EC : ELECTRONICS AND COMMUNICATION ENGINEERING

Duration: Three Hours *Maximum Marks*: 100

Read the following instructions carefully.

1. Do not open the seal of the Question Booklet until you are asked to do so by the invigilator.
2. Take out the **O**ptical **R**esponse **S**heet (**ORS**) from this Question Booklet **without breaking the seal.** If you find that the Question Booklet Code printed at the right hand top corner of this page does not match with the Booklet Code on the **ORS**, exchange the booklet immediately with a new sealed Question Booklet.
3. Write your registration number, your name and name of the examination centre at the specified locations on the right half of the **ORS**. Also, using HB pencil, darken the appropriate bubble under each digit of your registration number and the letters corresponding to your test paper code (EC).
4. Write your name and registration number in the space provided at the bottom of this page.
5. This Booklet contains **20** pages including blank pages for rough work. After opening the seal at the specified time, please check all pages and report discrepancy, if any.
6. There are a total of 65 questions carrying 100 marks. All these questions are of objective type. Questions must be answered on the left hand side of the **ORS** by darkening the appropriate bubble (marked A, B, C, D) using HB pencil against the question number. **For each question darken the bubble of the correct answer.** In case you wish to change an answer, erase the old answer completely. More than one answer bubbled against a question will be treated as an incorrect response.
7. Questions Q.1 – Q.25 carry 1-mark each, and questions Q.26 – Q.55 carry 2-marks each.
8. Questions Q.48 – Q.51 (2 pairs) are common data questions and question pairs (Q.52, Q.53) and (Q.54, Q.55) are linked answer questions. The answer to the second question of the linked answer questions depends on the answer to the first question of the pair. If the first question in the linked pair is wrongly answered or is unattempted, then the answer to the second question in the pair will not be evaluated.
9. Questions Q.56 – Q.65 belong to General Aptitude (GA). Questions Q.56 – Q.60 carry 1-mark each, and questions Q.61 – Q.65 carry 2-marks each. The GA questions begin on a fresh page starting from page **16**.
10. Unattempted questions will result in zero mark and wrong answers will result in **NEGATIVE** marks. For Q.1 – Q.25 and Q.56 – Q.60, ⅓ mark will be deducted for each wrong answer. For Q.26 – Q.51 and Q.61 – Q.65, ⅔ mark will be deducted for each wrong answer. The question pairs (Q.52, Q.53), and (Q.54, Q.55) are questions with linked answers. There will be negative marks only for wrong answer to the first question of the linked answer question pair, i.e. for Q.52 and Q.54, ⅔ mark will be deducted for each wrong answer. There is no negative marking for Q.53 and Q.55.
11. Calculator is allowed whereas charts, graph sheets or tables are **NOT** allowed in the examination hall.
12. Rough work can be done on the question paper itself. Additionally, blank pages are provided at the end of the question paper for rough work.

Name								
Registration Number	**EC**							

Q. 1 – Q. 25 carry one mark each.

Q.1 The modes in a rectangular waveguide are denoted by TE_{mn}/TM_{mn} where m and n are the eigen numbers along the larger and smaller dimensions of the waveguide respectively. Which one of the following statements is **TRUE**?

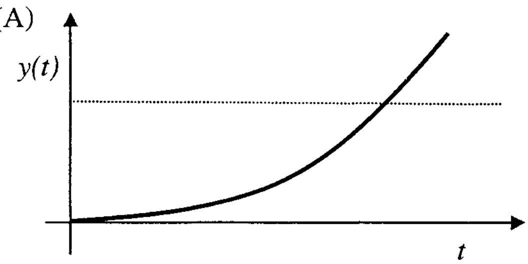
(A) The TM_{10} mode of the waveguide does not exist
(B) The TE_{10} mode of the waveguide does not exist
(C) The TM_{10} and the TE_{10} modes both exist and have the same cut-off frequencies
(D) The TM_{10} and the TM_{01} modes both exist and have the same cut-off frequencies

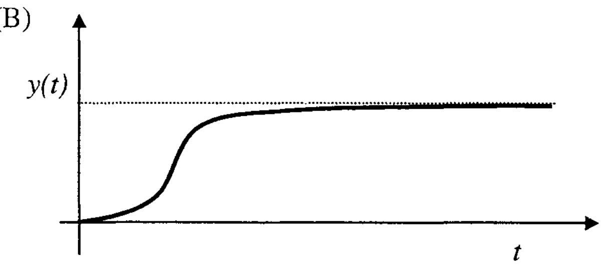
Q.2 The **Column-1** lists the attributes and the **Column-2** lists the modulation systems. Match the attribute to the modulation system that best meets it.

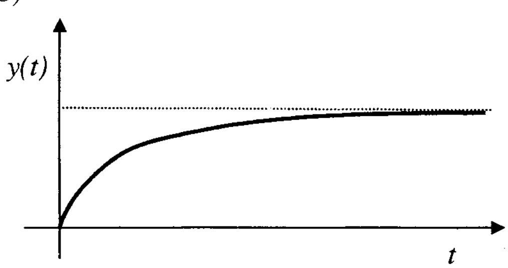
	Column-1		Column-2
P.	Power efficient transmission of signals	I.	Conventional AM
Q.	Most bandwidth efficient transmission of voice signals	II.	FM
R.	Simplest receiver structure	III.	VSB
S.	Bandwidth efficient transmission of signals with significant *dc* component	IV.	SSB-SC

(A) P-IV, Q-II, R-I, S-III
(B) P-II, Q-IV, R-I, S-III
(C) P-III, Q-II, R-I, S-IV
(D) P-II, Q-IV, R-III, S-I

Q.3 The differential equation $100\frac{d^2y}{dt^2} - 20\frac{dy}{dt} + y = x(t)$ describes a system with an input $x(t)$ and an output $y(t)$. The system, which is initially relaxed, is excited by a unit step input. The output $y(t)$ can be represented by the waveform

(A)


(B)


(C)


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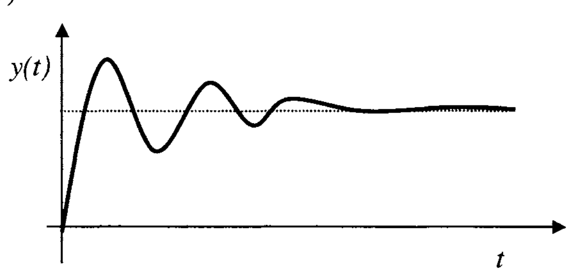
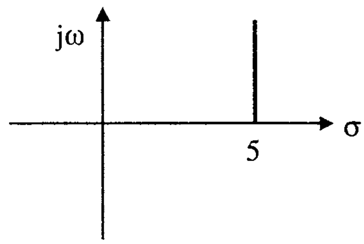
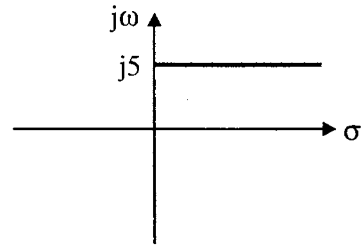


Q.4 For the transfer function $G(j\omega) = 5 + j\omega$, the corresponding Nyquist plot for positive frequency has the form

(A)



(B)



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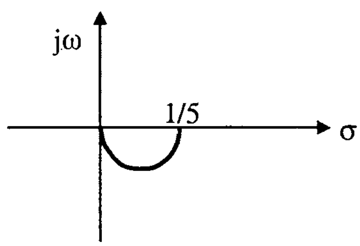
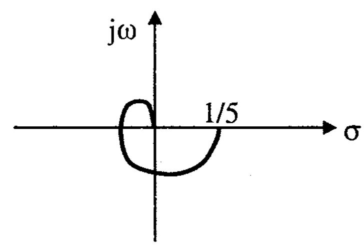


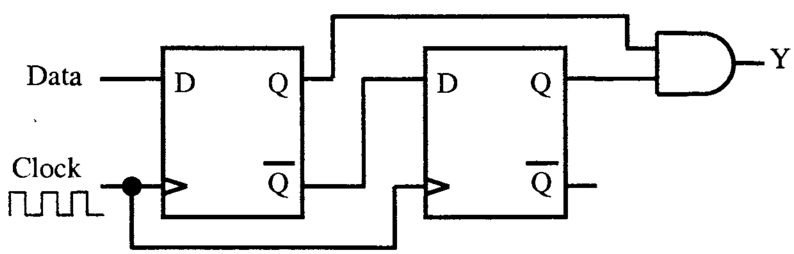
(D)



Q.5 The trigonometric Fourier series of an even function does not have the

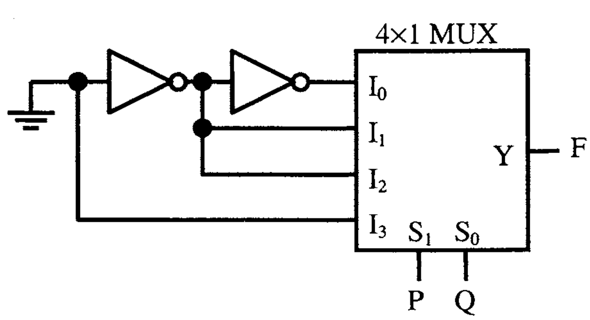
(A) dc term
(B) cosine terms
(C) sine terms
(D) odd harmonic terms

Q.6 When the output Y in the circuit below is "1", it implies that data has



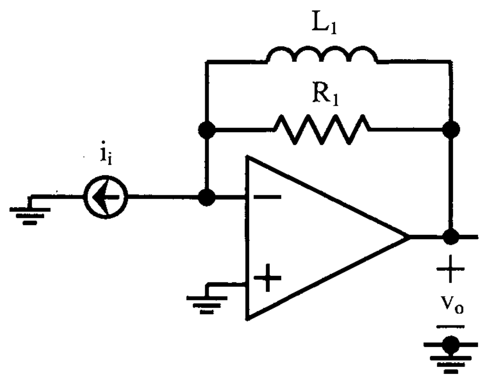
(A) changed from "0" to "1"
(B) changed from "1" to "0"
(C) changed in either direction
(D) not changed

Q.7 The logic function implemented by the circuit below is (ground implies a logic "0")



(A) F = AND(P,Q)
(B) F = OR(P,Q)
(C) F = XNOR(P,Q)
(D) F = XOR(P,Q)

Q.8 The circuit below implements a filter between the input current i_i and the output voltage v_o. Assume that the opamp is ideal. The filter implemented is a

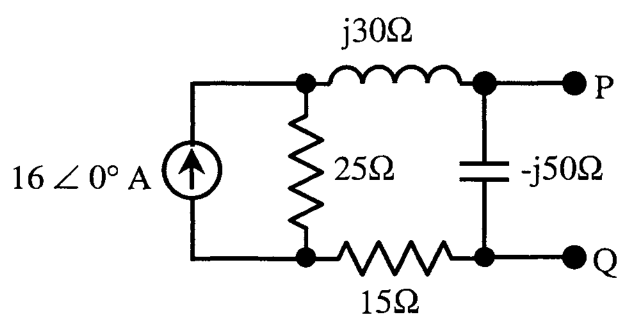


(A) low pass filter
(B) band pass filter
(C) band stop filter
(D) high pass filter

Q.9 A silicon PN junction is forward biased with a constant current at room temperature. When the temperature is increased by 10°C, the forward bias voltage across the PN junction

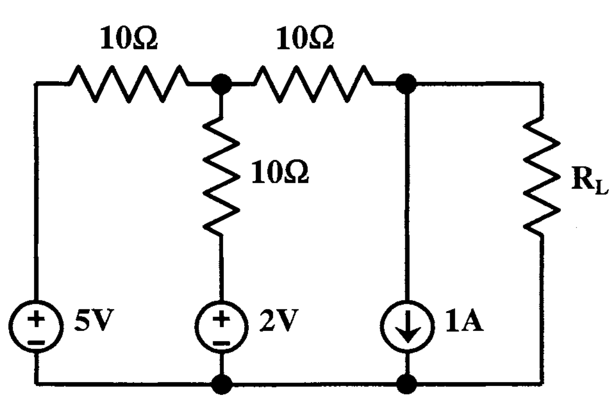
(A) increases by 60 mV
(B) decreases by 60 mV
(C) increases by 25 mV
(D) decreases by 25 mV

Q.10 In the circuit shown below, the Norton equivalent current in amperes with respect to the terminals P and Q is



(A) 6.4 – j4.8 (B) 6.56 – j7.87 (C) 10 + j0 (D) 16 + j0

Q.11 In the circuit shown below, the value of R_L such that the power transferred to R_L is maximum is



(A) 5 Ω (B) 10 Ω (C) 15 Ω (D) 20 Ω

Q.12 The value of the integral $\oint_c \frac{-3z+4}{(z^2+4z+5)}\,dz$ where c is the circle $|z| = 1$ is given by

(A) 0 (B) 1/10 (C) 4/5 (D) 1

Q.13 A transmission line of characteristic impedance 50 Ω is terminated by a 50 Ω load. When excited by a sinusoidal voltage source at 10 GHz, the phase difference between two points spaced 2 mm apart on the line is found to be $\pi/4$ radians. The phase velocity of the wave along the line is

(A) $0.8\times10^8\ m/s$ (B) $1.2\times10^8\ m/s$ (C) $1.6\times10^8\ m/s$ (D) $3\times10^8\ m/s$

Q.14 Consider the following statements regarding the complex Poynting vector $\vec{P}$ for the power radiated by a point source in an infinite homogeneous and lossless medium. $\text{Re}(\vec{P})$ denotes the real part of $\vec{P}$, S denotes a spherical surface whose centre is at the point source, and $\hat{n}$ denotes the unit surface normal on S. Which of the following statements is **TRUE**?

(A) $\text{Re}(\vec{P})$ remains constant at any radial distance from the source

(B) $\text{Re}(\vec{P})$ increases with increasing radial distance from the source

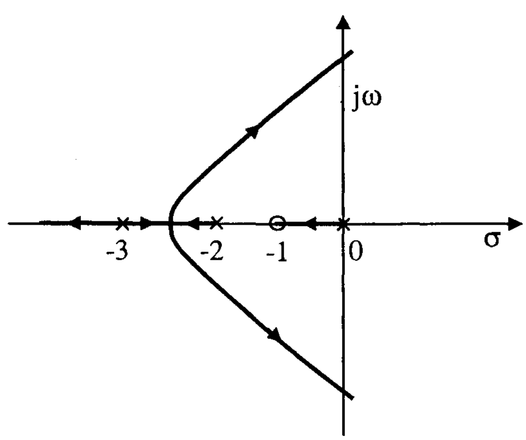
(C) $\oiint_S \text{Re}(\vec{P}).\,\hat{n}\,dS$ remains constant at any radial distance from the source

(D) $\oiint_S \text{Re}(\vec{P}).\,\hat{n}\,dS$ decreases with increasing radial distance from the source

Q.15 An analog signal is band-limited to 4 kHz, sampled at the Nyquist rate and the samples are quantized into 4 levels. The quantized levels are assumed to be independent and equally probable. If we transmit two quantized samples per second, the information rate is

(A) 1 bit/sec (B) 2 bits/sec (C) 3 bits/sec (D) 4 bits/sec

Q.16 The root locus plot for a system is given below. The open loop transfer function corresponding to this plot is given by



(A) $G(s)H(s) = k\frac{s(s+1)}{(s+2)(s+3)}$ (B) $G(s)H(s) = k\frac{(s+1)}{s(s+2)(s+3)^2}$

(C) $G(s)H(s) = k\frac{1}{s(s-1)(s+2)(s+3)}$ (D) $G(s)H(s) = k\frac{(s+1)}{s(s+2)(s+3)}$

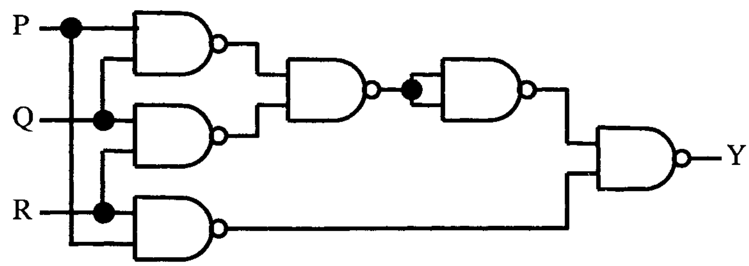
Q.17 A system is defined by its impulse response $h(n) = 2^n u(n-2)$. The system is

(A) stable and causal
(B) causal but not stable
(C) stable but not causal
(D) unstable and noncausal

Q.18 If the unit step response of a network is $(1-e^{-\alpha t})$, then its unit impulse response is

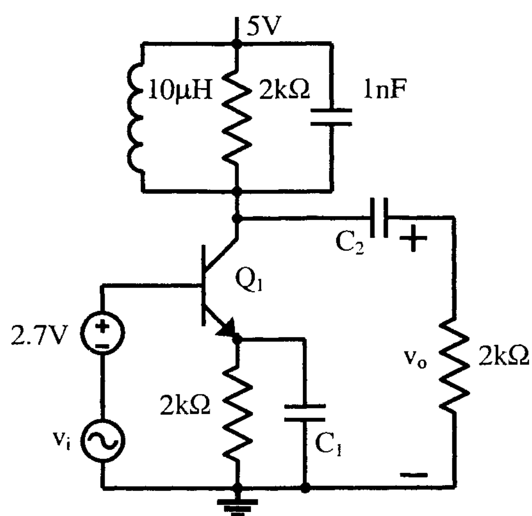
(A) $\alpha e^{-\alpha t}$
(B) $\alpha^{-1} e^{-\alpha t}$
(C) $(1-\alpha^{-1})e^{-\alpha t}$
(D) $(1-\alpha)e^{-\alpha t}$

Q.19 The output Y in the circuit below is always "1" when



(A) two or more of the inputs P, Q, R are "0"
(B) two or more of the inputs P, Q, R are "1"
(C) any odd number of the inputs P, Q, R is "0"
(D) any odd number of the inputs P, Q, R is "1"

Q.20 In the circuit shown below, capacitors C_1 and C_2 are very large and are shorts at the input frequency. v_i is a small signal input. The gain magnitude $|v_o/v_i|$ at 10 Mrad/s is



(A) maximum
(B) minimum
(C) unity
(D) zero

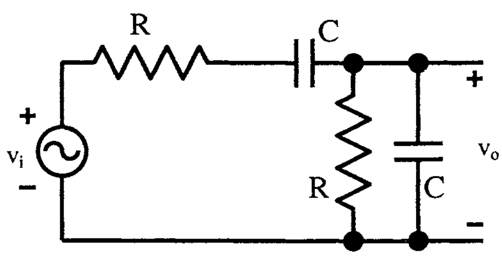
Q.21 Drift current in semiconductors depends upon

(A) only the electric field
(B) only the carrier concentration gradient
(C) both the electric field and the carrier concentration
(D) both the electric field and the carrier concentration gradient

Q.22 A Zener diode, when used in voltage stabilization circuits, is biased in

(A) reverse bias region below the breakdown voltage
(B) reverse breakdown region
(C) forward bias region
(D) forward bias constant current mode

Q.23 The circuit shown below is driven by a sinusoidal input $v_i = V_p\cos(t/RC)$. The steady state output v_o is



(A) $(V_p/3)\cos(t/RC)$ (B) $(V_p/3)\sin(t/RC)$ (C) $(V_p/2)\cos(t/RC)$ (D) $(V_p/2)\sin(t/RC)$

Q.24 Consider a closed surface S surrounding a volume V. If $\vec{r}$ is the position vector of a point inside S, with $\hat{n}$ the unit normal on S, the value of the integral $\oiint_S 5\vec{r}\cdot\hat{n}\, dS$ is

(A) 3V (B) 5V (C) 10V (D) 15V

Q.25 The solution of the differential equation $\dfrac{dy}{dx} = ky$, $y(0) = c$ is

(A) $x = ce^{-ky}$ (B) $x = ke^{cy}$ (C) $y = ce^{kx}$ (D) $y = ce^{-kx}$

Q. 26 to Q. 55 carry two marks each.

Q.26 The electric and magnetic fields for a TEM wave of frequency 14 GHz in a homogeneous medium of relative permittivity ε_r and relative permeability $\mu_r = 1$ are given by

$$\vec{E} = E_p e^{j(\omega t - 280\pi y)} \hat{u}_z \ V/m \qquad \vec{H} = 3e^{j(\omega t - 280\pi y)} \hat{u}_x \ A/m$$

Assuming the speed of light in free space to be 3×10^8 m/s, the intrinsic impedance of free space to be 120π, the relative permittivity ε_r of the medium and the electric field amplitude E_p are

(A) $\varepsilon_r = 3,\ E_p = 120\pi$ (B) $\varepsilon_r = 3,\ E_p = 360\pi$

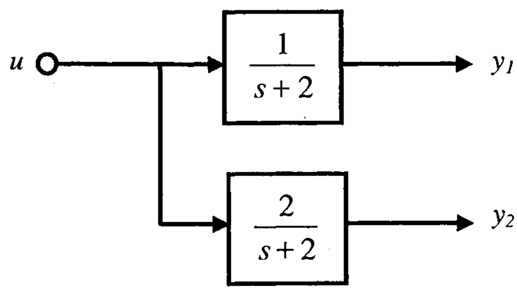
(C) $\varepsilon_r = 9,\ E_p = 360\pi$ (D) $\varepsilon_r = 9,\ E_p = 120\pi$

Q.27 A message signal $m(t) = \cos 2000\pi t + 4\cos 4000\pi t$ modulates the carrier $c(t) = \cos 2\pi f_c t$ where $f_c = 1$ MHz to produce an AM signal. For demodulating the generated AM signal using an envelope detector, the time constant RC of the detector circuit should satisfy

(A) 0.5 ms < RC < 1 ms (B) 1 μs << RC < 0.5 ms

(C) RC << 1 μs (D) RC >> 0.5 ms

Q.28 The block diagram of a system with one input u and two outputs y_1 and y_2 is given below.



A state space model of the above system in terms of the state vector $\underline{x}$ and the output vector $\underline{y} = [y_1 \quad y_2]^T$ is

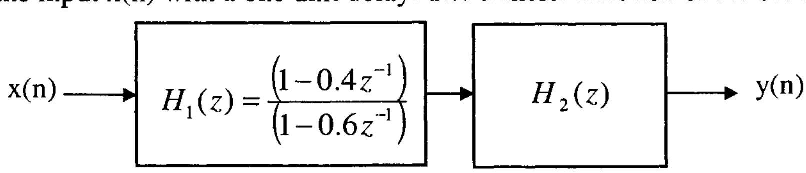
(A) $\dot{\underline{x}} = [2]\underline{x} + [1]u;$ $\quad \underline{y} = [1 \quad 2]\underline{x}$

(B) $\dot{\underline{x}} = [-2]\underline{x} + [1]u;$ $\quad \underline{y} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}\underline{x}$

(C) $\dot{\underline{x}} = \begin{bmatrix} -2 & 0 \\ 0 & -2 \end{bmatrix}\underline{x} + \begin{bmatrix} 1 \\ 1 \end{bmatrix}u;$ $\quad \underline{y} = [1 \quad 2]\underline{x}$

(D) $\dot{\underline{x}} = \begin{bmatrix} 2 & 0 \\ 0 & 2 \end{bmatrix}\underline{x} + \begin{bmatrix} 1 \\ 1 \end{bmatrix}u;$ $\quad \underline{y} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}\underline{x}$

Q.29 Two systems $H_1(z)$ and $H_2(z)$ are connected in cascade as shown below. The overall output y(n) is the same as the input x(n) with a one unit delay. The transfer function of the second system $H_2(z)$ is



(A) $\dfrac{(1-0.6z^{-1})}{z^{-1}(1-0.4z^{-1})}$ (B) $\dfrac{z^{-1}(1-0.6z^{-1})}{(1-0.4z^{-1})}$ (C) $\dfrac{z^{-1}(1-0.4z^{-1})}{(1-0.6z^{-1})}$ (D) $\dfrac{(1-0.4z^{-1})}{z^{-1}(1-0.6z^{-1})}$

Q.30 An 8085 assembly language program is given below. Assume that the carry flag is initially unset. The content of the accumulator after the execution of the program is

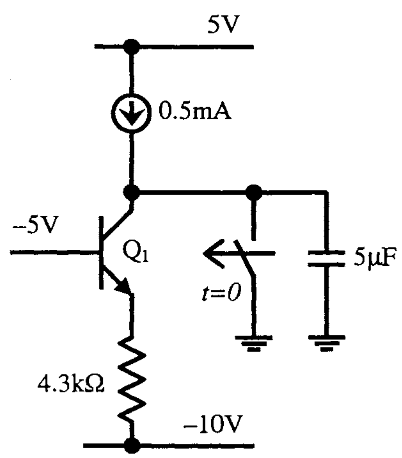
```
MVI  A, 07H
RLC
MOV  B,A
RLC
RLC
ADD  B
RRC
```

(A) 8CH (B) 64H (C) 23H (D) 15H

Q.31 The first six points of the 8-point DFT of a real valued sequence are 5, 1–j3, 0, 3–j4, 0 and 3+j4. The last two points of the DFT are respectively

(A) 0, 1–j3 (B) 0, 1+j3 (C) 1+j3, 5 (D) 1–j3, 5

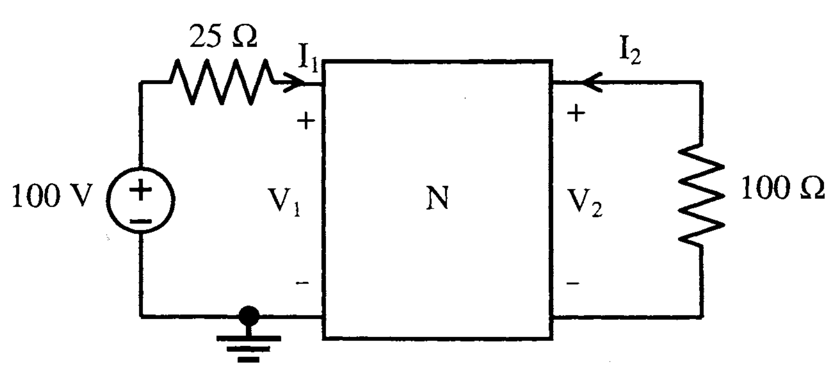
Q.32 For the BJT Q_1 in the circuit shown below, $\beta = \infty$, $V_{BEon} = 0.7V$, $V_{CEsat} = 0.7V$. The switch is initially closed. At time $t=0$, the switch is opened. The time t at which Q_1 leaves the active region is



(A) 10 ms (B) 25 ms (C) 50 ms (D) 100 ms

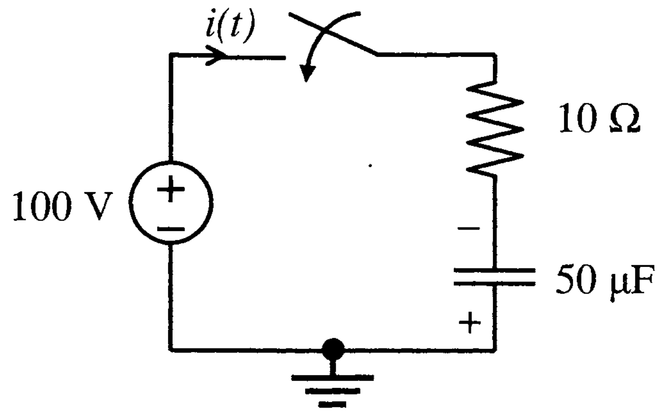
Q.33 In the circuit shown below, the network N is described by the following Y matrix:

$Y = \begin{bmatrix} 0.1\,S & -0.01\,S \\ 0.01\,S & 0.1\,S \end{bmatrix}$. The voltage gain $\frac{V_2}{V_1}$ is



(A) 1/90 (B) –1/90 (C) –1/99 (D) –1/11

Q.34 In the circuit shown below, the initial charge on the capacitor is 2.5 mC, with the voltage polarity as indicated. The switch is closed at time t=0. The current $i(t)$ at a time t after the switch is closed is



(A) $i(t) = 15\exp(-2\times10^3 t)$ A
(B) $i(t) = 5\exp(-2\times10^3 t)$ A
(C) $i(t) = 10\exp(-2\times10^3 t)$ A
(D) $i(t) = -5\exp(-2\times10^3 t)$ A

Q.35 The system of equations

$$x + y + z = 6$$
$$x + 4y + 6z = 20$$
$$x + 4y + \lambda z = \mu$$

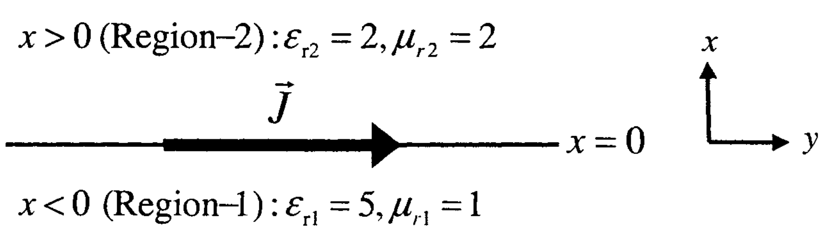
has **NO** solution for values of λ and μ given by

(A) $\lambda = 6$, $\mu = 20$ (B) $\lambda = 6$, $\mu \neq 20$ (C) $\lambda \neq 6$, $\mu = 20$ (D) $\lambda \neq 6$, $\mu \neq 20$

Q.36 A fair dice is tossed two times. The probability that the second toss results in a value that is higher than the first toss is

(A) 2/36 (B) 2/6 (C) 5/12 (D) 1/2

Q.37 A current sheet $\vec{J} = 10\hat{u}_y$ A/m lies on the dielectric interface $x = 0$ between two dielectric media with $\varepsilon_{r1} = 5$, $\mu_{r1} = 1$ in Region-1 ($x < 0$) and $\varepsilon_{r2} = 2$, $\mu_{r2} = 2$ in Region-2 ($x > 0$). If the magnetic field in Region-1 at $x = 0^-$ is $\vec{H}_1 = 3\hat{u}_x + 30\hat{u}_y$ A/m, the magnetic field in Region-2 at $x = 0^+$ is

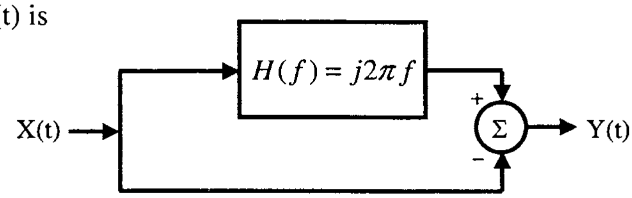


(A) $\vec{H}_2 = 1.5\hat{u}_x + 30\hat{u}_y - 10\hat{u}_z$ A/m
(B) $\vec{H}_2 = 3\hat{u}_x + 30\hat{u}_y - 10\hat{u}_z$ A/m
(C) $\vec{H}_2 = 1.5\hat{u}_x + 40\hat{u}_y$ A/m
(D) $\vec{H}_2 = 3\hat{u}_x + 30\hat{u}_y + 10\hat{u}_z$ A/m

Q.38 A transmission line of characteristic impedance 50 Ω is terminated in a load impedance Z_L. The VSWR of the line is measured as 5 and the first of the voltage maxima in the line is observed at a distance of $\lambda/4$ from the load. The value of Z_L is

(A) 10 Ω (B) 250 Ω (C) $(19.23 + j46.15)$ Ω (D) $(19.23 - j46.15)$ Ω

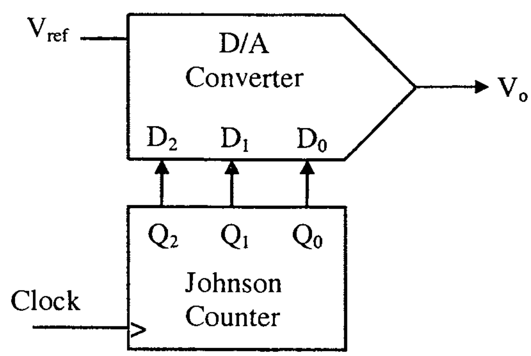
Q.39 X(t) is a stationary random process with autocorrelation function $R_X(\tau) = \exp(-\pi\tau^2)$. This process is passed through the system shown below. The power spectral density of the output process Y(t) is



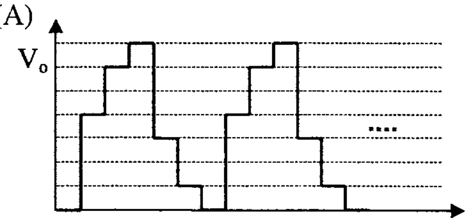
(A) $(4\pi^2 f^2 + 1)\exp(-\pi f^2)$ (B) $(4\pi^2 f^2 - 1)\exp(-\pi f^2)$

(C) $(4\pi^2 f^2 + 1)\exp(-\pi f)$ (D) $(4\pi^2 f^2 - 1)\exp(-\pi f)$

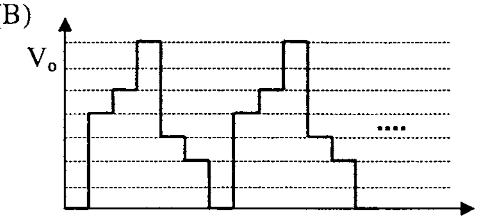
Q.40 The output of a 3-stage Johnson (twisted-ring) counter is fed to a digital-to-analog (D/A) converter as shown in the figure below. Assume all states of the counter to be unset initially. The waveform which represents the D/A converter output V_o is



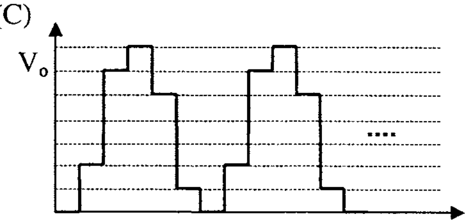
(A)



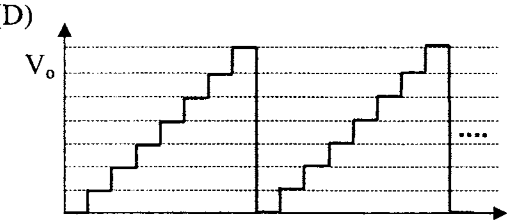
(B)



(C)



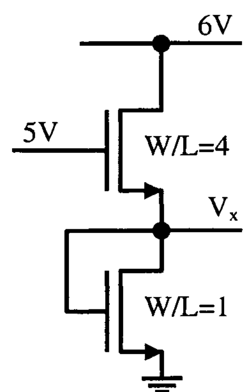
(D)



Q.41 Two D flip-flops are connected as a synchronous counter that goes through the following $Q_B Q_A$ sequence $00 \rightarrow 11 \rightarrow 01 \rightarrow 10 \rightarrow 00 \rightarrow \cdots$
The connections to the inputs D_A and D_B are

(A) $D_A = Q_B,\ D_B = Q_A$
(B) $D_A = \overline{Q}_A,\ D_B = \overline{Q}_B$
(C) $D_A = (Q_A\overline{Q}_B + \overline{Q}_A Q_B),\ D_B = Q_A$
(D) $D_A = (Q_A Q_B + \overline{Q}_A\overline{Q}_B),\ D_B = \overline{Q}_B$

Q.42 In the circuit shown below, for the MOS transistors, $\mu_n C_{ox} = 100\ \mu A/V^2$ and the threshold voltage $V_T = 1$ V. The voltage V_x at the source of the upper transistor is



(A) 1 V (B) 2 V (C) 3 V (D) 3.67 V

Q.43 An input $x(t) = \exp(-2t)u(t) + \delta(t-6)$ is applied to an LTI system with impulse response $h(t) = u(t)$. The output is

(A) $[1 - \exp(-2t)]\ u(t) + u(t+6)$
(B) $[1 - \exp(-2t)]\ u(t) + u(t-6)$
(C) $0.5[1 - \exp(-2t)]\ u(t) + u(t+6)$
(D) $0.5[1 - \exp(-2t)]\ u(t) + u(t-6)$

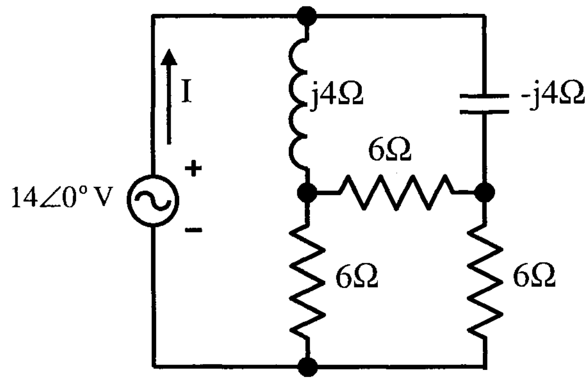
Q.44 For a BJT, the common-base current gain $\alpha = 0.98$ and the collector base junction reverse bias saturation current $I_{CO} = 0.6\ \mu A$. This BJT is connected in the common emitter mode and operated in the active region with a base drive current $I_B = 20\ \mu A$. The collector current I_C for this mode of operation is

(A) 0.98 mA (B) 0.99 mA (C) 1.0 mA (D) 1.01 mA

Q.45 If $F(s) = L[f(t)] = \frac{2(s+1)}{s^2+4s+7}$ then the initial and final values of $f(t)$ are respectively

(A) 0, 2 (B) 2, 0 (C) 0, 2/7 (D) 2/7, 0

Q.46 In the circuit shown below, the current I is equal to



(A) $1.4\angle 0^\circ$ A (B) $2.0\angle 0^\circ$ A (C) $2.8\angle 0^\circ$ A (D) $3.2\angle 0^\circ$ A

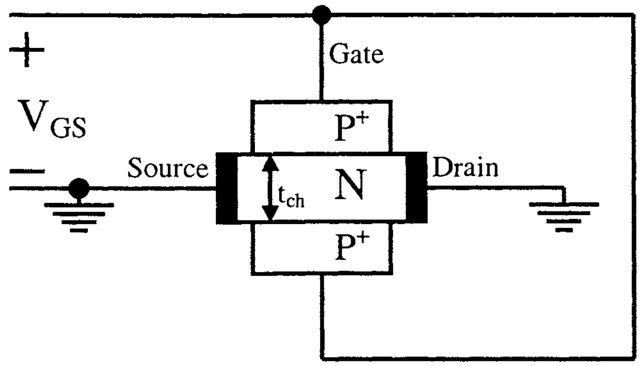
Q.47 A numerical solution of the equation $f(x) = x + \sqrt{x} - 3 = 0$ can be obtained using Newton-Raphson method. If the starting value is $x = 2$ for the iteration, the value of x that is to be used in the next step is

(A) 0.306 (B) 0.739 (C) 1.694 (D) 2.306

Common Data Questions

Common Data for Questions 48 and 49:

The channel resistance of an N-channel JFET shown in the figure below is 600 Ω when the full channel thickness (t_{ch}) of 10 μm is available for conduction. The built-in voltage of the gate P^+ N junction (V_{bi}) is –1 V. When the gate to source voltage (V_{GS}) is 0 V, the channel is depleted by 1 μm on each side due to the built-in voltage and hence the thickness available for conduction is only 8 μm.



Q.48 The channel resistance when V_{GS} = 0 V is

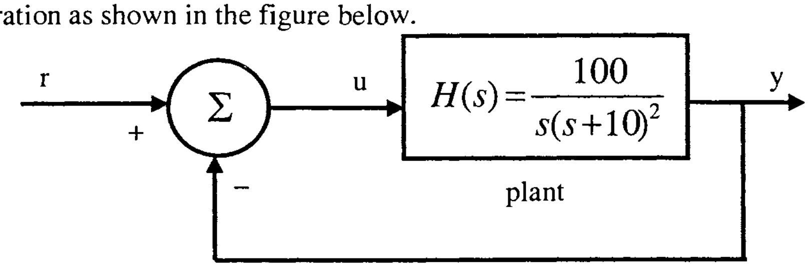
(A) 480 Ω (B) 600 Ω (C) 750 Ω (D) 1000 Ω

Q.49 The channel resistance when V_{GS} = –3 V is

(A) 360 Ω (B) 917 Ω (C) 1000 Ω (D) 3000 Ω

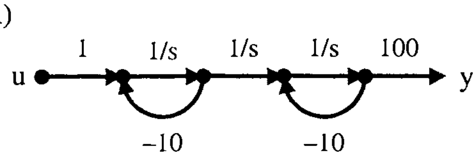
Common Data for Questions 50 and 51:

The input-output transfer function of a plant $H(s)=\dfrac{100}{s(s+10)^2}$. The plant is placed in a unity negative feedback configuration as shown in the figure below.

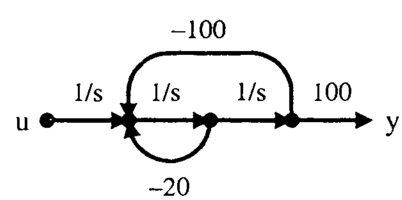


Q.50 The signal flow graph that **DOES NOT** model the plant transfer function *H(s)* is

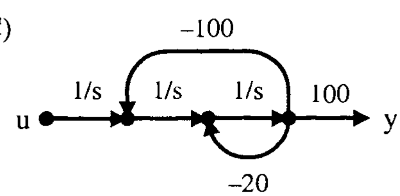
(A)



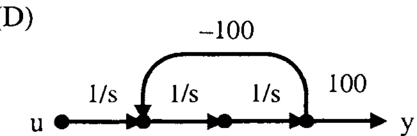
(B)



(C)



(D)



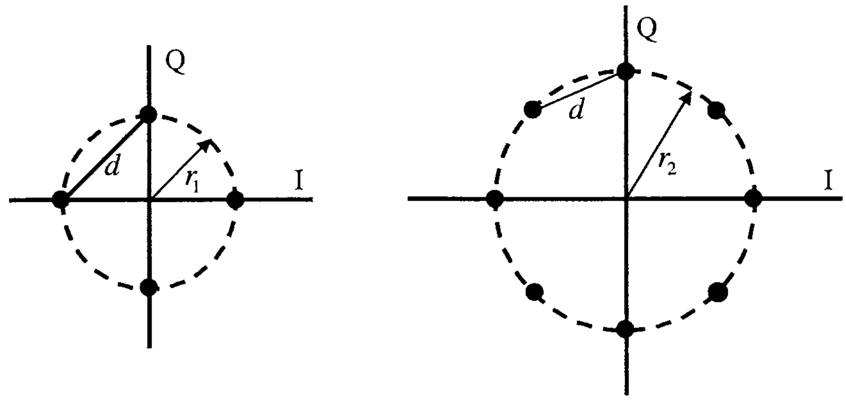
Q.51 The gain margin of the system under closed loop unity negative feedback is

(A) 0 dB (B) 20 dB (C) 26 dB (D) 46 dB

Linked Answer Questions

Statement for Linked Answer Questions 52 and 53:

A four-phase and an eight-phase signal constellation are shown in the figure below.



Q.52 For the constraint that the minimum distance between pairs of signal points be d for both constellations, the radii r_1 and r_2 of the circles are

(A) $r_1 = 0.707d,\ r_2 = 2.782d$ (B) $r_1 = 0.707d,\ r_2 = 1.932d$

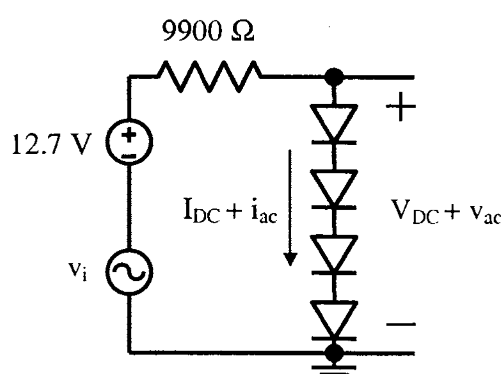
(C) $r_1 = 0.707d,\ r_2 = 1.545d$ (D) $r_1 = 0.707d,\ r_2 = 1.307d$

Q.53 Assuming high SNR and that all signals are equally probable, the additional average transmitted signal energy required by the 8-PSK signal to achieve the same error probability as the 4-PSK signal is

(A) 11.90 dB (B) 8.73 dB (C) 6.79 dB (D) 5.33 dB

Statement for Linked Answer Questions 54 and 55:

In the circuit shown below, assume that the voltage drop across a forward biased diode is 0.7 V. The thermal voltage $V_t = kT/q = 25$mV. The small signal input $v_i = V_p \cos(\omega t)$ where $V_p = 100$ mV.



Q.54 The bias current I_{DC} through the diodes is

(A) 1 mA (B) 1.28 mA (C) 1.5 mA (D) 2 mA

Q.55 The ac output voltage v_{ac} is

(A) $0.25\cos(\omega t)$ mV (B) $1\cos(\omega t)$ mV

(C) $2\cos(\omega t)$ mV (D) $22\cos(\omega t)$ mV

General Aptitude (GA) Questions

Q. 56 – Q. 60 carry one mark each.

Q.56 The question below consists of a pair of related words followed by four pairs of words. Select the pair that best expresses the relation in the original pair:
Gladiator : Arena

(A) dancer : stage
(B) commuter : train
(C) teacher : classroom
(D) lawyer : courtroom

Q.57 There are two candidates P and Q in an election. During the campaign, 40% of the voters promised to vote for P, and rest for Q. However, on the day of election 15% of the voters went back on their promise to vote for P and instead voted for Q. 25% of the voters went back on their promise to vote for Q and instead voted for P. Suppose, P lost by 2 votes, then what was the total number of voters?

(A) 100 (B) 110 (C) 90 (D) 95

Q.58 Choose the most appropriate word from the options given below to complete the following sentence:
It was her view that the country's problems had been ———— by foreign technocrats, so that to invite them to come back would be counter-productive.

(A) identified
(B) ascertained
(C) exacerbated
(D) analysed

Q.59 Choose the word from the options given below that is most nearly opposite in meaning to the given word:
Frequency

(A) periodicity
(B) rarity
(C) gradualness
(D) persistency

Q.60 Choose the most appropriate word from the options given below to complete the following sentence:
Under ethical guidelines recently adopted by the Indian Medical Association, human genes are to be manipulated only to correct diseases for which ———— treatments are unsatisfactory.

(A) similar
(B) most
(C) uncommon
(D) available

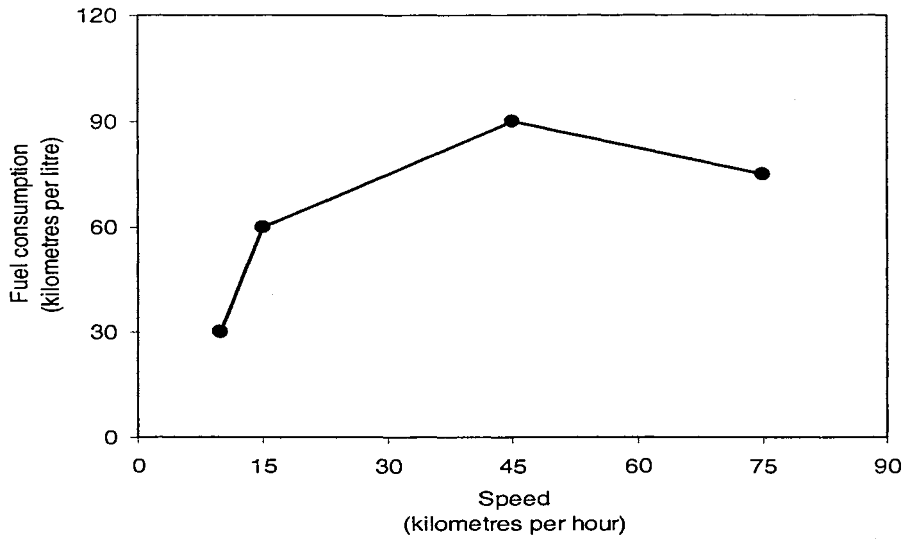
Q. 61 to Q. 65 carry two marks each.

Q.61 **The horse has played a little known but very important role in the field of medicine. Horses were injected with toxins of diseases until their blood built up immunities. Then a serum was made from their blood. Serums to fight with diphtheria and tetanus were developed this way.**

It can be inferred from the passage, that horses were

(A) given immunity to diseases
(B) generally quite immune to diseases
(C) given medicines to fight toxins
(D) given diphtheria and tetanus serums

Q.62 The fuel consumed by a motorcycle during a journey while traveling at various speeds is indicated in the graph below.



The distances covered during four laps of the journey are listed in the table below

Lap	Distance (kilometres)	Average speed (kilometres per hour)
P	15	15
Q	75	45
R	40	75
S	10	10

From the given data, we can conclude that the fuel consumed per kilometre was least during the lap

(A) P (B) Q (C) R (D) S

Q.63 Three friends, R, S and T shared toffee from a bowl. R took $1/3^{rd}$ of the toffees, but returned four to the bowl. S took $1/4^{th}$ of what was left but returned three toffees to the bowl. T took half of the remainder but returned two back into the bowl. If the bowl had 17 toffees left, how many toffees were originally there in the bowl?

(A) 38 (B) 31 (C) 48 (D) 41

Q.64 Given that $f(y) = |y| / y$, and q is any non-zero real number, the value of $|f(q) - f(-q)|$ is

(A) 0 (B) –1 (C) 1 (D) 2

Q.65 The sum of n terms of the series 4+44+444+.... is

(A) $(4/81)[10^{n+1} - 9n - 1]$
(B) $(4/81)[10^{n-1} - 9n - 1]$
(C) $(4/81)[10^{n+1} - 9n - 10]$
(D) $(4/81)[10^{n} - 9n - 10]$

END OF THE QUESTION PAPER