

Page No. 1/7

Subject Code **J-261**

Seat No.

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E

DATE : 22/06/2026

**SUBJECT : CHEMISTRY (55)**

Time : 11.00 - 2.00

DURATION : 3 Hours

TOTAL PAGES : 7

TOTAL MARKS : 70

**General Instructions :**

The question paper is divided into four sections.

- (i) Section A : Q. No. 1 contains Ten multiple choice type of questions carrying One mark each. Only the first attempt will be considered for evaluation.  
Q. No. 2 contains Eight very short answer type of questions carrying One mark each.
- (ii) Section B : Q. No. 3 to Q. No. 14 are Twelve short answer type of questions carrying Two marks each. (Attempt any Eight)
- (iii) Section C : Q. No. 15 to Q. No. 26 are Twelve short answer type of questions carrying Three marks each. (Attempt any Eight)
- (iv) Section D : Q. No. 27 to Q. No. 31 are Five long answer type of questions carrying Four marks each. (Attempt any Three)
- (v) Use of log table is allowed. Use of calculator is not allowed.
- (vi) Figures to the right indicate full marks.
- (vii) Physical Constants :
  - (1) Avogadro's Number =  $N_A = 6.022 \times 10^{23}$
  - (2) Gas constant  $R = 0.08206 \text{ L-atm K}^{-1} \text{ mol}^{-1} / 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$
  - (3) 1 Faraday = (F) = 96500 Coulombs



## SECTION - A

Q. 1. Select and write the correct answers for the following multiple choice type of questions :

10

- (i) Which of the following is NOT an elastomer?  
(a) vulcanized rubber (b) buna-S  
(c) neoprene (d) polyethene
- (ii) Anisole reacts with HI at 398K to form –  
(a) cyclohexanol (b) benzenol  
(c) iodobenzene (d) benzene
- (iii) Unit of Henry's constant is \_\_\_\_\_.  
(a)  $\text{mol L}^{-1} \text{bar}^{-1}$  (b)  $\text{mol L bar}$   
(c)  $\text{mol L}^{-1} \text{bar}$  (d)  $\text{mol}^{-1} \text{L}^{-1} \text{bar}^{-1}$
- (iv) The shape of bromine penta-fluoride is \_\_\_\_\_.  
(a) Linear (b) Bent · T · Shape  
(c) Tetrahedral (d) Square pyramidal
- (v) The relation between edge length and radius for body centered cubic structure is –  
(a)  $r = \frac{a}{2}$  (b)  $r = \sqrt{3} \frac{a}{4}$   
(c)  $r = \sqrt{2} \frac{a}{4}$  (d)  $r = \sqrt{3} \frac{a}{2}$
- (vi) Atomic number of post actinoid element range from–  
(a) 58 – 72 (b) 78 – 92  
(c) 93 – 103 (d) 104 – 118
- (vii) The pH of buffer solution containing 0.05 mol NaF per litre and 0.01 mol HF per litre ( $\text{pK}_a = 3.1427$ ) is \_\_\_\_\_.  
(a) 3.8417 (b) 3.1427  
(c) 0.3841 (d) 0.0384



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- (viii) Preparation of ethanamine from acetonitrile represents –
- (a) Gabriel phthalimide synthesis
  - (b) Mendius reduction
  - (c) Hofmann hypobromite degradation
  - (d) Sandmeyer reaction
- (ix) The source of dichlorocarbene is \_\_\_\_.
- (a) methyl chloride
  - (b) methylene chloride
  - (c) chloroform
  - (d) carbon tetrachloride
- (x) The reagent used to convert acetyl chloride to acetaldehyde is –
- (a)  $\text{SnCl}_2 + \text{HCl}$
  - (b)  $\text{Zn} \cdot \text{Hg} + \text{Conc. HCl}$
  - (c)  $\text{NH}_2\text{-NH}_2 + \text{KOH} / \begin{array}{c} \text{CH}_2\text{-OH} \\ | \\ \text{CH}_2\text{-OH} \end{array}$
  - (d)  $\text{H}_2/\text{Pd-BaSO}_4$

Q. 2. Answer the following questions :

8

- (i) Write the relation between conductivity and molar conductivity.
- (ii) Write the oxidation state of Nickel in  $[\text{Ni}(\text{Cl})_4]^{2\ominus}$  complex ion.
- (iii) Write the name of nanostructured material used in tyres of car to increase their life.
- (iv) Write the glycosidic linkage present in maltose.
- (v) Draw the structure of perchloric acid.
- (vi) Write the trade name of most common thermoplastic polyester.



- (vii) Calculate change over temperature for a certain reaction, whose  $\Delta H^\circ$  is  $-60\text{kJ}$  and  $\Delta S^\circ$  is  $-150\text{ JK}^{-1}$ .
- (viii) Write the unit of rate constant of zero order reaction.

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## SECTION - B

Attempt any EIGHT of the following questions :

16

- Q. 3. Write reactions involved during preparation of Nylon 6, 6 fibre.
- Q. 4. Derive Ostwald's dilution law equation for a weak acid.
- Q. 5. Draw the structures of two forms of alanine having  $\text{pH} \leq 2$  and  $\text{pH} \geq 10$ .
- Q. 6. Define the following terms :
- (a) Intensive property
  - (b) Standard enthalpy of combustion
- Q. 7. What is the action of following reagents on ethyl amine?  
(Indicate by reaction)
- (a) Nitrous acid
  - (b) Chloroform and KOH
- Q. 8. (a) State Kohlrausch law of independent migration of ions.  
(b) Write Nernst equation to calculate electrode potential.
- Q. 9. (a) Write general electronic configuration of 3d series elements.  
(b) Write any two points which explain about the colour of a transition metal ion.
- Q. 10. Explain aldol condensation reaction with respect to ethanal.



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- Q. 11. Write a note on Kolbe reaction.
- Q. 12. (a) Write the relation between standard cell potential and equilibrium constant.
- (b) Write the representation of sodium hexacyanoferrate (III) complex.
- Q. 13. In first order reaction 60% of reactant decomposes in 40 min. Calculate the rate constant of the reaction.
- Q. 14. Explain optical activity of 2-chlorobutane.

## SECTION - C

Attempt any EIGHT of the following questions :

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- Q. 15. (a) Derive a relationship between molar mass, density of the substance and unit cell edge length.
- (b) Define · paramagnetic solids.
- Q. 16. (a) Mention the names of four principles of green chemistry.
- (b) Write advantages of nanoparticles and nanotechnology in the field of energy sector.
- Q. 17. (a) State second law of thermodynamics.
- (b) Define · Nucleotides.
- (c) Write chemical reaction for conversion of benzene diazonium chloride into benzene.
- Q. 18. The solubility product of AgBr is  $5.2 \times 10^{-13}$ . Calculate its solubility in  $\text{mol dm}^{-3}$  and  $\text{g dm}^{-3}$ .
- (Molar mass of AgBr =  $187.8 \text{ g mol}^{-1}$ )



- Q. 19. Convert the following :
- (a) Ethanol to ethoxyethane.
  - (b) Phenol to p-benzoquinone
  - (c) Salicylic acid to aspirin
- Q. 20.
- (a) State Raoult's law.
  - (b) Derive the relationship to determine molar mass of non volatile solute by depression of freezing point.
- Q. 21.
- (a) Explain the formation of  $[\text{CoF}_6]^{3-}$  complex ion with respect to
    - (i) Oxidation State of Cobalt
    - (ii) Type of hybridisation
    - (iii) Magnetic property
    - (iv) Geometrical shape
  - (b) Write the name of ligand used to estimate hardness of water.
- Q. 22.
- (a) Write cell reactions of hydrogen-oxygen fuel cell at anode and cathode.
  - (b) Write an application of electrochemical series.
- Q. 23.
- (a) Explain anomalous behaviour of oxygen with respect to
    - (i) Atomicity
    - (ii) Magnetic property
    - (iii) Oxidation state
    - (iv) Nature of hydride
  - (b) Write any two uses of helium.
- Q. 24. What is the energy of activation of a reaction whose rate constant doubles when the temperature changes from 303 K to 313 K?
- Q. 25.
- (a) Write chemical reactions taking place during extraction of iron in zone of reduction of the blast furnace.
  - (b) Write observed electronic configuration of gadolinium. (Z=64)



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26. Convert the following :
- (a) Acetic acid to ethyl alcohol
  - (b) Acetic acid to acetic anhydride
  - (c) Acetyl chloride to acetamide

## SECTION - D

Attempt any **THREE** of the following questions :

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27. (a) Define : (i) Co-ordination numbers  
(ii) Ambidentate ligand
- (b) Write a note on Clemmensen reduction of propanone.
28. (a) Derive relationship between  $\Delta H$  and  $\Delta U$  for a gaseous chemical reaction.
- (b) Give reason – Ozone is a good bleaching agent.
- (c) Write any two uses of  $\text{SO}_2$ .
29. (a) Define - Polymorphism.
- (b) State and explain Hess's law of constant summation. Write its one application.
30. (a) 0.01 m aqueous formic acid solution freezes at  $-0.021^\circ\text{C}$ . Calculate its degree of dissociation. ( $K_f = 1.86 \text{ K. kg.mol}^{-1}$ )
- (b) Write properties of interstitial compounds.
31. (a) What is the action of following reagents on Bromoethane?
- (i)  $\text{KNO}_2$
  - (ii) 'Mg' metal
  - (iii) Silver acetate
- (b) Draw structure - DDT insecticide.





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Subject Code **J-229**

Seat No.

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E

DATE : 19/06/2026

**SUBJECT : PHYSICS (54)**

Time : 11.00 - 2.00

DURATION : 3 Hours

TOTAL PAGES : 7

TOTAL MARKS : 70

**General Instructions :**

The question paper is divided into four sections :

(i) Section A : Q. No. 1 contains Ten multiple choice type of questions carrying One mark each.

Q. No. 2 contains Eight very short answer type of questions carrying One mark each.

(ii) Section B : Q. No. 3 to Q. No. 14 contain Twelve short answer type of questions carrying Two marks each. (Attempt any Eight).

(iii) Section C : Q. No. 15 to Q. No. 26 contain Twelve short answer type of questions carrying Three marks each. (Attempt any Eight).

(iv) Section D : Q. No. 27 to Q. No. 31 contain Five long answer type of questions carrying Four marks each.(Attempt any Three).

(v) Use of the log table is allowed. Use of the calculator is NOT allowed.

(vi) Figures to the right indicate full marks.

(vii) For multiple choice type of questions, only the first attempt will be considered for evaluation.

(viii) Physical constants : -

(1) Velocity of light in air =  $3 \times 10^8$  m/s

(2) Planck's constant =  $6.63 \times 10^{-34}$  Js

(3)  $\pi = 3.142$

(4)  $\mu_0 = 4\pi \times 10^{-7}$  Wb/Am

(5)  $1 \text{ eV} = 1.6 \times 10^{-19}$  J

(6)  $\epsilon_0 = 8.85 \times 10^{-12}$  C<sup>2</sup>/Nm<sup>2</sup>

(7) Rydberg's constant =  $1.097 \times 10^7$  per meter.



## SECTION – A

Q. 1. Select and write the correct answers for the following multiple choice type of questions :

10

- (i) The MI of ring of radius ' $R$ ' and mass ' $M$ ' about its central axis is \_\_\_\_\_
- (a)  $2MR^2$  (b)  $\frac{MR^2}{2}$
- (c)  $MR^2$  (d)  $\frac{3}{2}MR^2$
- (ii) For a monoatomic gas enclosed in a container at a constant temperature has degrees of freedom
- (a) 5 (b) 3
- (c) 7 (d) 4
- (iii) The equation of the first law of thermodynamics for isochoric process is
- (a)  $Q = \Delta U$  (b)  $Q = 0$
- (c)  $Q = \Delta U + W$  (d)  $Q = \Delta U - W$
- (iv) Cyclotron can not accelerate \_\_\_\_\_
- (a) protons (b)  $\alpha$ -particles
- (c) neutrons (d) deuterons
- (v) In a purely inductive and capacitive circuit, power factor is, \_\_\_\_\_
- (a) one (b) zero
- (c) infinity (d) 10
- (vi) The Boolean equation for NOR gate is
- (a)  $Y = A \cdot B$  (b)  $Y = A + B$
- (c)  $Y = \overline{A}$  (d)  $Y = \overline{A + B}$



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- (vii) When  $n$  number of capacitors having each of capacity ' $C$ ' are connected in series, their equivalent capacity is

- (a)  $\frac{1}{C}$  (b)  $nC$   
(c)  $\frac{C}{n}$  (d)  $\frac{1}{nC}$

- (viii) A polarising angle for an optical material is  $35^\circ$ . Then refractive index of the material is

- (a) 0.647 (b) 0.7002  
(c) 0.7265 (d) 0.7133

- (ix) For a streamline flow, the relative velocity between the two liquid layers is 10 cm/s. The distance between them is 5 cm. The velocity gradient is

- (a)  $3 \text{ S}^{-1}$  (b)  $5 \text{ S}^{-1}$   
(c)  $4 \text{ S}^{-1}$  (d)  $2 \text{ S}^{-1}$

- (x) The wavelength of a stationary wave on a string is 0.75 m with frequency of 64 Hz. Then, the velocity of wave is

- (a) 48 m/s (b) 50 m/s  
(c) 64 m/s (d) 60 m/s

Q. 2. Answer the following questions :

8

- (i) Absorption of ink by a blotting paper is an example of which phenomenon of fluids?
- (ii) State Kirchhoff's first law for electrical network.
- (iii) Define 'photoelectric work function.'
- (iv) Which series of spectral lines belongs to the ultraviolet region of the hydrogen spectrum?



- (v) Which semiconductor device converts solar energy into electrical energy?
  - (vi) Define the term wavefront.
  - (vii) A motorcyclist performs horizontal circular motion inside a well of inner radius 3 m. Calculate the minimum speed to perform the stunt if coefficient of static friction is 0.3.  
[  $g = 10 \text{ m/s}^2$  ].
  - (viii) Calculate the maximum velocity of a particle having amplitude of oscillation 4 cm and period 4 seconds.
- 

## SECTION – B

Attempt any EIGHT questions from the following :

16

- Q. 3. Obtain an expression for the maximum speed of a vehicle along horizontal circular curved road.
- Q. 4. For a thermodynamic system :  
Define : (a) Mechanical equilibrium  
(b) Chemical equilibrium
- Q. 5. What are polar molecules and non polar molecules?
- Q. 6. Explain how will you convert moving coil galvanometer into voltmeter?
- Q. 7. Distinguish between free and forced vibrations.
- Q. 8. State any two postulates of Bohr's theory of hydrogen atom.
- Q. 9. Explain the cyclic process with the help of a neat  $p - V$  diagram.
- Q. 10. A star is emitting light at the wavelength of  $4000\text{\AA}$ . Determine the limit of angular resolution of a telescope having an objective of diameter of 400 cm.



- Q. 11. Calculate the value of  $\lambda_{\max}$  for solar radiation assuming the temperature on the surface of the sun is 5800 K.  
[ Wien's constant =  $2.897 \times 10^{-3}$  m.k. ]
- Q. 12. Calculate the radius of water drop, so that the excess pressure inside it is  $24 \text{ N/m}^2$ .  
[ Surface tension of water =  $7.2 \times 10^{-2} \text{ N/m}$  ]
- Q. 13. The susceptibility of magnetic material is  $\chi$  at  $27^\circ\text{C}$ . At what temperature its susceptibility will be  $\chi/3$  ?
- Q. 14. An alternating voltage source given by  $e = 140 \sin(314.2 t)$  is connected across a pure resistor of  $50 \Omega$ . Determine :  
(i) Frequency of the source.  
(ii) RMS value of emf.

## SECTION – C

Attempt any EIGHT questions of the following :

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- Q. 15. State and prove perpendicular axes theorem.
- Q. 16. On the basis of molecular theory, explain the phenomenon of surface tension.
- Q. 17. Show that all harmonics are present in the case of an air column vibrating in a pipe open at both the ends.
- Q. 18. What is interference of light? State any four conditions for obtaining well defined and steady interference pattern.
- Q. 19. With the help of a neat circuit diagram, explain the working of a half wave rectifier. Draw input and output waveforms.



- Q. 20. Obtain an expression for orbital magnetic moment of an electron revolving around the nucleus of an atom.
- Q. 21. Define the terms :
- (a) Inductive reactance
  - (b) Capacitive reactance
  - (c) Impedance
- Q. 22. A parallel plate capacitor filled with air has an area  $6 \text{ cm}^2$  and the plate separation is 2 mm. Calculate its capacity.
- Q. 23. Two resistances  $X$  and  $Y$  in the two gaps of a meterbridge give a null point dividing the wire in the ratio 4 : 6. If both resistances are increased by  $30 \Omega$ , the null point divides the wire in the ratio 5 : 6. Calculate the value of  $X$  and  $Y$ .
- Q. 24. Calculate the shortest wavelength of Paschen series and the longest wavelength of Balmer series for hydrogen atom.
- Q. 25. Calculate the current flowing through two long parallel wires carrying equal currents and separated by a distance of 1.35 cm experiencing a force per unit length of  $4.76 \times 10^{-2} \text{ N/m}$ .
- Q. 26. An emf of 90 mV is induced in the winding of a coil, when current in a nearby coil is increasing at the rate of 4.5 A/s. What is the mutual inductance of the two coils?

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## SECTION – D

Attempt any **THREE** questions of the following :

12

- Q. 27. Derive an expression for pressure exerted by a gas on the basis of kinetic theory of gases.



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- Q. 28. State differential equation of linear S.H.M. hence obtain an expression for acceleration, velocity and displacement of a particle performing S.H.M.
- Q. 29. With the help of neat diagram explain construction of a transformer. Calculate energy required to build up current of 1A in an inductor of inductance 20 mH.
- Q. 30. Draw a neat schematic diagram of a photo cell.  
The photoelectric work function for a metal is 4.2 eV. Find threshold wavelength.
- Q. 31. Obtain an expression for magnetic induction of a toroid of N no. of turns about an axis passing through its centre and perpendicular to plane.  
A Carnot refrigerator operates between 150 K and 200 K, calculate its coefficient of performance.





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Subject Code **J-276**

Seat No.

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E

DATE : 24/06/2026

Time : 11.00 - 2.00

**SUBJECT : MATHEMATICS & STATISTICS  
(ARTS & SCIENCE) (40)**

DURATION : 3 Hours

TOTAL PAGES : 8

TOTAL MARKS : 80

**General instructions :**

The question paper is divided into FOUR sections.

- (i) Section A : Q.1 contains Eight multiple choice type questions, each carrying Two marks.  
Q. 2 contains Four very short answer type questions, each carrying One mark.
- (ii) Section B : Q.3 to Q. 14 contain Twelve short answer type questions, each carrying Two marks.  
(Attempt any Eight)
- (iii) Section C : Q.15 to Q. 26 contain Twelve short answer type questions, each carrying Three marks.  
(Attempt any Eight)
- (iv) Section D : Q.27 to Q. 34 contain Eight long answer type questions, each carrying Four marks.  
(Attempt any Five)
- (v) Use of log table is allowed. Use of calculator is not allowed.
- (vi) Figures to the right indicate full marks.
- (vii) Use of graph paper is not necessary. Only rough sketch of graph is expected.
- (viii) For each multiple choice type of question, only the first attempt will be considered for evaluation.
- (ix) Start answer to each section on a new page.



## SECTION - A

Q. 1. Select and write the correct answer of the following multiple choice type of questions :

16

(i) If  $A = \{1, 2, 3, 4, 5\}$  then which of the following is not true?

(a)  $\exists x \in A$  such that  $x + 3 = 8$

(b)  $\exists x \in A$  such that  $x + 2 < 9$

(c)  $\forall x \in A, x + 6 \geq 9$

(d)  $\forall x \in A, x + 5 \leq 10$

(2)

(ii) The value of  $\sin \left[ \sin^{-1} \left( -\frac{1}{\sqrt{2}} \right) - 3 \sin^{-1} \left( \frac{\sqrt{3}}{2} \right) \right] =$

(a)  $-\frac{1}{\sqrt{2}}$

(b)  $\frac{1}{\sqrt{2}}$

(c)  $\frac{\sqrt{3}}{2}$

(d)  $-\frac{\sqrt{3}}{2}$

(2)

(iii) If  $\hat{p}, \hat{q}, \hat{r}$  are mutually perpendicular unit vectors and form a right handed triplet then the value of  $\hat{p} \cdot (\hat{q} \times \hat{r}) + \hat{q} \cdot (\hat{p} \times \hat{r}) + \hat{r} \cdot (\hat{p} \times \hat{q}) = \dots\dots$

(a)  $-2$

(b)  $0$

(c)  $1$

(d)  $3$

(2)

(iv) The Cartesian equation of the line passing through the points  $A(3, 4, -1)$  and  $B(2, -1, 3)$  is \_\_\_\_\_.

(a)  $\frac{x-3}{1} = \frac{y-4}{5} = \frac{z+1}{-4}$

(b)  $\frac{x-3}{-1} = \frac{y-4}{-5} = \frac{z+1}{-4}$

(c)  $\frac{x-3}{-1} = \frac{y-4}{-5} = \frac{z+1}{4}$

(d)  $\frac{x-3}{-1} = \frac{y-4}{5} = \frac{z+1}{-4}$

(2)



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(v) If  $y = \log_x a$  then  $\frac{dy}{dx} = \underline{\hspace{2cm}}$ .

(a)  $\frac{-\log a}{x(\log x)^2}$

(b)  $x \log a$

(c)  $-\frac{1}{\log_x a}$

(d)  $\frac{1}{x \log a}$

(2)

(vi) If  $f(x) = \frac{\sin^{-1} x}{\sqrt{1-x^2}}$  and  $g(x) = e^{\sin^{-1} x}$  then

$\int f(x) \cdot g(x) dx = \underline{\hspace{2cm}}$

(a)  $e^{\sin^{-1} x} (1 - \sin^{-1} x) + c$

(b)  $e^{\sin^{-1} x} (\sin^{-1} x - 1) + c$

(c)  $e^{\sin^{-1} x} (\sin^{-1} x + 1) + c$

(d)  $e^{\cos^{-1} x} (\cos^{-1} x - 1) + c$

(2)

(vii) The area bounded by the line  $y = 2x$ ,  $X$ -axis and the lines  $x = -1$ ,  $x = 4$  is  $\underline{\hspace{2cm}}$  sq. units.

(a) 15

(b) 17

(c) 16

(d) 14

(2)

(viii) In a Binomial Distribution,  $E(X) = 6$ ,  $\text{Var}(X) = 4.2$  then the value of  $n$  is  $\underline{\hspace{2cm}}$

(a) 22

(b) 24

(c) 20

(d) 26

(2)

Answer the following questions :

4

(i) Write the dual of  $p \wedge t$

(1)

(ii) What is the distance of point  $(3, -5, 6)$  from  $XZ$  plane?

(1)



- (iii) The displacement of a particle at time  $t$  is given by

$$S = 3t^2 + 4t + 1. \text{ Find its velocity at time } t.$$

(1)

- (iv) Write the order of differential equation

$$\left(\frac{d^2 y}{dx^2}\right)^{\frac{5}{2}} = 3\sqrt{\frac{dy}{dx}}$$

(1)

## SECTION - B

Attempt any EIGHT of the following questions :

16

- Q. 3. Construct the switching circuit for the statement  $(\sim p \wedge q) \vee (p \wedge \sim r)$ . (2)
- Q. 4. Find the matrix of cofactors of matrix  $\begin{bmatrix} 5 & 2 \\ -1 & 6 \end{bmatrix}$ . (2)
- Q. 5. Find the general solution of equation  $\cos 5\theta = \frac{1}{2}$ . (2)
- Q. 6. Find the value of  $k$ , if  $2x + y = 0$  is one of the lines represented by  $3x^2 + kxy + 2y^2 = 0$ . (2)
- Q. 7. If  $\vec{a}, \vec{b}, \vec{c}$  are the position vectors of points  $A, B, C$  respectively and  $10\vec{a} = 7\vec{b} + 3\vec{c}$  then find the ratio in which the point  $C$  divides the line segment  $AB$ . (2)
- Q. 8. Find the angle between the lines  
 $\vec{r} = (\hat{i} + 2\hat{j} + 3\hat{k}) + \lambda(2\hat{i} - \hat{j} + \hat{k})$   
 $\vec{r} = (\hat{i} + 2\hat{j} + 3\hat{k}) + \mu(\hat{i} + 2\hat{j} + \hat{k})$  (2)
- Q. 9. Test whether the function  $f(x) = x - \frac{1}{x}, x \in R, x \neq 0$  is increasing or decreasing. (2)



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10. Evaluate :  $\int_{-1}^1 |x| dx$  (2)

11. Evaluate :  $\int x \log x dx$  (2)

12. Find the area bounded by curve  $x^2 + y = 0$ , X - axis and lines  $x = 1$  and  $x = 4$ . (2)

13. The probability distribution of r.v.  $X$  is as follows:

|            |     |     |      |      |     |
|------------|-----|-----|------|------|-----|
| $X = x$    | 0   | 1   | 2    | 3    | 4   |
| $P(X = x)$ | 0.1 | $k$ | $2k$ | $2k$ | $k$ |

Find : (i)  $k$  (ii)  $F(2)$  (2)

14. Evaluate :  $\int \frac{e^x(1+x)}{\cos^2(xe^x)} dx$  (2)

## SECTION – C

Attempt any EIGHT of the following questions :

24

15. Using truth table, determine whether statement pattern

$[(p \vee q) \wedge \sim p] \wedge \sim q$  is a tautology or a contradiction or a contingency. (3)

16. Prove that :

$$\sin^{-1}\left(\frac{3}{5}\right) + \cos^{-1}\left(\frac{12}{13}\right) = \sin^{-1}\left(\frac{56}{65}\right) \quad (3)$$

17. In  $\triangle ABC$ , if  $a = 10$ ,  $b = 8$ ,  $c = 6$  then find the value of

(i)  $\sin\left(\frac{C}{2}\right)$  (ii)  $\cos\left(\frac{B}{2}\right)$  (3)



18. Are the four points  $A(1, 2, 1)$ ,  $B(2, -3, 4)$ ,  $C(3, 4, -5)$ ,  $D(2, 3, -2)$  coplanar? Justify your answer. (3)
19. Find the distance between parallel lines  
 $\frac{x}{2} = \frac{y}{-1} = \frac{z}{2}$  and  
 $\frac{x+1}{2} = \frac{y-1}{-1} = \frac{z+1}{2}$  (3)
20. Find the vector equation of the plane passing through the points  $A(2,1,1)$ ,  $B(0,2,3)$  and  $C(4,5,6)$ . (3)
21. If  $y = \log \left[ \frac{x + \sqrt{x^2 + a^2}}{\sqrt{x^2 + a^2} - x} \right]$ , find  $\frac{dy}{dx}$ . (3)
22. A wire of length 36 cm is bent to form a rectangle. Find its dimensions, if the area of the rectangle is maximum. (3)
23. Verify Rolle's theorem for the function  $f(x) = x^2 - 5x + 9$ ,  $x \in [1, 4]$  (3)
24. Solve the differential equation  $x \frac{dy}{dx} - \sqrt{x^2 + y^2} = y$  (3)
25. The following is the p.d.f. of continuous r.v.  
 $f(x) = \frac{x}{8}; 0 < x < 4$   
 $= 0$ , Otherwise  
Find (i) expression for c.d.f of  $X$ .  
(ii)  $F(x)$  at 0.5 and 5 (3)



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26. If the p.m.f of r.v.  $X$  be

$$P(X=x) = {}^4C_x \left(\frac{5}{9}\right)^x \left(\frac{4}{9}\right)^{4-x} \quad \text{for } x=0,1,2,3,4$$

$$= 0 \quad ; \quad \text{otherwise}$$

then find  $E(X)$  and  $\text{Var}(X)$ .

(3)

## SECTION - D

Attempt any FIVE of the following questions :

20

27. Find the inverse of matrix  $\begin{bmatrix} -4 & -3 & -3 \\ 1 & 0 & 1 \\ 4 & 4 & 3 \end{bmatrix}$  (4)

28. Prove that the homogeneous equation of degree two in  $x$  and  $y$ ,  
 $ax^2 + 2hxy + by^2 = 0$  represents a pair of lines passing through  
 the origin if  $h^2 - ab \geq 0$  (4)

29. Prove that, if  $\vec{a}, \vec{b}, \vec{c}$  are three non coplanar vectors then any vector  $\vec{r}$  in  
 the space can be uniquely expressed as a linear  
 combination of  $\vec{a}, \vec{b}, \vec{c}$ . (4)

30. Solve the linear programming problem (L.P.P.) by graphical method.

Minimize :  $z = 8x + 10y$

Subject to ,  $2x + y \geq 7$

$$2x + 3y \geq 15$$

$$x \geq 0$$

$$y \geq 2$$

(4)



31. If  $x = f(t)$  and  $y = g(t)$  are differentiable functions of  $t$ , so that  $y$  is

differentiable function of  $x$  and  $\frac{dx}{dt} \neq 0$  then prove that  $\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}}$ .

Hence find  $\frac{dy}{dx}$ , if  $x = \sin t$   $y = \cos t$ . (4)

32. Evaluate :  $\int \frac{2}{3 + 2\sin^2 x + 5\cos^2 x} dx$  (4)

33. Prove that,

$$\int_{-a}^a f(x) dx = 2 \int_0^a f(x) dx, \text{ if } f(x) \text{ is even}$$
$$= 0, \quad \text{if } f(x) \text{ is odd} \quad (4)$$

34. A body cools according to Newton's law from  $100^\circ\text{C}$  to  $60^\circ\text{C}$  in 20 minutes.  
The temperature of the surrounding being  $20^\circ\text{C}$ .

How long will it take to cool down to  $40^\circ\text{C}$ ? (4)





Page No. 1/7

Subject Code **J-297**

Seat No.

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E

DATE : 27/06/2026

**SUBJECT : BIOLOGY (56)**

Time : 11.00 - 2.00

DURATION : 3 Hours

TOTAL PAGES : 7

TOTAL MARKS : 70

**General Instructions :**

The question paper is divided into four sections.

- (i) Section A : Q. No. 1 contains Ten multiple choice type of questions carrying one mark each. Evaluation will be done for the first attempt only.  
Q. No. 2 Contains Eight very short answer type of questions carrying one mark each.
- (ii) Section B : Q. No. 3 to 14 are short answer type of questions carrying two marks each. (Attempt any Eight)
- (iii) Section C : Q. No. 15 to 26 are short answer type of questions carrying three marks each. (Attempt any Eight)
- (iv) Section D : Q. No. 27 to 31 are long answer type of questions carrying four marks each. (Attempt any Three)
- (v) Begin the answer of each section on a new page.

**SECTION – A**

Q. 1. Select and write the correct answer for the following multiple choice type of questions :

10

- (i) The microorganism used for production of beverages like wine, whisky, etc. is \_\_\_\_\_.
  - (a) Streptomyces venezuelae
  - (b) Saccharomyces cerevisiae
  - (c) Aspergillus niger
  - (d) Streptomyces griseus



- (ii) Which of the following is NOT a Day Neutral Plant (DNP)?  
(a) Cucumber (b) Tomato  
(c) Cotton (d) Tobacco
- (iii) When food is translocated from phloem to pith, it is called \_\_\_\_ translocation.  
(a) radial (b) tangential  
(c) upward (d) downward
- (iv) Extinction of a host fish leads to extinction of unique parasites of it. This is an example of \_\_\_\_\_.  
(a) Over exploitation (b) Invasion of alien species  
(c) Co-extinction (d) Habitat loss
- (v) Flavr savr tomato is genetically modified variety for improving \_\_\_\_\_.  
(a) shelf life (b) disease resistance  
(c) iron content (d) yield
- (vi) A petridish containing nutrient medium shows tremendous increase in number of bacteria in short time. It is \_\_\_\_ growth.  
(a) slow (b) exponential  
(c) logistic (d) linear
- (vii) Weight loss, increased BMR and protruding eyeballs are the characteristics of \_\_\_\_\_.  
(a) Cretinism (b) Exophthalmic goitre  
(c) Myxodema (d) Simple goitre
- (viii) Charas and ganja are different products obtained from \_\_\_\_\_.  
(a) Papaver somniferum (b) Erythroxylum coca  
(c) Atropa belladonna (d) Cannabis sativa



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- (ix) Select the analogous organs.
- (a) Forelimbs of lizards and birds.
  - (b) Sweet potato and potato.
  - (c) Thorns of Bougainvillea and tendrils of cucurbita.
  - (d) Vermiform appendix and the caecum.
- (x) Which one of the following is an example of primary succession?
- (a) Abandoned agricultural fields grow wild plants.
  - (b) New grasses grown on savanna after a wildfire.
  - (c) Newly formed volcanic island is colonised by Lichens.
  - (d) Miyawaki plantation on hill slopes.

Q. 2. Answer the following questions :

8

- (i) How many meiotic divisions are required to produce 80 male gametes in Angiosperms?
- (ii) Which biological tool in rDNA technology is also called molecular scissors?
- (iii) When turgor pressure is equal to wall pressure of a turgid cell, then what would be the diffusion pressure deficit?
- (iv) What are Long Day Plants (LDP)?
- (v) Which part of human brain is responsible for maintaining body balance?
- (vi) What is the approximate volume of blood pumped out during one cardiac cycle in adult human?
- (vii) Name the milk secreted by mammary gland soon after parturition.
- (viii) Name the causative agent of typhoid.



## SECTION – B

Attempt any EIGHT of the following questions :

16

- Q. 3. Give the properties of water.
- Q. 4. Mention the characteristics of plasmids which make it a good vector.
- Q. 5. Sketch and label the structure of antibody.
- Q. 6. Match the crop and its hybrid variety and rewrite the following :

| Column I    | Column II      |
|-------------|----------------|
| Crop        | Hybrid Variety |
| (i) Rice    | (1) Ganga-3    |
| (ii) Maize  | (2) Niphad     |
| (iii) Jowar | (3) Ratna      |
| (iv) Bajra  | (4) CO-12      |

- Q. 7. Identify the labels-A, B, C and D in the given diagram.



- Q. 8. Considering Griffith experiment, answer the following.
- (a) Name the bacterium used.
- (b) Write conclusion of the experiment.



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9. Write a note on Angina Pectoris.
10. Explain the term plasticity.
11. Sketch and label the Graafian follicle showing theca externa, antrum and corona radiata.
12. Give the skeletal features of *Homo erectus*.
13. Enlist the names of VI, VII, VIII and IX cranial nerves.
14. With the help of graphical representation explain sex determination in honey-bees.

## SECTION – C

Attempt any EIGHT of the following questions :

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15. Write any three characters each of Archaeopteryx showing Reptilian and Avian features.
16. Give an account of cutting and grafting as vegetative reproduction methods.
17. Explain leaching, humification and mineralization as the steps of decomposition process.
18. Describe commensalism giving two examples.
19. With the help of a labelled diagram, describe the structure of root-hair.
20. (a) Write a note on meninges of central nervous system in human being.  
(b) Give functions of cerebrospinal fluid.



- Q. 21. (a) Enlist any four mineral deficiency symptoms seen in plants.  
(b) Give the function of molybdenum as mineral nutrient.

- Q. 22. Match the following from Column-A and Column-B. Write the correct pairs.

| Column A             | Column B                                             |
|----------------------|------------------------------------------------------|
| (i) Anaemia          | (1) Platelet derived growth factor                   |
| (ii) Atherosclerosis | (2) Relaxin                                          |
| (iii) Parturition    | (3) Insulin                                          |
| (iv) Blood clots     | (4) Erythropoietin                                   |
| (v) Cancer           | (5) Tissue plasminogen activator (TPA)               |
| (vi) Diabetes        | (6) Interferons, tumour necrosis factor interleukins |

- Q. 23. Write a note on in situ conservation of biodiversity.
- Q. 24. Explain the phase of menstrual cycle which occurs after ovulation.
- Q. 25. Differentiate between inspiration and expiration during breathing process.
- Q. 26. (a) Give the composition of biogas.  
(b) Enlist the benefits of biogas.

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## SECTION – D

Attempt any THREE of the following questions :

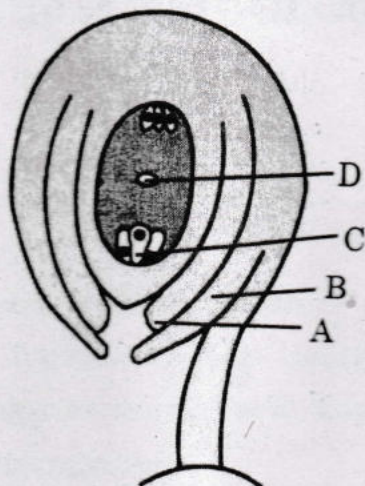
12

- Q. 27. Give location and function of any four valves present in human heart.



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28. Identify A, B, C and D parts in the given diagram of an Angiospermic ovule and give the fate of each part after fertilization:



9. Give an account of different functional areas of cerebrum.

10. (a) Write a note on Holandric genes.

- (b) Complete the following table:

| A                         | B                        |
|---------------------------|--------------------------|
| (i) Monosomy              | (1) <input type="text"/> |
| (ii) <input type="text"/> | (2) $2n-2$               |
| (iii) Trisomy             | (3) <input type="text"/> |
| (iv) <input type="text"/> | (4) $2n+2$               |

- (a) What is DNA profiling?

- (b) Arrange the following steps of DNA profiling in correct sequence:

- |                            |                            |
|----------------------------|----------------------------|
| (i) Selection of DNA probe | (ii) Isolation of DNA      |
| (iii) Gel electrophoresis  | (iv) Hybridization         |
| (v) Southern blotting      | (vi) Restriction digestion |





Page No. 1/8

Subject Code **J-276**

Seat No.

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**E**

DATE : 24/06/2026

Time : 11.00 - 2.00

**SUBJECT : MATHEMATICS & STATISTICS  
(ARTS & SCIENCE) (40)**

DURATION : 3 Hours

TOTAL PAGES : 8

TOTAL MARKS : 80

**General instructions :**

The question paper is divided into FOUR sections.

- (i) Section A : Q.1 contains Eight multiple choice type questions, each carrying Two marks.  
Q. 2 contains Four very short answer type questions, each carrying One mark.
- (ii) Section B : Q.3 to Q. 14 contain Twelve short answer type questions, each carrying Two marks.  
(Attempt any Eight)
- (iii) Section C : Q.15 to Q. 26 contain Twelve short answer type questions, each carrying Three marks.  
(Attempt any Eight)
- (iv) Section D : Q.27 to Q. 34 contain Eight long answer type questions, each carrying Four marks.  
(Attempt any Five)
- (v) Use of log table is allowed. Use of calculator is not allowed.
- (vi) Figures to the right indicate full marks.
- (vii) Use of graph paper is not necessary. Only rough sketch of graph is expected.
- (viii) For each multiple choice type of question, only the first attempt will be considered for evaluation.
- (ix) Start answer to each section on a new page.



## SECTION - A

1. Select and write the correct answer of the following multiple choice type of questions :

16

(i) If  $A = \{1, 2, 3, 4, 5\}$  then which of the following is not true?

(a)  $\exists x \in A$  such that  $x + 3 = 8$

(b)  $\exists x \in A$  such that  $x + 2 < 9$

(c)  $\forall x \in A, x + 6 \geq 9$

(d)  $\forall x \in A, x + 5 \leq 10$

(2)

(ii) The value of  $\sin \left[ \sin^{-1} \left( -\frac{1}{\sqrt{2}} \right) - 3 \sin^{-1} \left( \frac{\sqrt{3}}{2} \right) \right] =$

(a)  $-\frac{1}{\sqrt{2}}$

(b)  $\frac{1}{\sqrt{2}}$

(c)  $\frac{\sqrt{3}}{2}$

(d)  $-\frac{\sqrt{3}}{2}$

(2)

(iii) If  $\hat{p}, \hat{q}, \hat{r}$  are mutually perpendicular unit vectors and form a right handed triplet then the value of  $\hat{p} \cdot (\hat{q} \times \hat{r}) + \hat{q} \cdot (\hat{p} \times \hat{r}) + \hat{r} \cdot (\hat{p} \times \hat{q}) = \dots\dots\dots$

(a) -2

(b) 0

(c) 1

(d) 3

(2)

(iv) The Cartesian equation of the line passing through the points  $A(3, 4, -1)$  and  $B(2, -1, 3)$  is \_\_\_\_\_.

(a)  $\frac{x+3}{1} = \frac{y-4}{5} = \frac{z+1}{-4}$

(b)  $\frac{x-3}{-1} = \frac{y-4}{-5} = \frac{z+1}{-4}$

(c)  $\frac{x-3}{-1} = \frac{y-4}{-5} = \frac{z+1}{4}$

(d)  $\frac{x-3}{-1} = \frac{y-4}{5} = \frac{z+1}{-4}$

(2)



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(v) If  $y = \log_x a$  then  $\frac{dy}{dx} = \underline{\hspace{2cm}}$ .

(a)  $\frac{-\log a}{x(\log x)^2}$

(b)  $x \log a$

(c)  $-\frac{1}{\log_x a}$

(d)  $\frac{1}{x \log a}$

(2)

(vi) If  $f(x) = \frac{\sin^{-1} x}{\sqrt{1-x^2}}$  and  $g(x) = e^{\sin^{-1} x}$  then

$\int f(x) \cdot g(x) dx = \underline{\hspace{2cm}}$ .

(a)  $e^{\sin^{-1} x} (1 - \sin^{-1} x) + c$

(b)  $e^{\sin^{-1} x} (\sin^{-1} x - 1) + c$

(c)  $e^{\sin^{-1} x} (\sin^{-1} x + 1) + c$

(d)  $e^{\cos^{-1} x} (\cos^{-1} x - 1) + c$

(2)

(vii) The area bounded by the line  $y = 2x$ ,  $X$ -axis and the lines  $x = -1$ ,  $x = 4$  is  $\underline{\hspace{2cm}}$  sq. units.

(a) 15

(b) 17

(c) 16

(d) 14

(2)

(viii) In a Binomial Distribution,  $E(X) = 6$ ,  $\text{Var}(X) = 4.2$  then the value of  $n$  is  $\underline{\hspace{2cm}}$

(a) 22

(b) 24

(c) 20

(d) 26

(2)

Q. 2. Answer the following questions :

4

(i) Write the dual of  $p \wedge t$

(1)

(ii) What is the distance of point  $(3, -5, 6)$  from  $XZ$  plane?

(1)



- (iii) The displacement of a particle at time
- $t$
- is given by

$$S = 3t^2 + 4t + 1. \text{ Find its velocity at time } t. \quad (1)$$

- (iv) Write the order of differential equation

$$\left(\frac{d^2y}{dx^2}\right)^{\frac{5}{2}} = 3\sqrt{\frac{dy}{dx}} \quad (1)$$

## SECTION – B

Attempt any EIGHT of the following questions :

16

- Q. 3. Construct the switching circuit for the statement
- $(\sim p \wedge q) \vee (p \wedge \sim r)$
- . (2)

- Q. 4. Find the matrix of cofactors of matrix
- $\begin{bmatrix} 5 & 2 \\ -1 & 6 \end{bmatrix}$
- . (2)

- Q. 5. Find the general solution of equation
- $\cos 5\theta = \frac{1}{2}$
- . (2)

- Q. 6. Find the value of
- $k$
- , if
- $2x + y = 0$
- is one of the lines represented by
- $3x^2 + kxy + 2y^2 = 0$
- . (2)

- Q. 7. If
- $\vec{a}, \vec{b}, \vec{c}$
- are the position vectors of points
- $A, B, C$
- respectively and
- $10\vec{a} = 7\vec{b} + 3\vec{c}$
- then find the ratio in which the point
- $C$
- divides the line segment
- $AB$
- . (2)

- Q. 8. Find the angle between the lines

$$\vec{r} = (\hat{i} + 2\hat{j} + 3\hat{k}) + \lambda(2\hat{i} - \hat{j} + \hat{k})$$

$$\vec{r} = (\hat{i} + 2\hat{j} + 3\hat{k}) + \mu(\hat{i} + 2\hat{j} + \hat{k}) \quad (2)$$

- Q. 9. Test whether the function
- $f(x) = x - \frac{1}{x}, x \in R, x \neq 0$
- is increasing or decreasing. (2)



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10. Evaluate :  $\int_{-1}^1 |x| dx$  (2)

11. Evaluate :  $\int x \log x dx$  (2)

12. Find the area bounded by curve  $x^2 + y = 0$ ,  $X$ -axis and lines  $x = 1$  and  $x = 4$ . (2)

13. The probability distribution of r.v.  $X$  is as follows:

|            |     |     |      |      |     |
|------------|-----|-----|------|------|-----|
| $X = x$    | 0   | 1   | 2    | 3    | 4   |
| $P(X = x)$ | 0.1 | $k$ | $2k$ | $2k$ | $k$ |

Find : (i)  $k$  (ii)  $F(2)$  (2)

14. Evaluate :  $\int \frac{e^x(1+x)}{\cos^2(xe^x)} dx$  (2)

## SECTION – C

Attempt any EIGHT of the following questions :

24

15. Using truth table, determine whether statement pattern

$[(p \vee q) \wedge \sim p] \wedge \sim q$  is a tautology or a contradiction or a contingency. (3)

16. Prove that :

$$\sin^{-1}\left(\frac{3}{5}\right) + \cos^{-1}\left(\frac{12}{13}\right) = \sin^{-1}\left(\frac{56}{65}\right) \quad (3)$$

17. In  $\triangle ABC$ , if  $a = 10$ ,  $b = 8$ ,  $c = 6$  then find the value of

(i)  $\sin\left(\frac{C}{2}\right)$  (ii)  $\cos\left(\frac{B}{2}\right)$  (3)



Q. 18. Are the four points  $A(1, 2, 1)$ ,  $B(2, -3, 4)$ ,  $C(3, 4, -5)$ ,  $D(2, 3, -2)$  coplanar? Justify your answer. (3)

Q. 19. Find the distance between parallel lines

$$\frac{x}{2} = \frac{y}{-1} = \frac{z}{2} \text{ and}$$

$$\frac{x+1}{2} = \frac{y-1}{-1} = \frac{z+1}{2} \quad (3)$$

Q. 20. Find the vector equation of the plane passing through the points  $A(2,1,1)$ ,  $B(0,2,3)$  and  $C(4,5,6)$ . (3)

Q. 21. If  $y = \log \left[ \frac{x + \sqrt{x^2 + a^2}}{\sqrt{x^2 + a^2} - x} \right]$ , find  $\frac{dy}{dx}$ . (3)

Q. 22. A wire of length 36 cm is bent to form a rectangle. Find its dimensions, if the area of the rectangle is maximum. (3)

Q. 23. Verify Rolle's theorem for the function  $f(x) = x^2 - 5x + 9$ ,  $x \in [1, 4]$  (3)

Q. 24. Solve the differential equation  $x \frac{dy}{dx} - \sqrt{x^2 + y^2} = y$  (3)

Q. 25. The following is the p.d.f. of continuous r.v.

$$f(x) = \frac{x}{8}; \quad 0 < x < 4$$

$$= 0, \quad \text{Otherwise}$$

Find (i) expression for c.d.f of  $X$ .

(ii)  $F(x)$  at 0.5 and 5 (3)



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If the p.m.f of r.v.  $X$  be

$$P(X=x) = {}^4C_x \left(\frac{5}{9}\right)^x \left(\frac{4}{9}\right)^{4-x} \quad \text{for } x=0,1,2,3,4$$

$$= 0 \quad ; \quad \text{otherwise}$$

then find  $E(X)$  and  $\text{Var}(X)$ .

(3)

## SECTION – D

Attempt any FIVE of the following questions :

20

Find the inverse of matrix  $\begin{bmatrix} -4 & -3 & -3 \\ 1 & 0 & 1 \\ 4 & 4 & 3 \end{bmatrix}$  (4)

Prove that the homogeneous equation of degree two in  $x$  and  $y$ ,  
 $ax^2 + 2hxy + by^2 = 0$  represents a pair of lines passing through  
 the origin if  $h^2 - ab \geq 0$  (4)

Prove that, if  $\vec{a}, \vec{b}, \vec{c}$  are three non coplanar vectors then any vector  $\vec{r}$  in  
 the space can be uniquely expressed as a linear  
 combination of  $\vec{a}, \vec{b}, \vec{c}$ . (4)

Solve the linear programming problem (L.P.P.) by graphical method.

Minimize :  $z = 8x + 10y$

Subject to ,  $2x + y \geq 7$

$$2x + 3y \geq 15$$

$$x \geq 0$$

$$y \geq 2$$

(4)



1. If  $x = f(t)$  and  $y = g(t)$  are differentiable functions of  $t$ , so that  $y$  is

differentiable function of  $x$  and  $\frac{dx}{dt} \neq 0$  then prove that  $\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}}$ .

Hence find  $\frac{dy}{dx}$ , if  $x = \sin t$   $y = \cos t$ . (4)

2. Evaluate :  $\int \frac{2}{3+2\sin^2 x + 5\cos^2 x} dx$  (4)

3. Prove that,

$$\int_{-a}^a f(x) dx = 2 \int_0^a f(x) dx, \text{ if } f(x) \text{ is even}$$

$$= 0, \quad \text{if } f(x) \text{ is odd} \quad (4)$$

4. A body cools according to Newton's law from  $100^\circ\text{C}$  to  $60^\circ\text{C}$  in 20 minutes.

The temperature of the surrounding being  $20^\circ\text{C}$ .

How long will it take to cool down to  $40^\circ\text{C}$ ? (4)

