GENERAL APTITUDE

Q. No. 1 -5 Carry One Mark Each

1. Define [x] as the greatest integer less than or equal to x, for each $x \in (-\infty, \infty)$. If $y = [x]$, then area under

y for $x \in [1,4]$ is _____.
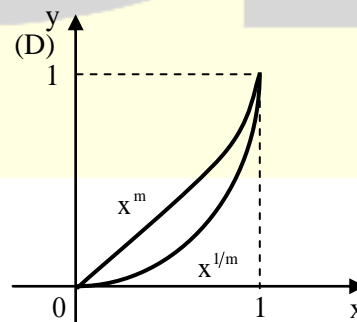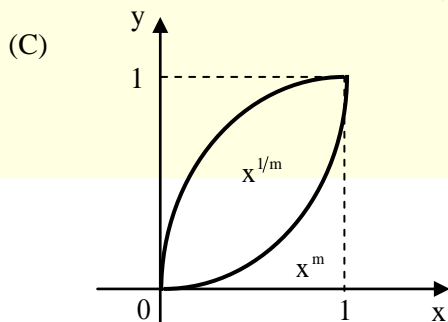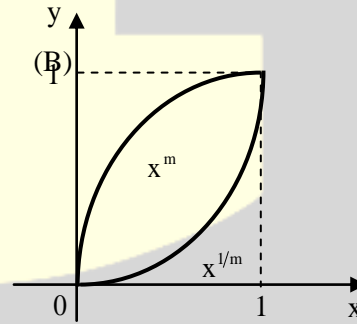
(A) 6   (B) 3   (C) 4   (D) 1

Answer: **(A)**

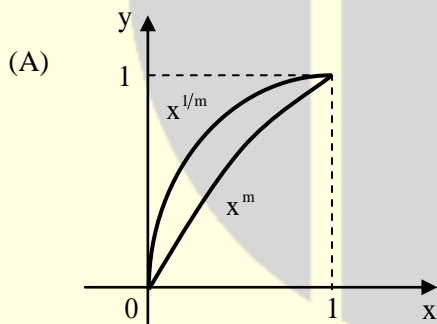**2.** He is known for his unscrupulous ways. He always sheds _____ tears to deceive people.

(A) crocodile   (B) fox's   (C) crocodile's   (D) fox

Answer: **(A)**

---

3. Select the graph that schematically represents BOTH $y = x^m$ and $y = x^{1/m}$ properly in the interval

$0 \le x \le 1$. for integer values of m, where m > 1.

Answer: **(C)**

4. The sum of the first n terms in the sequence 8, 88, 888, 8888, … is _____.

(A) $\frac{80}{81}\left(10^n - 1\right) + \frac{8}{9}n$

(B) $\frac{81}{80}\left(10^n - 1\right) + \frac{9}{8}n$

(C) $\frac{81}{80}\left(10^n - 1\right) - \frac{9}{8}n$

(D) $\frac{80}{81}\left(10^n - 1\right) - \frac{8}{9}n$

Answer: **(D)**

---

5. Crowd funding deals with mobilisation of funds for a project from a large number of people, who would be willing to invest smaller amounts through web-based platform in the project.

Based on the above paragraph, which of the following is correct about crowd funding?

(A) Funds raised through coerced contributions on web-based platforms.

(B) Funds raised through voluntary contributions on web-based platforms.

(C) Funds raised through large contributions on web-based platforms.

(D) Funds raised through unwilling contributions on web-based platforms.

Answer: **(B)**

---

6. **I do not think you know the case well enough to have opinions. Having said that, I agree with your other point.**

What does the phrase "having said that" mean in the given text?

(A) as opposed to what I have said

(B) in addition to what I have said

(C) contrary to what I have said

(D) despite what I have said

Answer: **(D)**

---

7. P, Q, R and S are to be uniquely coded using α and β. If P is coded as $\alpha\alpha$ and Q as $\alpha\beta$, then R and S, respectively, can be coded as_____.

(A) $\alpha\beta$ and $\beta\beta$ (B) $\beta\beta$ and $\alpha\alpha$ (C) $\beta\alpha$ and $\beta\beta$ (D) $\beta\alpha$ and $\alpha\beta$
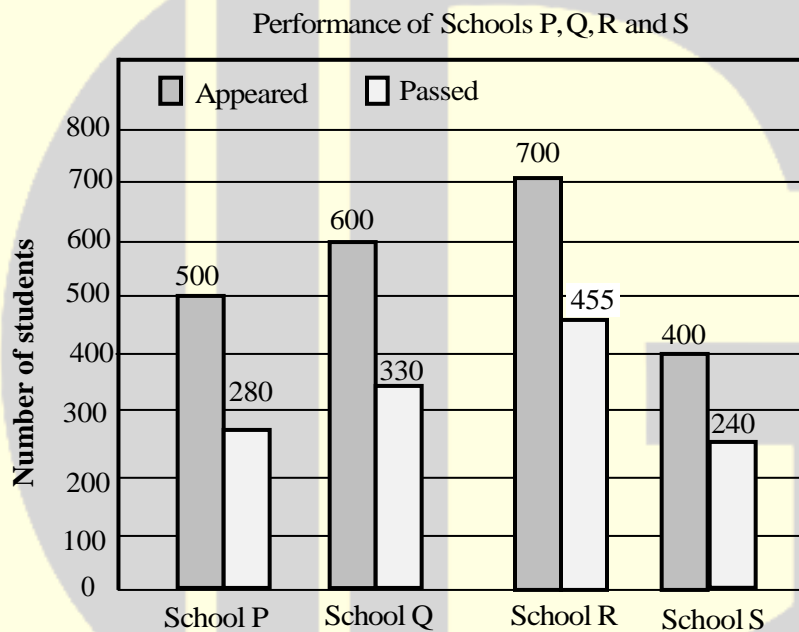
Answer: **(C)**

8. Select the word that fits the analogy:

Build: Building::Grow: _____.

(A) Growth   (B) Grown   (C) Grew   (D) Growed

Answer: **(A)**

---

9. The bar graph shows the data of the students who appeared and passed in an examination for four schools P, Q, R and S. The average of success rates (in percentage) of these four schools is _____.

Performance of Schools P, Q, R and S

- Appeared
- Passed

Number of students

School P: Appeared 500, Passed 280
School Q: Appeared 600, Passed 330
School R: Appeared 700, Passed 455
School S: Appeared 400, Passed 240

(A) 59.0%   (B) 59.3%   (C) 58.5%   (D) 58.8%

Answer: **(A)**

---

10. Jofra Archer, the England fast bowler, is _____ then accurate.

(A) more fast   (B) more faster   (C) less fast   (D) faster

Answer: **(A)**

INSTRUMENTATION ENGINEERING

Q. No. 1 -25 Carry One Mark Each

1. Two 100Ω resistors having tolerance 3% and 4% are connected in series. The effectivetolerance of the series combination **(in %, rounded off to one decimal place) is** _____.
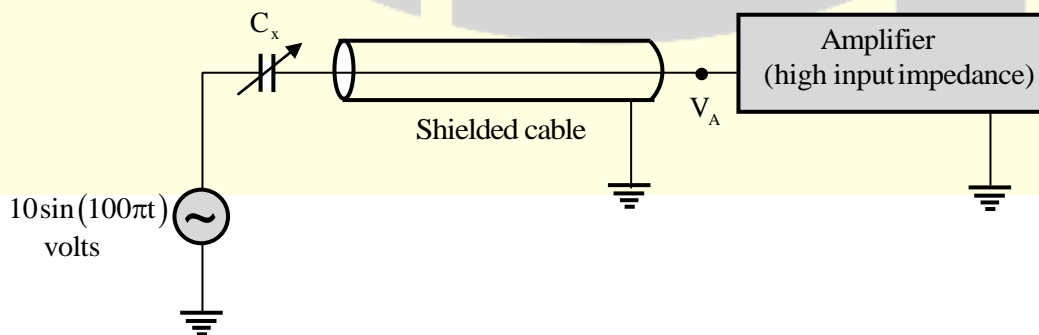
Answer: **(3.5)**

2. If I is the current flowing through a Hall effect sensor and B is the magnetic flux density perpendicular to the direction of the current (in the plane of the Hall effect sensor), the Hallvoltage generated is _____.

(A) Directly proportional to both I and B

(B) Inversely proportional to I and directly proportional to B

(C) Inversely proportional to I and inversely proportional to B

(D) Inversely proportional to both I and B

Answer: **(A)**

3. The capacitance C_x of a capacitive type sensor is $(1000x)\,pF,$ where x is the input to the sensor. As shown in the figure, the sensor is excited by a voltage $10\sin(100\pi t)\,V.$ The other terminal of the sensor is tied to the input of a high input impedence amplifierthrough a shielded cable, with shield connected to ground. The cable capacitance is 100pF.

The peak of the voltage V_A at the input of the amplifier when $x = 0.1$ **(in volts)** is _____.

Answer: **(5)**

4. Three 400Ω resistors are connected in delta and powered by a 400V(rms), 50Hz, balanced,symmetrical R-Y-B sequence, three-phase three-wire mains. The rms value of the **line current (in amperes, rounded off to one decimal place) is _____.**

Answer: **(1.732)** **Click here to watch video explanation**

5. A differentiator has a transfer function whose

(A) magnitude increases linearly with frequency

(B) magnitude remains constant

(C) magnitude increases linearly with frequency

(D) magnitude decreases linearly with frequency

Answer: **(C)** **Click here to watch video explanation**

6. A player throws a ball at a basket kept at a distance. The probability that the ball falls into the Basket in a single attempt is 0.1. The player attempts to throw the ball twice. Considering each attempt to be independent, the probability that this player puts the ball into the basket only in the second attempt (**rounded off to two decimal places**) is _____.
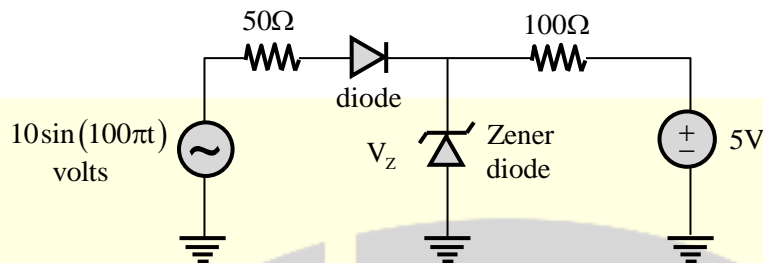
Answer: **(0.09)**

7. The closed loop transfer function of a control system is given by $\dfrac{C(s)}{R(s)} = \dfrac{1}{s+1}$. For the input $r(t) = \sin t$, the steady state response c(t) is _____

(A) 1

(B) $\dfrac{1}{\sqrt{2}}\sin\left(t - \dfrac{\pi}{4}\right)$

(C) $\dfrac{1}{\sqrt{2}}\cos t$

(D) $\dfrac{1}{\sqrt{2}}\sin\left(t + \dfrac{\pi}{4}\right)$

Answer: **(B)**

8. If the diodes in the circuit shown are ideal and the breakdown voltage V_Z of the Zener diode is 5V, the power dissipated in the 100Ω resistor (**in watts**) is _____.

(A) 0   (B) 1   (C) $\dfrac{25}{100}$ (D) $\dfrac{225}{100}$

Answer: (A)

---

9. A Q meter is best suited for the measurement of the _____ .

(A) Distributed capacitance of a coil.

(B) Quality factor of a capacitance.

(C) Quality factor of piezoelectric sensor.

(D) Turns-ratio of a transformer.

Answer: (A)   **Click here to watch video explanation**

---

10. Consider the signal $x(t) = e^{-|t|}$. Let $X(j\omega) = \int\limits_{-\infty}^{\infty} x(t)e^{-j\omega t}dt$ be the Fourier transform of $x(t)$. The value of $X(j0)$ is _____

Answer: (2)   **Click here to watch video explanation**

---

11. Consider the recursive equation $X_{n+1} = X_n - h\left(F(X_n) - X_n\right)$, with initial condition $X_0 = 1$ and $h > 0$ being a very small valued scalar. This recursion numerically solves the ordinary differential equation _____ .

(A) $\dot{X} = F(X) + X,\ X(0) = 1$

(B) $\dot{X} = -F(X) + X,\ X(0) = 1$

(C) $\dot{X} = -F(X),\ X(0) = 1$

(D) $\dot{X} = F(X),\ X(0) = 1$

Answer: **(B)**

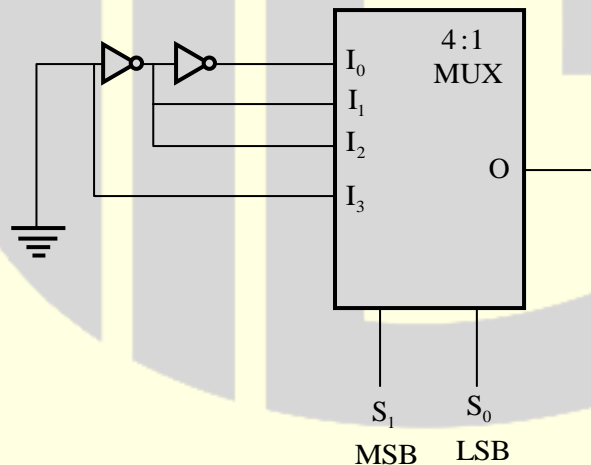--

12.   A phase lead network has the transfer function $G(s) = \dfrac{1 + 0.2s}{1 + 0.05s}$. The angular frequency at which the maximum phase shift for the network occurs is _____

(A)   20 rad/s   (B)   100 rad/s   (C)   200 rad/s   (D)   10 rad/s

Answer: **(D)**   **Click here to watch video explanation**

----

13.   The Boolean operation performed by the following circuit at the output O is _____.

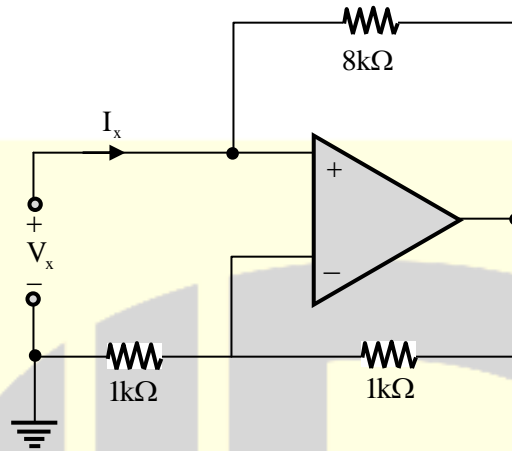(A) $O = S_1 . \bar{S}_0$ (B) $O = S_1 \oplus S_0$ (C) $O = S_0 . \bar{S}_1$ (D) $O = S_1 + S_0$

Answer: **(B)**   **Click here to watch video explanation**

14. Assume that the opamp in the circuit shown in ideal. The value of $\dfrac{V_x}{I_x}$ (in kΩ) is _____.

Answer: **(-4)**

- -

15. A second order has closed loop poles located at $s = -3 \pm j4$. The time t at which the maximum value of the step response occurs (**in seconds, rounded off to two decimal places**) is _____.
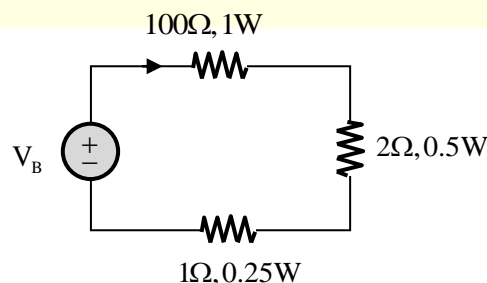
Answer: **(0.785)** **Click here to watch video explanation**

- -

16. The unit vectors along the mutually perpendicular x,y, and z axes are $\hat{i}, \hat{j}$ and $\hat{k}$ respectively. Consider the plane z=0 and two vectors $\vec{a}$ and $\vec{b}$ on that plane such that $\vec{a} \neq \alpha \vec{b}$ for any Scalar α. A vector perpendicular to both $\vec{a}$ and $\vec{b}$ is _____.

(A) $\hat{i} - \hat{j}$　　　　　(B) $\hat{i}$　　　　　(C) $-\hat{j}$　　　　　(D) $\hat{k}$

Answer: **(D)**

- -

17. In the circuit shown below, the safe maximum value for the current I is _____.

(A)   0.05A   (B)   1.0A   (C)   0.5A   (D)   0.1A

Answer: **(B)**

....

18.   Assuming ideal opamps, the output voltage at V_1 in the figure shown (**in volts**) is _____.
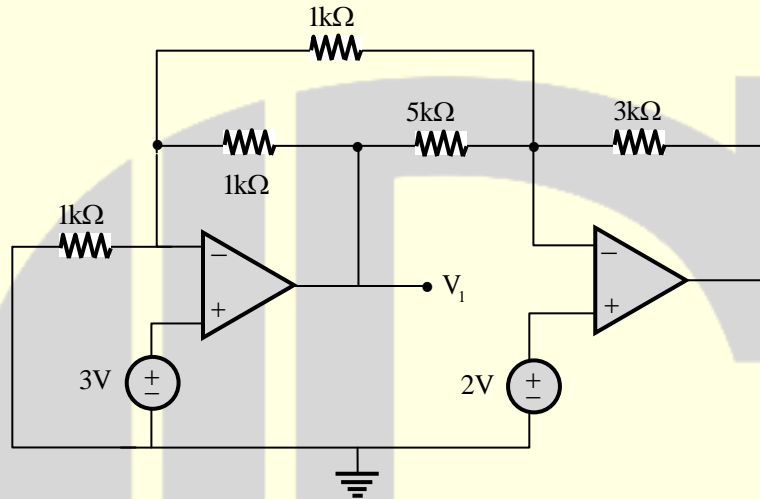
Answer: **(7)**

....

19.   A sinusoid of 10kHz is sampled at 15k samples/s. The resulting signal is passed through anideal low pass filter (LPF) with cut-off frequency of 25kHz. The maximum frequency component at the output of the LPF (in kHz) is _____ .

Answer: **(25)**

....
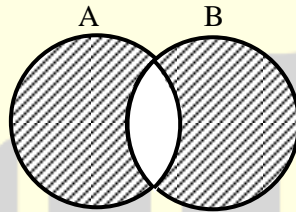
20.   A set of linear equations is given in the form Ax=b, where A is a 2×4 matrix with real numbers entries and $b \neq 0$. Will it be possible to solve for x and obtain a **unique solution** by multiplying both left and right sides of the equation by A^T (the super script T denotes the transpose) and inverting the matrix $A^T A$? Answer is _____ .

(A)   Yes, can obtain a unique solution provided the matrix $A^T A$ is well conditioned

(B)   Yes, can obtain a unique solution provided the matrix A is well conditioned

(C)   No, it is not possible to get a unique solution for any 2×4 matrix A.

(D)   Yes, it is always possible to get a unique solution for any 2×4 matrix A.

Answer: (C)

---

21.   The Boolean expression for the shaded regions as shown in the figure is _____ .

(A) $\left(A+\bar{B}\right).\left(\bar{A}+B\right)$

(B) $\left(\bar{A}+B\right).\left(\bar{A}+\bar{B}\right)$

(C) $\left(\bar{A}+\bar{B}\right).\left(A+\bar{B}\right)$

(D) $\left(A+B\right).\left(\bar{A}+\bar{B}\right)$

Answer: (D)   **Click here to watch video explanation**

---

22.   Consider the signal $x[n] = \sin(2\pi n)\,u[n]$, where $u[n] = \begin{cases} 1 & n = 0,1,2,3........ \\ 0 & \text{otherwise} \end{cases}$

The period of this signal $x[n]$ is _____

(A)   3   (B)   2   (C)   1   (D)   4

Answer: (C)   **Click here to watch video explanation**

---

23.   Let $f(z) = \dfrac{1}{z+a}, a > 0.$ The value of the integral $\oint f(z)dz$ over a circle C with center

(-a,0) and radius R>0 evaluated in the anti-clockwise direction is _____

(A) $2\pi i$ (B)   0   (C) $4\pi i$ (D) $-2\pi i$

Answer: (A)

24. A 200mV full-scale dual-slope analog to digital converter (DS-ADC) has a reference voltage of 100mV. The first integration time is set as 100ms. The DS-ADC is operated in the continuous conversion mode. The conversion time of the DS-ADC for an input voltage of 123.4mV (**in ms, rounded off to one decimal place**) is _____.
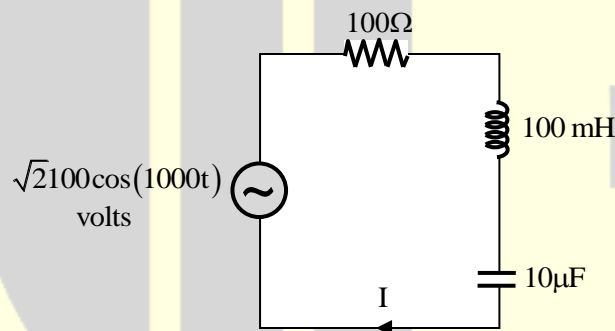
Answer: **(223.4)** **Click here to watch video explanation**

25. Given $f(A,B,C,D) = \sum m(0,1,2,6,8,9,10,11) + \sum d(3,7,14,15)$ is a Boolean function, where m represents min-terms and d represents don't-cares. The minimal sum of products expression for f is _____.

(A) $f = \bar{A}B + \bar{C}D$ (B) $f = \bar{D} + A$ (C) $f = \bar{B} + C$ (D) $f = A\bar{B} + CB$

Answer: **(C)** **Click here to watch video explanation**

26. The rms value of the phasor current I in the circuit shown (in amperes) is_____.

**Answer:** **(1)** **Click here to watch video explanation**

27. A circuit consisting of capacitors, DC voltage source and an amplifier having a voltage gain G=-5 is shown in the figure.
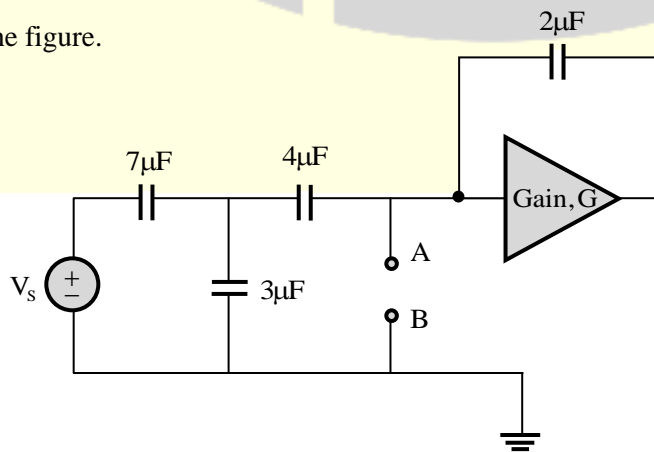
The effective capacitance across the nodes A and B (in μF, rounded off to one decimal place) is_____ .

Answer: **(14.857)**

---

28. Assuming that the opamp used in the circuit shown is ideal, the reading of the 1 Hz bandwidth, permanent magnet moving coil (PMMC) type voltmeter (in volts) is_____.
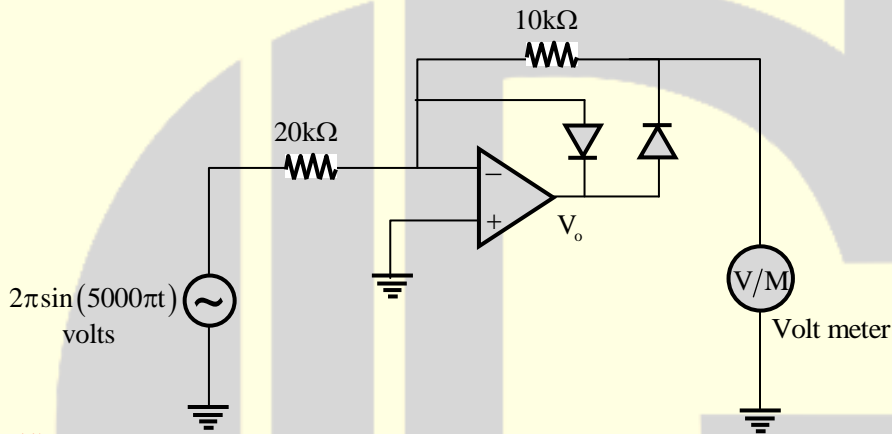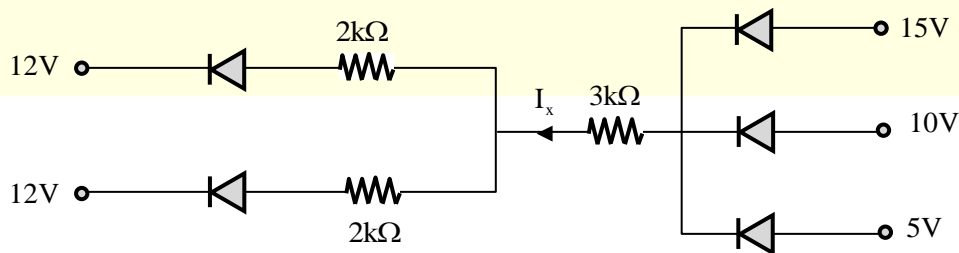

Answer: **(1)**

---

29. A $6\frac{1}{2}$ digit timer-counter is set in the 'time period' mode of operation and the range is set as 'ns'. For an input signal, the timer-counter displays 1000000. With the same input signal, the timer-counter is changed to 'frequency' mode of operation and the range is set as 'Hz'. The display will show the number _____ .

Answer: **(1000)**

---

30. Assume the diodes in the circuit shown are ideal.

The current I_x flowing through the $3\,k\Omega$ resistor (in mA, rounded off to one decimal place) is

_____.

Answer: **(1.8)**

**31.** Consider the following state variable equations:

$$\dot{x}_1(t) = x_2(t)$$
$$\dot{x}_2(t) = -6x_1(t) - 5x_2(t)$$

The initial conditions are $x_1(0) = 0$ and $x_2(0) = 1$. At $t = 1$ second, the value of $x_2(1)$ (rounded off to two decimal places) is

Answer: **(-0.12)**

---

32. Two T-flip flops are interconnected as shown in the figure. The present state of the flip flops are: $A = 1, B = 1$. The input x is given as 1, 0, 1 in the next three clock cycles. The decimal equivalent of $(ABy)_2$ with A being the MSB and y being the LSB, after the 3rd clock cycle is _____ .
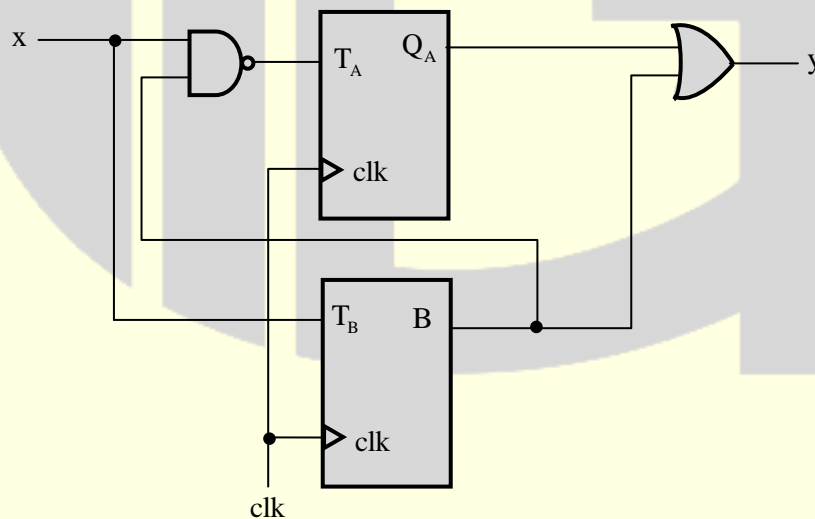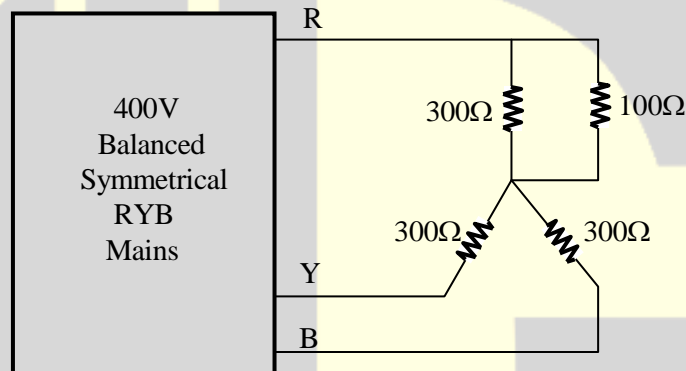

Answer: **(7)**

33. Consider the differential equation $\dfrac{dx}{dt} = \sin(x)$, with the initial condition x(0) =0.

The solution to this ordinary differential equation is

(A) x(t) = cos (t)

(B) x(t) = 0

(C) $x(t) = \sin(t) - \cos(t)$

(D) $x(t) = \sin(t)$

Answer: (B)

---

34. In the circuit shown, the rms value of the voltage across the 100Ω resistor (in volts) is_____.

Answer: (115.47)

---

35. A straight line drawn on an x-y plane intercepts the x-axis at-0.5 and the y-axis at 1.

The equation that describes this line is

(A) $y = x - 0.5$

(B) $y = -0.5x + 1$

(C) $y = 2x + 1$

(D) $y = 0.5x - 1$

Answer: (C)

---

36. Consider the finite sequence X=(1, 1, 1). The inverse discrete Fourier transform (IDFT) of X is given as $\big(x(0), x(1), x(2)\big)$. The value of x(2) is

Answer: (0)

37. A metallic strain gauge of resistance R_x with a gauge factor of 2 is bonded to a structure made of a metal with modulus of elasticity of $200\,GN/m^2$. The value of R_x is $1\,k\Omega$ when no stress is applied. R_x is a part of a quarter bridge with three identical fixed resistors of $1\,k\Omega$ each. The bridge is excited from a DC voltage of 4 V. The structure is subjected to a stress of $100\,MN/m^2$. Magnitude of the output of the bridge (in mV, rounded off to two decimal places) is

Answer: **(1)**

38. Consider the function $f(x,y) = x^2 + y^2$. The minimum value the function attains on the line $x + y = 1$ (rounded off to one decimal place) is

Answer: **(0.5)**

39. I_1, I_2 and I_3 in the figure below are mesh currents. The correct set of mesh equations for these currents, in matrix form, is _____.
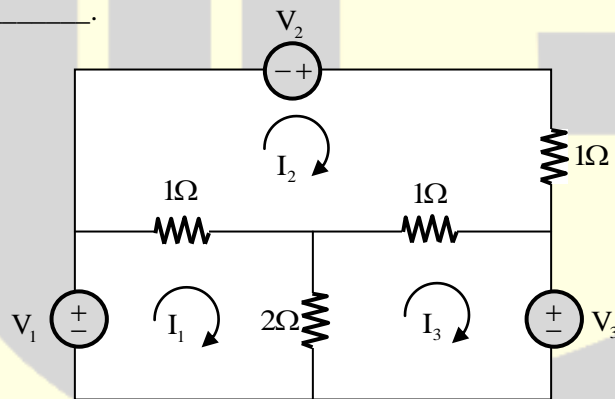
(A) $\begin{bmatrix} 1 & -1 & -2 \\ -1 & 2 & -1 \\ -2 & -1 & 3 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix}$

(B) $\begin{bmatrix} -3 & -1 & -2 \\ -1 & 3 & -1 \\ -2 & -1 & 3 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} V_1 \\ V_2 \\ -V_3 \end{bmatrix}$

(C) $\begin{bmatrix} 3 & -1 & -2 \\ -1 & 3 & -1 \\ -2 & -1 & -3 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix}$

(D) $\begin{bmatrix} 3 & -1 & -2 \\ -1 & 3 & -1 \\ -2 & -1 & 3 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} V_1 \\ V_2 \\ -V_3 \end{bmatrix}$

Answer: **(D)** **Click here to watch video explanation**

40. A 1000/1 A, 5VA, UPF bar-primary measuring current transformer has 1000 secondary turns. The current transformer exhibits a ratio error of -0.1% and a phase error of 3.438 minutes when the primary current is 1000 A. At this operating condition, the rms value of the magnetization current of the current transformer (in amperes, rounded off to two decimal places) is
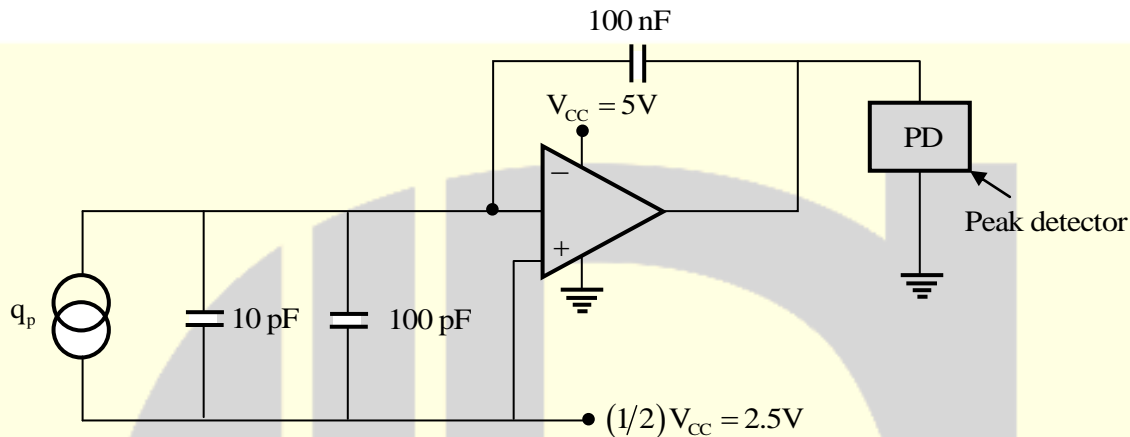
Answer: **(1)**

41. The mutual inductances between the primary coil and the secondary coils of a linear variable differential transformer (LVDT) shown in the figure are M_1 and M_2. Assume that the self-inductances L_{S_1} and L_{S_2} remain constant and are independent of x. When $x = 0, M_1 = M_2 = M_0$. When x is in the range $\pm 10\,mm$, M_1 and M_2 change linearly with x. At x=+10 mm or -10 mm, the change in the magnitudes of M_1 and M_2 is 0.25 M_0.
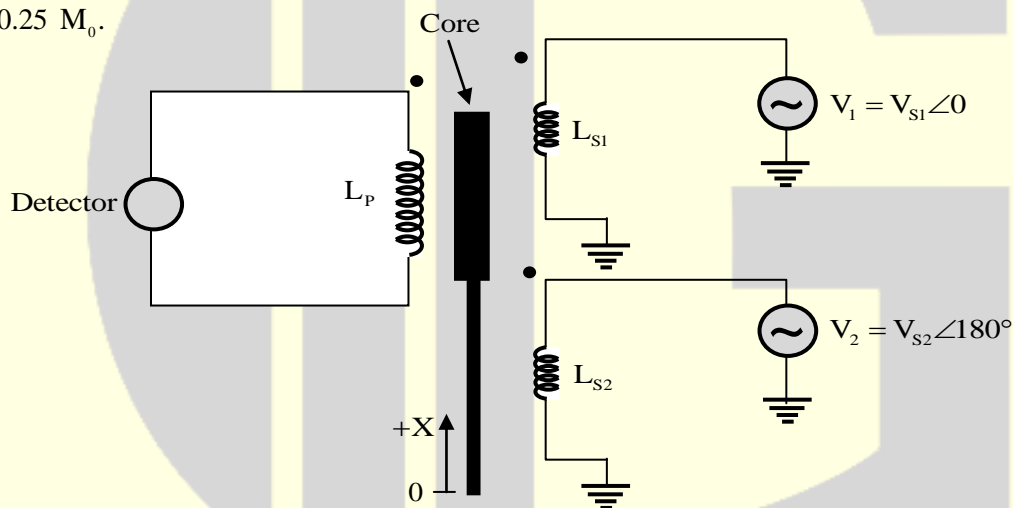
For a particular displacement x=D, the voltage across the detector becomes zero when $|V_2| = 1.25|V_1|$. The value of D (in mm, rounded off to one decimal place) is_____.

**Answer:** **(4.3 to 4.6)**

42. The circuit shown uses ideal opamp powered form a supply $V_{CC} = 5V.$ If the charge q_p generated by the piezoelectric sensor is of the form $q_p = 0.1\sin(10000\pi t)\,\mu C,$ the peak detector output after 10 cycles of q_p (in volts, rounded off to one decimal place) is_____.

Answer: (3.5)

43. In the Maxwell-Wien bridge shown, the detector D reads zero when $C_1 = 100\,nF$ and $R_1 = 100\,k\Omega.$ The Q factor of the coil is _____.
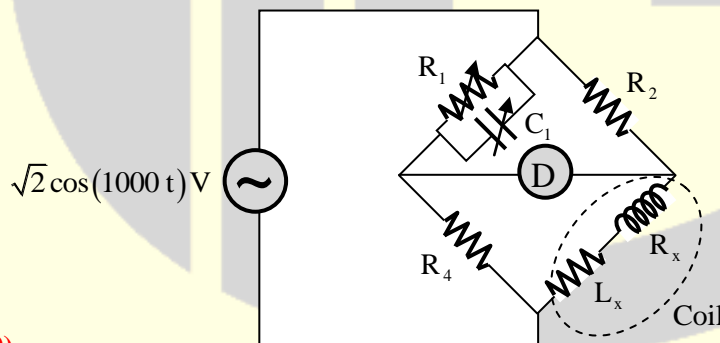
Answer: (10)

44. The real power drawn by a balanced load connected to a 400V, 50 Hz, balanced, symmetrical 3-phase, 3-wire, RYB sequence mains is measured using the two wattmeter method. Wattmeter W_1 is connected in the R line and wattmeter W_2 is connected in the B line. The line current is measured as $1/\sqrt{3}$ A. If the wattmeter W_1 reads zero, the reading on W_2 (in watts) is

Answer: (200)

45. The system shown in Fig. (a) has a time response y(t) to an input r(t) = 10 u (t) as shown in Fig. (b), u(t) being the unit step input. Both K, τ are positive. The gain K of the system is_____.
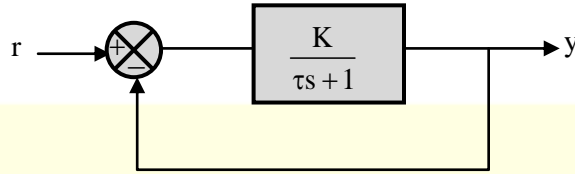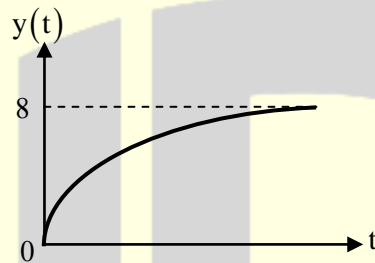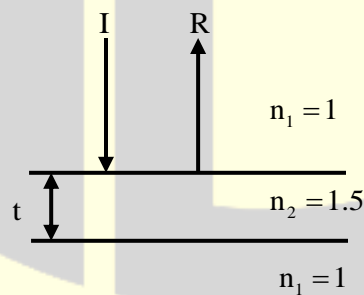
r → ⊕ (+, −) → $\dfrac{K}{\tau s + 1}$ → y

Figure (a)

y(t)

8 ┄┄┄┄┄┄┄

0 ────────→ t

Figure(b)

Answer: **(4)**   **Click here to watch video explanation**

- -

46. As shown in the figure, a slab of finite thickness t with refractive index $n_2 = 1.5$, has air $(n_1 = 1)$ above and below it. Light of free space wavelength 600 nm is incident normally from air as shown.

I   R

$n_1 = 1$

t ↕ $n_2 = 1.5$

$n_1 = 1$

For a destructive interference to be observed at R, the minimum value of thickness of the slab t (in nm) is _____.

Answer: **(200)**

47. A laser beam of 10 mm beam diameter is focused onto an optical fibre using a thin biconvex lens as shown in the figure. The refractive index of the lens is 1.5. The refractive indices of the core and cladding of the fibre are 1.55 and 1.54 respectively.

The minimum value of the focal length of the lens to attain the maximum coupling to the fibre (in mm, rounded off to one decimal place) is_____.
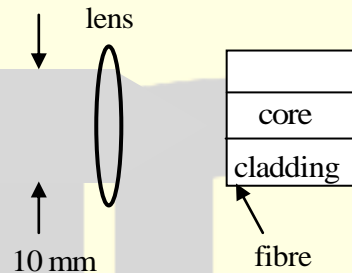
Answer: **(28.08)**

---

48. Consider the matrix $M = \begin{bmatrix} 1 & -1 & 0 \\ 1 & -2 & 1 \\ 0 & -1 & 1 \end{bmatrix}$. One of the eigenvectors of M is

(A) $\begin{bmatrix} -1 \\ 1 \\ -1 \end{bmatrix}$ (B) $\begin{bmatrix} 1 \\ -1 \\ 1 \end{bmatrix}$ (C) $\begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$ (D) $\begin{bmatrix} 1 \\ 1 \\ -1 \end{bmatrix}$

Answer: **(C)**

---

49. The loop transfer function of a negative feedback system is $G(s)H(s) = \dfrac{1}{s(s-2)}$. The Nyquist plot for the above system

(A) encircles $(-1 + j0)$ point once in the counterclockwise direction

(B) does not encircle $(-1 + j0)$ point

(C) encircles $(-1 + j0)$ point once in the clockwise direction

(D) encircles $(-1 + j0)$ point twice in the counterclockwise direction

Answer: **(C)** **Click here to watch video explanation**

---

50. Let $g[n] = \begin{cases} 1 & n = 0 \\ 0 & n = \pm 1, \pm 2, \pm 3,.. \end{cases}$ and $h[n] = \begin{cases} 1 & n = 0, 3, 6, 9.... \\ 0 & \text{otherwise} \end{cases}$

Consider $y[n] = h[n] \otimes g[n]$, where $\otimes$ denotes the convolution operator. The value of y [2] is

Answer: **(0)** **Click here to watch video explanation**

---

51. The loop transfer function of a negative feedback system is $G(s)H(s) = \dfrac{2(s+1)}{s^2}$. The phase margin of

the system (in degrees, rounded off to one decimal place) is

Answer: **(65.45)**

---

52. Consider two identical bags B1 and B2 each containing 10 balls of identical shapes and sizes. Bag B1 contains 7 Red and 3 Green balls, while bag B2 contains 3 Red and 7 Green balls. A bag is picked at random and a ball is drawn from it, which was found to be Red. The probability that the Red ball came from bag B1 (rounded off to one decimal place) is

Answer: **(0.7)**

---

53. The loop transfer function of a negative feedbacks system is given by

$G(s)H(s) = \dfrac{K}{s(s+2)(s+6),}$ where $K > 0$. The value of K at the breakaway point of the root locus for the

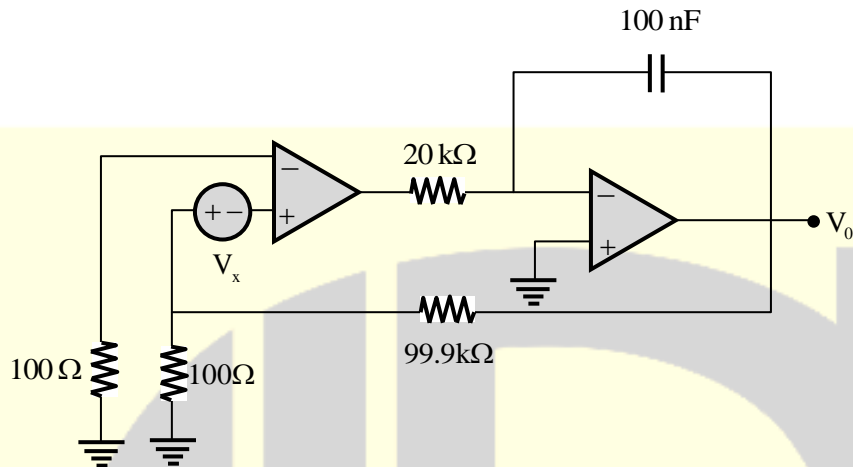above system (rounded off to one decimal place) is

Answer: **(5.049)** **Click here to watch video explanation**

---

54. The address lines $A_9...A_2$ of a 10 bit, 1.023 V full-scale digital to analog converter (DAC) is connected to

the data lines D_7 to D_0 of an 8-bit microprocessor, with A_1 and A_0 of the DAC grounded. Now, $D_7...D_0$

is changed from 1010 1010 to 1010 1011.

The corresponding change in the output of the DAC (in mV, rounded off to one decimal place) is

Answer: **(4)**

55. If the opamps in the circuit shown are ideal and $V_x = 0.5\text{mV}$, the steady state value of V_0 (in volts, rounded off to two decimal places) is_____.

Answer: **(0.5)**

★★★ **END OF THE PAPER** ★★★