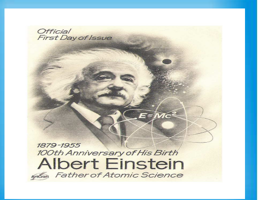

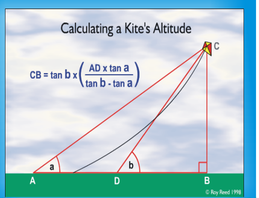

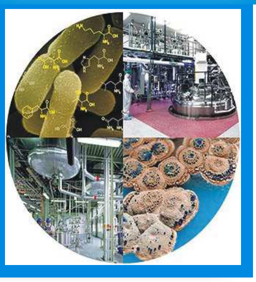

GATE - ELECTRONICS & COMMUNICATION

MOCK TEST PAPER

- *There are a total of 65 questions carrying 100 marks.*
- *Questions (1-25) will carry 1-mark each and questions (26-55) will carry 2-marks each.*
- *Questions (56-65) belongs to general aptitude (GA). Questions (56-60) will carry 1-mark each, and question (61-65) will carry 2-marks each*
- *For Q.1-25 and Q.56-60 1/3 mark will be deducted for each wrong answer.For Q.26-51 and Q. 61-65 2/3 mark will be deducted for each wrong answer. The question pairs (Q.52, Q.53) and (Q.54, Q.55) are linked questions.For Q.52 &54 2/3 mark will be deducted. There is no negative marking for Q.53 &Q.55.*
- *Q.48-51 are common data questions. If first question is attempted wrongly then answer of second question will not be evaluated.*
- *Pattern of questions : MCQs & Numerical*
- *Total marks : 100*
- *Duration of test : 3 Hours*

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1. If A is a non - singular matrix and the eigen values of A are 2,3, –3 then the eigen values of A^{-1} are

(A) 2, 3, – 3

(B) $\frac{1}{2}, \frac{1}{3}, \frac{-1}{3}$

(C) 2 | A|, 3|A|, –3 |A|

(D) None of these

2. If an error of 1% is made in measuring the major and minor axes of an ellipse, then the percentage error in the area is approximately equal to

(A) 1%

(B) 2%

(C) □%

(D) 4%

3. $\int \frac{dx}{e^x - 1}$ is equal to

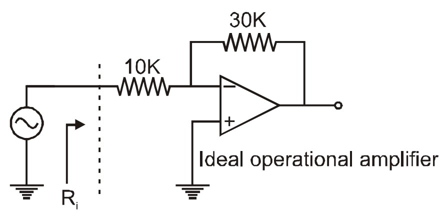
(A) log $(e^X – 1)$

(B) log $(1 – e^X)$

(C) log $(e^{-X} – 1)$

(D) log $(1 – e^{-X})$

4. The input resistance R_i of the amplifier shown in the figure is



(A) $\frac{30}{4}$ k□

(B) 10 k□

(C) 40 k□

(D) infinite

5. The first and the last critical frequency of an RC-driving point impedance function must respectively be

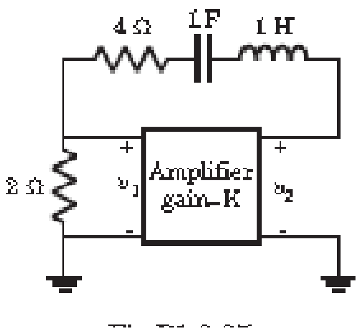
(A) a zero and a pole

(B) a zero and a zero

(C) a pole and a pole

(D) a pole and a zero

6. The amplifier network shown in fig is stable if



(A) $K < 3$

(B) $K \geq 3$

(C) $K \le \frac{1}{3}$

(D) $K \ge \frac{1}{3}$

7. A can solve 90% of the problems given in a book and B can solve 70%. What is the probability that at least one of them will solve a problem, selected at random from the book?

(A) 0.16

(B) 0.63

(C) 0.97

(D) 0.20

8. An pn junction diode is operating in reverse bias region. The applied reverse voltage, at which the ideal reverse current reaches 90% of its reverse saturation current, is

(A)- 59.6 mV

(B) 2.7 mV

(C) 4.8 mV

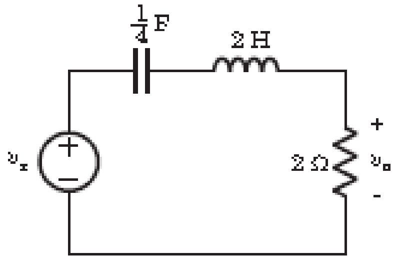
(D) 42.3 m

9. Following are the value of a function

$y(x): y(-1) = 5, y(0), y(1) = 8$

$\frac{dy}{dx}$ at x = 0 as per Newton's central difference scheme is________.

10. In the network of Fig. , all initial condition are zero. The damping exhibited by the network is



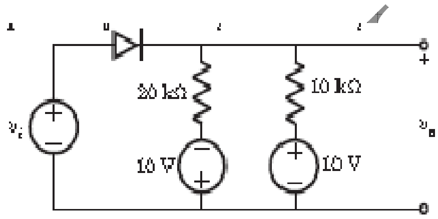
(A) Over damped

(B) Under damped

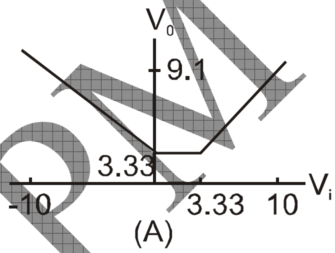
(C) Critically damped

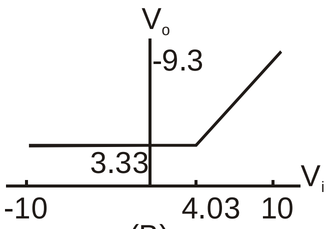
(D) Value of voltage is required

11. For the circuit in fig., let cutting voltage $V_{\square}$ = 0.7 V. the Plot of u_0 verses V_i for – 10 ≤ u_1 ≤10 V is

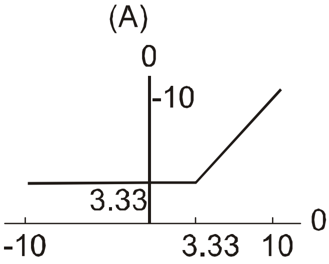


(A)



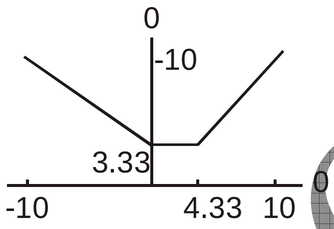
(B) 

(B)



(C)

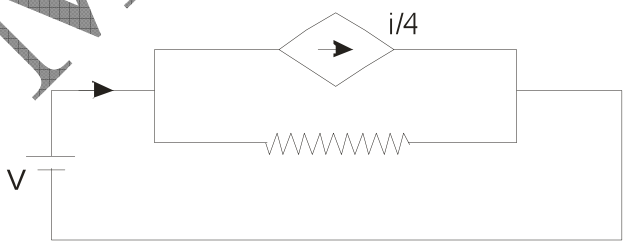
(C)



(D)

(D)

12. In the network shown in the figure, the effective resistance faced by the voltage source is________.



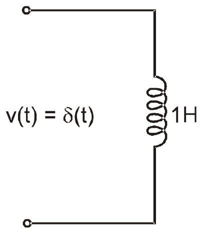
13. Consider the signed binary number A = 01010110 and B = 1110 1100 where B is the 1's complement and MSB is the sign bit. In list-I operation is given, and in list-II resultant binary number is given.

List I	List-II
P. $A + B$	1. 0100 0011
Q. $B \quad A$	2. 0110 1001
R. $A \quad B$	3. 0100 0010
S. $A \quad B$	4. 1001 0101
	5. 1011 1100
	6. 1001 0110
	7. 1011 1101
	8. 0110 1010

The correct match is

	P	Q	R	S
(A)	3	4	2	5
(B)	3	6	8	7
(C)	1	4	8	7
(D)	1	6	2	5

14. When a unit impulse voltage is applied to an inductor of 1 H, the energy supplied by the source is __________.



15. In silicon at T = 300 K if the Fermi energy is 0.22 eV above the valence band energy, the value of p_0 is

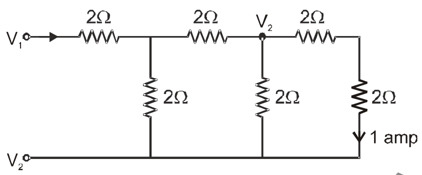
(A) 2×10^{15} cm^{-3}

(B) 10^{15} cm^{-3}

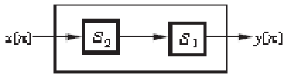
(C) 3×10^{15} cm^{-3}

(D) 4×10^{15} cm^{-3}

16. The voltage transfer ratio V_2/V_1 for the network shown in the figure is ________.



17. Two discrete time systems S1 and S2 are connected in cascade to form a new system as shown in fig.



Consider the following statements

(a) If S_1 and S_2 are linear, then S is linear

(b) If S_1 and S_2 are nonlinear, then S is nonlinear

(c) If S_1 and S_2 are causal, then S is causal

(d) If S_1 and S_2 are time invariant, then S is time invariant

True statements are :

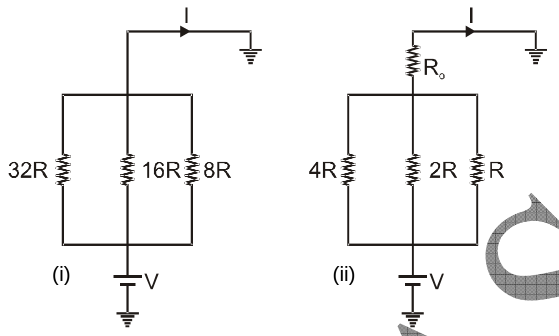
(A) a, b, c

(B) b, c, d

(C) a, c, d

(D) All

18. The circuit shown in Fig-I is replaced by that in Fig-II. If current I remains the same, then R_0 will be ________.



19. The transfer function of a system is given as

$$H(z) = \frac{2\left(z+\frac{1}{2}\right)}{\left(z+\frac{1}{2}\right)\left(z-\frac{1}{3}\right)}$$

Consider the two statements

Statement(i) : System is causal and stable.

Statement(ii) : Inverse system is causal and stable.

The correct option is

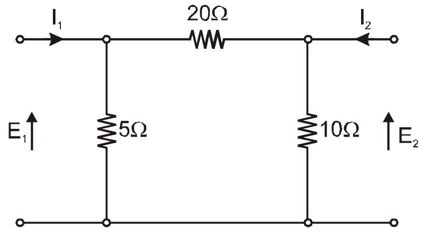
(A) (i) is true

(B) (ii) is true

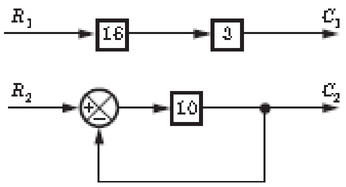
(C) Both (i) and (ii) are true

(D) Both are false

20. The admittance parameter Y_{12} in the 2-port network in the given figure is __________.



21. Consider the systems shown in fig. If the forward path gain is reduced by 10% in each system, then the variation in C1 and C2 will be respectively



(A) 10% and 1%

(B) 2% and 10%

(C) 10% and 0%

(D) 5% and 1%

22. The closed loop transfer function of a system is

$$T(s) = \frac{S^3 + 4s^2 + 8s + 16}{s^5 + 3s^4 + 5s^2 + s + 3}$$

The number of poles in right half - plane and in left half - plane are

(A) 3, 2

(B) 2, 3

(C) 1, 4

(D) 4, 1

23. A system has a damping ratio of 1.25, a natural frequency of 200 rad/s and DC gain of 1.

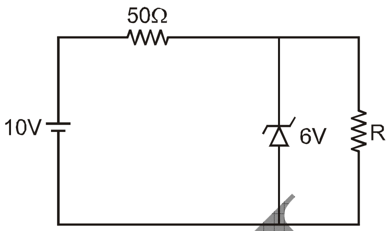
(A) overdamped

(B) under damped

(C) critically damped

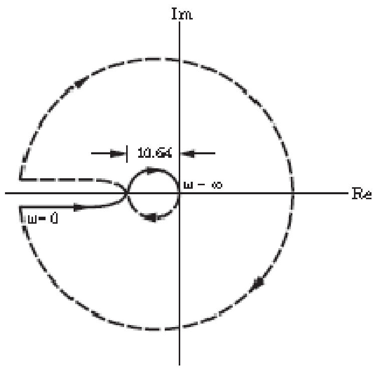
(D) None of the above

24. The 6V zener diode shown in the figure, has zero zener resistance and a knee current of 5mA. The minimum value of R so that the voltage across it does not fall below 6 V is ____________.



25. The Nyquist plot of a system is shown in fig. The open-loop transfer function is

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



The no. of poles of closed loop system in RHP are

(A) 0

(B) 1

(C) 2

(D) 4

26. An n-channel JFET having a pinch-off voltage (V_P) of –5V shows a transconductance (g_m) of 1 mA/V, when applied gate-to-source voltage (V_{GS}) is –3V. Its maximum transconductance (in mA/V) will be ______.

27. What is the maximum average effective input noise temperature that an amplifier can have if its average standard noise figure does not exceed 1.7 ?

(A) 203 K

(B) 215 K

(C) 235 K

(D) 255 K

28. The aerial current of an AM transmitter is 18 A when unmodulated but increases to 20 A when modulated.The modulation index is

(A) 0.68

(B) 0.73

(C) 0.89

(D) None of the above

29. A super heterodyne receiver is designed to receive transmitted signals between 5 and 10 MHz. High-side tuning is to be used. The tuning range of the local oscillator for IF frequency 500 kHz would be

(A) 4.5 MHz - 9.5 MHz

(B) 5.5 MHz - 10.5 MHz

(C) 4.5 MHz - 10.5 MHz

(D) None of the above

30. In a PCM system, if the code word length is increased form 6 to 8 bits, the signal to quantization noise ratio improves by the factor.

(A) 8/6

(B) 12

(C) 16

(D) 8

31. A vector field is given by

$E = 4zy^2 y_z + 2y \sin 2xu_y + y^2 \sin 2xu_z$

The region in which E = 0 is

(A) Plane y = 0

(B) Plane x = 0

(C) Plane z = 0

(D) all

32. The grad $\nabla \times A$ of a vector field

$A = x2yu_x + y2zu_y - 2xzu_z$ is

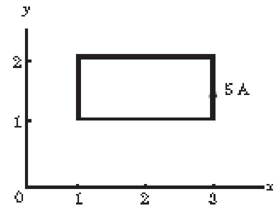
(A) $2xy + 2yz - 2x$

(B) $x^2y + y^2z - 2xz$

(C) $2x^2y + 2y^2z - 2xz$

(D) 0

33. Consider the rectangular loop on z = 0 plane shown in fig. the magnetic flux density is $B = 6xu_x - 9yu_y + 3zu_z$ Wb/m^2. The total force experienced by the rectangular loop is



(A) $30u_z$N

(B) $-30u_z$ N

(C) $36u_z$N

(D) $-36u_z$ N

34. In a nonmagnetic medium

$E = 5\cos(10^9t - 8x)\,u_x + 4\sin(10^9t - 8x)\,u_z$ V/m.

The dielectric constant of the medium is

(A) 3.39

(B) 1.84

(C) 5.76

(D) 2.4

35. A rectangular waveguide is filled with a polyethylene (ε_r = 2.25) and operates at 24 GHz. The cutoff frequency of certain mode is 16 GHz. The intrinsic impedance of this mode is

(A) 2248 Ω

(B) 337.2 Ω

(C) 421.4 Ω

(D) 632.2 Ω

36. The radiation resistance of an antenna is 63 Ω and loss resistance 7 Ω. If antenna has power gain of 16, then directivity is

(A) 48.26 dB

(B) 12.5 dB

(C) 38.96 dB

(D) 24.7 dB

37. The air filled cavity resonator has dimension a = 3cm, b = 2cm, C = 4cm. The resonant frequency for the TM_{110} mode is

(A) 5 GHz

(B) 6.4 GHz

(C) 16.2 GHz

(D) 9 GHz

38. A practical DC current source provide 20 kW to a 50Ω load and 20 kW to a 200Ω load. The maximum power, that can be drawn from it, is

(A) 22.5 kW

(B) 45 kW

(C) 30.3 kW

(D) 40 kW

39. The following results were obtained from measurements taken between the two terminal of a dissipated network

Terminal voltage	12 V	0 V
Terminal current	0 A	1.5 A

The Thevenin resistance of the network is

(A) 16

(B) 8

(C) 0

(D) ∞

40. The following fields exist in charge free regions

$P = 60 \sin(\omega t + 10x) u_z$

$Q = \frac{10}{\rho}\cos(\omega t - 2\rho) u\phi$

$R = 3\rho^2 \cot\phi u_\rho = \frac{1}{\rho}\cos\phi u_\phi$

$S = \frac{1}{r}\sin\theta \sin(\omega t - 6r) u_\theta$

The possible electromagnetic fields are

(A) P, Q

(B) R, S

(C) P, R

(D) Q, S

41. A signal is sampled at 8 kHz and is quantized using 8 bit uniform quantizer. Assuming SNR_q for a sinusoidal signal, the correct statement for PCM signal with a bit rate of R is

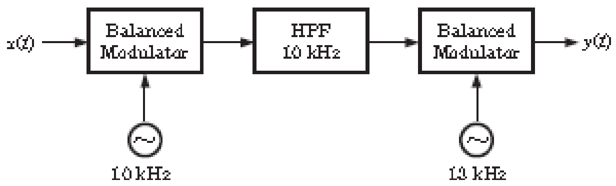
(A) R = 32 kbps, SNR_q = 25.8 dB

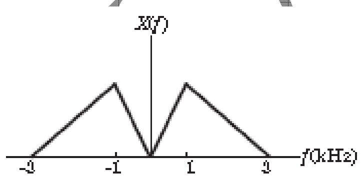
(B) R = 64 kbps, SNR_q = 49.8 dB

(C) R = 64 kbps, SNR_q = 55.8 dB

(D) R = 32 kbps, SNR_q = 49.8 dB

42. Consider a system shown in Figure . Let X (f) and Y(f) denote the Fourier transforms of x (t) and y (t) respectively. The ideal HPF has the cutoff frequency 10 kHz. The positive frequencies where Y (f) has spectral peaks are





(A) 1 kHz and 24 kHz

(B) 2 kHz and 24 kHz

(C) 1 kHz and 14 kHz

(D) 2 kHz and 14 kHz

43. The effect of current shunt feedback in an amplifier is to

(A) increase the input resistance and decrease the output resistance.

(B) increase both input and output resistances.

(C) decrease both input and output resistances.

(D) decrease the input resistance and increase the output resistance.

44. The 100110_2 is numerically equivalent to

1. 26_{16} 2. 36_{10} 3. 46_8 4. 212_4

The correct answer are

(A) 1, 2, and 3

(B) 2, 3, and 4

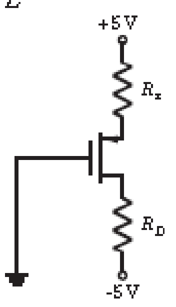
(C) 1, 2, and 4

(D) 1, 3, and 4

45. The PMOS transistor in Fig.has parameters

$$V_{TP} = -1.2\ V,\ \frac{W}{L} = 20\ ,\ \text{and}\ k'_p = 30\ mA / V^2.$$

If I_D = 0.5 mA and V_D = – 3V., then value of R_S and R_D are



(A) 4 k□, 5.8 k□

(B) 4 k□, 5 k□

(C) 5.8 k□, 4 k□

(D) 5 k□, 4 k□

46. Expand the given function in Taylor's series.

$f(z)=\frac{z-1}{z+1}$ about z = 1

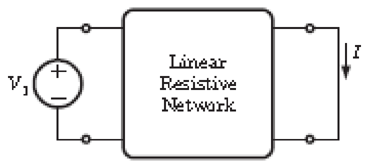
(A) 1 + 2 (z + z^2 + z^3 ....)

(B) –1 – 2 (z + z^2 + z^3 ....)

(C) –1 + 2 (z – z^2 + z^3 ....)

(D) None of the above

47. In the circuit shown in fig. when the voltage V_1 is 10 V, the current □ is 1 A. If the applied voltage at port-2 is 100 V, the short circuit current flowing through port 1 will be



(A) 0.1 A

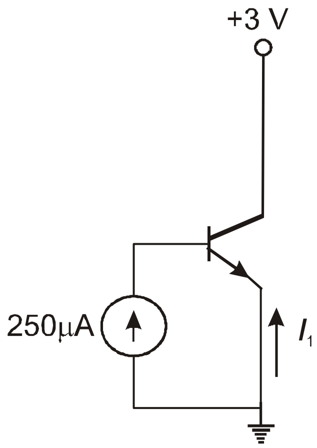
(B) 1 A

(C) 10 A

(D) 100 A

COMMON DATA Ques Q.48 - 49:

For the circuit shown in fig., let the value of $\square_R$ = 0.5. and $\square_F$ = 50. The saturation current is 10^{-16} A.



48. The base-emitter voltage is

(A) 0.53 V

(B) 0.7 V

(C) 0.84 V

(D) 0.98 V

49. The current I_1 is

(A) – 12.75 mA

(B) 12.75 mA

(C) 12 5 mA

(D) – 12 5 mA

Common data Q. 50-51

Consider a p – channel enhancement mode MOSFET with k'_p = 40 □A/V². The device has following observations:

I_D = 0.225 mA at $V_{SG} = V_{SD}$ = 3 V

I_D = 1.4 mA at $V_{SG} = V_{SD}$ = 4 V

50. Value of the threshold voltage V_{TP} is______

51. The ratio W/L is_______

Linked Answer Questions 52 and 53

The following two question refer to wide sense stationary stochastic processes

52. It is desired to generate a stochastic process (as voltage process) with power spectral density

$$S(\omega) = \frac{16}{16+\omega^2}$$

by driving a Linear-Time-Invariant system by zero mean white noise (as voltage process) with power spectral density being constant equal tom1. The system which can perfomr the desired task could be

(A) first order lowpass R-L filter

(B) first order highpass R-C filter

(C) tuned L-C filter

(D) sseries R-L filter

53. The parameters of the system obtained in Q . 78 would be

(A) first order R-L lowpass filter would have R = 4Ω, L = 4H

(B) first order R-C highpass filter would have R = 4Ω, C = 0.25 F

(C) tuned L-C filter would have L = 4H, C = 4F

(D) series R-L-C lowpass filter would have R = 1Ω, L = 4H, C = 4F

Linked Answer Questions 54 and 55

Consider the following Amplitude Modulated (AM) signal, where f_m < B

$$x_{AM}(t) = 10(1 + 0.5\sin 2\pi f_m t)\cos 2\pi f_c t$$

54. The average side-band power for the AM signal given above is

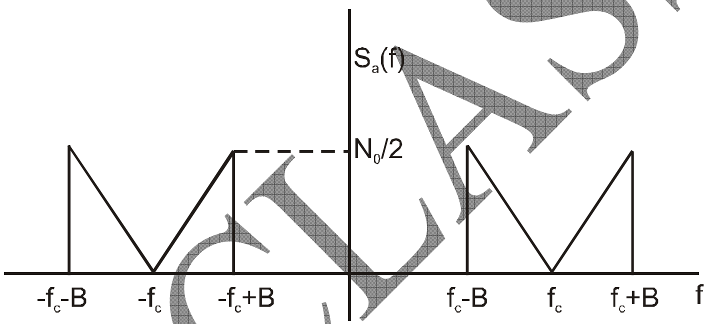
(A) 25

(B) 12.5

(C) 6.25

(D) 3.125

55. The AM signal gets added to a noise with Power Spectrial Density S_n (f) given in the figure below. The ratio of average side-band power to mean noise power would be



(A) $\frac{25}{8N_0B}$

(B) $\frac{25}{4N_0B}$

(C) $\frac{25}{2N_0B}$

(D) $\frac{25}{N_0B}$

56. REASON : SFBTPO :: THINK : ?

(A) SGHMJ

(B) UIJOL

(C) UHNKI

(D) UJKPM

57. MORTAL opposite word –

(A) Divine

(B) Immortal

(C) Spiritual

(D) Eternal

58. ALERT similar word –

(A) Energetic

(B) Observant

(C) Intelligent

(D) Watchful

59. A shopkeeper expects a gain of 22.5% on his cost price. If in a week, his sale was of Rs. 392, what was his profit?

(A) Rs. 18.20

(B) Rs. 70

(C) Rs. 72

(D) Rs. 88.25

60. IF '+' stands for '-' , '-' stands for 'x', 'x' stands for '÷'and '÷'stands for '+'then what is the value of 56x7÷13-11+15-8÷2-7?

(A) 30

(B) 45

(C) 60

(D) 90

61. 'Captain' is related to 'Soldier' in the same way as 'Leader' is related to

(A) Chair

(B) Followers

(C) Party

(D) Minister

62. PORK:PIG

(A) rooster:chicken

(B) mutton:sheep

(C) steer:beef

(D) lobster:crustacean

63. My uncle decided to take ...... and my sister to the market.

(A) I

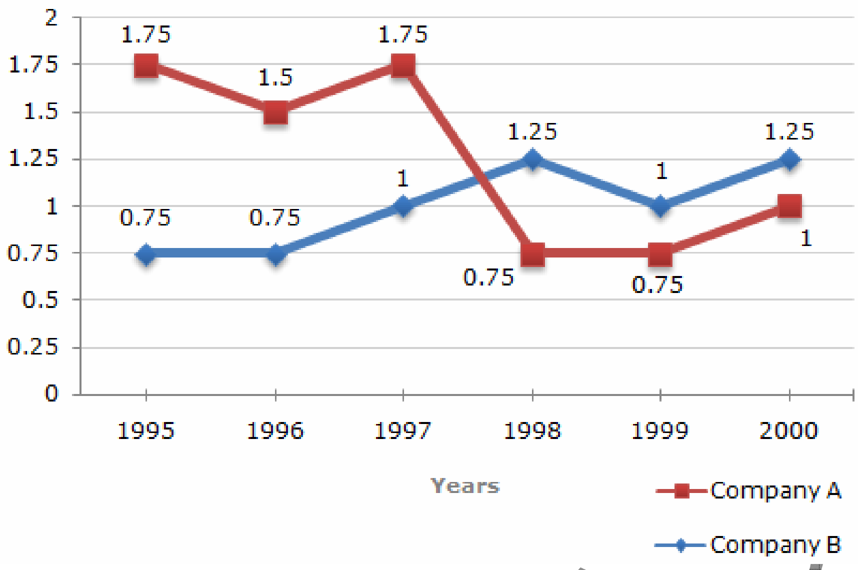
(B) mine

(C) me

(D) myself

64. Answer the question based on the given line graph.

Ratio of Exports to Imports (in terms of money in Rs. crores) of Two Companies Over the Years



In how many of the given years were the exports more than the imports for Company A?

(A) 2

(B) 3

(C) 4

(D) 5

65. Look at this series: 58, 52, 46, 40, 34, ... What number should come next?

(A) 26

(B) 28

(C) 30

(D) 32

Answer key

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Answer	B	B	D	B	D	A	C	A	1.5	B	B	3 ohm	D	1/2 J	A	2/13	C	4R	C	- 0.05 mho
Question	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
Answer	A	B	A	80 ohms	C	2.5	A	A	B	C	D	D	A	C	B	B	D	A	B	A
Question	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
Answer	B	B	D	D	D	C	C	C	A	- 2.33 V	25	A	A	C	B	B	B	D	C	B
Question	**61**	**62**	**63**	**64**	**65**															
Answer	B	B	C	B	B															

HINTS AND SOLUTIONS

1.(B) If $\lambda_1, \lambda_2 \ldots\ldots\ldots\ldots \lambda_n$ are the eigen values of a non - singular matrix, A , then A^{-1} has the eigen values $\frac{1}{\lambda_1}, \frac{1}{\lambda_2}, \ldots\ldots\ldots \frac{1}{\lambda_n}$. Thus eigen values of A^{-1} are $\frac{1}{2}, \frac{1}{3}, \frac{-1}{3}$

2.(B) Let 2a and 2b be the major and minor axes of the ellipse

Area A = πab

$\Rightarrow \quad \log A = \log \pi + \log a + \log b$

$\Rightarrow \quad \partial (\log A) = \partial (\log \pi) + \partial (\log a) + \partial (\log b)$

$$\Rightarrow \quad \frac{\partial a}{A} = 0 + \frac{\partial a}{a} + \frac{\partial b}{b}$$

$$\Rightarrow \quad \frac{100}{A}\partial A = \frac{100}{a}\partial a + \frac{100}{b}.\partial b$$

But it is given that $\frac{100}{a}\partial a = 1$ and $\frac{100}{b}\partial b = 1$

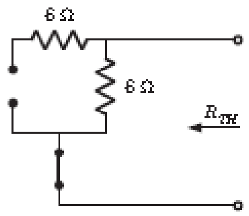
$$\frac{100}{A}\partial A = 1 + 1 = 2$$

Thus percentage error in A = 2 %

3.(D) Let $I = \int \frac{dx}{e^x - 1} = \int \frac{e^{-x}\,dx}{1 - e^{-x}}$

Put $1 - e^{-x} = t$ □ $e^{-x}\,dx = dt$

$$I = \int \frac{dt}{t} = \log t = \log\left(1 - e^{-x}\right)$$



4.(B) $R_i = \frac{V_i}{I_i}$

Since inverting input terminal is assumed to be at 0 volt.

Hence, only 10 k□ is seen as input resistance

□ R_i = 10 k□

5.(D) First frequency at a pole and last frequency at a zero for stability.

6.(A) $V_2(s) = KV_1(s)$

□ $\frac{V_1(s)}{2} + \frac{V_1(s) - KV_1(s)}{4 + s + \frac{1}{s}} = 0$

$$4 + s + \frac{1}{s} + 2 - 2k = 0$$

 $s^2 + (6 - 2K)s + 1 = 0$

$(6 - 2K) >$ $K < 3$

7.(C) Let E " the event that A solves the problem. and F " the event that B solves the problem.

Clearly E and F are independent events.

$$P(E) = \frac{90}{100} = 0.9, \qquad P(F) = \frac{70}{100} = 0.7$$

P (E F) = P(E) . P(F) = 0.9 ×0.7 = 0.63

Required probability = P $(E \cup F)$

= P (E) + P (F) – P ($E \cap$ F) = (0.9 + 0.7– 0.63) = 0.97

8.(A) $I = I_s\left(e^{\frac{V}{V_{1'}}} - 1\right) \Rightarrow V = V_t \ln\left(\frac{I}{I_s} + 1\right)$

$\frac{I}{I_s} = -0.90$ (– ive due to reverse current)

V = 0.0259 In (1 – 0.9) = – 59.6 mV

9. **1.5**

$$\left(\frac{dy}{dx}\right)_{at\,x=0} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{y(1) - y(-1)}{1-(-1)} = \frac{8-5}{2} = 1.5$$

10.(B) $\frac{V_0(s)}{V_s(s)} = \frac{2}{\frac{4}{s} + 2s + 2} = \frac{1}{s^2 + s + 2}$

The roots are imaginary so network is undamped.

11.(B) For D off , $u_0 = \dfrac{\frac{10}{20} - \frac{10}{20}}{\frac{1}{20} + \frac{1}{10}} = 3.33V.$

For $\upsilon_i \le 3.33 + 0.7 = 4.03V, \upsilon_0 = 3.33V$

For $\upsilon_i \ge 4.03V, \upsilon_0 = v_i - 0.7$

For $\upsilon_i = 10V, \upsilon_0 = 9.3V$

12. **3 ohm**

Current through the 4-ohm resistor = $i - \frac{i}{4} = \frac{3i}{4}$.

Therefore, the voltage drop across it

$$= \left(\frac{3i}{4}\right) \times 4 = 3i \text{ which must equal V.}$$

Thus effective resistance faced by the voltage source is 3 Ω

13.(D) Here $\bar{A}$, $\bar{B}$ are 1's complement.

A + B, A 01010110

B + 11101100

101000010

\+ 1

01000011

B – A = B + $\bar{A}$ B 11101100

$\bar{A}$ + 10101001

110010101

+ 1

10010110

$A - B = A + , \bar{B}$ A 01010110

$\bar{B}$ + 00010011

$- A - B = \bar{A} + \bar{B}$, $\bar{A}$ 10101001

$\bar{B}$ + 00010011

10111100

14. $\frac{1}{2}$ **J**

Current that flows is given by

v|s| = sL □(s) $\left\{\begin{matrix} \because\ v|t| = \delta|t| \\ \therefore\ v|s| = 1 \end{matrix}\right\}$

$\Rightarrow$ 1 = s(1) .□|s|

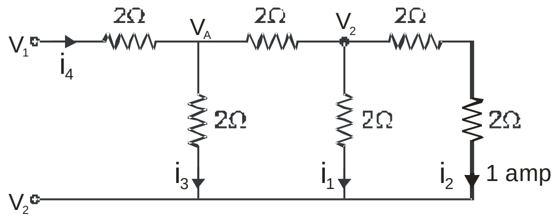
$\Rightarrow$ □|s| = $\frac{1}{s} = v\,|\,t\,| = 1$ Amp.

Energy supplied = $\frac{1}{2}LI^2 = \frac{1}{2}(1)\,(1) = \frac{1}{2}J$

15.(A) $p_0 = N_v e^{\frac{(E_F - E_V)}{KT}} = 1.04\times10^{19}\, e^{\frac{-0.22}{0.0259}} = 2\times10^{15}\,cm^{-3}$

16. $\frac{2}{13}$

Assume current flowing as shown



$V_2 = 4 \times 1 = 4$ V

□ $I_1 = \frac{V_2}{2} \Rightarrow \frac{4}{2} = 2$ Amp.

□ □□ = 2 + 1 = 3 A.

$V_A = V_2 + 2 \times 3$

□ $V_A = 4 + 6 = 10$ V

$I_3 = \frac{10}{2} = 5\,A$

$□_4 = □_3 + □_2 = 8A$

$V_1 = V_A + 8 \times 2 = 10 + 16 = 26$ V.

□ $\frac{V_2}{V_1} = \frac{4}{26} = \frac{2}{13}$

17.(C) Only statement (b) is false . For example

S_1 : y [n] = x [n] + b, and S_2 : y[n] = x [n] – b, where $b \neq 0$

S{x[n]} = {S_2 { x [n]} } = S2 {x [n]+ b= x [n]}

Hence S is linear.

18. **4R**

For both the circuits remains the same.

$$I = \frac{V}{R_{eq}}$$

 V is also same as given only V. so for same current, R_{eq} should be same for circuit (i), all the three resistors are in parallel,

 R_{eq} = 32 R || 16 R || 8 R.

$$R_{eq} = \frac{32}{7}R \quad \ldots$$

(1)

For circuit (ii)

R_{eq} = (4R|| 2R|| R) + R_0

{ R_0 is in series with parallel combination of 4R, 2R and R}

$$R_{eq} = \left[\left(\frac{4\times 2}{4+2}\right)11R\right] + R_0$$

$$R_{eq} = \frac{\frac{4}{3}\times 1}{\frac{4}{3}+1} + R_0$$

$$R_{eq} = \frac{4}{7}R + R_0 \quad \ldots(2)$$

Now (1) and (2) is equal

so $\frac{4}{7}R + R_0 = \frac{32}{7}R$

$$R_0 = \frac{28}{7}R = 4.R$$

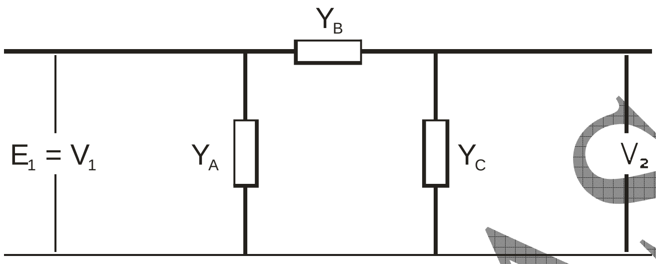
19.(C) Pole of system at : z = $-\frac{1}{2}, \frac{1}{3}$

Pole of inverse system at : $z = -\frac{1}{2}$

For this system and inverse system all poles are inside |z | = 1. So both system are both causal and stable.

20. – 0.05 mho

The equivalent Y – parameter circuit of given circuit is



$Y_{11} = Y_A + Y_B$

$Y_{12} = -Y_B$

$Y_{21} = -Y_B$

$Y_{22} = Y_B + Y_C$

Here $Y_A = \frac{1}{5} = 0.2$

$Y_B = \frac{1}{20} = 0.05$

$Y_C = \frac{1}{10} = 0.1$

$\therefore Y_{12} = -Y_B = -0.05$

21.(A) In open loop system change will be 10% in C_1 also but in closed loop system change will be less $C_2 = \frac{10}{10+1} = \frac{10}{11}$, $C'_2 = \frac{9}{9+1} = \frac{9}{10}$, C_2 is reduced by 1 %.

22.(B) Routh table is as shown in fig.

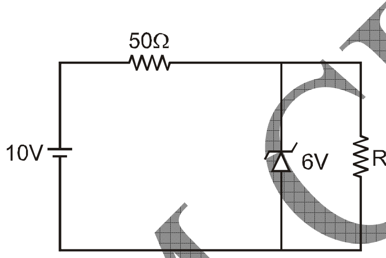
s^5	1	5	1
s^4	3	4	3
s^3	3.67	0	
s^2	4	3	
s^1	–2.75		
s^0	3		

In RHP –2 poles. In LHP – 3 poles.

23.(A) System has two different poles on negative real axis. So response is over damped.

24. **80 ohms**

Output voltage is regulated to the zener voltage 6 V.



□ $I = \frac{10.6}{50} = 80$ mA

Zener diode current, $□_{zk}$ = 5mA

This is the minimum current drawn by zener hence load current $□_L$ will be maximum.

□ $□_L max = 80 – 5 = 75$ mA

□ $R = \frac{6}{75 \times 10^{-3}} = 80$ ohms

25.(C) The open - loop poles in RHP are P = 0. Nyquist path enclosed 2 times the point (– 1 + j 0) taking clockwise encirclements as negative N = –2.

$N = P - Z$, $-2 = 0 - Z$, $Z = 2$ which implies that two Poles of closed loop system are on RHP.

26. 2.5

$V_p = -5V$

$V_{as} = -3V$

$g_m = 1ma/V$

$g_{m0} = ?$

Transconductance for JFET is given as –

$$g_m = g_{m0}\left(1 - \frac{V_a}{V_p}\right)$$

$$\Rightarrow g_{m0} = g_m\left(1 - \frac{V_a}{V_p}\right)^{-1}$$

$$\Rightarrow g_{m0} = 1\left[1 - \frac{-3}{-5}\right]^{-1}$$

$$\Rightarrow g_m = 1(0.4)^{-1} = \frac{1}{0.4}$$

$$\Rightarrow \boxed{g_m = 2.5\text{ mA/V}}$$

27.(A) $\bar{T}_e = T_0\left(\bar{F} - 1\right) = 290(1.7 - 1) = 203K$

28.(A) $I_t = I_c\left(1 + \frac{\alpha^2}{2}\right)^{\frac{1}{2}}$ or $20 = 18\left(1 + \frac{\alpha^2}{2}\right)^{\frac{1}{2}}$ or $\alpha = 0.68$

29.(B) Since High - side tuning is used

$f_{LO} = f_m + F_{IF} = 500$ kHz.

$f_{LOL} = 5 + 0.5 = 5.5$ MHz,

$f_{LOtj} = 10 + 0.5 = 10.5$ MHz

30.(C) $P = \dfrac{(SNR)_1}{(SNR)_2} = \dfrac{2^{2n_1}}{2^{n_2}}$, Here n = code word length, $n_1 = 6$, $n_2 = 8$,

Thus rate = $\dfrac{2^{16}}{2^{12}} = 16$

31.(D) For $E_y = 0$, 2y sin 2x = 0 □ y = 0

sin 2x = 0 □ 2x = 0, □, 3□ , □ x = 0 , $\dfrac{3\pi}{2}$

Hence (D) is correct.

32.(D) $\nabla \times A = \begin{bmatrix} u_x & u_y & u_z \\ \dfrac{\partial}{\partial x} & \dfrac{\partial}{\partial y} & \dfrac{\partial}{\partial z} \\ x^2y & y^2z & -2xz \end{bmatrix} = -y^2u_x + 2zu_y - x^2u_z$

$\nabla(\nabla \times A) = 0$

33.(A) $F = \int IdL \times R = I\int_1^2 dxu_x \times B + I\int_1^2 dyu_y \times B + I\int_1^3 dxu_x \times B + I\int_2^1 dyu_y \times B$

$u_x \times B = u_x [6xu_x - 9yu_y + 3zu_z] = 3zu_y - yu_z$

$u_y \times B = u_y [6xu_x - 9yu_y + 3zu_z] = 3zu_x - 6xu_z$

z = 0 for all element

$F = I\int_1^3 dx(-9yu_z)_{y=1} + I\int_1^2 dy(6xu_z)_{x3} + I\int_3^1 dx(-9yu_z)_{y=2} + I\int_2^1 dy(-6xu_z)_{x=1}$

$= I\,(-18 - 18 + 36 + 6)u_Z = 5 \times 6u_Z = 30u_Z$ N

34.(C) For nonmagnetic medium □$_r$ = 1

$$\beta = \frac{\omega}{\upsilon} = \frac{\omega}{c}\sqrt{\varepsilon_r} \qquad \omega = 10^9, \beta = 8$$

$$8 = \frac{10^9}{3} \times 10^8 \sqrt{\varepsilon_r} \qquad \Rightarrow \varepsilon_r = 5.76$$

35.(B) $\eta = \frac{377}{\sqrt{\varepsilon_r}} = \frac{377}{1.5} = 251.33\Omega$

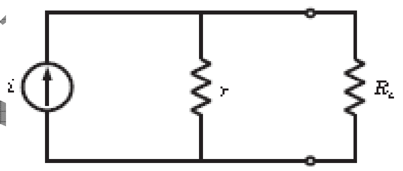
$$\eta = \frac{\eta}{\sqrt{1-\left(\frac{f_c}{f}\right)^2}} = \frac{251.33}{\sqrt{1-\left(\frac{16}{24}\right)^2}} = 337.2\Omega$$

36.(B) Efficiency = $\frac{63}{63+7} = 0.9$

$$D = \frac{\text{Gain}}{\text{Efficiency}} = \frac{16}{0.9} = 17.78 = 12.5\text{dB}$$

37.(D) $f_r = \frac{\upsilon}{2}\sqrt{\left(\frac{m}{a}\right)^2 + \left(\frac{n}{b}\right)^2 + \left(\frac{p}{c}\right)^2} = \frac{3\times 10^8}{2\times 0.01}\sqrt{\left(\frac{1}{3}\right)^2 + \left(\frac{1}{2}\right)^2} = 9\,\text{GHz}$

38.(A) $\left(\frac{ir}{r+50}\right)^2 50 = 20k, \left(\frac{ir}{r+200}\right)^2 200 = 20k$



(r + 200)2 = 4(r+50)2

□ r = 100□

$i = 30\text{ A},\ P_{max} = \dfrac{(30)^2 \times 100}{4} = 22.5\text{kW}$

39.(B) $R_{TH} = \dfrac{\upsilon_{oc}}{i_{sc}} = \dfrac{12}{1.5} = 8\Omega$

40.(A) $\nabla.P = 0,\ \nabla \times p = -\dfrac{\partial P_z}{\partial x} u_y \neq 0$

P is a possible EM field

$\nabla.Q = 0,\ \nabla \times Q = -\dfrac{1}{\rho}\dfrac{\partial}{\partial \rho}\,[10\cos(\Box t - 2\Box)]\,u_z \neq 0$

$\nabla.R = \dfrac{1}{\rho}\dfrac{\partial}{\partial \rho}\left(3\rho^2 \cot\phi\right).\dfrac{\sin\phi}{\rho} \neq 0$, R Q is a possible EM field

is not an EM field.

$\nabla.S = \dfrac{1}{r^2 \sin\theta}\sin(\omega t - 6r)\dfrac{\partial\left(\sin^2\phi\right)}{\partial r} \neq 0$

S is not an EM field . Hence (A) is correct.

41.(B) Bit Rate = 8k × 8 = 64 kbps

$(SNR)_q$ = 1.76 + 6.02n dB = 1.76 + 6.02 × 8 = 49.8 dB

42.(B) Since X (f) has spectral peak at 1 kHz so at the output of first modulator spectral peak will be at(10 + 1) kHz and (10 – 1)kHz. After passing the HPF frequency component of 11 kHz will remain. The output of 2nd modulator will be(13 ± 11) kHz. So Y(f) has spectral peak at 2 kHz and 24 kHz.

43.(D) A shunt feed back decreases R_i and increases R_0

44.(D) $100110_2 = 2^5 + 2^2 + 2^1 = 38_{10}$

$26_{16} = 2 \times 16 + 6 = 38_{10}$

$212_4 = 2 \times 4^2 + 4^1 = 38_{10}$

So 36_{10} is not equivalent

45.(D) $K_p = \left(\frac{30\times10^{-6}}{2}\right)(20) = 0.3\text{mA}/V^2$

$I_p = k_p (V_{SG} + V_{TP})^2 \quad 0.5 = 0.3\,(V_{GS} + 1.2)^2$

$\Rightarrow$ $V_{SG} = 2.49$ V, $V_G = 0$

$V_s = V_{SG} = 2.49$ V

$I_D = \frac{5 - V_s}{R_s} \Rightarrow R_D = \frac{5 - 2.49}{0.5m} = 5.02k\Omega$

$I_D = \frac{V_D - (-5)}{R_D} \Rightarrow R_D = \frac{-3+5}{0.5m} = 4k\Omega$

46.(C) $f(z) = \frac{z-1}{z+1} = 1 - \frac{2}{z+1}$

$\Rightarrow$ f (0) = – 1 , f (1) = 0

$\Rightarrow$ f(z) = $\frac{2}{(z+1)^2} \Rightarrow f'(0) = 2$

$f''(z) = \frac{-4}{(z+1)^3} \Rightarrow f''(0) = 12;$ and so on .

Now , Taylor series is given by

$$f(z) = f(z_0) + (z - z_0) f'(z_0) + \frac{(z-z_0)^2}{2!} f''(z_0) + \frac{(z-z_0)^3}{3!} f'''(z_0) + \ldots\ldots\ldots\ldots$$

about z = 0

$$f(z) = -1 + z\,(2) + \frac{z^2}{2!}(-4) + \frac{z^3}{3!}(12) + \dots\dots\dots$$

$$= -1 + 2z - 2z^2 + 2z^3 \dots\dots\dots$$

$$f(z) = -1 + 2\,(z - z^2 + z^3 \dots\dots)$$

47.(C) $\left.\frac{I_2}{I_1}\right|_{V_2=0}, = y_{21} = \frac{1}{10} = 0.1$

Interchanging the port $\frac{I_2'}{V_1'} = 0.1, I_2' = 100 \times 0.1 = 10$

48.(C) The current source will forward bias the base-emitter junction and the collector base junction will then be reverse biased. Therefore the transistor is in the forward active region

$$I_C = I_S e^{\left(\frac{V_{BE}}{V_t}\right)}$$

IC = □$_F$I$_□$ = 50 × 250 × 10^{-6} = 12.5×10^{-3} A

$$V_{BE} = V_1 \ln\left(\frac{I_C}{I_S}\right) = 0.0259 \ln\left(\frac{12.5 \times 10^{-3}}{10^{-16}}\right) = 0.84\ \text{V}$$

49.(A) I_E = (□$_F$ + 1)I_B = 12.75 mA

$I_1 = -I_E = -$ 12.75 mA

50. **– 2.33 V**

□$_D$ = $k_n[V_{SG} + V_{TP}]^2$

□ $\frac{I_{D1}}{I_{D2}} = \frac{(V_{Sa_1} + V_{TP})^2}{(V_{Sa_2} + V_{TP})^2}$

□ $\frac{0.225}{1.4} = \frac{(3+V_{TP})^2}{(4+V_{TP})^2} = 0.161$

□ $V_{TP} = -2.33$ V

51. **25**

$I_{D(Sat)} = \frac{\mu_n C''_{ox}}{2}\frac{W}{L}[V_{SG} + V_{TA}]^2$

$0.225 = \left(\frac{0.040}{2}\right)\left(\frac{W}{L}\right)(3 - 2.33)^2$

□ $\frac{W}{L} = 25$

52.(A) $S_{YY}(\square) = |H(\square)|^2.S_{XX}(\square)$

Given, $S_{XX}(\square) = 1$ [while noise]

$S_{YY}(\square) = \frac{16}{16+\omega^2} = |H(\square)|^2$

□ $|H(\square)| = \frac{4}{\sqrt{16+\omega^2}}$

□ $H(s) = \frac{4}{s+4}$ (First-order R-L filter)

53.(A) $H(s) = \frac{4}{s+4} = \frac{R}{R+L_S} = \frac{R/L}{s+R/L}$

Comparing we get

$R = 4\square$, $L = 4$ H

54.(C) Average side-band power, $P_{av} = \frac{\mu^2 A_c^2}{4}$

$$= \frac{0.5^2 \times 100}{4} = 6.25$$

55.(B) Noise power (Area endored by the spectrum) = N_0 B

Ratio of average side band honour to mean

noise honer = $\frac{25}{4N_0B} = \frac{6.25}{N_0B}$

56.(B)

As		Similarly	
R $\xrightarrow{+1}$ S		T $\xrightarrow{+1}$ U	
E $\xrightarrow{+1}$ F		H $\xrightarrow{+1}$ I	
A $\xrightarrow{+1}$ B		I $\xrightarrow{+1}$ J	
S $\xrightarrow{+1}$ T		N $\xrightarrow{+1}$ O	
O $\xrightarrow{+1}$ P		K $\xrightarrow{+1}$ L	
N $\xrightarrow{+1}$ O			

57.(B) Mortal means causing or capable of causing death while Immortal means one who is not subject to death.

58.(D) Alert means engaged in or accustomed to close observation, ie. Watchfulness.

59.(C) C.P. = Rs. $\left(\frac{100}{122.5} \times 392\right) = \text{Rs}\left(\frac{1000}{1225} \times 392\right) = 320\text{Rs}$

Profit = Rs. (392 - 320) = Rs. 72.

60.(B) Changing the symbols as given in the problem the above expression is

56÷7+13x11-15x8+2x7

Solving the BODMAS rule, we get 8+143-120+14=165-120=45

61.(B) 'Captain' is supposed to lead the battalian of 'Soldiers' int he same way as 'Leader' is supposed to lead the 'Followers'

62.(B) Pork is meat from a domestic hog or pig. Similarly, mutton is meat from a mature domestic sheep.

63.(C) My uncle decided to take me and my sister to the market.

64.(B) The exports are more than imports in those years for which the exports to imports ratio are more than 1. For Company A, such years are 1995, 1996 and1997.

Thus, during these 3 years, the exports are more than the imports for Company A.

65.(B) This is a simple subtraction series. Each number is 6 less than the previous number.