Question 1 to 5 Carry One Mark Each

1. What is the opposite of **'Tremulous'**

(a) Healthy (b) Obese (c) Young (d) Steady

2. The population of a town is increased by $16\frac{2}{3}\%$ in first year, decreased $37\frac{1}{2}\%$ in second year and increased $57\frac{1}{7}\%$ in third year, then find the population of this town before three year if present population is 137500

(a) 110000 (b) 125500 (c) 120000 (d) 144000

3. Find the remainder of the division $\frac{2^{189}}{5}$

(a) 2 (b) 3 (c) 4 (d) 1

4. Which of the following option can replace the underline section

Scarcely we had reached the office when it started raining cats and dogs

(a) had we reached (b) we reached (c) we reach (d) did we reach

5. A group of men decided to do a job in 4 days but 20 men dropped out everyday, the job was completed at the end of 7^{th} day. The men who are in the work initially are

(a) 120 (b) 100 (c) 160 (d) 140

Question 6 to 10 Carry Two Marks Each

6. A company give 12% commission to his sales man on his total sales and above sales of 15000, 1% bonus if the salesman deposited 52350 Rs. in the company after deducting his commission from total sales then the total sales is

(a) Rs. 52200 (b) Rs. 502200 (c) Rs. 60000 (d) Rs. 64000

7. $\sqrt{-\sqrt{3}+\sqrt{3+8\sqrt{7+4\sqrt{3}}}}$?

(a) $\sqrt{3}$ (b) 2 (c) 4 (d) 1

8. JRD Tata used to say, "while profit motive, no doubt, provides the main spark for any economic activity any enterprisen which is not motivated by considerations of urgent service to the community becomes obsolete soon and cannot fulfill its real role in modern society.

Which of the following is the view of JRD Tata as described by the author?

(a) Consideration of urgent service to community should be side-lined.

(b) The main purpose for any economic activity should be only profitability.

(c) Profit should be earned with due consideration to social service.

(d) Motivation to earn profit has become an outdated concept.

9. Government have traditionally equated economic progress with steel mills and cement factories. While urban centers thrive and city dwellers get rich, hundreds of millions of farmers remain mired in poverty. Another green revolution is the need of the hour and to make if a reality, the global community still has much back breaking farm work to do.

What is the author's main objective in writing the passage

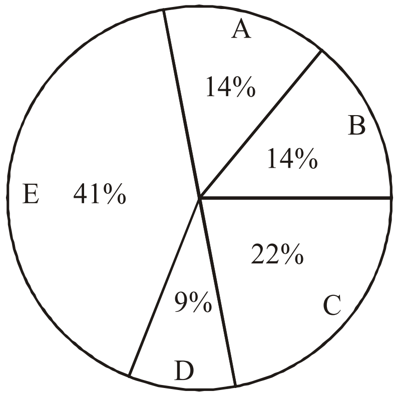
(a) Criticizing developed countries for not bolstering economic growth in poor nations.

(b) Analyzing the disadvantages of the Green Revolution.

(c) Persuading experts that a strong economy depends on industrialization and not agriculture.

(d) Making a case for the international society to engineer a second Green Revolution.

10. Revenue earned by the central government is given in pie-chart



A = Custom duty

B = Other

C = Income tax

D = Corporation Tax

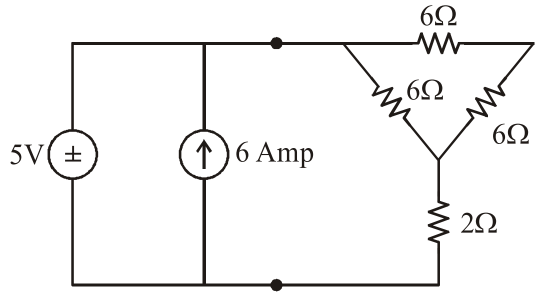
E = Excise duty

If the percentage of revenue earned by the central government from corporation Tax is x times to that of the percentage of money earned excise duty, then the value of x is

(a) $\frac{41}{9}$ (b) $\frac{9}{41}$ (c) $\frac{14}{41}$ (d) $\frac{41}{14}$

Question 1 to 25 Carry One Mark Each

1. Consider the circuit shown in below figure



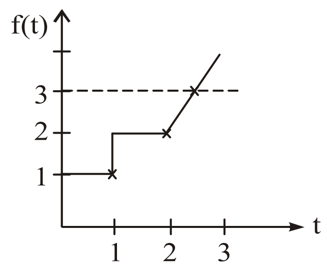
The power delivered/absorbed by 5V battery will be

(a) 26 W absorbed (b) 26 W delivered (c) 13 W absorbed (d) 13 W delivered

2. A 10 km long lossless transmission line has a reactance of 0.3 Ω/km and negligible shunt capacitance. The value of $\begin{bmatrix} A & B \\ C & D \end{bmatrix}$ is

(a) $\begin{bmatrix} 1 & 0 \\ j3 & 1 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 0 \\ 0.3 & 1 \end{bmatrix}$ (c) $\begin{bmatrix} 1 & j3 \\ 0 & 1 \end{bmatrix}$ (d) $\begin{bmatrix} j3 & 0 \\ 1 & 1 \end{bmatrix}$

3. Consider the following waveform diagram



Which one of the following gives the correct description of the waveform shown in the above diagram?

(a) $u(t)+u(t-1)$ (b) $u(t)+u(t-1)u(t-1)$

(c) $u(t)+u(t-1)+(t-2)u(t-2)$ (d) $u(t)+(t-2)u(t-2)$

4. $\lim\limits_{(y,x)\to(0,0)} \dfrac{x+\sqrt{y}}{x^2+y^2}$ is

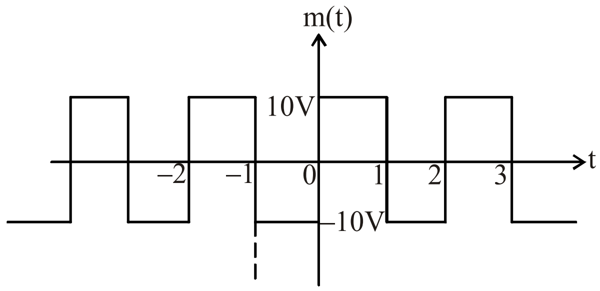
(a) 0 (b) 1

(c) ∞ (d) limit does not exist

5. An FM signal is given as

$$s(t) = 10\cos\left(2\pi f_c t + 100\int_{-\infty}^{t} m(\lambda)d\lambda\right)$$

where m(t) is shown is figure given below

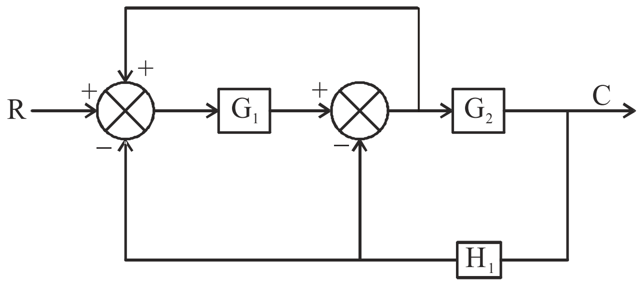


The peak frequency deviation of the above FM signal is

(a) $1000/\pi$ Hz (b) $500/\pi$ Hz

(c) $250/\pi$ Hz (d) 1000 Hz

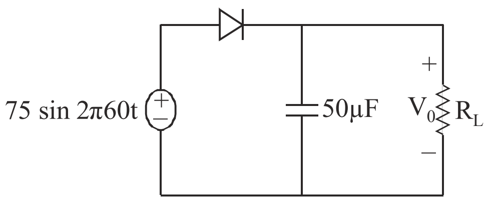
6. The $\frac{C}{R}$ of system shown in figure below is



(a) $\dfrac{G_1G_2}{1-G_1G_2H_1+G_2H_1-G_1}$ (b) $\dfrac{G_1G_2}{1+G_1G_2H_1+G_2H_1-G_1}$

(c) $\dfrac{G_1G_2}{1-G_1G_2H_1-G_2H_1-G_1}$ (d) $\dfrac{G_1G_2}{1+G_2H_1+G_1G_2+G_1}$

7. For the circuit shown in figure diode cut in voltage $V_\gamma = 0$ V. The Ripple voltage to not more than V_{rip}= 4V, the min load resistance that can be applied to the output is



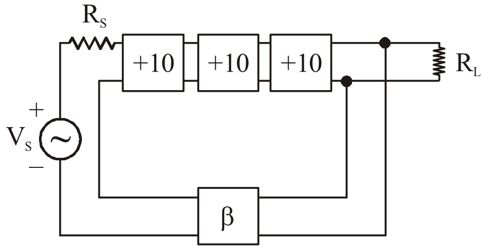
[ ] kΩ

8. Flash ADC is

(a) Serial ADC (b) Parallel ADC

(c) Serial-Parallel ADC (d) Successive approximation ADC

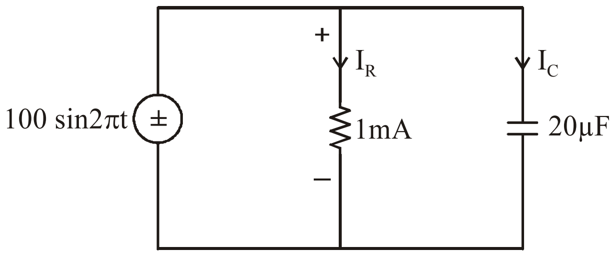
9. Consider the following amplifier with negative feedback :



If the closed-loop gain of the above amplifier is +100, the value β will be

(a) -9×10^{-3} (b) $+9\times10^{-3}$ (c) -11×10^{-3} (d) $+11\times10^{-3}$

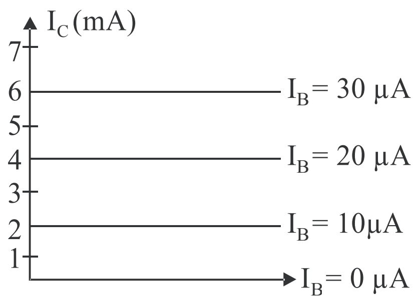
10. For the parallel RC circuit shown below



The ratio of max energy stored in capacitor and energy dissipated in resistor, in one half cycle is.

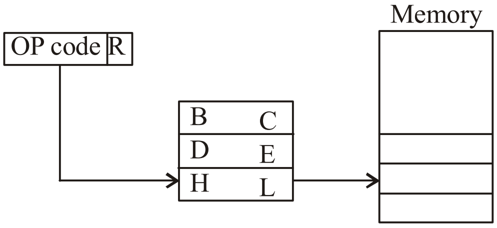
(a) 20 (b) 30 (c) 40 (d) 50

11. Consider the output characteristics as shown below β_{ac} for I_b = 10 μA is β'_{ac} and for line I_B = 20 μA is β''_{ac}. The correct relationship between β'_{ac} and β''_{ac} is



(a) $\beta'_{ac} > \beta''_{ac}$ (b) $\beta'_{ac} \le \beta''_{ac}$ (c) $\beta'_{ac} = \beta''_{ac} = \beta_{ac}$ (d) Both (a) & (b)

12. The addressing mode, as shown in figure, is



(a) direct (b) register (c) register indirect (d) immediate

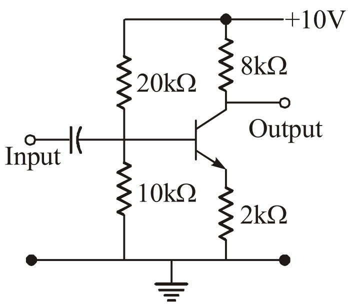
13. What is the total number of memory locations and input-output devices that can be addressed with a processor having 16-bits address bus, using memory mapped I/O?

(a) 64K memory locations and 256 I/O devices
(b) 256 I/O devices and 65279 memory locations
(c) 64K memory locations and no I/O devices
(d) 64K memory locations or input-output devices

14. $\int_{y=0}^{1}\int_{x=y}^{y^{1/3}} e^{x^2}\,dx\,dy =$

(a) 121e (b) $\frac{1}{2}(e-2)$ (c) e(e – 1) (d) e !

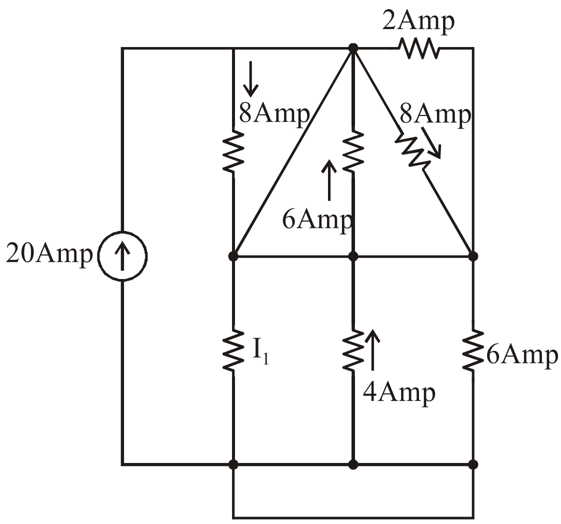
15. For the circuit shown in the below figure, assuming $\beta = 100$ for the transistor, the transistor will be in



(a) cut off region (b) inverse active region
(c) active region (d) saturation region

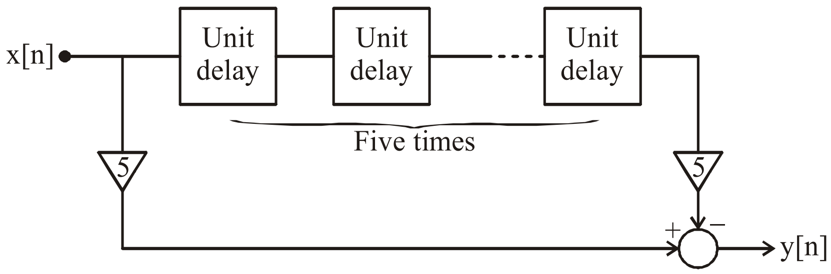
16. A superhetrodyne FM receiver operates in the frequency range 88 to 108 MHz. The IF and local oscillator frequencies are choosen such that $f_{IF} < f_{LO}$. The image frequency, f_{si} should fall outside of the 88 – 108 MHz range. The minimum value of intermediate frequency f_{IF} required (in MHz) is

17. In the Network shown below considering the value of all resistors equal, the value of I_1 in the circuit of figure is equal to



(a) 10 Amp (b) 30 Amp (c) 2 Amp (d) 18 Amp

18. The direct form structure of an FIR filter is shown in figure below



The filter can be used to approximate a

(a) LPF (b) HPF (c) BPF (d) Band stop filter

19. The hole concentration in P-type GaAs is given by

$$P = 10^{16}\left(1-\frac{x}{L}\right)\ cm^{-3}\ 0 < x < L.$$

Where L = 10 μm. The hole diffusion constant is 10cm^2/sec. The hole diffusion current density at x = 5 μm is

(a) 20 $\frac{A}{cm^2}$ (b) 16 $\frac{A}{cm^2}$ (c) 24 $\frac{A}{cm^2}$ (d) 30 $\frac{A}{cm^2}$

20. Let F is a scalar function & $\vec{v}$ is a vector in then which of the following options is incorrect

(a) $\nabla\cdot(\nabla\times\vec{v})=0$ (b) $\nabla\times(\nabla f)=0$

(c) $\nabla\cdot(f\,\vec{v})=f(\nabla.\vec{v})+)\ (\text{grad})\cdot\vec{v}$ (d) $\nabla(\nabla\cdot\vec{v})=\nabla\times(\nabla\cdot\vec{v})-\nabla^2\vec{v}$

21. A signal v(n) is defined by

$$v[n]=\begin{cases}1 & ; \quad n=1\\ -1 & ; \quad n=-1\\ 0 & ; \quad n=0 \text{ and } |n|>1\end{cases}$$

Which is the value of the composite signal defined as v[n] + v[–n]?

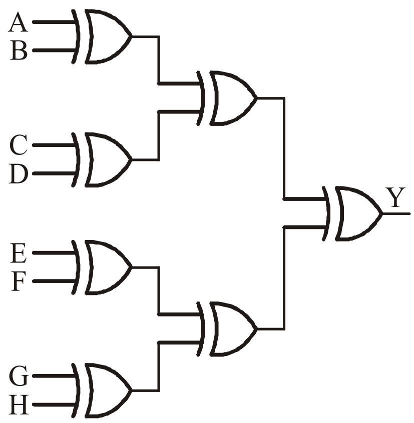
(a) 0 for all integer values of n (b) 2 for all integer values of n

(c) 1 for all integer values of n (d) –1 for all integer values of n

22. $u=\dfrac{x^3+y^3}{x+y}$ then $x\dfrac{\partial^2 u}{\partial x^2}+y\dfrac{\partial^2 u}{\partial x\partial y}$ equal to

(a) $\dfrac{\partial u}{\partial x}$ (b) $\dfrac{\partial u}{\partial x}+\dfrac{\partial u}{\partial y}$ (c) $\dfrac{\partial u}{\partial y}$ (d) $\dfrac{\partial u}{\partial x}-\dfrac{\partial u}{\partial y}$

23. The 8–input XOR circuit shown has an output of y = 1. Which input combination below (ordered A-H) is correct?



(a) 11100111 (b) 00011101 (c) 10111100 (d) 10111000

24. For a unity feedback system whose open - loop transfer function is $G(s)=\dfrac{50}{(1+0.1s)(1+2s)}$, the velocity error constant is

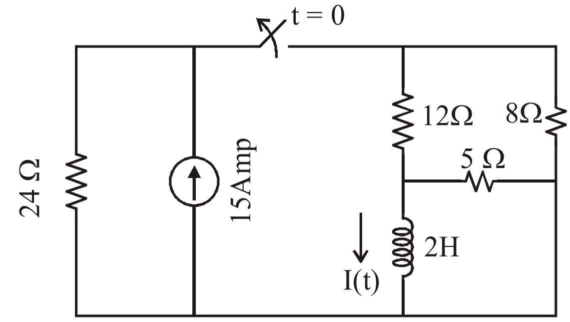
25. The minimum value of the function

$f(x, y) = 4x^2 + 9y^2 - 8x - 12y + 4$ is

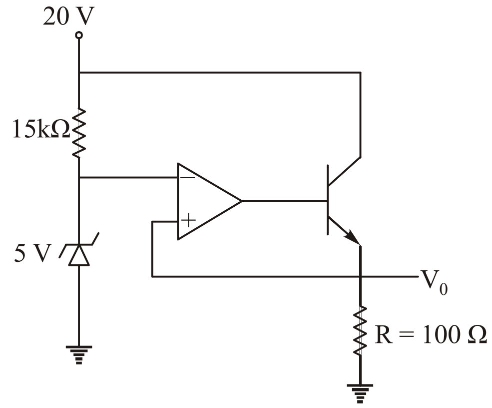
(a) –13 (b) –4 (c) 0 (d) 13

Question 26 to 55 Carry Two Marks Each

26. For the circuit in figure I(t) for t > 0 is given as A e^{-2t}, the value of A is _______.

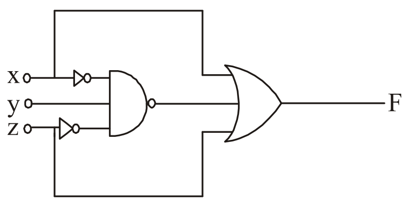


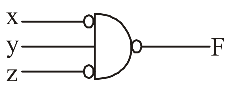
27. In the circuit shown below OP-AMP is ideal. The total current (in mA) supplied by 20V voltage supply is (Assume β of transistor is very large)

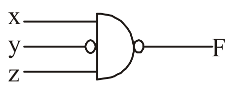


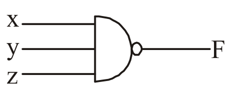
[ ] mA

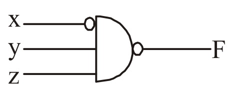
28. The minimized version of logic circuit shown in figure below is



(a) 

(b) 

(c) 

(d) 

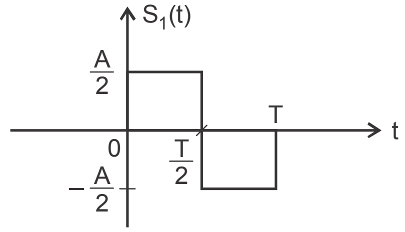
29. A bidirectional 4 – bit shift register is storing the nibble 1101. Its RIGHT $/\overline{\text{LEFT}}$ input is high. The nibble 1011 is waiting to be entered on the serial data – input line. After three clock pulses, the shift register is storing (in binary).

30. Two identical co-axial circular coil carry the same current I but in opposite direction. The magnitude of magnetic field B at a point on the axis midway between the coil is

(a) Zero (b) Same as that produced by one coil

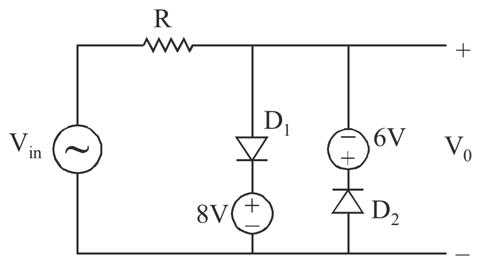
(c) Twice that produced by one coil (d) Half that produced by one coil

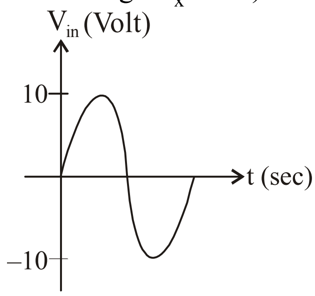
31. The peak value of the output of the matched filter, if the input pulse to the filter as shown below will be



(a) AT (b) $2A^2T$ (c) $-\frac{A^2}{4}T$ (d) None of these

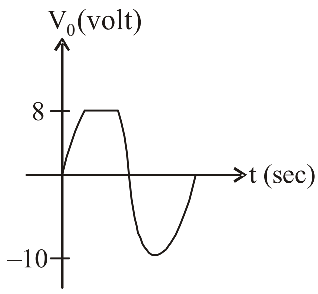
32. Consider the given circuit and waveform for the input diode (cut in voltage $V_x = 0$ V)



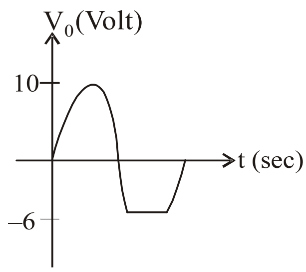


The waveform of output V_o is

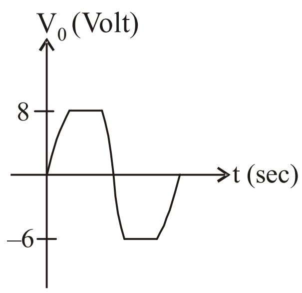
(a)



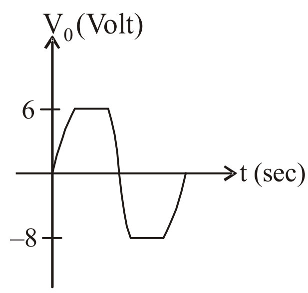
(b)



(c)



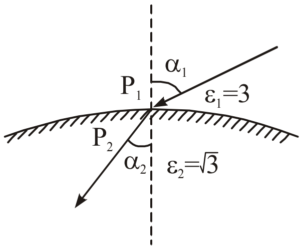
(d)



33. The solution of integration $\int_0^1 \frac{dx}{\sqrt{-\ln x}}$ is

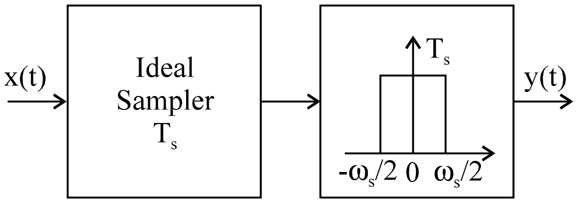
(a) π (b) $\sqrt{2}\pi$ (c) $\pi\sqrt{2}$ (d) $\sqrt{\pi}$

34. Two dielectric media with primitivities 3 and $\sqrt{3}$ are separated by a charge-free boundary as shown in figure. The electric field intensity in medium 1 at point P_1 has magnitude E_1 and makes an angle α_1 = 60° with the normal. The direction of the electric field intensity at point P_2, α_2 is



(a) $\sin^{-1}\left(\frac{\sqrt{3}E_1}{2}\right)$ (b) 45º (c) $\cos^{-1}\left(\frac{\sqrt{3}E_1}{2}\right)$ (d) 30º

35. The input to the following system is x(t) = 2 + cos (50πt). If it is sampled at T_s = 0.01 s, then the expression for the output signal y(t) is



(a) 2 + cos (50πt) (b) 2 + cos (5πt) (c) cos (50πt) (d) 2 + cos (30πt)

36. A particular p-n junction for which breakdown voltage is 120 V can dissipate 50 mW while maintaining its junction temperature at a value low enough to avoid permanent junction damage. What is continuous reverse current flow appears, likely to cause permanent failure.

(a) 0.042 mA (b) 4.2 mA (c) 0.42 A (d) 0.42 mA

37. For an LTI system with input x(n) = {2, 4, 6, 8, 10, 12} produces the output as y(n) = {1, 3, 5, 7, 9, 11 } then the impulse response is

(a) {1, 1} (b) $\left\{1, \frac{1}{2}\right\}$ (c) $\left\{\frac{1}{2}, \frac{1}{2}\right\}$ (d) $\left\{\frac{1}{2}, 0, 1\right\}$

38. The minimum value of the function $xy + \frac{9}{x} + \frac{3}{y}$ is [ ]

39. $\begin{bmatrix} 4 & 9 & 3 \\ 2 & 3 & 1 \\ 2 & 6 & 2 \end{bmatrix}\begin{bmatrix} x \\ y \\ 7 \end{bmatrix} = \begin{bmatrix} 6 \\ 2 \\ 7 \end{bmatrix}$. This system is

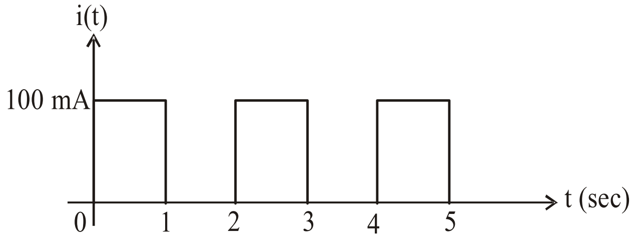
(a) Consistent with unique solution

(b) Consistent with infinite solutions

(c) Inconsistent with no solution

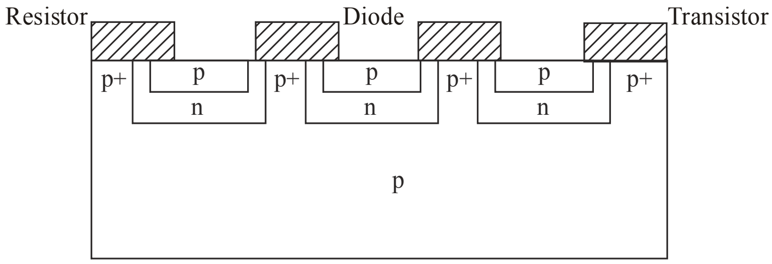
(d) Consistent with 2 solutions.

40. A waveform shown in the figure below is read by AC ammeter. The reading shown by the meter is (in mA)



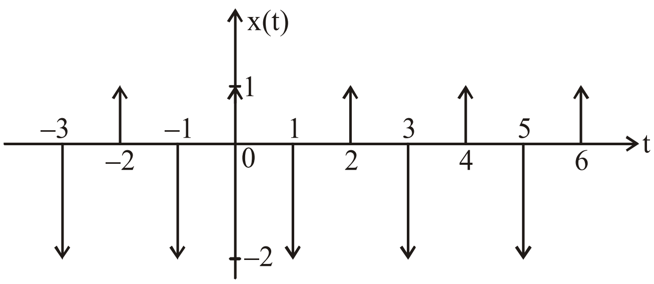
[ ] mA

41. For the figure shown below the capacitance from bottom of n-type region to the substrate and capacitance from side walls of the isolation islands to p^+ region are 0.2 pF and 0.06 pF. The parasitic capacitance is



[ ] pF

42. A signal x(t) is defined as



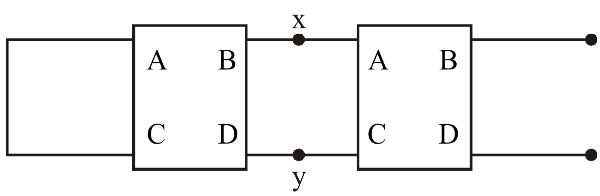
The complex fourier series coefficient C_k is

(a) $(0.5 - 2\cos k\pi)$ (b) $(0.5 + 2\cos k\pi)$ (c) $(1 + 2\cos k\pi)$ (d) $(1 - 2\sin k\pi)$

43. The random variable x is normally distributed with mean 9 and standard deviation 3 and z is standard normal variate with $P(0 \le z \le 2) = 0.4772$ and $P(0 \le z \le 3) = 0.4987$ then $P(x \le 15)$ is

44. For a unity feedback system with $G(s) = \frac{10}{s^2}$, the value of centroid would be

45. The equivalent impedance seen across X and Y terminal is



(a) $\frac{AB}{A^2 + BC}$ (b) $\frac{BD}{D^2 + BC}$ (c) $\frac{BC}{A^2 + AB}$ (d) None of the above

46. If memory chip size is 256 × 1 bits, the number of chips required 1 K Byte memory is

(a) 8 (b) 12 (c) 24 (d) 32

47. What is the magnetic dipole moment in $A.m^2$ for a square current loop having the vertices at the points A (10, 0, 0), B (0, 10, 0), C (–10, 0, 0) and D (0, –10, 0) and with current 0.01 A flowing in the sense ABCDA?

(a) $2\bar{a}_z$ $A.m^2$ (b) $-2\bar{a}_z$ $A.m^2$ (c) $-4\bar{a}_z$ $A.m^2$ (d) $4(\bar{a}_x + \bar{a}_y)$ $A.m^2$

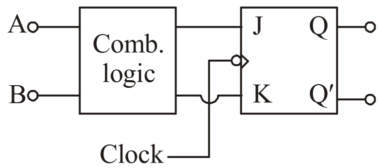
48. An antenna having normalized radiation intensity is defined as

$$u(\theta, \phi) = \begin{cases} \sin\theta & 0 \le \theta \le \frac{\pi}{2} \text{ and } 0 \le \phi \le 2\pi \\ 0 & \text{otherwise} \end{cases}$$

Directivity of the antenna will be

49. The following truth table has to be realized with the circuit shown in the figure:

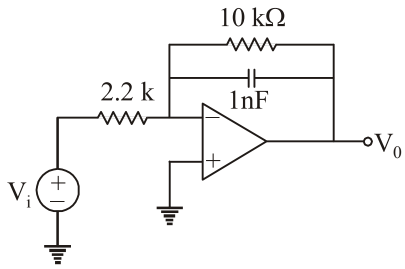
A	B	Q_{n+1}
0	0	Q'_n
0	1	1
1	0	Q_n
1	1	0



What is the output of the combinational logic circuit to the J input?

(a) $\overline{AB}$ (b) $\overline{A}$ (c) $\overline{B}$ (d) AB

50. Circuit shown below is a



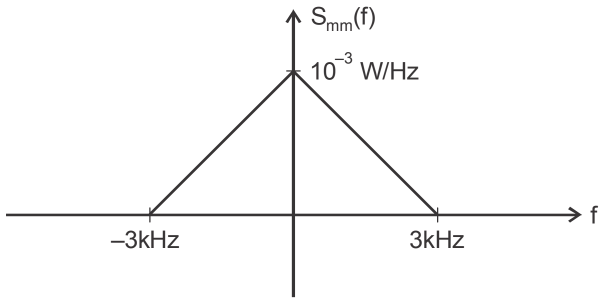
(a) LPF with cut off freq f_c = 15.9 kHz

(b) HPF with f_c = 15.9 kHz

(c) HPF with f_c = 79.5 kHz

(d) LPF with f_c = 79.5 kHz

51. A DSB-SC modulated signal s(t) = 10 cos(2π × 10^6t + ϕ) × m(t) is corrupted by an additive white Gaussian noise of power 10^{-4} W/Hz. The PSD of message signal is shown in figure below and ϕ is uniformly distributed over the range 0 to 2π.



Find the power ratio of modulated signal and the noise power in transmitted BW (in dB).

52. A LTI continuous time system has the frequency response $H(\omega)$. It is known that the input, $x(t) = 1 + 4\cos(2\pi t) + 8\sin(3\pi t - 90^\circ)$ produces the response.

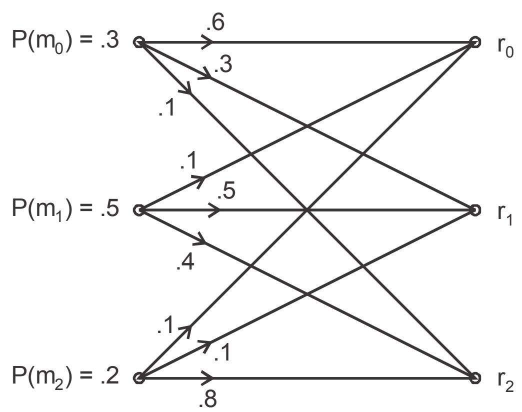
$y(t) = 2 - 2\sin(2\pi t)$. Then $H(\omega)$ at $\omega = 3\pi$ is

(a) 2 (b) 0 (c) $0.5\ e^{j\pi/2}$ (d) 8

53. The growth rate of a bacteria population is proportional to its size. Initially the population is 10000, while after 10 days it is 25000 then population after 20 days is

(a) 114400 (b) 54600 (c) 62500 (d) 82500

54. For the channel and message probabilities given in figure below. Find the probability of error.



55. A system has its open-loop transfer function of $\frac{K}{s(s^2+6s+10)}$. The break points are at s = –1.18 and s = –2.82, the centroid is at s = –2, while the asymptotic angles are ± 180°. The value of K for the closed loop system to be oscillatory and the frequency of oscillations are respectively

(a) 600 and 10 rad/sec (b) 120 and 5 rad/sec

(c) 60 and 3.16 rad/sec (d) 30 and 3.16 rad/sec

❍❍❍

ANSWERS KEY

1. ***Ans. (d)***

2. ***Ans. (c)***

$$16\frac{2}{3}\% = \frac{1}{6}$$

$$37\frac{1}{2}\% = \frac{3}{8}$$

$$57\frac{1}{7}\% = \frac{4}{7}$$

Let population $\Rightarrow$ x

$$x\times\frac{7}{6}\times\frac{5}{8}\times\frac{11}{7} = 137500$$

$$x = 120000$$

3. ***Ans. (a)***

$\frac{2^{189}}{5}$ is written as $\frac{2.(2^2)^{94}}{5} = 2\left[\frac{(5-1)^{94}}{5}\right] = 2$

4. ***Ans. (a)***

5. ***Ans. (d)***

Total work = m × 4 = 4m

m + (m – 20) + ... are in A.P.

$$S_n = \frac{n}{2}[2a+(n-1)d]$$

$$\Rightarrow \frac{7}{2}\ [2m + (7-1)(-20)] = 4m$$

$$m = 140$$

6. ***Ans. (c)***

Total sales = x

$$\text{Commission} = \frac{x\times 12}{100}$$

$$\text{Bonus} = (x - 15000)\times\frac{1}{100}$$

Total earning = Commission + Bonus

$$= \frac{12x}{100}+(x-15000)\frac{1}{100}$$

$$= \frac{12x}{100}+\frac{x}{100}-150$$

$$= \frac{13x}{100}-150$$

Total sales – Earning = 52350

$$x-\left(\frac{13x}{100}-150\right) \Rightarrow \frac{87x}{100} = 52350 - 150$$

$$= 52200$$

x = Rs. 60,000

7. ***Ans. (b)***

$$\sqrt{-\sqrt{3}+\sqrt{3+8\sqrt{(2+\sqrt{3})^2}}}$$

$$= \sqrt{-\sqrt{3}+\sqrt{19+8\sqrt{3}}}$$

$$= \sqrt{-\sqrt{3}+\sqrt{(4+\sqrt{3})^2}}$$

$$= \sqrt{-\sqrt{3}+4+\sqrt{3}} = \sqrt{4} = 2$$

8. ***Ans. (c)***

9. ***Ans. (d)***

10. ***Ans. (b)***

D = 9%,

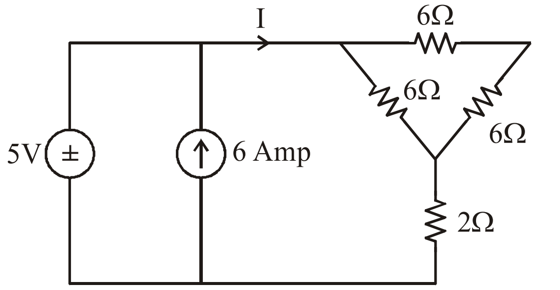
E = 41%

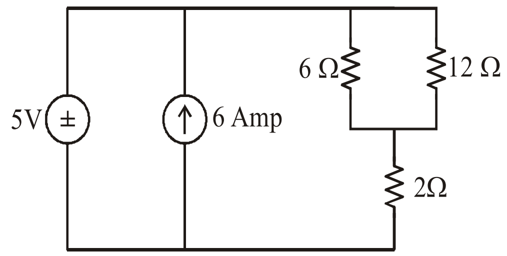
D = xE

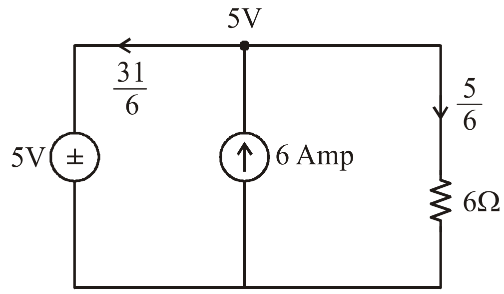
9% = 41% x

$$x = \frac{9}{41}$$

1. *Ans. (a)*







$$P_{absorbed} = V \times I$$

$$= 5 \times \frac{31}{6}$$

$$= \frac{155}{6} = 26 \text{ W absorbed}$$

2. *Ans. (c)*

$$X = 0.3 \ \Omega/\text{km}$$

So, Total $X = 0.3 \times 10 = 3 \ \Omega$

So, $Z = 0 + j3 = j3$

For short transmission line

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} 1 & Z \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & j3 \\ 0 & 1 \end{bmatrix}$$

3. *Ans.(c)*

$$f(t) = u(t) + u(t-1) + (t-2)\,u(t-2)$$

4. *Ans. (c)*

Let $I = \lim_{(x,y)\to(0,0)} \frac{x+\sqrt{y}}{x^2+y^2}$

Put $y = mx$

$\Rightarrow$ $I = \lim_{x\to 0} \frac{x+\sqrt{mx}}{x^2+m^2x^2}$

$$I = \lim_{x\to 0} \frac{\sqrt{x}\left(\sqrt{x}+\sqrt{m}\right)}{x^2(1+m^2)}$$

$$I = \infty$$

5. *Ans. (b)*

$$\Delta f_{max} = K_f \ |m(t)|_{max}$$

$$= \frac{100}{2\pi} \times [10]$$

$$\Delta f_{max} = \left(\frac{500}{\pi}\right) \text{Hz}$$

6. *Ans. (b)*

$$\frac{G_1G_2}{1+G_1G_2H_1+G_2H_1-G_1}$$

7. *Ans. (6.20 to 6.30) kΩ*

$$V_{rip} = \frac{V_{max}}{fCR_L}$$

$$R_L = \frac{V_{max}}{fCV_{rip}} = \frac{75}{60\times 50\times 10^{-5}\times 4} = 6.25\,\text{k}\Omega$$

8. ***Ans. (b)***

9. ***Ans. (b)***

Open loop gain,

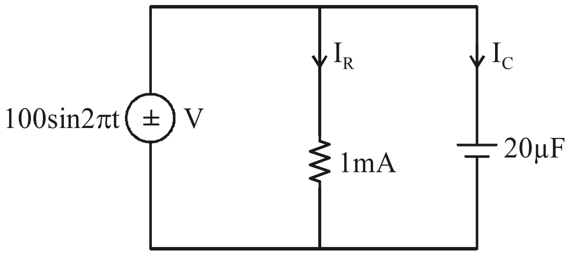
$$A = 10^3$$

$$\frac{A}{1+A\beta} = 100 \text{ or } \frac{10^3}{1+1000\beta} = 100$$

$$1 + 1000\beta = 10$$

$$\Rightarrow \quad \beta = 9 \times 10^{-3}$$

10. ***Ans. (c)***



Energy stored by capacitor:

$$w_c(t) = \frac{1}{2}CV^2$$

$$= \frac{1}{2}\times 20\times10^{-6}\times(100\sin 2\pi t)^2$$

$$= 10^{-5} \times 10^4 \sin^2 2\pi t$$

$$= 0.1 \sin^2 2\pi t \text{ Joule}$$

$\therefore$ max energy stored = 0.1 Joule

$$\omega_p = \int_0^{0.5} I^2 R dt = \int_0^{0.5} 10^{-8}\sin^2 2\pi t\cdot 10^6 dt$$

$$\int_0^{0.5} 10^{-2}\sin^2 2\pi t\, dt$$

$$= 2.5 \text{ mJ}$$

So ratio of stored energy and dissipated energy

$$= \frac{0.1}{2.5\times10^{-3}} = 40$$

11. ***Ans. (c)***

From output characteristics

$$\beta_{ac} = \frac{I_C}{I_B} = \frac{6}{30}\times 1000 = 200$$

at $\quad I_B = 10\ \mu A$

$$\beta'_{ac} = \frac{2 \text{ mA}}{10\ \mu A} = 200$$

at $\quad I_B = 20\ \mu A$

$$\beta''_{ac} = \frac{4 \text{ mA}}{20\ \mu A} = 200$$

$$\therefore \quad \beta_{ac} = \beta'_{ac} = \beta''_{ac}$$

12. ***Ans. (c)***

13. ***Ans. (d)***

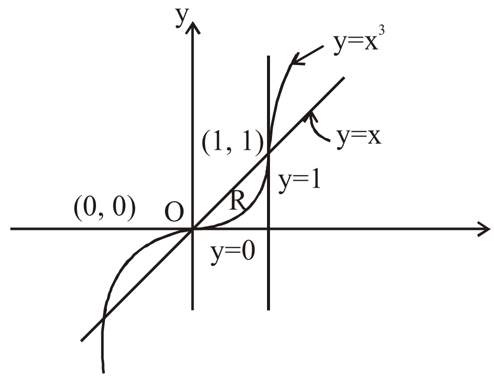
In case of memory mapped I/O $\rightarrow$ I/O devices are treated as memory locations having 16 bit address.

So microprocessor having 16 bit address line can address 2^{16} memory location and I/O devices.

2^{16} memory locations = $2^6 \times 2^{10}$ = 64 K memory locations.

14. ***Ans. (b)***

$$I = \int_{y=0}^{1}\int_{x=y}^{y^{\frac{1}{3}}} e^{x^2} dx\, dy$$



$$I = \iint_R e^{x^2} dx\, dy$$

$$I = \int_{x=0}^{1}\int_{y=x^3}^{x} e^{x^2} dy\, dx$$

$$I = \int_{x=0}^{1} (y)_{y=x^3}^{x} e^{x^2} dx$$

$$I = \int_{x=0}^{1} xe^{x^2} dx - \int_{x=0}^{1} x^3 e^{x^2} dx$$

Put $x^2 = t$

$2xdx = dt$

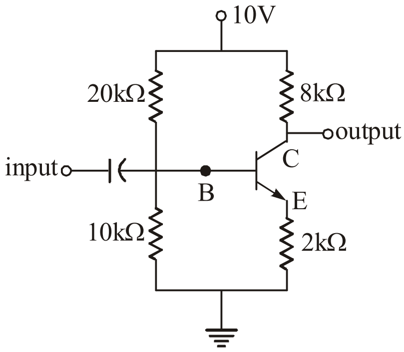
$$I = \frac{1}{2}\int_{t=0}^{1} e^t dt - \frac{1}{2}\int_{t=0}^{1} te^t dt$$

$$= \frac{1}{2}(e^t)_{t=0}^{1} - \frac{1}{2}\int_{t=0}^{1} te^t dt$$

$$= \frac{1}{2}(e^t)_{t=0}^{1} - \frac{1}{2}\left[e^t(t-1)\right]_{t=0}^{1}$$

$$= \frac{1}{2}(e-1) - \frac{1}{2}[1] = \frac{1}{2}(e-2)$$

15. ***Ans. (d)***



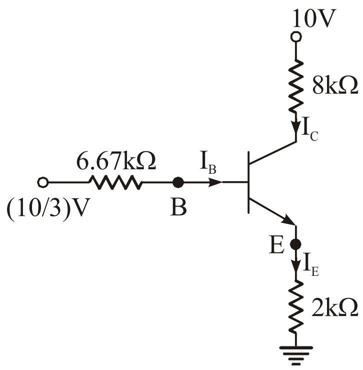
$\beta = 100$

Let us find Thevenin equivalent w.r.t. terminal B.

$$V_{th} = V_{OC} = \frac{10}{10+20}\times 10 = \frac{10}{3}V$$

$$R_{th} = 10k \,||\, 20k = 6.67\,k\Omega$$

$\therefore$ equivalent circuit



$I_E = (\beta+1)I_B$ in active region.

Since for transistor to be ON i.e. (either in active or saturation) emitter base junction should be forward biased and for this open circuit voltage across emitter base junction should be greater that $V_{BE} = 0.7V$

Now check for this,

$$V_{OC} > (V_B - V_E) \text{ when } I_B = I_E = 0$$

$$= (10/3 - 0) = 10/3V$$

$\because \quad V_{OC} > V_{BE}(=0.7V)$

$\therefore$ Transistor is ON

So, it is either in active or in saturation

Let it is in active region.

So, first in base-emitter junction loop according to KVL $\rightarrow$

$$10/3 - 6.67I_B - V_{BE} - 2\times(\beta+1)I_B = 0$$

Putting the values, we get

$$I_B = 0.0126 \text{ mA}$$

$\therefore$ Now find

$$V_{CE} = 10 - 8\times I_C - 2\times I_E$$

$$= 10 - 8\times\beta I_B - 2\times(\beta+1)I_B$$

$$= 10 - 8\times 1.26 - 2\times 101\times 0.0126$$

$$= -2.6252$$

Since V_{CE} is not greater than 0.2 V. So, our assumption that this is in active region is wrong. So, the transistor is in saturation region.

16. ***Ans. (10)***

As 88 MHz < f_s < 108 MHz

$|f_s - f_{si}| = 2f_{IF}$; if $f_{IF} < f_{LO}$

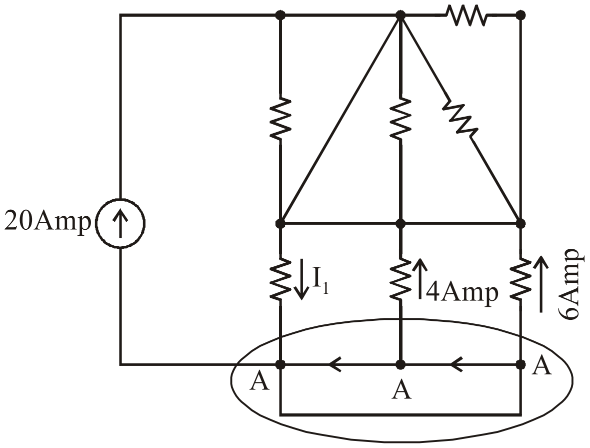
In order for the image frequency f_{si} to fall outside the interval [88, 108] MHz the minimum frequency f_{IF} is such that

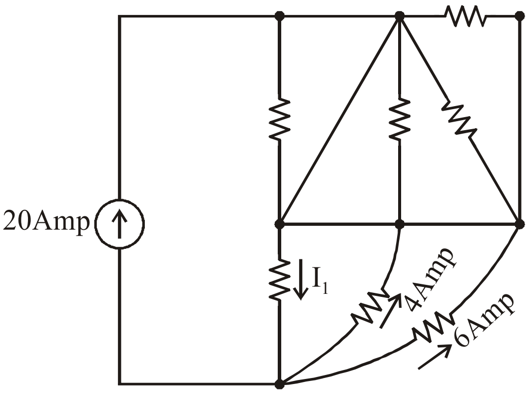
$$2f_{IF} = 108 - 88$$

$$f_{IF} = 10 \text{ MHz}$$

17. ***Ans. (b)***

Apply KCL to the gaussian surface (closed surface) which is shown below





$I_1 - 4 - 6 - 20 = 0$

$I_1 = 30$ Amp

18. ***Ans. (b)***

$Y(n) = 5x[n] - 5x[n-5]$

$Y(z) = 5X(z)\,[1 - z^{-5}]$

$H(z) = 5(1 - z^{-5})$

High pass filter $H(z) = \dfrac{1}{M}\sum_{n=0}^{M-1}(-1)^n z^{-n}$

So it resembles with HPF so answer is HPF

19. ***Ans.(b)***

Given

$q = 1.6\times10^{-19}$ C

$D = 10\ \text{cm}^2/\text{sec}$

$P = 10^{16}\left(1-\dfrac{x}{L}\right)\ \text{cm}^{-3}\ 0 < x < L.$

$\dfrac{dP}{dx} = \dfrac{10^{16}}{L}$

$J_p = -qD\times\dfrac{dP}{dx} = 16\ \text{A/cm}^2$

20. ***Ans. (d)***

$\nabla\cdot(\nabla\times\vec{v}) = 0$

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

$\nabla\cdot(f\,\vec{v}) = f(\nabla\cdot\vec{v}) + (\nabla f)\cdot\vec{v}$

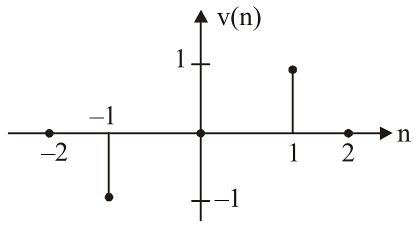
$\nabla(\nabla\cdot\vec{v}) = \nabla\times(\nabla\times\vec{v}) + \nabla^2\vec{v}$

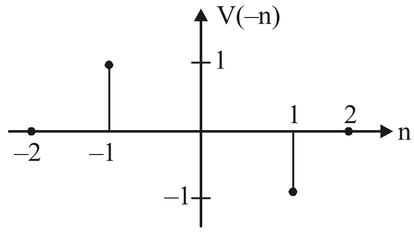
$\Rightarrow$ option (d) is wrong

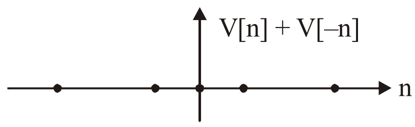
21. ***Ans.(a)***

$v[n] + v[-n] = 0$

for all integer values of n.







22. ***Ans. (a)***

$u = \dfrac{x^3 + y^3}{x + y}$

It is homogeneous function of degree n = 2 in x and y.

$$x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = nu = 2u$$

differentiating practically with respect to x

$$x\frac{\partial^2 u}{\partial x^2} + \frac{\partial u}{\partial x} + y\frac{\partial^2 u}{\partial x \partial y} = 2\frac{\partial u}{\partial x}$$

$$x\frac{\partial^2 u}{\partial x^2} + y\frac{\partial^2 u}{\partial x \partial y} = \frac{\partial u}{\partial x}$$

23. ***Ans. (c)***

24. ***Ans. (0)***

$$k_v = \lim_{s\to 0} sG(s)$$

$$= \lim_{s\to 0}\frac{50s}{(1+0.1s)(1+2s)}$$

$$= 0$$

25. ***Ans. (b)***

$$z = f(x, y) = 4x^2 + 9y^2 - 8x - 12y + 4$$

$$p = z_x = 8x - 8$$

$$q = z_y = 18y - 12$$

$$r = z_{xx} = 8$$

$$s = z_{xy} = 0$$

$$t = z_{yy} = 18$$

Put $p = q = 0$

$8x - 8 = 0$ …(1)

$18y - 12 = 0$ …(2)

$$x = 1,\ y = \frac{2}{3}$$

Critical point $= p\left(1, \frac{2}{3}\right)$

$\because\ (rt - s^2)_p > 0\ \&\ r_p > 0$

$\Rightarrow p\left(1, \frac{2}{3}\right)$ is point of minima

$$f_{min} = f\left(1, \frac{2}{3}\right)$$

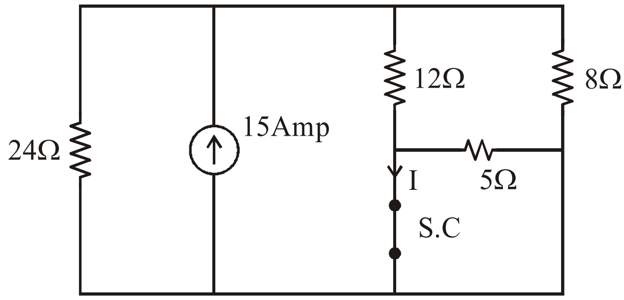
$$= 4(1)^2 + 9\left(\frac{2}{3}\right)^2 - 8(1) - 12\left(\frac{2}{3}\right) + 4$$

$$= 4 + 4 - 8 - 8 + 4$$

$$= -4$$

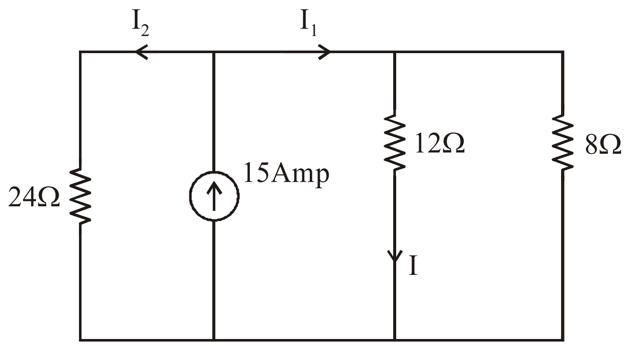
26. ***Ans. (5)***

At $t = 0^-$ Inductor gets short-circuited



Since 5Ω has short circuit in its parallel No current flow through It.

5Ω is of no use.

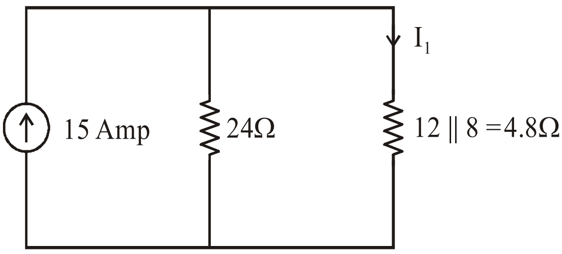


Since $12\Omega \parallel 8\Omega = \frac{12\times 8}{12+8} = \frac{96}{20} = 4.8\Omega$

$$I = \frac{8}{12+8}\times I_1$$

$$I = \frac{8}{20} \cdot I_1$$

$$\boxed{I = \frac{2}{5} \cdot I_1}$$



$$I_1 = \frac{24}{24+4.8} \times 15$$

$I_1 = 12.5$ Amp

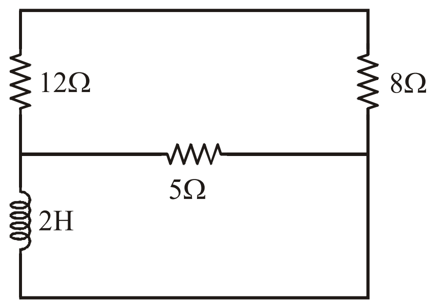
$$I = \frac{2}{5} \times 12.5$$

$$I = \frac{25}{5}$$

$I = 5$ Amp

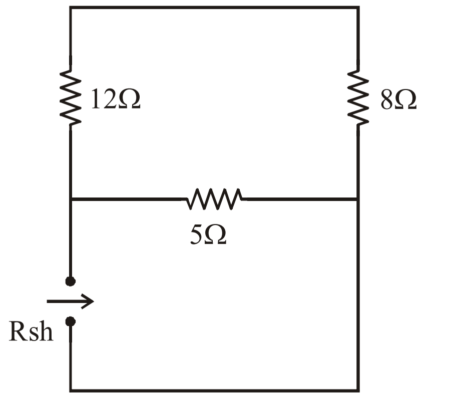
$I_L(0^-) = I_1(0^+) = I_1(0) = 5$ Amp

at $t = 0$



$I_L(t = \infty) = 0$ Amp

Calculation for R_{sh}



$R_{sh} = 22 \parallel 5$

$R_{sh} = 4\ \Omega$

$$I_L(t) = I_1(\infty) - [I_1(\infty) - I_1(0)]\, e^{-\frac{R_{eq}}{L}(t-t_0)}$$

$$I_L(t) = 0 - [0-5]e^{-\frac{4}{2}t}$$

$$I_L(t) = 5e^{-2t}$$

Hence the value of A is 5.

27. ***Ans. (51)***

As OP-AMP is ideal.

$$V_A = V_B$$

$$I_E = \frac{5}{100} = 50\text{mA}$$

β is very large

$$I_C = I_E = 50 \text{ mA}$$

Current into 15 kΩ resistor

$$I = \frac{20-5}{15k} = 1\text{mA}$$

total current $I_C + I_E = 51$ mA

28. ***Ans. (a)***

29. *Ans. (0111)*

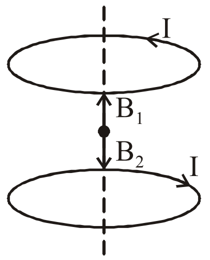
Right/$\overline{\text{left}}$ is high given

So it does right shifting

Clock	1 0 1 1	Q_3	Q_2	Q_1	Q_0
0		1	1	0	1
1		1	1	1	0
2		1	1	1	1
3		0	1	1	1

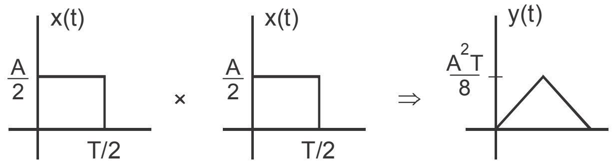
So, after 3rd clock pulse content will be 0111

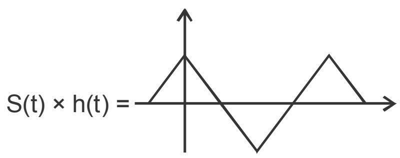
30. *Ans. (a)*



$\vec{B} = \vec{B}_1 + \vec{B}_2 = \vec{B}_1 - \vec{B}_1 = 0$

31. *Ans. (d)*





S(t) × h(t)

$$= \left[x(t) - x\left(t + \frac{T}{2}\right)\right] \times \left[-x(t) + x\left(t - \frac{T}{2}\right)\right]$$

32. *Ans. (c)*

If V_i < 8V both diode are off $V_0 = V_i$

if V_i > 8V, V_0 = 8V, D_1 is ON.

during negative cycle for $|V_i|$ > 6V ; D_2 is on

V_0 = –6 V

33. *Ans. (d)*

$$I = \int_0^1 \frac{dx}{\sqrt{-\ln x}}$$

Put $-\ln x = t^2$

or $\ln x = -t^2$

or $x = e^{-t^2}$

Hence, $dx = -2te^{-t^2}dt$

$$I = -2\int_\infty^0 e^{-t^2}dt = 2\int_0^\infty e^{-t^2}dt$$

Put $t^2 = y$

or $t = y^{1/2}$

$$dt = \frac{1}{2}y^{-\frac{1}{2}}dy$$

$$I = \int_0^\infty e^{-y}y^{-\frac{1}{2}}dy = \int_0^\infty e^{-y}y^{\frac{1}{2}-1}dy$$

$$= \left\lceil \frac{1}{2} \right. = \sqrt{\pi}$$

34. *Ans. (b)*

Using boundary condition at dielectric-dielectric interface for oblique incidence, we have

$$\frac{\tan\theta_1}{\tan\theta_2} = \frac{\epsilon_1}{\epsilon_2}$$

$$\Rightarrow \quad \frac{\tan 60°}{\tan\theta_2} = \frac{3}{\sqrt{3}}$$

$$\Rightarrow \quad \tan\theta_2 = \frac{\sqrt{3}}{3}\tan 60°$$

$$= \frac{\sqrt{3}\times\sqrt{3}}{3} = 1$$

$$\therefore \quad \theta_2 = 45°$$

35. *Ans. (a)*

$x(t) = 2 + \cos(50\pi t)$, f_{max} = 25 Hz

$$T_s = 0.01\text{sec},\ f_s = 100\text{Hz}, \frac{f_s}{2} = 50\text{Hz}$$

As $f_s > 2f_{max}$, the input signal x(t) is completely recovered at the output of the filter, H(ω).

Spectrum of the sampled signal,

$$X^*(\omega) = \sum_{k=-\infty}^{\infty} f_s X(\omega - K\omega_s)$$

$$Y(\omega) = H(\omega)X^*(\omega) = X(\omega)$$

$\therefore \quad y(t) = x(t)$

36. ***Ans. (d)***

$$P_D = V_B I_R$$

$$I_R = \frac{P_D}{V_B} = \frac{50\times10^{-3}}{120} = 0.42 \text{ mA}$$

37. ***Ans. (c)***

$x(n) = \{2, 4, 6, 8, 10, 12\}$

$y(n) = \{1, 3, 5, 7, 9, 11\}$

$X(z) = 2 + 4Z^{-1} + 6Z^{-2} + 8Z^{-3} + 10Z^{-4} + 12Z^{-5}$

$Y(z) = 1 + 3Z^{-1} + 5Z^{-2} + 7Z^{-3} + 9Z^{-4} + 11Z^{-5}$

$$H(z) = \frac{1+3Z^{-1}+5Z^{-2}+7Z^{-3}+9Z^{-4}+11Z^{-5}}{2+4Z^{-1}+6Z^{-2}+8Z^{-3}+10Z^{-4}+12Z^{-5}}$$

$$H(z) = \frac{1}{2} + \frac{1}{2}z^{-1} + ------$$

$$h(n) = \left\{\frac{1}{2}, \frac{1}{2}\right\}$$

38. ***Ans. (9)***

$$z = f(x, y) = xy + \frac{9}{x} + \frac{3}{y}$$

$$P = \frac{\partial z}{\partial x} = y - \frac{9}{x^2},\ q = \frac{\partial z}{\partial y} = x - \frac{3}{y^2}$$

$$r = \frac{\partial^2 z}{\partial x^2} = \frac{18}{x^3},\ s = \frac{\partial^2 z}{\partial x \partial y} = 1,$$

$$t = \frac{\partial^2 z}{\partial y^2} = \frac{6}{y^3}$$

Putting $p = q = 0$

$$y - \frac{9}{x^2} = 0 \text{ or } x^2 = \frac{9}{y} \qquad \ldots(1)$$

$$x - \frac{3}{y^2} = 0 \qquad \ldots(2)$$

Put $x = \frac{3}{y^2}$ in equation (1)

$$\frac{9}{y^4} = \frac{9}{y}$$

$\Rightarrow \quad y^4 = y$

or $\quad y(y^3 - 1) = 0$

$y = 0$ or $y = 1$

when $\quad y = 0;\ x = 0$

when $\quad y = 1;\ x = \pm 3$

⇒ critical points are (3, 1), (–3, 1) and (0, 0)

At (3, 1), $\quad rt - s^2 > 0$ & $r > 0$

⇒ (3, 1) is point of minimum

At (3, 1), $\quad (rt - s^2) < 0$

⇒ (–3, 1) is point of inflection

At (0, 0), $\quad (rt - s^2) < 0$

⇒ (0, 0) is point of inflection

$$\Rightarrow \quad f_{min} = f(3, 1) = (3)(1) + \frac{9}{3} + \frac{3}{1}$$

$$= 3 + 3 + 3 = 9$$

39. ***Ans. (c)***

$$(A|B) = \begin{bmatrix} 4 & 9 & 3 & 6 \\ 2 & 3 & 1 & 2 \\ 2 & 6 & 2 & 7 \end{bmatrix}$$

$R_2 \to 2R_2 - R_1,\ R_3 \to 2R_3 - R_1$

$$\approx \begin{bmatrix} 4 & 9 & 3 & 6 \\ 0 & -3 & -1 & -2 \\ 0 & 3 & 1 & 8 \end{bmatrix}$$

$R_3 \rightarrow R_3 + R_2$

$$\approx \begin{bmatrix} 4 & 9 & 3 & 6 \\ 0 & -3 & -1 & -2 \\ 0 & 0 & 0 & 6 \end{bmatrix}$$

$\rho(A) = 2$, $\rho(A|B) = 3$, No. of unknown = n = 3

$\because \quad \rho(A) < \delta(A|B)$

Hence, system is inconsistent and have no solution.

40. ***Ans*** **(70 to 71) mA**

41. ***Ans.(0.20 to 0.30) pF***

The parasitics capacitance is the sum of two componants.

$$C_{TS} = C_1 + C_2 = 0.2\,\text{pF} + 0.06\,\text{pF} = 0.26\,\text{pF}$$

42. **Ans.** ***(a)***

$$C_k = \frac{1}{T}\int_{-T/2}^{T/2} x(\tau)e^{-jk\omega_0 t}dt$$

$$C_k = \frac{1}{T=2}\int_{-1}^{1} x(t)e^{-jk\pi t}dt$$

$$= \frac{1}{2}\int_{-1}^{1}\left(-2\delta(t+1) - 2\delta(t-1) + \delta(t)\right)e^{-jk\pi t}dt$$

$$= \left(\frac{1}{2} - 2\cos k\pi\right)$$

$$= 0.5 - 2\cos k\pi$$

43. ***Ans. (0.902 to 1.05)***

$$\mu = 9, \quad \sigma = 3$$

$$P(x \le 15 = P\left(\frac{x-\mu}{\sigma} \le \frac{15-\mu}{\sigma}\right)$$

$$= P\left(z \le \frac{15-9}{3}\right)$$

$$= P(z \le 2)$$

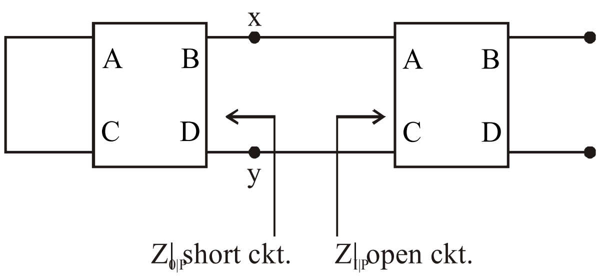
$$= 0.5 + P(0 \le z \le 2)$$

$$= 0.5 + 0.4772$$

$$= 0.9772$$

44. ***Ans. (0)***

45. ***Ans. (a)***



$$Z_{o/p} = Z_{1i/p}\text{ short circuit} = \frac{B}{A}$$

$$Z_{i/p} = Z_{2o/p}\text{ open circuit} = \frac{A}{C}$$

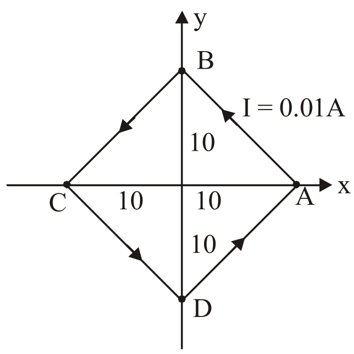
So equivalent impedance seen across x and y is

$$Z_{xy} = \frac{Z_1 \times Z_2}{Z_1 + Z_2} = \frac{\frac{B}{A} \times \frac{A}{C}}{\frac{B}{A} + \frac{A}{C}}$$

$$= \frac{AB}{A^2 + BC}$$

46. ***Ans. (d)***

47. ***Ans. (a)***



Area of the square

$$A = (10\sqrt{2})^2$$

$$A = 200\ m^2$$

Magnetic dipole moment

$$M = IA$$

$$M = 0.01 \times 200 = 2$$

The direction of the magnetic dipole moment can be found out by right Hand rule and that is $\bar{a}_z$.

So, $\vec{M} = 2\bar{a}_z$

48. ***Ans. (2 to 3)***

$$U_{avg} = \frac{1}{4\pi}\int_s U(\theta,\phi)\sin\theta d\theta d\phi$$

$$= \frac{1}{4\pi}\int_0^{\pi/2}\sin^2\theta d\theta\int_0^{2\pi}d\phi$$

$$= \frac{1}{4\pi}\left[\int_0^{\pi/2}\frac{1-\cos 2\theta}{2}d\theta\right]2\pi$$

$$= \frac{1}{2}\left[\frac{1}{2}\theta - \frac{1}{2}\frac{\sin 2\theta}{2}\right]_0^{\pi/2} = \frac{\pi}{8}$$

$$D = \frac{U_{max}}{U_{arg}} = \frac{1}{\pi/8} = \frac{8}{\pi} = 2.546$$

49. ***Ans. (b)***

Truth table can be formed on the basis of data given

A	B	J	K	Q_{n+1}
0	0	1	1	$\bar{Q}_n$ (as to get $\bar{Q}_n$; J = 1, K = 1)
0	1	1	0	1
1	0	0	0	Q_n
1	1	0	1	0

From truth table, it is clear that $J = \bar{A}$

50. ***Ans. (a)***

51. ***Ans. (20.0 to 21.5) dB***

$R_{ss}(\tau)$

$$= \underbrace{100E[\cos(\omega_c t + \phi)\cos(\omega_c(t+\tau)+\phi)}_{In}$$

$$\underbrace{m(t)\cdot m(t+\tau)]}_{In}$$

$$= \frac{100}{2}E[\cos(2\omega_c t + \omega_c\tau + 2\phi)m(t)m(t+\tau) +$$

$$\cos\omega_c\tau(m(t)\cdot m(t+\tau)]$$

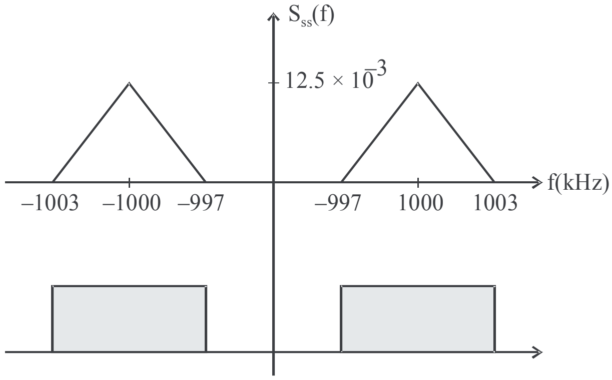
$$= \frac{100}{2}E[\cos(2\omega_c t + \omega_c\tau + 2\phi)]\cdot E(m(t)m(t+\tau) +$$

$$\cos\omega_c\tau E(m(t)\cdot m(t+\tau)]$$

$$= 50[R_{mm}(\tau)\ \cos(t_{\omega c})]$$

$$S_{ss}(f) = \frac{50}{4}[S_m(f+f_c) + S_m(f-f_c)],$$

$f_c = 1000$ kHz



$$\overline{s^2(t)} = 2 \times 0.5 \times 12.5 \times 10^{-3} \times 6 \times 10^{-3} = 75\ W$$

$$N_o = 10^{-4} \times 6 \times 10^3 = 0.6$$

$$\frac{\overline{s^2}}{N_o} = 20.96\ dB$$

52. ***Ans. (b)***

$Y(\omega) = H(\omega)X(\omega)$

The system is not passing the input frequency, $\omega = 3\pi$ to the output as the output is not containing $\omega = 3\pi$ sinusoid.

$\therefore$ System function, $H(\omega)$ at $\omega = 3\pi$ should be zero.

53. ***Ans. (c)***

Let p= population of bacteria

According to question, $\frac{dp}{dt} \propto p$

$$\Rightarrow \quad \frac{dp}{dt} = kp$$

$$\text{or,} \quad \int \frac{dp}{p} = \int k\,dt$$

$$ln(p) = kt + c$$

$$p = e^{kt} \cdot e^{c}$$

$$p = ne^{kt} \; ; \; n = e^{c}$$

Put $t = 0, p = 10000$

Hence, $n = 10000$

$$p = (10000)e^{kt} \quad \ldots(1)$$

Put $t = 10, \; p = 25000$

Put $t = 20$, in equation (1)

$$p = (10000)e^{20k} = (10000)\,(e^{10k})^2$$

$$p = (10000)(2.5)^2 = 62500$$

54. ***Ans. (0.35 to 0.45)***

$$P(\bar{e}) = P\text{ (no error)}$$

$$= P\{\underbrace{(m_0, r_0)}_{E_1}, \underbrace{(m_1, r_1)}_{E_2}, \underbrace{(m_2, r_2)}_{E_3}\}$$

$$= P(E_1) + P(E_2) + P(E_3)$$

$$= P(m_0) \cdot P\left(\frac{r_0}{m_0}\right) + P_1(m_1)\left(\frac{r_1}{m_1}\right) + P(m_2) \cdot \left(\frac{r_2}{m_2}\right)$$

$$= .3 \times .6 + .5 \times .5 + .2 \times .8$$

$$= 0.59$$

$$P(e) = 1 - P(\bar{e}) = 0.41$$

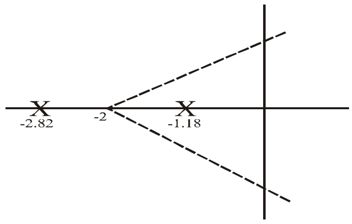
55. ***Ans. (c)***

OLTF $\quad G(s)\,H(s) = \frac{K}{s(s^2 + 6s + 10)}$

Break away points

$$s = -1.18 \text{ and } -2.82$$

centroid $\quad s = -2$



The gain, k can be found out using the Routh criterion

The characteristic equation is

$$1 + G(s)\,H(s) = 0$$

$$s^3 + 6s^2 + 10s + K = 0$$

s^3	1	10
s^2	6	K
s^1	$\frac{60-K}{6}$	0
s^0	K	

system is marginally stable or oscillatory

$$\text{If} \quad \frac{60-K}{6} = 0$$

$$K_{marginal} = 60$$

Auxiliary equation is given as

$$6s^2 + 60 = 0$$

$$-\omega^2 + 10 = 0$$

$$\omega = \sqrt{10}$$

$$= 3.16 \text{ rad/sec}$$

❍❍❍