

41

IC-16

Test Booklet Serial No: 10161

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Total Number of Pages: 28

Time Allowed: 02 Hours

Number of Questions: 100

MICM

Maximum Marks: 100

Roll No. [REDACTED]

Date of Examination: 22-06-2016

Name of the

Candidate: [REDACTED]

(in capital letters)

Candidate's Signature: [REDACTED]

Invigilator's Signature: [REDACTED]

SOME IMPORTANT INSTRUCTIONS TO THE CANDIDATES

1. Fill up the information above by Pen/Ball Point Pen (Black or Blue).
2. The OMR sheet to mark your answers is placed inside the test booklet. Without breaking the seal of the Test Booklet, take the Answer Sheet out. Don't break open the seal until you are asked to do so.
3. There are 100 questions. Each correct answer gets a score of one mark. There is no negative marking.
4. Each question is followed by four answers. You should select one answer from A, B, C or D considered by you as the most appropriate or correct answer and fill the circle completely on the OMR Sheet in black/blue ink in the box opposite the question number.
5. Do your rough work only on the blank pages provided at the end of the question booklet.
6. Uses of mobile phone, calculators, calculator-watch, slide rules, mathematical table, etc. are not allowed.
7. Make sure that you do not possess any pages (Blank or Printed) or any unauthorized material. If such material is found in your possession during the examination, you will be disqualified from entrance examination.
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10. At the end of examination, candidate may be permitted to take the question booklet.
11. Only numerical part of the Roll No. is to be entered in OMR Sheet.

P.T.O.

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Q.1-3 Which of the phrase A, B, C and D given below each sentence should replace the phrase printed in **bold italic** in the sentence to make it grammatically correct?

✓ Q.1 The argument against privatization stems from a fear that the national **assets were being handed** to private sector.

- A. assets is being handled by
- B. assets have been handed over to
- C. assets are being handed over to—
- D. assets are being handled into

✓ Q.2 The Governor has a good collection of **paintings adorning the walls** of the Raj Bhavan.

- A. paintings adoring the walls
- B. paintings sticking the walls
- C. paintings adorn the walls
- D. no correction required. —

✓ Q.3 Some people feel that the medium of instruction in all colleges in India **would be only English.**

- A. should has been only English
- B. would be English only
- C. should be only English —
- D. no correction required..

Q. 4-8 In each of the following questions four words are given of which two words are most nearly the same or opposite in meaning. Find the two words which are most nearly the same or opposite in meaning and select the number of the correct letter combination as your answer.

✓ Q.4 (a) instigate (b) enquire (c) construe (d) interpret

- | | |
|-------------------|------------|
| A. (a)-(c) | B. (a)-(b) |
| C. <u>(c)-(d)</u> | D. (b)-(d) |

Q.5 (a) superficial (b) superfluous (c) enlightened (d) surplus

A. (a)-(c)

B. (a)-(b)

C. (b)-(d)

D. (b)-(c)

Q.6 (a) appalling (b) sinister (c) perturbed (d) threatening

A. (a)-(b)

B. (b)-(d)

C. (a)-(c)

D. (d)-(c)

Q.7 (a) imprison (b) torture (c) exercise (d) extract

A. (b)-(d)

B. (b)-(c)

C. (a)-(b)

D. (c)-(d)

Q.8 (a) pertinent (b) impolite (c) irrelevant (d) insecure

A. (a)-(c)

B. (b)-(d)

C. (c)-(d)

D. (a)-(d)

(Q9-11) Read the following information carefully and answer the questions given below it:

(i) In a family of six persons - P, Q, R, S, T and U - there are three gents and three ladies. There are two married couples and two persons are unmarried. Each one of them reads different newspapers, viz. The Times of India, Indian express, Hindustan Times, Business Herald, Navbharat Times and the Tribune.

(ii) T, who reads Indian Express, is the mother-in-law of P, who is wife of R. S is the father of U and he does not read The Times of India or The Tribune. Q reads Navbharat Times and she is the sister of U who reads Hindustan Times. R does not read The Tribune.

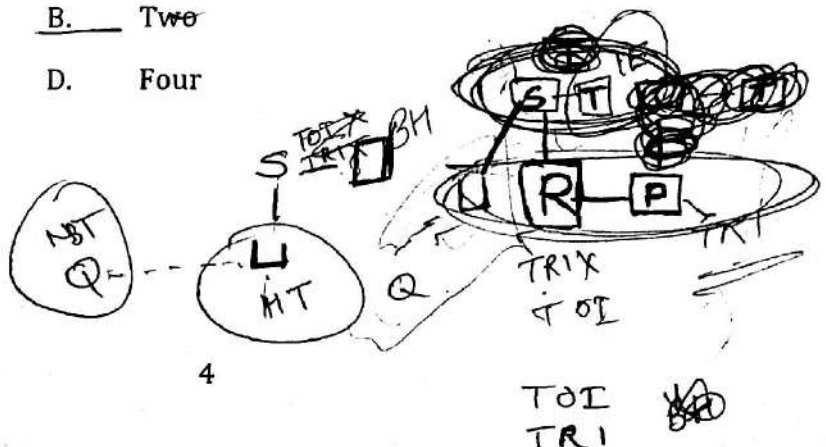
Q.9 How many sons does T have?

A. One

B. Two

C. Three

D. Four



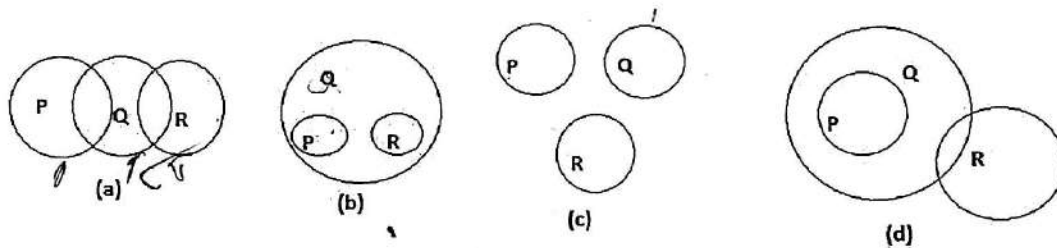
Q.10 Which of the following newspapers is read by P?

- A. Business Herald B. The Times of India
C. Navbharat Times D. None of these

Q.11 Which of the following is one of the married couples?

- A. QU B. TU
C. SQ D. ST

Directions(Questions 12-13): Given below are five patterns represented by circles P, Q and R which indicate the logical relationship between and among the respective descriptions. On the basis of description given for P, Q and R respectively in the questions, decide which of the given patterns (a), (b), (c) and (d) best indicates the logical relationship.



Q.12 (P) Rose (Q) Flower (R) Lotus

- A. (a) B. (b)
C. (c) D. (d)

Q.13 (P) Gold (Q) Ornament (R) Silver

- A. (a) B. (b)
C. (c) D. (d)

Directions(questions 14 -15): In each of the following questions , a matrix of certain characters is given. These characters follow a certain trend, row-wise or column- wise. Find out this trend and chose the missing character from the given alternatives.

Q.14

Handwritten calculations:

$$\begin{array}{r} 518 \\ 7 \\ \hline 126 \end{array}$$

$$\begin{array}{r} 16 \\ 6 \\ \hline 120 \end{array}$$

$$\begin{array}{r} 24 \\ 5 \\ \hline 120 \end{array}$$

6	6	8
5	7	5
4	3	? 8
120	126	320

Handwritten numbers around the matrix: 15, 16, 17, 20, 3, 17, 6, 11, 32, 264, 5, 320.

A. 4 B. 8 —
C. 12 D. 16

Q.15

13	12	5
17	15	8
25	24	2
29	21	20

Handwritten numbers around the matrix: 7, 17, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100.

A. 7 — B. 9 —
C. 11 . D. 15 .

Q.16 A clock is fastened to the \hat{L} frame at some point (x, y, z) . At a certain moment it reads exactly 200s. Later the same clock reads 300s (two events at the same location in \hat{L}). Find the time interval between these two events, as measured in the stationary frame L, if $v = 2 \times 10^8 \text{ m/s}$.

- A. 0 s B. 100.00 s ✓
C. 153.36 s D. 134.24 s

~~Q.17~~ A beam of radioactive particles is measured as it shoots through the laboratory. It is found that, on the average, each particle lives for a time of 20 ns; after that the particle changes to a new form. When at rest in the laboratory, the same particles live for 7.5 ns on the average. How fast are the particles in the beam moving?

- A. 0.927c B. 0.309c
C. ~~0.05c~~ D. 0.031c

~~Q.18~~ An electron moving horizontally with a velocity of $1.7 \times 10^7 \text{ m/s}$ enters a vertical uniform electric field of $3.4 \times 10^4 \text{ volts/m}$ acting in the electric field at a time when its horizontal displacement is 3 cm. Find the magnitude of B required to neutralize the vertical displacement.

- A. $4 \times 10^{-3} \text{ Wb/m}^2$ B. $2 \times 10^3 \text{ Wb/m}^2$ ~~2e6~~
C. $2 \times 10^{-3} \text{ Wb/m}^2$ D. $4 \times 10^3 \text{ Wb/m}^2$

~~Q.19~~ What is the momentum of an electron of kinetic energy 100 electron volts. ($m_e = 9.1 \times 10^{-28} \text{ gms}$)

- A. $5.37 \times 10^{-19} \text{ gm} - \text{cm/sec}$ ~~22~~
B. $4.37 \times 10^{-19} \text{ gm} - \text{cm/sec}$
C. $3.37 \times 10^{-19} \text{ gm} - \text{cm/sec}$
D. $2.37 \times 10^{-19} \text{ gm} - \text{cm/sec}$

~~Q.20~~ A flywheel rotating at 200 revolutions per minute slows at a constant rate of 2 rad/sec^2 . What time is required to stop the flywheel?

- A. 10.47 sec
B. 9.47 sec ~~sec~~
C. 11.47 sec
D. 8.47 sec



$$\begin{aligned} 60 \text{ sec} &\rightarrow 200 \times 2\pi^\circ \\ &200 \times 2\pi \\ 1 \text{ sec} &\rightarrow \frac{200 \times 2\pi}{60} \\ &= \frac{20\pi}{3} \end{aligned}$$

~~Q. 21~~ An oil having a relative density of 0.75 and dynamic viscosity of $8 \times 10^{-3} \text{ Nsm}^{-2}$ flows through a horizontal pipe of 2.0cm diameter and 20m length. Calculate the pressure drop in order to maintain the flow of 0.15 litre per second.

A. $6.11 \times 10^3 \text{ Nm}^{-2}$

B. $6.11 \times 10^6 \text{ Nm}^{-2}$

C. $3.11 \times 10^3 \text{ Nm}^{-2}$

D. $3.11 \times 10^6 \text{ Nm}^{-2}$

~~Q. 22~~ Estimate the mean free path of a molecule of air with radius $r = 2.0 \times 10^{-10} \text{ m}$ at 27°C and 1atm.

A. $5.8 \times 10^{-8} \text{ m}$

B. $6.8 \times 10^{-8} \text{ m}$

C. $7.8 \times 10^{-8} \text{ m}$

D. $8.8 \times 10^{-8} \text{ m}$

~~Q. 23~~ What is the average translational kinetic energy of an ideal gas molecule at 27°C ?

A. $6.21 \times 10^{-21} \text{ J}$

B. $8.21 \times 10^{-21} \text{ J}$

C. $9.21 \times 10^{-21} \text{ J}$

D. $12.21 \times 10^{-21} \text{ J}$

~~Q. 24~~ A comet moves in an elongated elliptical orbit around the sun. Its distance from the sun at perihelion and aphelion are $8.75 \times 10^7 \text{ km}$ and $5.26 \times 10^9 \text{ km}$, respectively. Find the orbital semi-major axis.

A. $1.67 \times 10^9 \text{ km}$

B. $2.67 \times 10^9 \text{ km}$

C. $3.67 \times 10^9 \text{ km}$

D. $4.67 \times 10^9 \text{ km}$

~~Q.25~~ At what speed must a satellite be travelling so that it shall remain in an orbit $1.6 \times 10^6 \text{ km}$ above the earth's surface? Mass of earth $6 \times 10^{24} \text{ Kg}$; Radius of earth $6.4 \times 10^6 \text{ m}$ and $G = 6.7 \times 10^{-11} \text{ Nm}^2 \text{ Kg}^{-2}$

A. 7.5 km/sec

B. 7.3 km/sec

C. 7.1 km/sec

D. 6.5 km/sec

~~Q.26~~ A toroidal coil has N closely-wound turns. Assume the current through the coil to be I and the toroid is filled with a magnetic material of relative permeability μ_r . The magnitude of magnetic induction \vec{B} inside the toroid, at a radial distance r from the axis, given by

A. $\mu_r \mu_0 N I r$

B. $\frac{\mu_r \mu_0 N I}{r}$

C. $\frac{\mu_r \mu_0 N I}{2\pi r}$

D. $2\pi \mu_r \mu_0 N I r$

~~Q.27~~ A circular disc of radius a on the xy -plane has a surface charge density

$\sigma = \frac{\sigma_0 r \cos \theta}{a}$. The electric dipole moment of this charge distribution is

A. $\frac{\sigma_0 \pi a^4}{4} \hat{x}$

B. $\frac{\sigma_0 \pi a^3}{4} \hat{x}$

C. $-\frac{\sigma_0 \pi a^3}{4} \hat{x}$

D. $-\frac{\sigma_0 \pi a^4}{4} \hat{x}$

~~Q.28~~ A metallic rod of length L and mass M is moving under the action of two equal and opposite forces F acting at its ends along its length. Ignore gravity and any external magnetic field. If specific charge of electrons is $\frac{e}{m}$, then the potential difference between the ends of the rod is in steady state must be

- A. $\frac{FmL}{eM}$ B. $\frac{2FmL}{eM}$ C. $\frac{mL}{eM} \ln 2$ D. $\frac{3mL}{eM}$

~~Q.29~~ In a certain region uniform electric field E and magnetic field B are present in mutually opposite directions. At the instant $t=0$, a particle of mass m carrying a charge q is given velocity v_0 at angle θ , with the y -axis, in the yz plane. The time after which the speed of the particle would be minimum is equal to

- A. $\frac{mv_0}{qE}$ B. $\frac{mv_0 \sin \theta}{qE}$ C. $\frac{mv_0 \cos \theta}{qE}$ D. $\frac{2\pi m}{qB}$

~~Q.30~~ Electromagnets are made of soft iron because soft iron has

- A. high retentivity and high coercive force
 B. high retentivity and low coercive force
 C. low retentivity and high coercive force
 D. low retentivity and high coercive force

~~Q.31~~ A charged particle is released from rest in a region of steady uniform electric and magnetic fields which are parallel to each other. The particle will move in a

- A. Straight Line
 B. circle
 C. helix
 D. cycloid

~~Q.32~~ Consider a Young's double slit experiment where the two slits are spaced $d = 0.1$ mm apart. If the screen is at a distance $l = 2$ m and the first bright maximum is displaced $y = 1$ cm from the central maximum, then find the wavelength of the light.

- A. 4000 \AA B. 8000 \AA
 C. $20,000 \text{ \AA}$ D. 5000 \AA

~~Q.33~~ In the photoelectric effect, the threshold wavelength is 2756 Å. If light of wavelength 1700 Å is incident on a metal substance, determine the kinetic energy of the photoelectrons.

- A. 4.50 eV B. 2.25 eV
C. 3.60 eV D. 2.79 eV

~~Q.34~~ A He-Ne laser operating at 632.8 nanometers has an internal beam-waist diameter of 0.30 mm. Find the angular divergence or the angular full-width of this laser beam.

- A. 5.14×10^{-3} radians B. 0.6 mm
C. 1 degree D. 2.3 degrees

~~Q.35~~ If the kinetic energy of an electron is 292 keV what would be the phase velocity of the associated electron waves?

- A. 0.771c B. 0.100c
C. 1.21c D. 1.30c

~~Q.36~~ A positronium 'atom' is a positron bound to an electron. How will the wavelengths of the spectral lines from such an atom compare to spectral lines of a Hydrogen atom?

- A. Unchanged B. 0.05 % larger
C. halved D. doubled

~~Q.37~~ A particle of Energy $E < V$ is incident on a step potential of height V . If k and K are the wavenumbers of the particle outside and inside the step potential, what is the transmission coefficient?

- A. $4k^2/(k^2 + K^2)$ B. 1
C. 0 D. K/k

~~Q.38~~ The ground state wave function is proportional to $\exp(-x^2/2)$ for which kind of quantum physical system:

- A. Harmonic oscillator B. Hydrogen atom
C. Particle in a box D. Finite potential well

~~Q.39~~ For the Hydrogen atom, which one of the following is a forbidden transition:

- A. $4s \rightarrow 2p$ B. $3p \rightarrow 1s$
C. $4f \rightarrow 3p$ D. $4d \rightarrow 3p$

~~Q.40~~ The Stern-Gerlach experiment was a demonstration of

- A. Space quantization B. Conservation of angular momentum
C. Hund's Rule D. Pauli's Exclusion Principle

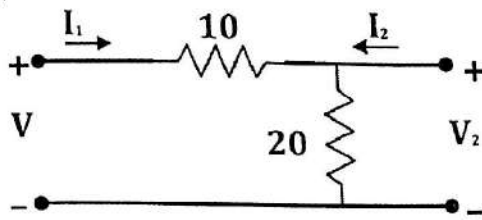
~~Q.41~~ Which one of the following is not the advantage of ion-implantation over diffusion doping?

- A. Point imperfections are not produced
B. It is a low temperature process
C. Shallow doping is possible
D. Gettering is possible

~~Q.42~~ If P is passivation, Q is n-well implant, R is metallization and S is Source/drain diffusion, then the order in which they are carried out in a standard n-well CMOS fabrication process is

- A. R - P - S - Q B. P - Q - R - S
C. Q - S - R - P D. S - R - Q - P

Q. 43 The h-parameters of the circuit shown in figure are

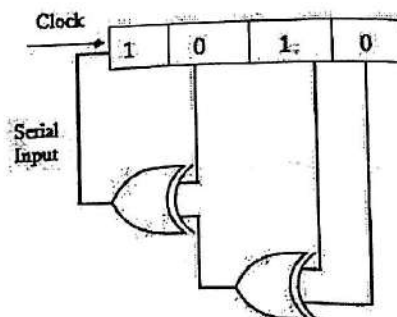


- A. $\begin{bmatrix} 0.1 & 0.1 \\ -0.1 & 0.3 \end{bmatrix}$ B. $\begin{bmatrix} 10 & 1 \\ -1 & 0.50 \end{bmatrix}$
 C. $\begin{bmatrix} 10 & -1 \\ 1 & 0.05 \end{bmatrix}$ D. $\begin{bmatrix} 30 & 20 \\ 20 & 20 \end{bmatrix}$

Q. 44 What should be done to unused inputs on TTL gates?

- A. Unused AND and NAND gate inputs should be tied to V_{cc} through $1\text{ k}\Omega$ resistor, unused OR and NOR input should be grounded.
 B. All unused gates inputs should be connected together and tied to V through a $1\text{ k}\Omega$ resistor.
 C. All unused inputs should be connected to unused output; this will ensure compatible loading on both the unused inputs and unused outputs.
 D. They should be left disconnected so as not to produce a load on any of the other circuits and to minimize power loading on the voltage source.

Q. 45 The shift register shown in the figure is initially loaded with the but pattern 1010. Subsequently the shift register is clocked, and with each clock pulse the pattern get shifted by one bit position to the right. With each shift, the bit at the serial input is pushed to the left most position (MSB). After how many pulses will the content of the shift register becomes 1010 again?



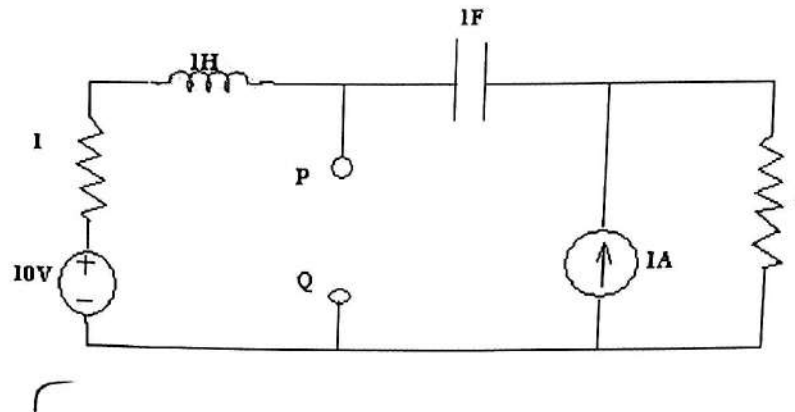
A. 7

B. 15

C. 3

D. 11

Q.46 The Thevenin equivalent impedance Z_{TH} between the nodes P and Q in the following circuit is



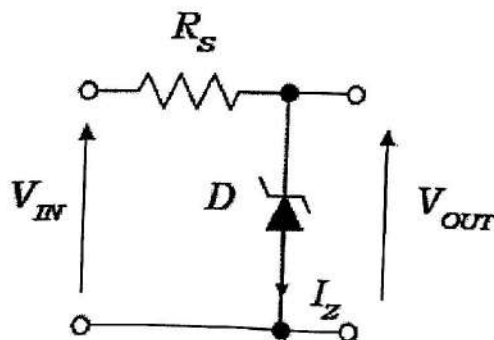
- A. 1 B. 3
C. 0.5 D. 7

Q.47 During a test the strain gauge with resistance 200 ohm undergoes a change of 0.12 and the strain of the gauge is 1.2×10^{-4} . The gauge factor will be

- A. 6 B. 4
C. 4.5 D. 5

Q.48 For the circuit shown bellow the Zener diode current I_Z is

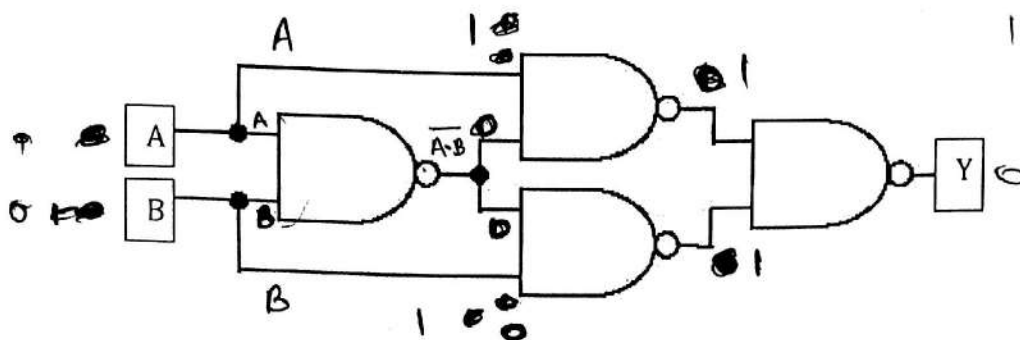
Given ($V_{IN} = 12V$, $R_S = 320\Omega$, $V_Z = 8.6V$, $R_Z = 20\Omega$)



- A. 19mA B. 9 mA
C. 10mA D. 7mA

Q. 49 Which is incorrect in the output of the circuit?

0, 0 - 0
0, 1 - 1
1, 0 - 1
1, 1 - 0



A. AB

B. $A \oplus B$

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

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

$\overline{A \cdot B}$

$\overline{A \cdot \overline{A \cdot B}}$

Q. 50 In a common base connection the emitter current is 1 mA. If the emitter circuit is open the collector current is 50 μ A. Find the total collector current? (Given $\alpha = 0.92$).

A. 0.97 mA

B. 0.92 mA

C. 0.87 mA

D. 0.82 mA

Q. 51 A nibble is defined as group of

A. 16 bits

B. 4 bits

C. 8 bits

D. 32 bits

Q. 52 Which of the following may be the address range of 1K memory chip.

A. 0000H-01FFH

B. 0000H-02FFH

C. 0000H-FFFFH

D. 0000H-03FFH

~~Q. 53~~ What is the memory capacity of 8085 microprocessor?

- A. 256KB
- B. 256MB
- C. 64KB
- D. 64MB

~~Q. 54~~ How many memory locations can be addressed by a microprocessor with 14 address lines?

- A. 16384
- B. 32768
- C. 65536
- D. 131072

~~Q. 55~~ If the 8085 adds 87H and 79H, the contents of the accumulator and the status of S, Z, and CY flags are,

- A. 66H, S = 1, CY = 1, Z = 0
- B. 66H, S = 1, CY = 0, Z = 1
- C. 00H, S = 0, CY = 0, Z = 0
- D. 00H, S = 0, CY = 1, Z = 1

~~Q. 56~~ Data byte 28H is stored in register B and data byte 97H is stored in the accumulator. Show the contents of registers B, C, and the accumulator after the execution of the following two instructions:

MOV A,B

MOV C,A

- A. 28H, 28H, 28H
- B. 97H, 28H, 28H
- C. 28H, 28H, 97H
- D. 97H, 97H, 97H

~~Q. 57~~ What operation can be performed by using the instruction XRA A? Specify the status of Z and CY.

A. $A = 1, CY = 1, Z = 0$

B. $A = 0, CY = 1, Z = 0$

C. $A = 1, CY = 0, Z = 1$ ✓

D. $A = 0, CY = 0, Z = 1$

~~Q. 58~~ The following instructions subtract two unsigned numbers. Specify the contents of register A and the status of the S and CY flags.

MVI A, F8H

SUI 69H

A. $A = 8FH, S = 0, CY = 1$

B. $A = 8FH, S = 1, CY = 0$

C. $A = 89H, S = 0, CY = 0$

D. $A = 89H, S = 0, CY = 1$ ✓

~~Q. 59~~ Specify the memory location and its contents after the following instructions are executed.

MVI B, F7H

MOV A, B

STA 2075H

HLT

A. F7H ✓

B. 20H

C. 75H

D. 00H

~~Q. 60~~ Identify the contents of memory location 2065H when the instruction INR M is executed

LXI H, 2065H

MVI M, FFH

INR M

HLT

A. 00H

B. 65H

C. 20H

D. FFH

~~Q.61~~ To get Boolean expression in the product of sum form, from a given Karnaugh map

A. don't care conditions should not be present

~~B.~~ don't care conditions, if present, should be taken as zeros

C. one should cover all the 0's present and complement the resulting expression

D. one should cover all the 1's present and complement the resulting expression

~~Q.62~~ The minimum number of gates required to implement the Boolean expression $AB + AB' + A'C$ is

A. 1 AND gate and 1 OR gate

B. 2 NAND gates

C. 3 AND gates and 2 OR gates

~~D.~~ 3 AND gates and 1 OR gate

~~Q.63~~ Which of the following logic families is well suited for high-speed operation?

A. TTL

B. ECL

C. MOS

D. CMOS

~~Q.64~~ How many address bits are required to represent a 32K memory?

A. 10 bits

B. 12 bits

C. 14 bits

D. 16 bits

Q. 65 The output of a logic gate is '1' when all its input are at logic 0. The gate is either

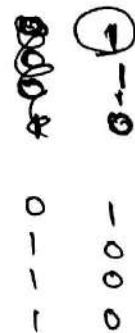
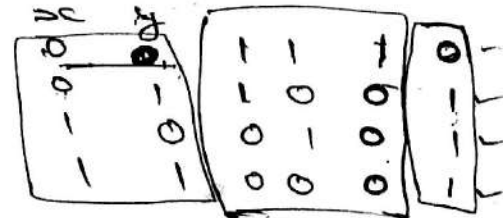
- A. NAND or an XOR gate
- B. NOR or an X-NOR gate
- C. an OR or an X-NOR gate
- D. an AND or an XOR gate

Q. 66 A bulb in a staircase has two switches, one switch being at the ground floor and the other one at the first floor. The bulb can be turned ON and also can be turned OFF by and one of the switches irrespective of the state of the other switch. The logic of switching of the bulb resembles.

- A. an AND gate
- B. an OR gate
- C. an XOR gate
- D. a NAND gate

Q. 67 An AND gate will function as OR if

- A. all the inputs to the gates are "1"
- B. all the inputs are '0'
- C. either of the inputs is "1"
- D. all the inputs and outputs are complemented.



Q. 68 Excess-3 code is known as

- A. Weighted code
- B. Cyclic redundancy code
- C. Self-complementing code
- D. Algebraic code.

Q. 69 A 6 bit ladder D/A converter has input 101001. For 1 = 10 V and 0 = 0V, The output is

- A. 4.23V ~~B. 6.51V~~
C. 5.52V D. 9.23V

Q. 70 What would be required for a TTL driver to operate a +20V device?

- A. open collector output B. pull down resistor
C. twenty volt logic system D. additional fan out

Q. 71 $\lim_{x \rightarrow \infty} \left(\frac{x}{2+x} \right)^{2x}$ is equal to

- A. $\frac{1}{e^4}$ B. $\frac{1}{e^2}$
C. $\frac{1}{e}$ D. e^2

Q. 72 The points P, Q, R with position vectors $3\vec{i} - 2\vec{j} - \vec{k}$, $\vec{i} + 3\vec{j} + 4\vec{k}$, $2\vec{i} + \vec{j} - 2\vec{k}$, respectively, relative to the origin O. Then, the distance of P from the plane OQR is

- A. 3 B. 2
C. 6 D. 4

Q. 73 Constant forces $\vec{P} = 2\vec{i} - 5\vec{j} + 6\vec{k}$ and $\vec{Q} = -\vec{i} + 2\vec{j} - \vec{k}$ act on a particle. Then work done by the forces for a displacement from point A with position vector $4\vec{i} - 3\vec{j} - 2\vec{k}$ to point B with position vector $6\vec{i} + \vec{j} - 3\vec{k}$ is

- A. -15 B. 15/2
C. -15/2 D. 15

Q. 74 For $r = |\vec{r}|$ and $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$, $\nabla \times \frac{\vec{r}}{r^3}$ is given by

- A. $3 \frac{\vec{r}}{r^2}$ B. $4\vec{r}$
C. $\frac{1}{2}\vec{r}$ D. 0

Q.75 The directional derivative of a two-dimensional scalar field $f = x^2 + y^2$ at a point $(1,1)$ in the directions of the vector $\vec{b} = \hat{i} + \hat{j}$ is

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

Q.76 In order that the function $f(x) = (x+1)^{\cot x}$ is continuous at $x=0$, $f(0)$ must be defined as

- ~~A. 1~~ B. $\frac{1}{e}$
C. $\frac{1}{e^2}$ D. e

Q.77 The points with position vectors $10\vec{i} + 3\vec{j}$, $12\vec{i} - 5\vec{j}$, and $a\vec{i} + 11\vec{j}$ are collinear if a equals to

- ~~A. -8~~ B. 2
C. 8 D. 4

Q.78 Unit tangent vector on $\vec{r}(t) = 2 \cos t \vec{i} + t \vec{j} + 2 \sin t \vec{k}$ is given by

- A. $\frac{2}{\sqrt{5}} \sin t \vec{i} + \frac{2}{\sqrt{5}} \cos t \vec{k}$ B. $-\frac{2}{\sqrt{5}} \sin t \vec{i} + \frac{1}{\sqrt{5}} \vec{j} + \frac{2}{\sqrt{5}} \cos t \vec{k}$
C. $\frac{2}{\sqrt{5}} \sin t \vec{i} + \frac{1}{\sqrt{5}} \vec{j} - \frac{2}{\sqrt{5}} \cos t \vec{k}$ D. $-\frac{2}{\sqrt{5}} \sin t \vec{i} + \frac{1}{\sqrt{5}} \vec{j} - \frac{2}{\sqrt{5}} \cos t \vec{k}$

Q.79 If $u = \frac{4x^2y^3}{z^4}$ and errors in x, y, z be 0.001, then the relative maximum error in u when $x = y = z = 1$ is

- A. $.9 \times 10^{-3}$ B. $.09 \times 10^{-3}$
C. 9×10^{-3} D. $.09 \times 10^{-2}$

~~Q.80~~ The number of terms of the exponential series such that their sum gives the value of e^x correct upto five decimal places at $x = 1$ is

- A. 9 B. 10
C. 8 D. 7

~~Q.81~~ If $Y = a + bX$ is a linear fit between the data sets X and Y , then the change in Y for each unit of change in X is:

- A. ab B. a/b
C. a D. b

~~Q.82~~ The solution of the differential equation $\frac{dy}{dx} = \frac{ax+g}{by+f}$ represents a circle when

- A. $a = b$ B. $a = -3b$
C. $a = -b$ D. $a = -2b$

~~Q.83~~ The period of the function $f(x) = |\cot 3x| + \sin^3 x + \cos 2x$ is

- A. 2π B. π
C. $\frac{\pi}{2}$ D. $\frac{\pi}{3}$

~~Q.84~~ If $\mathcal{L}\{e^{5t}\} = \frac{1}{s-5}$ then, $\mathcal{L}\{te^{5t}\}$ is

- A. $\frac{1}{s-5}$
B. $-\frac{1}{s-5}$
C. $\frac{1}{(s-5)^2}$
D. $-\frac{1}{(s-5)^2}$

~~Q.85~~ The period of the function $f(x) = 2\sin x + 3\cos 2x$ is

- A. π
B. 2π
C. $\pi/2$
D. 3π

✓ Q.86 The general solution of $2 \frac{d^2 y}{dx^2} + 5 \frac{dy}{dx} + 2y = 0$ is

- A. $y = Ae^{-2x}$
- B. $y = Ae^{\frac{1}{2}x}$
- C. $y = Ae^{-2x} + Be^{\frac{1}{2}x}$
- ✓ D. $y = Ae^{-2x} + Be^{-\frac{1}{2}x}$

✗ Q.87 The general solution of $\frac{dy}{dx} + \frac{1}{x}y = x^2$

- ✓ A. $xy = \frac{1}{4}x^4 + C$
- B. $xy = C$
- C. $\frac{x}{y} = C$
- D. $y = x^4$

✗ Q.88 The equation $y = Ae^{3x} + Be^{5x}$ can be represented as

- ✓ A. $y'' - 8y' + 15y = 0$
- B. $y'' + 8y' = 0$
- C. $y'' + 8y = 0$
- D. $y'' + 8y' + 15y = 0$

✗ Q.89 The relation between the selling price of a car (in \$ 1000) and its age (in years) is estimated from a random sample of cars of a specific model. The relation is given by the following formula:

$$\text{Selling price} = 15.9 - 0.983(\text{age})$$

Which of the following can we conclude from this equation?

- A. For every year the car gets older, the selling price goes down by approximately 9.83 percent.
- B. A new car costs on average \$9830.
- ✓ C. For every year the car gets older, the selling price drops by \$983
- D. Every year the car gets older the selling price drops by \$1590.

~~Q.90~~ Find all the values of μ for which rank of the matrix

$$M = \begin{bmatrix} \mu & -1 & 0 & 0 \\ 0 & \mu & -1 & 0 \\ 0 & 0 & \mu & -1 \\ -6 & 11 & -6 & 1 \end{bmatrix}$$

is equal to 3.

- A. 2 or 4
- B. 1 or 2 or 4
- C. 1 or 3 or 4
- D. 1 or 2 or 3

~~Q.91~~ Find the inverse of the matrix

$$M = \begin{bmatrix} 2 & 0 & -1 \\ 5 & 1 & 0 \\ 0 & 1 & 3 \end{bmatrix}$$

$$M^{-1}M = IM$$

A. $M^{-1} = M^2 - 7M + 10I$

B. $M^{-1} = M^2 + 7M + 10I$

C. $M^{-1} = M^2 - 6M + 11I$

D. $M^{-1} = M^2 + 6M + 10I$

~~Q.92~~ Let V be the set of all ordered pairs (x, y) , where x, y are real numbers. Let $\vec{a} = (x_1, y_1)$ and $\vec{b} = (x_2, y_2)$ be two elements in V . Define the addition as

$$\vec{a} + \vec{b} = (x_1, y_1) + (x_2, y_2) = (x_1x_2, y_1y_2)$$

and scalar multiplication as

$$\alpha(x_1, y_1) = (\alpha x_1, \alpha y_1).$$

Then V is

- A. a vector space
- B. not a vector space
- C. a subspace
- D. a function

~~Q.93~~ Let T be a linear transformation defined by

$$T\left[\begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix}\right] = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}, T\left[\begin{pmatrix} 0 & 1 \\ 1 & 1 \end{pmatrix}\right] = \begin{pmatrix} 1 \\ -2 \\ 3 \end{pmatrix}, T\left[\begin{pmatrix} 0 & 0 \\ 1 & 1 \end{pmatrix}\right] = \begin{pmatrix} 1 \\ -2 \\ -3 \end{pmatrix}, T\left[\begin{pmatrix} 0 & 0 \\ 0 & 1 \end{pmatrix}\right] = \begin{pmatrix} -1 \\ 2 \\ 3 \end{pmatrix}.$$

Find $T\left[\begin{pmatrix} 4 & 5 \\ 3 & 8 \end{pmatrix}\right]$?

- A. $\begin{pmatrix} -2 \\ -20 \\ 36 \end{pmatrix}$ B. $\begin{pmatrix} -2 \\ 20 \\ 36 \end{pmatrix}$ C. $\begin{pmatrix} -2 \\ 20 \\ -36 \end{pmatrix}$ D. $\begin{pmatrix} 2 \\ -20 \\ 36 \end{pmatrix}$ ✓

~~Q.94~~ Find the matrix of a linear transformation $T:R^3 \rightarrow R^3$ such that

$$T\begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} = \begin{pmatrix} 6 \\ 2 \\ 4 \end{pmatrix}, T\begin{pmatrix} 1 \\ -1 \\ 1 \end{pmatrix} = \begin{pmatrix} 2 \\ -4 \\ 2 \end{pmatrix}, T\begin{pmatrix} 1 \\ -2 \\ 3 \end{pmatrix} = \begin{pmatrix} 6 \\ 6 \\ 5 \end{pmatrix}.$$

- A. $\begin{bmatrix} 1 & 2 & 3 \\ -15/2 & 3 & 13/2 \\ 1 & 1 & 2 \end{bmatrix}$ C. $\begin{bmatrix} 1 & 2 & 3 \\ -15/2 & 3 & 13/2 \\ -1 & 1 & 2 \end{bmatrix}$
 B. $\begin{bmatrix} 1 & 2 & 3 \\ -15/2 & 3 & 13/2 \\ 1 & -1 & 2 \end{bmatrix}$ D. $\begin{bmatrix} 1 & -2 & 3 \\ -15/2 & 3 & 13/2 \\ 1 & 1 & 2 \end{bmatrix}$

~~Q.95~~ Find the eigenvectors of the following matrix

$$M = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{bmatrix}.$$

- A. $[-1 \ -1 \ 1]^T, [0 \ 1 \ 0]^T, [0 \ -1 \ 1]^T$ ✓
 B. $[1 \ -1 \ 1]^T, [0 \ 1 \ 0]^T, [0 \ -1 \ 1]^T$
 C. $[-1 \ -1 \ -1]^T, [0 \ 1 \ 0]^T, [0 \ -1 \ 1]^T$
 D. $[-1 \ -1 \ 1]^T, [0 \ 1 \ 0]^T, [0 \ 1 \ 1]^T$

~~Q.96~~ Obtain the symmetric matrix B for the quadratic form $Q = 2x_1^2 + 3x_1x_2 + x_2^2$.

A. $\begin{bmatrix} 2 & 3/2 \\ 3/2 & 1 \end{bmatrix}$ B. $\begin{bmatrix} 2 & 3/2 \\ 3/2 & -1 \end{bmatrix}$ C. $\begin{bmatrix} -2 & 3/2 \\ 3/2 & 1 \end{bmatrix}$ D. $\begin{bmatrix} 2 & -3/2 \\ 3/2 & 1 \end{bmatrix}$

~~Q.97~~ Find the condition numbers of the following matrix

$$M = \begin{bmatrix} 1 & 4 \\ 3 & 2 \end{bmatrix}$$

A. 2.018

B. 2.518

C. 2.618

D. 2.718

~~Q.98~~ Find all values of z which satisfy $e^z = 1 + i$.

A. $z = \frac{1}{2} \ln 2 + i \left(\frac{\pi}{4} \pm n\pi \right), n = 0, \pm 1, \pm 2, \dots$

B. $z = \frac{1}{2} \ln 2 - i \left(\frac{\pi}{4} + n\pi \right), n = 0, \pm 1, \pm 2, \dots$

C. $z = \frac{1}{2} \ln 2 + i \left(\frac{\pi}{4} + n\pi \right), n = 0, \pm 1, \pm 2, \dots$

D. $z = \frac{1}{2} \ln 2 - i \left(\frac{\pi}{4} - n\pi \right), n = 0, \pm 1, \pm 2, \dots$

~~Q.99~~ Evaluate the integral $I = \int z^2 dz$ over the contour C an arc of a circle $|z| = 2$ from $\theta = 0$ to $\theta = \pi/3$.

A. $-8/3$

B. $-16/3$

C. $3/8$

D. $3/16$

Q.100

The scores of 10 candidates obtained in tests before and after attending some coaching classes are given below

Before:	54	76	92	65	75	78	66	82	80	78
After:	60	80	86	72	80	72	66	88	82	73

Is the coaching for the test effective? Test at 5% level of significance. Given that the value of t for $P = 0.05$ and $\nu = 9$ is 1.8333.

- A. The null hypothesis that the students have not benefitted from coaching is accepted.
- B. The null hypothesis that the students have not benefitted from coaching is rejected.
- C. The null hypothesis that the students have not benefitted from coaching may or may not be rejected.
- D. The null hypothesis that the students have not benefitted from coaching cannot be predicted.