)(s^2+4)},$$

$$F_3 = \frac{s(s^2+3)}{(s^2+2)(s^2+4)} \text{ and}$$

$$F_4 = \frac{(s^2+2)(s^2+5)}{s(s^2+4)}$$

Among these, the LC functions would include
a. F_1 and F_2
b. F_2 and F_3
c. F_3 and F_4
d. F_1 and F_4

57. A driving - point impedance function is given by

$$F = \frac{(s+k_1)(s+k_2)(s+k_3)}{(s+1)(s+2)(s+3)(s+4)}$$

The product $k_1k_2k_3$ cannot be more than
a. 48
b. 24
c. 10
d. 4

58. The hot resistance of the filament of a bulb is higher than the cold resistance because the temperature coefficient of the filament is
a. negative
b. infinite
c. zero
d. positive

59. The Laplace transform of the function f(t) is F(s). u(t) represents the unit step function. The inverse Laplace transform of e^{-s} F(s) is
a. f(t) u(t–1)
b. f(t–1) u(t)
c. f(t–1) u(t–1)
d. f(t)/(t–1)

60. If the unilateral Laplace transform X(s) of a signal x(t) is $\frac{7s+10}{s(s+2)}$, then the initial and final values of the signal would be respectively.
a. 3.5 and 5
b. zero and 7
c. 5 and zero
d. 7 and 5

61. In the circuit shown in Figure I, the switch 'k' was initially at position '1' and a current 'I' was flowing through the inductor 'L' and a voltage 'V_0' existed across the capacitor 'C'.

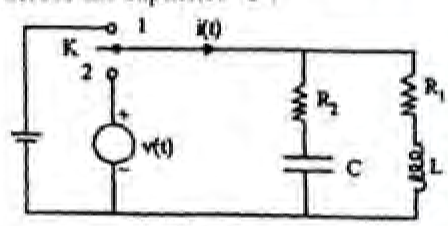
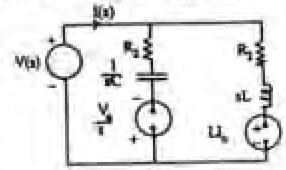
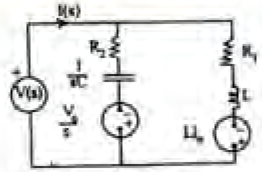
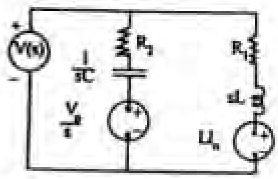


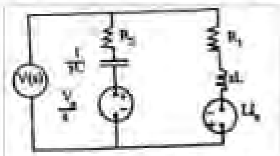
Figure I

If at t = 0, the switch 'k' is put on the position '2' in the circuit shown in Figure I, which one of the following transformed circuits will give i(t) for t > 0 ?

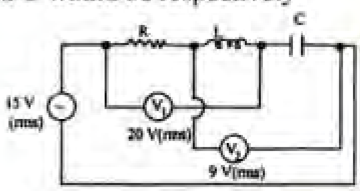
a. 

b. 

c. 

d. 

62. In the case of the RLC circuit shown in the given figure, the voltage across the R, L and C would be respectively



a. 12V, 16V and 7V or 25V
b. 16V, 12V and 7V or 25V
c. 7V, 16V and 12V
d. 16V, 12V and 25V

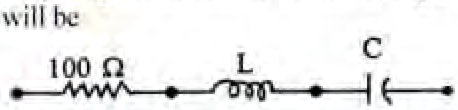
63. In an amplifier, the increase in gain is 12dB if the frequency doubled. If the frequency is increased by 10 times, then the increase in gain will be

a. 2.4 dB
b. 20 dB
c. 40 dB
d. 60 dB

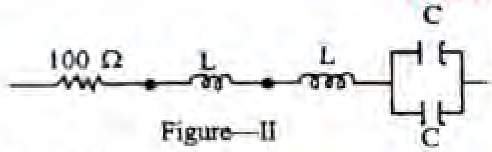
64. For a second order system, if both the roots of the characteristic equation are real, then the value of damping ratio will be

a. less than unity
b. equal to unity
c. equal to zero
d. greater than unity

65. If the resonant frequency of the circuit shown in Figure I is 1 kHz, the resonant frequency of the circuit shown in Figure II will be



Figure–I



Figure—II

a. 4 kHz
b. 2 kHz
c. 0.5 kHz
d. 0.25 kHz

66. Match List I (Readings obtained while measuring 3-phase power by two-wattmeter method) with List II (Power factors for the load) and select the correct answer :

List I

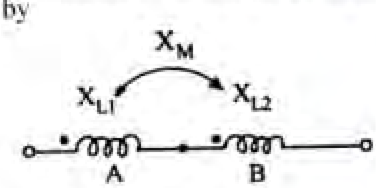
A. Both the wattmeters read equal values of power but of opposite sign
B. Both the wattmeters read equal values of power and both are of positive sign
C. One wattmeter reads zero and the other reads the, complete power

List II

1. Unity
2. Zero
3. 0.5
4. 0.866

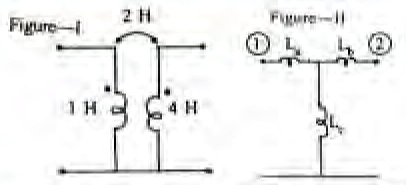
	A	B	C
a.	2	3	4
b.	3	1	2
c.	1	4	3
d.	2	1	3

67. The equivalent inductance of two coils A and B connected as in the given figure is given by



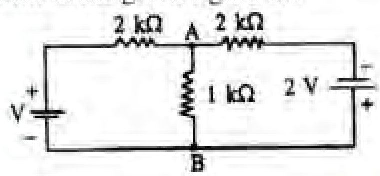
a. $X_{L1} + X_{L2} - 2X_M$
b. $X_{L1} + X_{L2} + X_M$
c. $X_{L1} + X_{L2} - X_M$
d. $X_{L1} + X_{L2} + 2X_M$

68. A linear transformer and its T-equivalent circuit are shown in Figure I and Figure II respectively. The values of inductance L_a, L_b and L_c are respectively



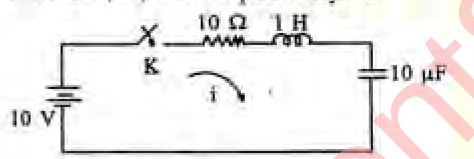
a. 1H, –2H and 2H
b. –1H, 2H and 2H
c. 3H, 6H and –2H
d. 3H, 6H and 2H

69. The voltage across the 1 kΩ resistor between the nodes A and B of the network shown in the given figure is :



a. 2 V
b. 3 V
c. 4 V 10 V
d. 8 V

70. Initially, the circuit shown in the given figure was relaxed. If the switch is closed at t = 0, the values of $i(0^+)$, $di/dt\,(0^+)$ and $d^2i/dt^2\,(0^+)$ will respectively be



a. 0, 10 and –100
b. 0, 10 and 100
c. 10, 100 and 0
d. 100, 0 and 10

71. If the number of branches in a network is 'B', the number of nodes is 'N' and the number of dependent loops is 'L', then the number of independent node equations will be

a. N + L – 1
b. B – 1
c. B – N
d. N – 1

72. A resistance of 'R' Ω and inductance of 'L' H are connected across 240 V, 50 Hz supply. Power dissipated in the circuit is 300-W and the voltage across R is 100 V. In order to improve the power factor to unity., the capacitor that is to be connected in series should have a value of

a. 43.7 μF
b. 4.37 μF
c. 437 μF
d. 4.37 mF

73. The circuit shown in Figure I is replaced by its Norton's equivalent in Figure II. The value of I' will be

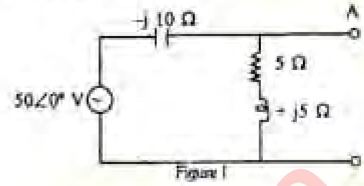


Figure I

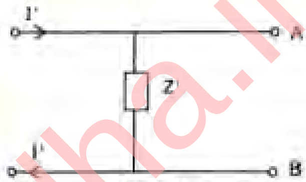


Figure II

a. 2.5 ∠45° A
b. 5 ∠90° A
c. 10 ∠–90° A
d. 15 ∠–45° A

74. A certain network N feeds a load resistance R as shown in Figure I. It consumes a power of 'P' W. If an identical network is added as shown in Figure II, the power consumed by R will be

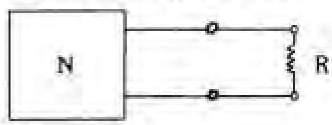


Figure I

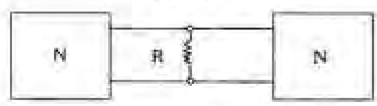
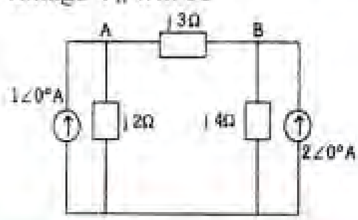


Figure II

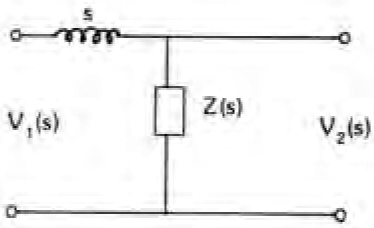
a. less than P
b. equal to P
c. between P and 4P
d. more than 4P

75. For the network shown in the given figure, the voltage V_B will be



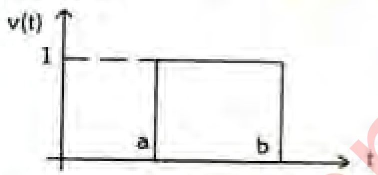
a. (j 5.33) V
b. (5.33) V
c. (–j 5.33) V
d. (j 3.33)

76. In the two-port network shown in the given figure, if $G_{21}(s)$ is $\frac{1}{s^2+1}$, then Z(s) will be



a. s
b. $s+1$
c. $\frac{1}{s}$
d. $s+\frac{1}{s}$

77. Consider the following functions for the rectangular voltage pulse shown in the given figure :

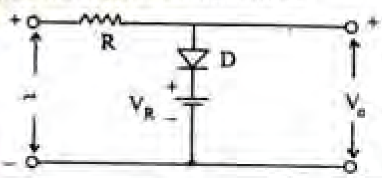


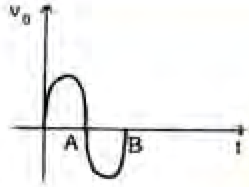
1. v(t) = u(t — a) — u(t — b)
2. v(t) = u(b — t) — u(a — t)
3. v(t) = u(b — t) . u(t — a)
4. v(t) = u(a — t) . u(t — b)

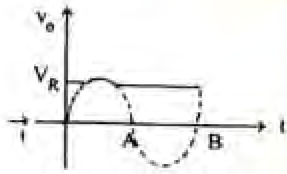
Which of these functions describe the pulse shown in the given figure?

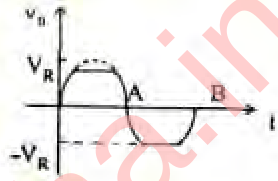
a. 1, 2 and 3
b. 1, 2 and 4
c. 2, 3 and 4
d. 1, 3 and 4

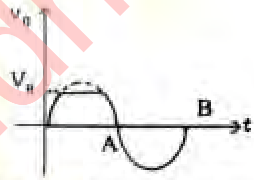
78. If a sinusoidal input is applied to the circuit shown in the given figure, the output waveform of V_0 will be



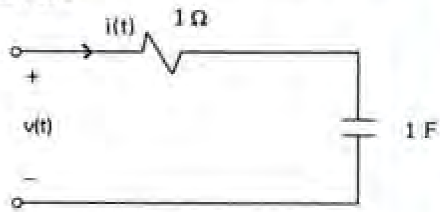
a. 

b. 

c. 

d. 

79. Match List I {Input voltage v(t)} with List II {I(s), the Laplace transform of i(t)} for the given circuit and select the correct answer :



List I
A. Unit step
B. Unit ramp
C. Unit impulse
D. sin t

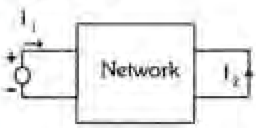
List II
1. $\frac{s}{s+1}$
2. $\frac{1}{s+1}$
3. $\frac{1}{(s+1)^2}$
4. $\frac{1}{s(s+1)}$

A B C D

a.	2	4	1	3
b.	2	1	4	3
c.	3	1	4	2
d.	3	4	1	3

80. For a two-port symmetrical bilateral network, if A = 3 and B = 1 Ω, the value of parameter C will be
   a. 4s
   b. 6s
   c. 8s
   d. 16s

81. Consider the following two-port network configurations:



1.

2.

3.

4.

Which of these configurations relate to the definition of short- circuit admittance parameters?
   a. 1 and 2
   b. 1 and 4
   c. 2 and 3
   d. 2 and 4

82. Match List I (Terms) with List II (Definitions) and select the correct answer:

List I
A. Resolution
B. Precision
C. Sensitivity
D. Accuracy

List II
1. Closeness with which the instrument reading approaches the true value V
2. Reproducibility of measurements V
3. Smallest change in measured value to which the instrument can respond
4. Ratio of response of the instrument to the input variable.

	A	B	C	D
a.	1	2	3	
b.	4	2	1	
c.	3	4	2	
d.	4	3	1	

83. Match List I with List II and select the correct answer,:

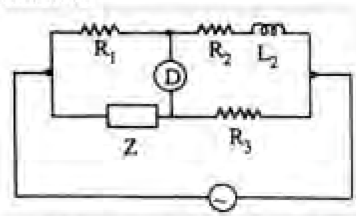
List I (Quantity)
A. Resistance
B. emf
C. Capacitance

List II (Dimensions)
1. $[M^{-1} L^{-2} T^4 I^2]$
2. $[M^{-1} L^{-2} T^2 I^{-2}]$
3. $[ML^2 T^{-3} I^{-1}]$
4. $[ML^2 T^{-3} I^{-2}]$

	A	B	C
a.	1	2	3
b.	4	2	1
c.	3	4	2
d.	4	3	1

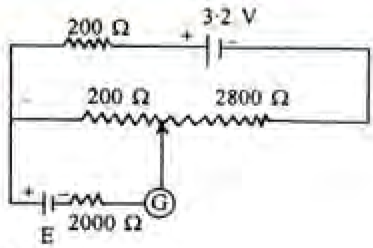
84. To achieve, the optimum transient response, the indicating instruments are so designed as to
   a. be critically damped
   b. be undamped
   c. provide damping which is slightly more than the critical value
   d. provide damping which is slightly less than the critical value

85. The ac bridge shown in the given figure will remain balanced if impedance Z consists of



   a. resistance and inductance in series
   b. resistance and capacitance in parallel
   c. capacitance only
   d. inductance only

86. In the potentiometer circuit shown in the given figure, the value of unknown voltage 'E' under balanced condition will be



a. 200mV
b. 2.8V
c. 3V
d. 3.2 V

87. A wattmeter has a range of 1000 W with an error of ±1% of full scale deflection. If the true power passed through it is 100 W, then the relative error would be
a. ±10%
b. ±5%
c. ±1%
d. ±0.5%

88. In a permanent magnet moving coil instrument, if the control spring is replaced by another one having a higher spring constant, then the natural frequency and damping ratio will
a. decrease
b. increase and decrease respectively
c. decrease and increase respectively
d. increase

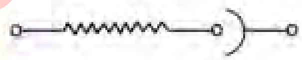
89. Consider the following statements in respect of thermoelectric instruments :
1. They indicate the rms value of current or voltage.
2. They suffer from waveform errors.
3. They can be used for frequency ranges of the order MHz.
4. They have a low overload capacity.
Which of these statements are correct ?
a. 1, 3 and 4
b. 1, 2 and 4
c. 1, 2 and 3
d. 2, 3 and 4

90. Match List I (Type of CRO) with List II (Appropriate use) and select the correct answer :

List I
A. Storage
B. Electrostatic deflection
C. Magnetic deflection
D. Multitrace

List II
1. Voltage and current transient studies
2. Comparison of waveforms in time domain
3. Television receiver
4. Accurate voltage measurements

	A	B	C	D
a.	4	1	2	3
b.	1	4	2	3
c.	4	1	3	2
d.	1	4	3	2

91. Which one of the following resistance configurations is best suited for the construction of a low resistance?
a. 
b. 
c. 
d. 

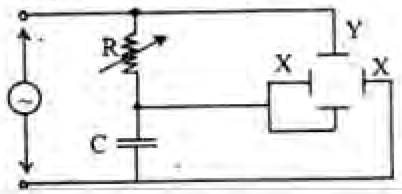
92. High resistance are provided with a guard terminal in order to
a. protect the resistance against stray electrostatic field
b. bypass the leakage current
c. protect the resistance against overloads
d. protect the resistance against stray electromagnetic field

93. The capacitance and loss angle of a capacitor can be accurately measured by
a. Kelvin's bridge
b. Anderson's bridge
c. Schering bridge
d. Carey-Foster's bridge

94. A resistance strain gauge is fastened to a beam subjected to a strain of 1×10^{-6}, yielding a resistance change of 240 μΩ. If the original resistance of the strain gauge is 120 Ω, the gauge factor would be
a. 5
b. 2
c. 1
d. 0.2

95. In the CR0 plate connections shown in the given figure, the supply frequency is 500

Hz and the capacitance 'C' is $\frac{0.2}{\pi}\mu F$. The value of resistance 'R' required to obtain a circle on the CRO screen (X and Y plates have equal sensitivities) is



a. 2 kΩ
b. 5 kΩ
c. 7 kΩ
d. 10 kΩ

96. The measurement junction of a thermocouple is taken from an environment of 300° C to 600° C. If the time constant of the thermocouple is 1 s, temperature indicated by it after 1 s will be nearly
a. 300°C
b. 400° C
c. 500° C
d. 600° C

97. In a single phase induction type energy meter, the Lag adjustment is done to ensure that
a. current coil flux lags the applied voltage by 90°
b. pressure coil flux lags the applied voltage by 90°
c. pressure coil flux is in phase with the applied voltage
d. current coil lags the pressure coil flux by 90°

98. A voltage of $\{200\sqrt{2}\sin 314t + 6\sqrt{2}\sin(942t + 30°) + 8\sqrt{2}\cos t(1570t + 30°)\}$ V is given to a harmonic distortion meter. The meter will indicate a total harmonic distortion of approximately
a. 4.5%
b. 6.5%
c. 7.5%
d. 8.5%

99. To eliminate 50 Hz pick-up in a dual slope DVM, the minimum period of integration of the input signal is
a. 1 ms
b. 20 ms
c. 1 s
d. 100 s

100. Which one of the following sets of building block mainly decides the accuracy of a frequency counter?
a. Crystal and ADC
b. ADC and DAC
c. DAC and gate width generator
d. Gate width generator and crystal

101. If the largest frequency present in the measured signal and number of bits used in the binary code, are respectively 'f_m' and 'n', then the minimum bandwidth of a pulse code modulation channel used for telemetry would be
a. $f_m / 2n$
b. f_m / n
c. nf_m
d. $2nf_m$

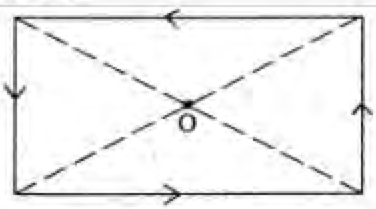
102. LCD displays are preferred over LED displays because they
a. are more reliable
b. consume less power
c. respond quickly
d. are cheaper

103. The plane x = 3 has a layer of charge density 2 nC/m^2. A line charge of density 20 nC/m is located at x = 1, z = 4. The force acting on unit metre length of the line charge is
a. $\frac{2\times10^{-9}\times20\times10^{-9}}{4\pi\varepsilon_0}\bar{a}_x N$
b. $\frac{2\times10^{-9}\times20\times10^{-9}}{2\pi\varepsilon_0}\bar{a}_z N$
c. $\frac{2\times10^{-9}\times20\times10^{-9}}{2\varepsilon_0}\bar{a}_x N$
d. $\frac{2\times10^{-9}\times20\times10^{-9}}{4\varepsilon_0}\bar{a}_x N$

104. The electrostatic field on the surface of a conductor at a certain point is $0.3\,a_x + 0.4\,a_y$. If the normal to the surface of the conductor at that point makes an angle θ with respect to x-axis, the value of cos θ will be
a. 0.8
b. 0.75
c. 0.6

d. 0.5

105. A rectangular loop carrying a current is shown in the given figure The magnetic potential $\overline{A}$ at the centre 'O' satisfies the conditions



a. $\overline{A}=0$ and $\nabla\times\overline{A}\neq 0$

b. $\overline{A}\neq 0$ and $\nabla\times\overline{A}\neq 0$

c. $\overline{A}\neq 0$ and $\nabla\times\overline{A}=0$

d. $\overline{A}\neq 0$ and $\nabla\times\overline{A}\neq 0$

106. A filamentary current of 10 π A flows in the negative z - direction. The magnetic field at (0, 5, 0) is

a. $\overline{a}_x$ A/m

b. $\overline{a}_y$ A/m

c. $\overline{a}_z$ A/m

d. $\left(\overline{a}_x+\overline{a}_y\right)$ A/m

107. The electric energy density is 'W' at a point in free space where the electric field is $\hat{a}_x$ E. If the electric field is $\hat{a}_x$ E—a_y E, in a dielectric of relative permittivity 4, then the electric energy density at that point will be

a. Zero

b. 2 W

c. 4 W

d. 8 W

108. If the open- and short-circuit input impedances of a loss-less line are respectively Z_1 and Z_2, its characteristic impedance will be

a. Z_1+Z_2

b. $\sqrt{Z_1^2+Z_2^2}$

c. $\dfrac{Z_1^2+Z_2^2}{Z_1+Z_2}$

d. $\sqrt{Z_1Z_2}$

109. The directive gain of an antenna is 30 dB. If the antenna radiates 7.5 kW, the power density at a distance of 40 km will be

a. $\dfrac{7.5\times10^3}{40\times10^3}\times 30W/m^2$

b. $\dfrac{7.5\times10^3\times30}{4\pi(40\times10^3)^2}W/m^2$

c. $\dfrac{7.5\times10^3\times1000}{4\pi(40\times10^3)^2}W/m^2$

d. $\dfrac{7.5\times10^3}{(40\times10^3)^2}\times 30W/m^2$

110. The projection of the vector $6a_x+2a_y-3a_z$ along $3a_x-4a_y$ is

a. 2

b. $18\bar{a}_x-8\bar{a}_y$

c. 10

d. $21\bar{a}_x-28\bar{a}_y$

111. If a uniform plane wave propagating. in the direction $(4\bar{a}_x-2\bar{a}_y+\bar{a}_z)$ has its E field in the direction $(4\bar{a}_x-2K\,a_y+4K\,a_z)$, the value of K must be

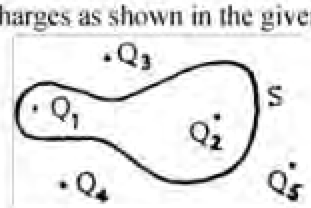
a. 2

b. −2

c. 1

d. Zero

112. The net flux of electric field-emanating from the surface 'S' with location of point charges as shown in the given figure is



a. $\dfrac{Q_1+Q_2}{\varepsilon_0}$

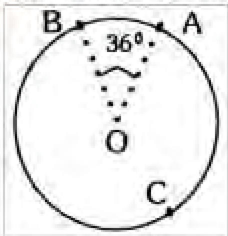
b. $\dfrac{Q_1+Q_2+Q_3+Q_4+Q_5}{\varepsilon_0}$

c. $\dfrac{Q_3+Q_4+Q_5}{\varepsilon_0}$

d. $\varepsilon_0\left(Q_1+Q_2\right)$

113. If the 36° arc AB of a circle shown in the given figure is uniformly charges leaving the arc BCA uncharged, the electric field at the centre 'O' is E. If the arc BCA is given the same linear charge density and

the arc AB left uncharged, then the electric field at the centre 'O' will be



a. $\overline{E}$

b. $-\overline{E}$

c. $9\overline{E}$

d. $-9\overline{E}$

114. If $\overline{B} = B_0 z \cos \omega t\, a_y$ and $\overline{E} = a_x E_x$ then

a. $E_X = 0$

b. $E_X = + B_0 z\, \omega \sin \omega t$

c. $E_X = + B_0 \cos \omega t$

d. $E_X = \frac{1}{2} B_0 z^2 \omega \sin \omega t$

115. A voltage of 50 sin 1000 t V is applied across a parallel plate capacitor with plate area of 5 cm^2 and plate separation gap of 5 mm. If the dielectric material in the capacitor has $\varepsilon = 2\varepsilon_0$, then the capacitor current (in Amperes) will be

a. $\frac{10^4}{\varepsilon_0} \cos 10^3 t$

b. $\varepsilon_0 10^4 \cos 10^3 t$

c. $\frac{10^4}{\varepsilon_0} \sin 10^3 t$

d. $\varepsilon_0 10^4 \sin 10^3 t$

116. The torque on a dipole consisting of 1 μC of charge at $(0, 0, 10^{-3})$m and −1 μC of charge at $(0, 0, -10^{-3})$ m in an electric field $\overline{E} = 10^3 \left(2a_x - 2a_y - 2a_z\right)$ V/m. The value of torque would be

a. $2 \times 10^{-6} \left(a_x + 2a_y\right)$ N-m

b. $10^{-6} \left(a_x + 2a_y\right)$ N-m

c. -4×10^{-6} N-m

d. $-2 \times 10^{-6} \left(a_x + 2a_y\right)$ N-m

117. The region $z \le 0$ is dielectric of relative permittivity 2 while the region $z \ge 0$ is a dielectric of relative permittivity 5. If the electric field intensity in region $z \le 0$ is $\overline{E} = 10 a_z$ kV/m, the potential difference between $(0, 0, -10^{-3})$ m and $(0, 0, 10^{-3})$m will be

a. zero

b. 70V

c. 20V

d. 14V

118. An infinite plane sheet of uniform surface charge density σ C/m^2 is lying in the x-y plane. The electric field $\overline{E}$ at a point P(0, 0, z) above the sheet (z > 0) would be (ε_0 is the free space permittivity)

a. $\overline{E} = \frac{\sigma}{2\varepsilon_0} a_z$

b. $\overline{E} = \frac{\sigma}{\varepsilon_0} a_z$

c. $\overline{E} = \frac{a_z \sigma}{4\pi\varepsilon_0 z^2}$

d. $\overline{E} = \frac{\sigma^2}{4\pi\varepsilon_0 z^2} a_z$

119. If the vector $\overline{B} = x^2 a_x - xy\, a_y - Kxz\, a_z$ represents a magnetic field, the value of the constant K must be

a. 0

b. 1

c. 2

d. 3

120. The region $z < 0$ has $\mu_r = 6$ and the region $z > 0$ has $\mu_r = 4$. If the magnetic flux density in region $z > 0$ is $5a_x + 8a_z$ m Wb/m^2, the magnetic field intensity in region $z < 0$ would be

a. $\frac{5a_x + 8a_z}{4\mu_0} mA/m$

b. $\frac{5a_x + 8a_z}{6\mu_0} mA/m$

c. $\frac{5a_x}{4\mu_0} + \frac{8a_z}{6\mu_0} mA/m$

d. $\frac{5a_x}{6\mu_0} + \frac{8a_z}{4\mu_0} mA/m$