1. Which of the following options is the closest in meaning to the word underlined in the sentence below?
In a democracy, everybody has the freedom to disagree with the government.
A. Dissent
B. Descent
C. Decent
D. Decadent

2. After the discussion, Tom said to me, 'Please revert!' He expects me to __________.
A. Retract
B. Get back to him
C. Move in reverse
D. Retreat

3. While receiving the award, the scientist said, "I feel vindicated". Which of the following is closest in meaning to the word 'vindicated'?
A. Punished
B. Substantiated
C. Appreciated
D. Chastened

4. Let $f(x,y)=x^n y^m = P$. If x is doubled and y is halved, the new value of f is
A. $2^{n-m}P$
B. $2^{n-n}P$
C. $2(n-m)P$
D. $2(m-n)P$

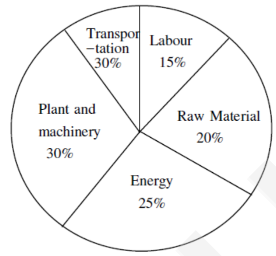
5. In a sequence of 12 consecutive odd numbers, the sum of the first 5 numbers is 425. What is the sum of the last 5 numbers in the sequence?
A. 295
B. 395
C. 455
D. 495

6. Find the next term in the sequence: 13M, 17Q, 19S, ___
A. 21W
B. 21V
C. 23W
D. 23V

7. If 'KCLFTSB' stands for 'best of luck' and 'SHSWDG' stands for 'good wishes', which of the following indicates 'ace the exam'?
A. MCHTX
B. MXHTC
C. XMHCT
D. XMHTC

8. Industrial consumption of power doubled from 2000-2001 to 2010-2011. Find the annual rate of increase in percent assuming it to be uniform over the years.
A. 5.6
B. 7.2
C. 10.0
D. 12.2

9. A firm producing air purifiers sold 200 units in 2012. The following pie chart presents the share of raw material, labour, energy, plant & machinery, and transportation costs in the total manufacturing cost of the firm in 2012. The expenditure on labour in 2012 is Rs. 4,50,000. In 2013, the raw material expenses increased by 30% and all other expenses increased by 20%. What is the percentage increase in total cost for the company in 2013?



A. 18%
B. 20%
C. 22%
D. 24%

10. A five-digit number is formed using the digits 1,3,5,7 and 9 without repeating any of them. What is the sum of all such possible five digit numbers?
A. 6666660
B. 6666600
C. 6666666
D. 6666606

11. The series $\sum_{n=0}^{\infty}\frac{1}{n!}$ converges to
A. $|2In2$
B. $\sqrt{2}$
C. 2
D. e

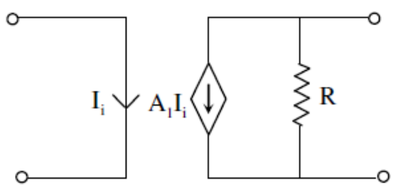
12. The magnitude of the gradient for the function $f(x,y,z)=x^2+3y^2+z^3$ at the point (1,1,1) is
A. 7
B. 9
C. 12
D. 5

13. Let X be a zero-mean unit variance Gaussian random variable. $E\left[|X|\right]$ is equal to _____
A. 0.8
B. 1.34
C. 5
D. 6

14. If a and b are constants, the most general solution of the differential equation
$\frac{d_2x}{dt}+2\frac{dx}{dt}+x=0is$
A. ae^{-t}
B. $ae^{-t}+bte^{-t}$
C. $ae^{t}+bte^{-t}$
D. ae^{-2t}

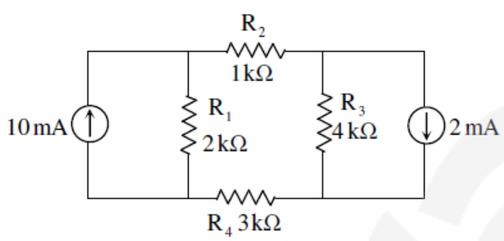
15. The directional derivative of $f(x,y)=\frac{xy}{\sqrt{2}}(x+y)$ in the direction of the unit vector at an angle of $\frac{\pi}{4}$ with y-axis, is given by ______.
A. 3
B. 5
C. 8
D. 4

16. The circuit shown in the figure represents a



A. Voltage controlled voltage source
B. Voltage controlled current source
C. Current controlled current source
D. Current controlled voltage source

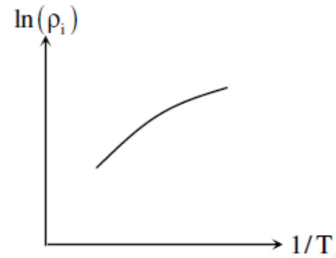
17. The magnitude of current (in mA) through the resistor R_2 in the figure shown is________.



A. 2.8
B. 3.4
C. 5
D. 4.4

18. At T = 300 K, the band gap and the intrinsic carrier concentration of GaAs are 1.42 eV and $10^6\ cm^{-3}$. respectively. In order to generate electron hole pairs in GaAs, which one of the wavelength (λ_C) ranges of incident radiation, is most suitable? (Given that: Plank's constant is $6.62\times10^{-34}\ J-s$, velocity of light is 3×10^{10} cm/s and charge of electron is $1.6\times10^{-19}C$)
A. $0.42\ \mu m<\lambda_C<0.87\ \mu m$
B. $0.87\ \mu m<\lambda_C<1.42\ \mu m$
C. $1.42\ \mu m<\lambda_C<1.62\ \mu m$
D. $1.62\mu m<\lambda_C<6.62\ \mu m$

19. In the figure in (ρ_i) is plotted as a function of 1/T, where ρ_i the intrinsic resistivity of silicon, T is is the temperature, and the plot is almost linear.

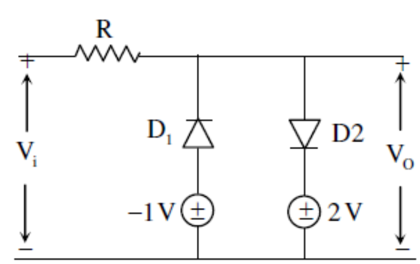


The slope of the line can be used to estimate
A. Band gap energy of silicon (Eg)
B. Sum of electron and hole mobility in silicon $(\mu_n+\mu_p)$
C. Reciprocal of the sum of electron and hole mobility in silicon $(\mu_n+\mu_p)^{-1}$
D. Intrinsic carrier concentration of silicon

20. The cut-off wavelength (in μm) of light that can be used for intrinsic excitation of a emiconductor material of bandgap Eg= 1.1 eV is _________
A. 0.85
B. 1.125
C. 1.450
D. 2.250

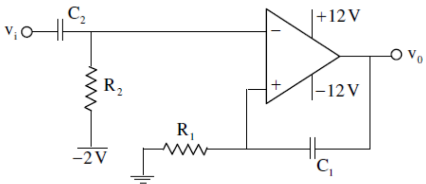
21. If the emitter resistance in a common-emitter voltage amplifier is not bypassed, it will
A. Reduce both the voltage gain and the input impedance
B. Reduce the voltage gain and increase the input impedance
C. Increase the voltage gain and reduce the input impedance
D. Increase both the voltage gain and the input impedance

22. Two silicon diodes, with a forward voltage drop of 0.7 V, are used in the circuit shown in the figure. The range of input voltage V_i for which the output voltage $V_0=V_i, is$



A. $-0.3V<V_i<1.3V$
B. $-0.3V<V_i<2V$
C. $-1.0V<V_i<2.0V$
D. $-1.7V<V_i<2.7V$

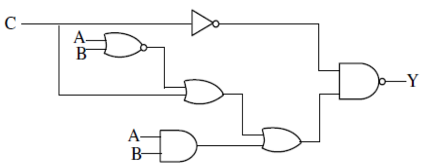
23. The circuit shown represents:



A. A bandpass filter
B. A voltage controlled oscillator
C. An amplitude modulator
D. A monostable multivibrator

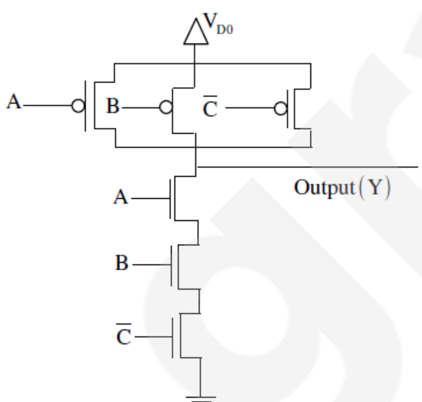
24. For a given sample-and-hold circuit, if the value of the hold capacitor is increased, then
A. Droop rate decreases and acquisition time decreases
B. Droop rate decreases and acquisition time increases
C. Droop rate increases and acquisition time decreases
D. Droop rate increases and acquisition time increases

25. In the circuit shown in the figure, if C=0, the expression for Y is



A. $Y=A\overline{B}+\overline{A}B$
B. $Y=A+B$
C. $Y=\overline{A}+\overline{B}$
D. $Y=AB$

26. The output (Y) of the circuit shown in the figure is



A. $\overline{A}+\overline{B}+C$
B. $A+\overline{B}.\overline{C}+A.\overline{C}$
C. $\overline{A}+B+\overline{C}$
D. $A.B.\overline{C}$

27. A Fourier transform pair is given by

$$\left(\frac{2}{3}\right)^n u[n+3] \overset{FT}{\Leftrightarrow} \frac{Ae^{-j6\pi f}}{1-\left(\frac{2}{3}\right)e^{-j6\pi f}}$$

where u[n] denotes the unit step sequence. The value of A is __________.

A. 2.345
B. 2.375
C. 3.345
D. 3.375

28. A real-valued signal x(t) limited to the frequency band $|f| \le \frac{w}{2}$ *is* is passed through a linear time invariant system whose frequency response is

$$H(f)=\begin{cases} e^{-j4\pi f}, |f| \le \frac{w}{2} \\ 0, |f| > \frac{w}{2} \end{cases}$$

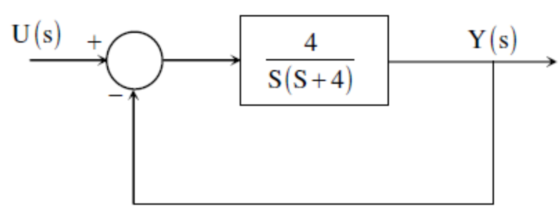
The output of the system is
A. $x(t+4)$
B. $x(t-4)$
C. $x(t+2)$
D. $x(t-2)$

29. The sequence $x[n]=0.5^n u[n]$, where u[n] is the unit step sequence, is convolved with itself to obtain y[n]. Then $\sum_{n=-\infty}^{\infty} y(n)$ __________.

A. 4
B. 8
C. 7
D. 5

30. In a Bode magnitude plot, which one of the following slopes would be exhibited at high frequencies by a 4th order all-pole system?
A. – 80 dB/decade
B. – 40 dB/decade
C. +40 dB/decade
D. +80 dB/decade

31. For the second order closed-loop system shown in the figure, the natural frequency (in rad/s) is



A. 16
B. 4
C. 2
D. 1

32. If calls arrive at a telephone exchange such that the time of arrival of any call is independent of the time of arrival of earlier or future calls, the probability distribution function of the total number of calls in a fixed time interval will be

A. Poisson
B. Gaussian
C. Exponential
D. Gamma

33. In a double side-band (DSB) full carrier AM transmission system, if the modulation index is doubled, then the ratio of total sideband power to the carrier power increases by a factor of__________________.
A. 2
B. 4
C. 6
D. 8

34. For an antenna radiating in free space, the electric field at a distance of 1 km is found to be 12mV/m. Given that intrinsic impedance of the free space is $120\pi\Omega$, the magnitude of average power density due to this antenna at a distance of 2 km from the antenna $\left(\text{in nW/m}^2\right)$ is_________________.
A. 50.7
B. 48.7
C. 45.7
D. 47.7

35.Match column A with column B

Column A	Column B
(1) Point electromagnetic source	(P) Highly directional
(2) Dish antenna	(Q) End free
(3) Yagi-Uda antenna	(R) Isotropic

A. $1 \to P$, $2 \to Q$, $3 \to R$
B. $1 \to R$, $2 \to P$, $3 \to Q$
C. $1 \to Q$, $2 \to P$, $3 \to R$
D. $1 \to R$, $2 \to Q$, $3 \to P$

Q. No. 26 – 55 Carry Two Marks Each

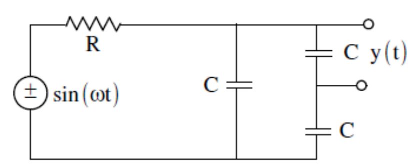
36. With initial values y(0) = y′(0)=1 the solution of the differential equation
$\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 4y = 0$ at x = 1 _________
A. 0.44
B. 0.48
C. 0.54
D. 0.62

37. Parcels from sender S to receiver R pass sequentially through two post-offices. Each post-office has a probability $\frac{1}{5}$ of losing an incoming parcel, independently of all other parcels. Given that a parcel is lost, the probability that it was lost by the second post-office is__________.
A. 0.22
B. 0.33
C. 0.44
D. 0.55

38. The unilateral Laplace transform of $f(t) is \frac{1}{s^2+s+1}$. Which one of the following is the unilateral Laplace transform of g(t) = t. f(t)?
A. $\frac{-s}{(s^2+s+1)^2}$
B. $\frac{-(2s+1)}{(s^2+s+1)^2}$
C. $\frac{S}{(s^2+s+1)^2}$
D. $\frac{2s+1}{(s^2+s+1)^2}$

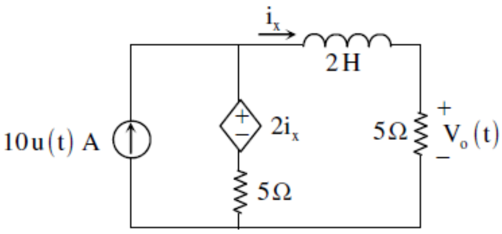
39. For a right angled triangle, if the sum of the lengths of the hypotenuse and a side is kept constant, in order to have maximum area of the triangle, the angle between the hypotenuse and the side is
A. 12°
B. 36°
C. 30°
D. 45°

40. The steady state output of the circuit shown in the figure is given by $y(t) = A(\omega)\sin(\omega t + \phi(\omega))$. If the amplitude $|A(\omega)| = 0.25$, then the frequency ω is



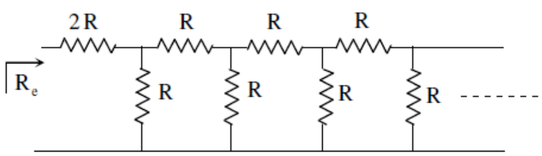
A. $\frac{1}{\sqrt{3}RC}$
B. $\frac{2}{\sqrt{3}RC}$
C. $\frac{1}{RC}$
D. $\frac{2}{RC}$

41. In the circuit shown in the figure, the value of $V_0(t)$ (in Volts) for $t \to \infty is$ ______.



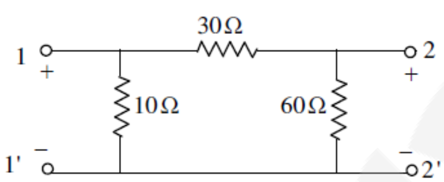
A. 21.25
B. 25.50
C. 31.25
D. 35.0

42. The equivalent resistance in the infinite ladder network shown in the figure is R_e.



The value of Re/R is _________
A. 2.0
B. 2.618
C. 4.0
D. 4.618

43. For the two-port network shown in the figure, the impedance (Z) matrix (in Ω) is

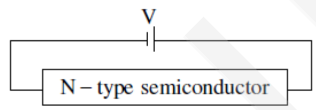


A. $\begin{bmatrix} 6 & 24 \\ 42 & 9 \end{bmatrix}$
B. $\begin{bmatrix} 9 & 8 \\ 8 & 24 \end{bmatrix}$
C. $\begin{bmatrix} 9 & 6 \\ 6 & 24 \end{bmatrix}$
D. $\begin{bmatrix} 42 & 6 \\ 6 & 60 \end{bmatrix}$

44. Consider a silicon sample doped with $N_D = 1\times10^{15} / cm^3$ donor atoms. Assume that the intrinsic carrier concentration $n_i = 1.5\times10^{10} / cm^3$. If the sample is additionally doped with $NA = 10\times10^{18} / cm^3$ acceptor atoms, the approximate number of electrons/cm3 in the sample, at T=300 K, will be _________________.
A. 225.2
B. 245.2
C. 255.2
D. 265.2

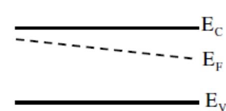
45. Consider two BJTs biased at the same collector current with area $A_1 = 0.2\mu m \times 0.2\mu m \, and \, A_2 = 300\mu m \times 300\mu m.$ Assuming that all other device parameters are identical, kT/q = 26 mV, the intrinsic carrier concentration is $1\times10^{10} cm^{-3}, and \, q = 1.6\times10^{-19} C,$ the difference between the base-emitter voltages (in mV) of the two BJTs $(i.e., V_{BE1} - V_{BE2}) is$ ________.
A. 361
B. 381
C. 412
D. 418

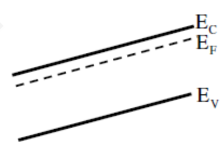
46. An N-type semiconductor having uniform doping is biased as shown in the figure.

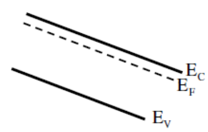


If E_C is the lowest energy level of the conduction band, E_V is the highest energy level of the valance band and E_F is the Fermi level, which one of the following represents the energy band diagram for the biased N-type semiconductor?

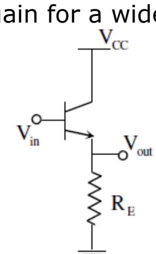
A.


B.


C.


D.


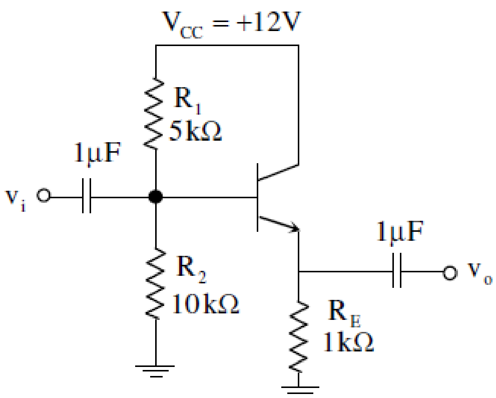
47. Consider the common-collector amplifier in the figure (bias circuitry ensures that the transistor operates in forward active region, but has been omitted for simplicity). Let I_C be the collector current, V_{BE} be the base-emitter voltage and V_T be the thermal voltage. Also, g_m and r_0 are the small-signal trans conductance and output resistance of the transistor, respectively. Which one of the following conditions ensures a nearly constant small signal voltage gain for a wide range of values of R_E?



A. $g_m R_E << 1$
B. $I_C R_E >> V_T$
C. $g_m r_0 >> 1$
D. $V_{BE} >> V_r$

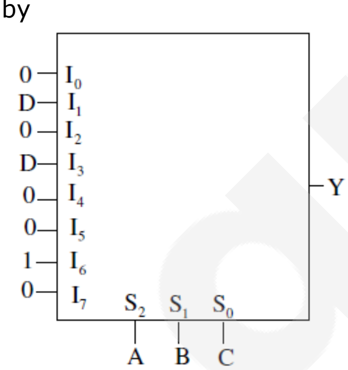
48. A BJT in a common-base configuration is used to amplify a signal received by a 50 Ω antenna. Assume kT/q = 25 mV. The value of the collector bias current (in mA) required to match the input impedance of the amplifier to the impedance of the antenna is_________.
A. 0.2
B. 0.4
C. 0.5
D. 0.75

49. For the common collector amplifier shown 39. in the figure, the BJT has high β, negligible $V_{CE(sat)}, and\, V_{BE} = 0.7V$. The maximum undistorted peak-to-peak output voltage v_o (in Volts)is______.



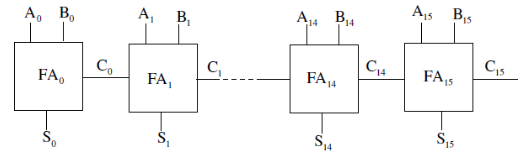
A. 9.6
B. 8.3
C. 8.9
D. 9.4

50. An 8-to-1 multiplexer is used to implement a logical function Y as shown in the figure. The output Y is given by



A. $Y = A\overline{B}C + A\overline{C}D$
B. $Y = \overline{A}BC + A\overline{B}D$
C. $Y = AB\overline{C} + \overline{A}CD$
D. $Y = \overline{A}\overline{B}D + A\overline{B}C$

51. A 16-bit ripple carry adder is realized using 16 identical full adders (FA) as shown in the figure. The carry-propagation delay of each FA is 12 ns and the sum-propagation delay of each FA is 15 ns. The worst case delay (in ns) of this 16-bit adder will be ___________.



A.170
B.175
C. 185
D. 195

52. An 8085 microprocessor executes “STA 1234H” with starting address location 1FFEH (STA copies the contents of the Accumulator to the 16-bit address location). While the instruction is fetched and executed, the sequence of values written at the address pins $A_{15} - A_8$ is
A. 1FH, 1FH, 20H, 12H
B. 1FH, FEH, 1FH, FFH, 12H
C. 1FH, 1FH, 12H, 12H
D. 1FH, 1FH, 12H, 20H, 12H

53. A stable linear time invariant (LTI) system has a transfer function $H(s) = \dfrac{1}{s^2 + s - 6}$. To make this system causal it needs to be cascaded with another LTI system having a transfer function $H_1(s)$. A correct choice for $H_1(s)$ among the following options is
A. s + 3
B. s - 2
C. s – 6
D. s + 1

54. A causal LTI system has zero initial conditions and impulses response h (t). Its input x (t) and output y (t) are related through the linear constant-coefficient differential equation

$$\frac{d^2y(t)}{dt^2} + a\frac{dy(t)}{dt} + a^2y(t) = x(t)$$

Let another signal g(t) be defined as

$$g(t) = a^2\int_0^t h(\tau)d\tau + \frac{dh(t)}{dt} + ah(t)$$

If G(s) is the Laplace transform of g(t), then the number of poles of G(s) is ________.
A. 0
B. 1
C. 2
D. 4

55. The N-point DFT X of a sequence $x[n], 0 \le n \le N-1$ is given by

$$X[k] = \frac{1}{\sqrt{N}}\sum_{N=0}^{N-1} x[n]e^{-j\frac{2\pi}{N}nk,} 0 \le k \le N - L$$

Denote this relation as X = DFT(x). For N = 4, which one of the following sequences satisfies DFT (DFT (x))=x ?
A. $x = [1\ 2\ 3\ 4]$
B. $x = [1\ 2\ 3\ 2]$
C. $x = [1\ 3\ 2\ 2]$
D. $x = [1\ 2\ 2\ 3]$

56. The state transition matrix
$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

A. $\begin{bmatrix} t & 1 \\ 1 & 0 \end{bmatrix}$

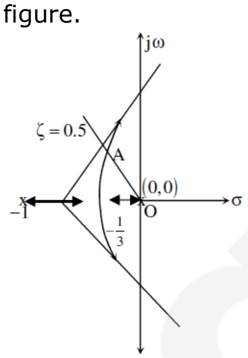
B. $\begin{bmatrix} 1 & 0 \\ t & 1 \end{bmatrix}$

C. $\begin{bmatrix} 0 & 1 \\ 1 & t \end{bmatrix}$

D. $\begin{bmatrix} 1 & t \\ 0 & 1 \end{bmatrix}$

57. Consider a transfer function $G_P(s) = \dfrac{ps^2 + 3ps|-2}{s^2 + (3+p)s + (2-p)}$ with p a positive real parameter.
The maximum value of p until which G_P remains stable is ________.
A. 2
B. 4
C. 6
D. 8

58. The characteristic equation of a unity negative feedback system 1 + KG(s) = 0. The open loop transfer function G(s) has one pole at 0 and two poles at -1. The root locus of the system for varying K is shown in the figure.



The constant damping ratio line, for $\xi = 0.5$, intersects the root locus at point A. The distance from the origin to point A is given as 0.5. The value of K at point A is ________ .
A. 0.275
B. 0.345
C. 0.375
D. 0.425

59. Consider a communication scheme where the binary valued signal X satisfies $P\{X=+1\}=0.75\, and\, P\{X=-1\}=0.25$. The received signal Y = X + Z, where Z is a Gaussian random variable with zero mean and variance σ^2. The received signal Y is fed to the threshold detector. The output of the threshold detector $\hat{X}\, is$:

$$\hat{X} = \begin{cases} +1. & Y > \tau \\ -1. & Y \le \tau. \end{cases}$$

To achieve a minimum probability of error $P\{\hat{X} \ne X\}$, the threshold τ should be

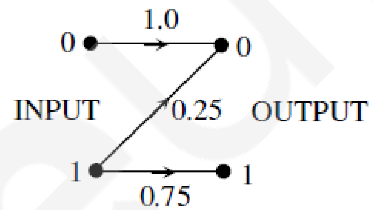
A. Strictly positive

B. Zero

C. Strictly negative

D. Strictly positive, zero, or strictly negative depending on the nonzero value of

60. Consider the Z-channel given in the figure. The input is 0 or 1 with equal probability.



If the output is 0, the probability that the input is also 0 equals ____________
A. 0.4
B. 0.6
C. 0.7
D. 0.8

61. An M-level PSK modulation scheme is used to transmit independent binary digits over a band-pass channel with bandwidth 100 kHz. The bit rate is 200 kbps and the system characteristic is a raised-cosine spectrum with 100% excess bandwidth. The minimum value of M is ________.
A. 12
B. 14
C. 16
D. 18

62. Consider a discrete-time channel Y =- X + Z, where the additive noise z is signal-dependent. In particular, given the transmitted symbol $X \in \{-a, +a\}$. at any instant, the noise sample Z is chosen independently from a Gaussian distribution with mean βX and unit variance. Assume a threshold detector with zero threshold at the receiver.
When β = 0, the BER was found to be $Q(a) = 1\times10^{-8}$
$$\left(Q(v) = \frac{1}{\sqrt{2\pi}} \int_v^\infty e^{-u^2/2} du, and\ for\, v > 1, use Q(v) \approx e^{-v^2/2} \right)$$
When β = −0.3, the BER is closest to

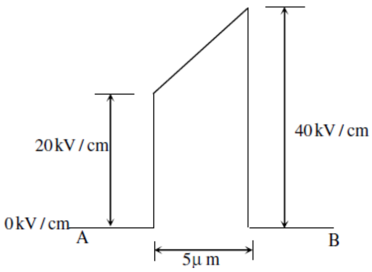
A. 10^{-7}

B. 10^{-6}

C. 10^{-4}

D. 10^{-2}

63. The electric field (assumed to be one-dimensional) between two points A and B is shown. Let Ψ_A *and* Ψ_B be the electrostatic potentials at A and B, respectively. The value of $\Psi_B - \Psi_A$ in Volts is __________.



A. 10
B. -10
C. 15
D. -15

64. Given $\vec{F} = z\hat{a}_x + x\hat{a}_y + y\hat{a}_z$. If S represents the portion of the sphere $x^2 + y^2 + z^2 = 1$ for $z \geq 0, then \int_s \nabla \times \overline{F}.\overline{ds}$ is

____________.

A. 2.14
B. 2.75
C. 3.14
D. 3.75

65. $If\ E = -\left(2y^3 - 3yz^2\right)\hat{x} - \left(6xy^2 - 3xz^2\right)\hat{y} + \left(6xyz\right)\hat{z}$ is the electric field in a source free region, a valid expression for the electrostatic potential is

A. $xy^3 - yz^2$

B. $2xy^3 - xyz^2$

C. $y^3 + xyz^2$

D. $2xy^3 - 3xyz^2$

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