BPSC
Lecturer

Previous Year Paper

Electronics 2015

1. Picard's formula for the numerical solution of an ordinary differential equation is :

(A) $y^{(n)} = y_0 + \int_{x_0}^{x} f(x, y^{(n-1)})dx,$ $n = 1, 2, ...$

(B) $y^{(n)} = y_n + \int_{x_0}^{x} f(x, y^{(n-1)})dx,$ $n = 0, 1, 2, ...$

(C) $y^{(n)} = y_0 + \int_{x_0}^{x_n} f(x, y^{(n-1)})dx,$ $n = 1, 2, ...$

(D) $y^{(n)} = y_n + \int_{x_0}^{x_n} f(x, y^{(n-1)})dx,$ $n = 0, 1, 2, ...$

2. Limit of a function $f(x)$ exists, if it does, at a

(A) point in its domain only

(B) point outside its domain only

(C) point not necessarily in its domain

(D) None of the above

3. The value of the $\lim_{x \to 0} \left\{\frac{1}{x}\right\}$

(A) is 0

(B) is 1

(C) does not exist

(D) None of the above

4. The value of the $\lim_{x \to 0} \left\{\frac{\int \cos x \, dx}{x}\right\}$ is

(A) 3/2

(B) 1

(C) −1

(D) None of the above

5. Which of the following functions is not continuous at the origin?

(A) $\sin x$

(B) x

(C) $x \sin x$

(D) $\frac{\sin x}{x}$

6. The function $f(x)$ is defined by $f(x) = |x|$. Then $f(x)$ is

(A) continuous and differentiable at $x = 0$

(B) neither continuous nor differentiable at $x = 0$

(C) continuous but not differentiable at $x = 0$

(D) None of the above

7. If a, b are positive real numbers, then the least value of $(a+b)(1/a+1/b)$ is

(A) 1

(B) 2

(C) 3

(D) 4

8. If $x+y=4$, then the least value of $(1/x+1/y)$ is

(A) 1

(B) 2

(C) 3

(D) 4

9. The value of $\int (x-3y^2+z)\,ds$ over the line segment C joining the point (0, 0, 0) to the point (1, 1, 1) is

(A) 0

(B) 1

(C) 2

(D) 3

10. The area of the region R bounded by the line $y=x$ and the curve $y=x^2$ in the first quadrant is

(A) 3 sq. units

(B) 1 sq. unit

(C) 2 sq. units

(D) $\frac{1}{6}$ sq. unit

11. The value of $\iiint_D dxdydz$ over the tetrahedron D with vertices (0, 0, 0), (1, 1, 0), (0, 1, 0), and (1, 1, 1) is

(A) $\frac{1}{6}$

(B) 1

(C) 2

(D) 3

12. Which of the following is correct?

(A) Green's theorem is a particular case of Stokes' theorem

(B) Stokes' theorem is a particular case of Green's theorem

(C) Both Stokes' theorem and Green's theorem are same

(D) None of the above

13. The gradient of the function $f(x, y) = x+y$ at the point (0, 0) is

(A) 0

(B) $i+j$

(C) 1

(D) $i+2j$

14. The value of $\int_C F.dr$, where $F(x, y, z) = z\mathbf{i} + xy\mathbf{j} - y^2\mathbf{k}$ along the curve C given by $r(t) = t^2\mathbf{i} + t\mathbf{j} + \sqrt{t}\mathbf{k}$ $(0 \le t \le 1)$ is

(A) $\frac{1}{6}$

(B) $\frac{17}{20}$

(C) 2

(D) 3

15. The circulation of the field $F = (x-y)\mathbf{i} + x\mathbf{j}$ around the circle $r(t) = \cos t\,\mathbf{i} + \sin t\,\mathbf{j}$ $(0 \le t \le 2\pi)$ is

(A) 0

(B) π

(C) 2π

(D) 1

16. The set of eigenvectors of an identity matrix of order 2 is

(A) $R^2 - \{(0, 0)\}$

(B) R^2

(C) $\{(0, 0)\}$

(D) None of the above

17. Let A and B be any square matrices. Then

(A) $AB = BA$

(B) $A + B \neq B + A$

(C) $A - B = B - A$

(D) None of the above

18. Let A and B be any non-singular matrices of order n. Then

(A) AB is singular

(B) $(AB)^{-1} = A^{-1}B^{-1}$

(C) $(AB)^{-1}$ does not exist

(D) None of the above

19. The matrix A satisfying the equation

$$\begin{pmatrix} 1 & 3 \\ 0 & 1 \end{pmatrix} A = \begin{pmatrix} 1 & 1 \\ 0 & -1 \end{pmatrix}$$

is

(A) $\begin{pmatrix} 1 & 3 \\ 0 & 1 \end{pmatrix}$

(B) $\begin{pmatrix} 1 & -3 \\ 0 & 1 \end{pmatrix}$

(C) $\begin{pmatrix} 1 & 3 \\ 0 & -1 \end{pmatrix}$

(D) None of the above

20. If A is an $m \times n$ matrix such that AB and BA both are defined, then B is an

(A) $m \times n$ matrix

(B) $n \times m$ matrix

(C) $n \times n$ matrix

(D) $m \times m$ matrix

21. The inverse of a symmetric matrix is

(A) symmetric

(B) skew-symmetric

(C) diagonal matrix

(D) None of the above

22. Which of the following is correct?

(A) Determinant is a square matrix

(B) Determinant is a number associated to a matrix

(C) Determinant is a number associated to a square matrix

(D) None of the above

23. If A is a singular matrix, then $A(\text{adj} A)$ is a/an

(A) scalar matrix

(B) null matrix

(C) identity matrix

(D) orthogonal matrix

24. If A and B are two matrices such that $AB = A$ and $BA = B$, then B^2 is equal to

(A) B

(B) A

(C) AB

(D) BA

25. Let A be the set of all matrices of order 3 whose entries are either 0 or 1. Then the number of elements in the set A is

(A) 2^3

(B) 2^6

(C) 2^9

(D) None of the above

26. If $x \in [0, 5]$, then what is the probability that $x^2 - 3x + 2 \geq 0$?

(A) $\frac{4}{5}$

(B) $\frac{3}{5}$

(C) 1

(D) None of the above

27. Five coins are tossed simultaneously. The probability that at least one head turning up is

(A) $\frac{5}{32}$

(B) $\frac{31}{32}$

(C) $\frac{1}{2}$

(D) None of the above

28. In eight throws of a die, 1 or 3 is considered as a success. Then the standard deviation of the success is

(A) $\frac{4}{3}$

(B) $\frac{2}{3}$

(C) $\frac{1}{2}$

(D) None of the above

29. If the mean and standard deviation of a binomial distribution are 20 and 4 respectively, then the number of trials is

(A) 50

(B) 100

(C) 80

(D) None of the above

30. An unbiased coin is tossed n times. Let X denote the number of times the head occurs. If $P(X=4)$, $P(X=5)$ and $P(X=6)$ are in AP, then the values of n can be

(A) 7, 14

(B) 10, 14

(C) 12, 7

(D) None of the above

31. If L is the Laplace transform, then $L\{\sin at\} =$

(A) $\frac{a}{s^2+a^2}$

(B) $\frac{a}{s^2-a^2}$

(C) $\frac{s}{s^2+a^2}$

(D) $\frac{s}{s^2-a^2}$

32. The differential equation representing the heat equation is

(A) $\nabla^2 f = 0$

(B) $u_t = k u_{xx}$

(C) $u_{tt} = k\nabla^2 u$

(D) None of the above

33.

34.

35.

33. The solution of the differential equation $dx + e^{(y-x)}dy = 0$ is

(A) $e^x + e^y = c$

(B) $e^x - e^y = c$

(C) $e^{xy} = c$

(D) None of the above

34. The solution of the differential equation $x^2y'' + 2xy' - 2y = 0$ is

(A) cx^2

(B) $c_1x + c_2/x^2$

(C) c

(D) None of the above

35. The solution of the differential equation $y'' + 4y = 6\cos x$ is

(A) $c_1\cos 2x + c_2\sin 2x + 2\cos x$

(B) $c\sin 2x + 2\cos x$

(C) $c\cos 2x + 2\cos x$

(D) None of the above

36. By trapezoidal rule, the integral $\int_{x_0}^{x_3} y\,dx =$

(A) $\frac{h}{2}(y_0 + 2y_1 + 2y_2 + y_3)$

(B) $\frac{h}{2}(y_0 + 4y_1 + 2y_2 + y_3)$

(C) $\frac{h}{2}(y_0 + 2y_1 + 4y_2 + y_3)$

(D) $\frac{h}{2}(y_0 + 4y_1 + 4y_2 + y_3)$

37. By Simpson's $\frac{1}{3}$rd rule, the integral $\int_{x_0}^{x_2} y\,dx =$

(A) $\frac{h}{2}(y_0 + 2y_1 + 2y_2)$

(B) $\frac{h}{2}(y_0 + 4y_1 + 2y_2)$

(C) $\frac{h}{2}(y_0 + 2y_1 + 4y_2)$

(D) $\frac{h}{3}(y_0 + 4y_1 + y_2)$

38. By Simpson's $\frac{3}{8}$th rule, the integral $\int_{x_0}^{x_3} y\,dx =$

(A) $\frac{3h}{8}(y_0 + 3y_1 + 3y_2 + y_3)$

(B) $\frac{h}{2}(y_0 + 4y_1 + 2y_2 + y_3)$

(C) $\frac{3h}{8}(y_0 + 3y_1 + 2y_2 + y_3)$

(D) $\frac{h}{3}(y_0 + 3y_1 + 3y_2 + y_3)$

39. Runge-Kutta second-order formula for the numerical solution of an ordinary differential equation is

(A) $y_1 = y_0 + \frac{1}{2}(k_1 + k_2)$, where $k_1 = hf(x_0, y_0)$ and $k_2 = hf(x_0 + h, y_0 + k_1)$

(B) $y_1 = y_0 + \frac{1}{2}(k_1 + k_2)$, where $k_1 = hf(x_0, y_0)$ and $k_2 = hf(x_0 + h, y_0)$

(C) $y_1 = y_0 + \frac{1}{2}(k_1 + k_2)$, where $k_1 = hf(x_0, y_0)$ and $k_2 = hf(x_0 + h, y_0 + h)$

(D) None of the above

40. Euler's formula for the numerical solution of an ordinary differential equation is

(A) $y_{n+1} = y_n + hf(x_n, y_n)$, $n = 0, 1, 2, \ldots$

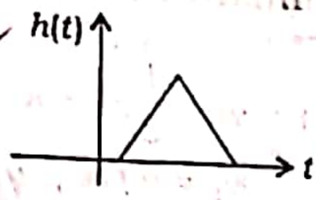
(B) $y_{n+1} = y_0 + hf(x_n, y_n)$, $n = 0, 1, 2, \ldots$

(C) $y_{n+1} = y_n + hf(x_0, y_0)$, $n = 0, 1, 2, \ldots$

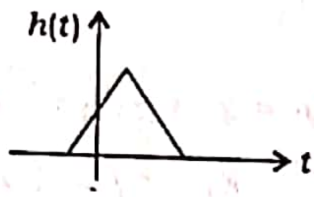
(D) $y_{n+1} = y_n + hf(x_n, y_n)$, $n = 1, 2, \ldots$

41. Which of the following can be impulse response of a causal system?

(A)

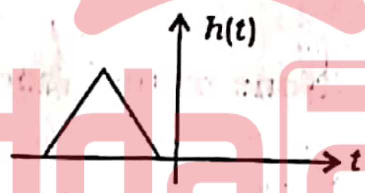


(B)



(C)

(D)



42. The Fourier series of a real periodic function has only

P. cosine terms if it is even
Q. sine terms if it is even
R. cosine terms if it is odd
S. sine terms if it is odd

Which of the above are correct?

(A) *Q* and *R*

(B) *P* and *S*

(C) *P* and *R*

(D) *Q* and *S*

43. If the Laplace transform of a signal $y(t)$ is $Y(s) = \frac{1}{s(s-1)}$, then its final value is

(A) 1

(B) −1

(C) 0

(D) unbounded

44. A band-limited signal is sampled at the Nyquist rate. The signal can be recovered by passing the samples through

(A) a PLL

(B) an R-C filter

(C) an ideal low-pass filter with appropriate bandwidth

(D) an envelope detector

45. A silicon sample is uniformly doped with 10^{16} phosphorus atoms/cm^3 and 2×10^{16} boron atoms/cm^3. If all the dopants are fully ionized, the material is

(A) n-type with carrier concentration of 10^{16} cm^{-3}

(B) n-type with carrier concentration of 2×10^{16} cm^{-3}

(C) p-type with carrier concentration of 10^{16} cm^{-3}

(D) p-type with carrier concentration of 2×10^{16} cm^{-3}

46. A silicon *p-n* junction at a temperature of 20 °C has a reverse saturation current of 10 pA. The reverse saturation current at 40 °C for the same bias is approximately

(A) 50 pA

(B) 30 pA

(C) 60 pA

(D) 40 pA

47. Group—I lists four types of *p-n* junction diodes. Match each device in Group—I with one of the options in Group—II to indicate the bias condition of that device in its normal mode of operation :

Group—I	Group—II
a. Zener diode	1. Forward bias
b. Laser diode	2. Reverse bias
c. Avalanche photodiode	
d. Solar cell	

Codes :

	a	b	c	d
(A)	2	1	2	2
(B)	2	2	1	1
(C)	1	2	1	2
(D)	2	1	1	2

48. A half-wave rectifier uses a diode with a forward resistance R_f. The voltage is $V_m \sin \omega t$ and the load resistance is R_L. The d.c. current is given by

(A) $\frac{V_m}{\sqrt{2}R_L}$

(B) $\frac{V_m}{R_L}$

(C) $\frac{2V_m}{\sqrt{\pi}}$

(D) $\frac{V_m}{\pi(R_f + R_L)}$

49. In a uniformly doped BJT, assume that N_E, N_B and N_C are the emitter, base and collector dopings in atoms/cm^3 respectively. If the emitter injection efficiency of the BJT is close to unity, which one of the following conditions is TRUE?

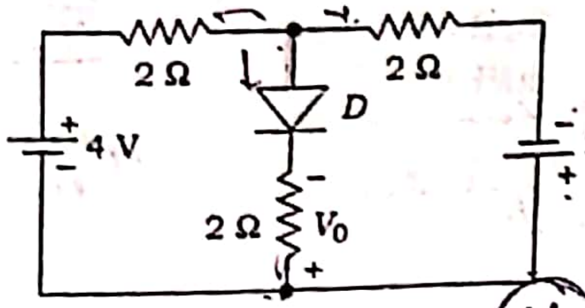
(A) $N_E = N_B$ and $N_B < N_C$

(B) $N_E < N_B < N_C$

(C) $N_E >> N_B$ and $N_B > N_C$

(D) $N_E = N_B = N_C$

50. For the circuit shown in the figure below, the voltage V_0 is (here D is an ideal diode)



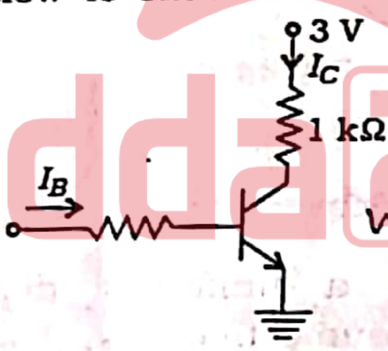
(A) −1 V

(B) 1 V

(C) 2 V

(D) None of the above

51. Assuming $V_{CE\,sat} = 0{\cdot}2$ V and $\beta = 50$, the minimum base current (I_B) required to drive the transistor shown in the figure below to saturation is



(A) 3 μA

(B) 56 μA

(C) 60 μA

(D) 140 μA

52. The DC current gain (β) of a BJT is 50. Assuming that the emitter injection efficiency is 0·995, the base transport factor is

(A) 0·995

(B) 0·990

(C) 0·985

(D) 0·980

53. Introducing a resistor in the emitter of a common amplifier stabilizes the d.c. operating point against variations in

(A) only β of the transistor

(B) only temperature

(C) both β and temperature

(D) None of the above

54. The threshold voltage of an n-channel MOSFET can be increased by

(A) reducing the channel length

(B) reducing the gate-oxide thickness

(C) reducing the channel dopant concentration

(D) increasing the channel dopant concentration

55. A silicon wafer has 100 nm of oxide on it and is inserted in a furnace at a temperature above 1000 °C for further oxidation in dry oxygen. The oxidation rate

(A) slows down as the oxide grows

(B) is independent of current oxide thickness and temperature

(C) is zero as the existing oxide prevents further oxidation

(D) is independent of current oxide thickness but depends on temperature

56. At room temperature, a possible value for the mobility of electrons in the inversion layer of a silicon n-channel MOSFET is

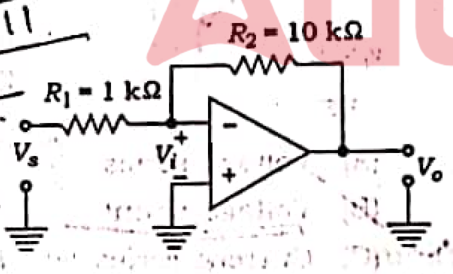
(A) 3600 $cm^2/V\text{-}s$

(B) 1800 $cm^2/V\text{-}s$

(C) 1350 $cm^2/V\text{-}s$

(D) 450 $cm^2/V\text{-}s$

57. The inverting OP-AMP shown in the figure below has an open-loop gain of 100. The closed-loop gain $\frac{V_o}{V_s}$ is



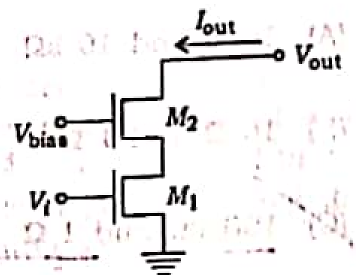
(A) −10

(B) −8

(C) −11

(D) −9

58. Two identical NMOS transistors M_1 and M_2 are connected as shown in the figure below. V_{bias} is chosen so that both the transistors are in saturation. The equivalent g_m of the pair is defined to be $\frac{\partial I_{out}}{\partial V_i}$ at constant V_{out}. The equivalent g_m of the pair is



(A) the product of individual g_m's of the transistors

(B) the sum of individual g_m's of the transistors

(C) nearly equal to g_m / g_o of M_2

(D) nearly equal to g_m of M_1

59. A high-Q quartz crystal exhibits series resonance at the frequency ω_s and parallel resonance at the frequency ω_p. Then

(A) ω_s is very close to, but less than ω_p

(B) ω_s is very close to, but greater than ω_p

(C) $\omega_s >> \omega_p$

(D) $\omega_s << \omega_p$

60. An amplifier has an open-loop gain of 100, an input impedance of 1 kΩ and an output impedance of 100 Ω. A feedback network with a feedback factor of 0·99 is connected to the amplifier in a voltage series feedback mode. The new input and output impedances respectively are

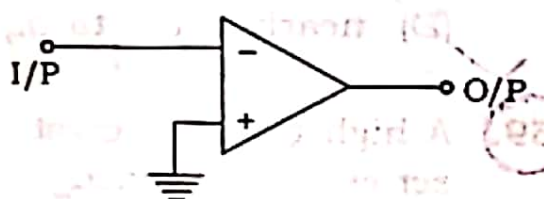
(A) 10 Ω and 10 kΩ

(B) 10 Ω and 1 Ω

(C) 100 kΩ and 1 Ω

(D) 100 Ω and 1 Ω

61. If the input to the circuit shown in the figure below is sine wave, then the output will be



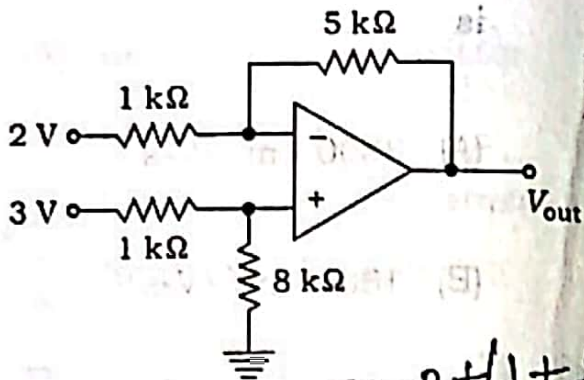
(A) a triangular wave

(B) a square wave

(C) a half-wave rectified sine wave

(D) a full-wave rectified sine wave

62. If the OP-AMP shown in the figure below is ideal, then the output voltage V_{out} will be equal to



(A) 17 V
(B) 1 V
(C) 6 V
(D) 14 V

63. The circuit shown in the figure below is an example of feedback of which of the following types?

(A) Voltage series
(B) Voltage shunt
(C) Current series
(D) Current shunt

64. If $T(s) = \dfrac{s-5}{(s+2)(s+3)}$, then it is

(A) a non-minimum phase system
(B) a minimum phase system
(C) an uncontrollable system
(D) an unstable system

72. Assuming perfect conductors of a transmission line, pure TEM propagation is *not* possible in

(A) a quadrupole

(B) coaxial cable

(C) air-filled cylindrical wave-guide

(D) both monopole and dipole

73. A lossless transmission line is terminated in a load which reflects a part of the incident power. The measured VSWR is 2. The percentage of the power that is reflected back is

(A) 11·11%

(B) 0·11%

(C) 33·33%

(D) 57·73%

74. Some unknown material has a conductivity of 10^6 mho/m and a permeability of $4\pi \times 10^{-7}$ H/m. The skin depth for the material at 1 GHz is

(A) 20·9 μm

(B) 25·9 μm

(C) 30·9 μm

(D) 15·9 μm

75.

76.

77.

75. The magnitudes of the open-circuit and short-circuit input impedances of a transmission line are 100 Ω and 25 Ω respectively. The characteristic impedance of the line is

(A) 50 Ω

(B) 100 Ω

(C) 75 Ω

(D) 25 Ω

76. The minimum number of MOS transistors required to make a dynamic RAM cell is

(A) 4

(B) 3

(C) 2

(D) 1

77. The minimum number of NAND gates required to implement the Boolean function $A + A \cdot \overline{B} + A \cdot \overline{B} \cdot C$ is equal to

(A) 7

(B) 4

(C) 1

(D) 0

83. In an 8085 microprocessor, the instruction CMP B has been executed while the contents of the accumulator are less than the contents of register B. As a result

(A) both carry flag and zero flag are reset

(B) both carry flag and zero flag are set

(C) carry flag is reset but zero flag is set

(D) carry flag is set but zero flag is reset

84. An instruction used to set the carry flag in a computer can be classified as

(A) arithmetic

(B) data transfer

(C) logical

(D) program control

85. Quadrature multiplexing is

(A) the same as TDM

(B) the same as FDM

(C) a combination of TDM and FDM

(D) quite different from TDM and FDM

86. The amplitude spectrum of a Gaussian pulse is

(A) Gaussian

(B) uniform

(C) sine function

(D) impulse function

87. At a given probability of error, binary coherent FSK is inferior to binary coherent PSK by

(A) 0 dB

(B) 2 dB

(C) 3 dB

(D) 6 dB

88. An AM signal is detected using an envelope detector. The carrier frequency and modulating signal frequency are 1 MHz and 2 kHz respectively. An appropriate value for time constant of envelope detector is

(A) 0·2 μs

(B) 1 μs

(C) 20 μs

(D) 500 μs

89. The signal

$$\cos \omega_c t + 0 \cdot 5 \cos \omega_m t \sin \omega_c t$$

is

(A) AM only

(B) FM only

(C) both AM and FM

(D) neither AM nor FM

90. Which of the following analog modulation schemes requires the minimum transmitted power and minimum channel bandwidth?

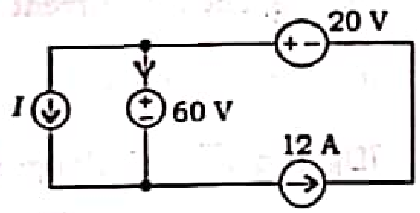
(A) AM

(B) VSB

(C) SSB

(D) DSB-SC

91. In the inter-connection of ideal sources shown in the figure below, the 60 V source is absorbing power. Which of the following can be the value of the current source I?



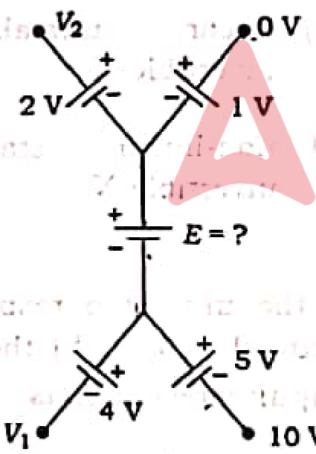
(A) 10 A

(B) 13 A

(C) 15 A

(D) 18 A

92. In the circuit shown in the figure below, the value of the voltage source E is



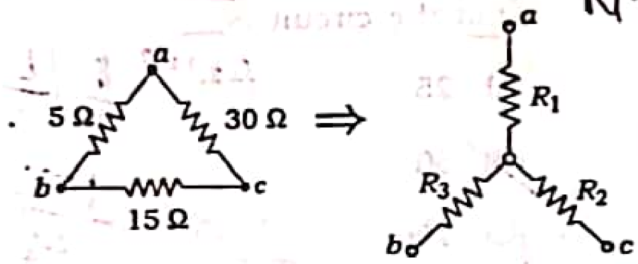
(A) − 16 V

(B) 4 V

(C) − 6 V

(D) 16 V

93. A delta-connected network with its star equivalent is shown in the figure below. The resistances R_1, R_2 and R_3 (in ohms) are respectively



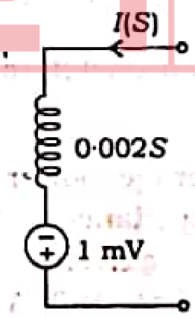
(A) 1·5, 3 and 9

(B) 3, 9 and 1·5

(C) 9, 3 and 1·5

(D) 3, 1·5 and 9

94. A 2 mH inductor with some initial current can be represented as shown in the figure below, where S is the Laplace transform variable. The value of the initial current is



(A) 0·5 A

(B) 2·0 A

(C) 1·0 A

(D) 0 A

95. A series R-L-C circuit has a resonance frequency of 1 kHz and a quality factor $Q = 100$. If each of R, L and C is doubled from its original value, the new Q of the circuit is

(A) 25

(B) 50

(C) 100

(D) 200

96. Two 2-port networks are connected in cascade. The combination is to be represented as a single 2-port network. The parameters of the network are obtained by multiplying the individual

(A) z-parameter matrix

(B) y-parameter matrix

(C) $ABCD$-parameter matrix

(D) h-parameter matrix

97. The average power delivered to an impedance $(4 - j3)\ \Omega$ by a current source $5\cos(100\pi t + 100)$ A is

(A) 62·0 W

(B) 120 W

(C) 44·5 W

(D) 50 W

98. The superposition theorem is ***not*** applicable to the network containing

(A) non-linear elements

(B) dependent current sources

(C) transformers

(D) dependent voltage sources

99. A system with input $x[n]$ and output $y[n]$ is given as $y[n] = \left[\sin \frac{5}{6}\pi n\right] x[n]$. The system is

(A) linear, stable and non-invertible

(B) linear, stable and invertible

(C) linear, unstable and invertible

(D) non-linear, stable and invertible

100. If the unit step response of a network is $(1 - e^{-\alpha t})$, then its unit impulse response is

(A) $\alpha^{-1} e^{-\alpha t}$

(B) $(1-\alpha) e^{-\alpha t}$

(C) $(1-\alpha^{-1}) e^{-\alpha t}$

(D) $\alpha e^{-\alpha t}$.