

# CAREER POINT

## MOCK TEST PAPER for IIT JEE (Advanced)

### PAPER-1

#### Physics, Chemistry & Mathematics

Time : 3 Hours

Maximum Marks : 180

#### IMPORTANT INSTRUCTIONS

##### A. GENERAL :

1. Please read the instructions given for each question carefully and mark the correct answers against the question numbers on the answer sheet in the respective subjects.
2. The answer sheet, a machine readable Optical Mark Recognition (OMR) is provided separately.
3. Do not break the seal of the question-paper booklet before being instructed to do so by the invigilators.

##### B. MARKING SCHEME :

Each subject in this paper consists of following types of questions:-

###### SECTION - I

4. Multiple choice questions with **multiple** correct answer. **3 marks** will be awarded for each correct answer and **NO negative marking** for wrong answer.

###### SECTION - II

5. Numerical response questions. **3 marks** will be awarded for each correct answer and **NO negative marking** for wrong answer. Answers to this Section are to be given in the form of **single digit integer type**.

This paper does not consist of **Section-II**.

##### C. FILLING THE OMR :

6. Fill your Name, Roll No., Batch, Course and Centre of Examination in the blocks of OMR sheet and darken circle properly.
7. Use only HB pencil or blue/black pen (avoid gel pen) for darkening the bubbles.
8. While filling the bubbles please be careful about **SECTIONS** [i.e. **Section-I** (include single correct, reason type, multiple correct answers), **Section-II** (column matching type), **Section-III** (include integer answer type)]

For example if only 'A' choice is correct then, the correct method for filling the bubbles is

A	B	C	D
●	○	○	○

For example if only 'A & C' choices are correct then, the correct method for filling the bubbles is

A	B	C	D
●	○	●	○

the wrong method for filling the bubble are

⊙	⊗	◐	◑
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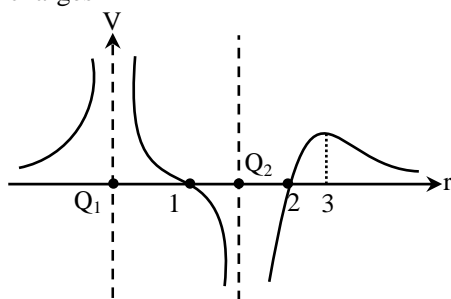
SEAL

# PHYSICS

## Section – I [Q.1 to Q.10]

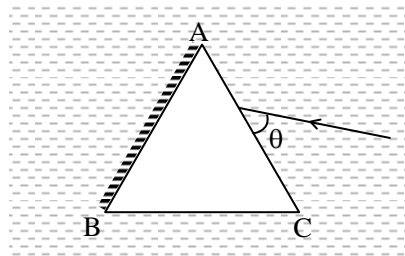
Questions 1 to 10 are multiple choice questions. Each question has four choices (A), (B), (C) and (D), out of which ONE or MORE may be correct. Mark your response in OMR sheet against the question number of that question. +3 marks will be given for each correct answer and NO NEGATIVE marks for wrong answer.

**Q.1** Two point charges  $Q_1$  &  $Q_2$  are positioned at a certain distance from each other. The curves in the figure represent the distribution of potential along the straight line connecting the two charges



- (A) E at 1 is zero
- (B) E at 3 is zero
- (C)  $Q_2$  and  $Q_1$  are negative and positive respectively
- (D)  $|Q_1| > |Q_2|$

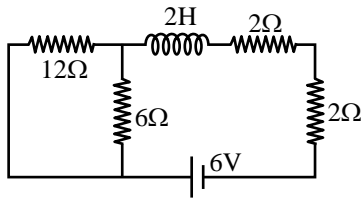
**Q.2** In equilateral prism ABC (polished at its surface AB) is surrounded by liquid of refractive index  $\mu$ . A ray is incident on its face AC as shown. Refractive index of the material of prism is  $\frac{3}{2}$ . Choose the correct statement(s).



- (A)  $\theta$  for which the ray retrace back its path is  $\sin^{-1}\left(\frac{3\sqrt{3}}{4\mu}\right)$
- (B)  $\theta$  for which the ray retrace back the path is  $\cos^{-1}\left(\frac{3\sqrt{3}}{4\mu}\right)$
- (C) For  $\theta = 45^\circ$ ,  $\mu = \frac{3}{2\sqrt{2}}$ , deviation of the ray finally emerging out of the prism is  $150^\circ$
- (D) For  $\theta = 45^\circ$ ,  $\mu = \frac{3}{2\sqrt{2}}$  deviation of the ray finally emerging out of the prism is  $0^\circ$

*Space for rough work*

Q.3

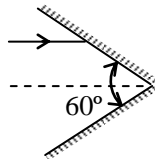


In the circuit shown in the figure -

- (A) Its time constant is  $\frac{1}{4}$  sec
- (B) Its time constant is 4 sec
- (C) In steady state current through battery will be equal to 0.75 A
- (D) In steady state current through inductance will be equal to 0.75A

Q.4

Two very large plane mirrors shown in figure are making an angle of  $60^\circ$  to each other. A light ray falls on one of the mirrors as shown in figure. The light ray is incident parallel to angular bisector of mirrors. Then-



- (A) light ray undergoes three reflection
- (B) light ray undergoes two reflection
- (C) deviation produced in the light ray after all reflections is  $\frac{4\pi}{3}$
- (D) deviation produced in the light ray after all reflections is  $\pi$

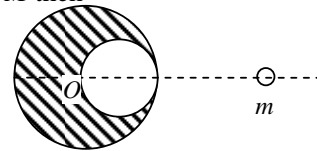
Q.5

An explosive of mass 6 kg is projected at 35 m/sec at an angle of  $60^\circ$  with the horizontal. At the top of its flight it explodes, breaking into two parts, one of which has twice the mass of the other. The two fragments land simultaneously. The lighter fragment lands back to launch point- ( $g = 9.8 \text{ m/s}^2$ )

- (A) heavier fragment lands at 162 m from launch point.
- (B) position of centre of mass will be at 108 m from point of projection
- (C) kinetic energy will remain constant in this process.
- (D) kinetic energy will increase due to explosion by 5512 J

Q.6

A spherical cavity is made in a uniform solid sphere of radius  $R$  such that its surface touches the outside surface of the sphere and passes through the centre of original sphere as shown below. Now a particle of mass  $m$  is kept at a distance  $2R$  from the centre. If mass of original sphere is  $M$  then -



- (A) net gravitational force on  $m$  is  $\frac{GMm}{36R^2}$
- (B) net gravitational force on  $m$  is  $\frac{7}{36} \frac{GMm}{R^2}$
- (C) gravitational field intensity inside cavity is zero
- (D) if we neglect the presence of  $m$  then gravitation field inside cavity is constant

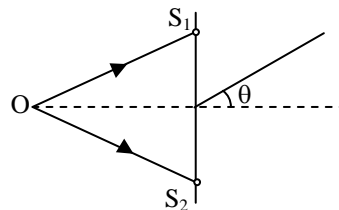
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- Q.7** A uniform disc of mass 2kg and radius 1m is mounted on an axle supported on fixed frictionless bearings. A light chord is wrapped around the rim of the disc and mass of 1kg is tied to the free end. If it is released from rest-
- (A) the tension in the chord is 5N  
 (B) in first four seconds the angular displacement of the disc is 40 rad  
 (C) the work done by the torque on the disc in first four seconds is 200J  
 (D) the increase in the kinetic energy of the disc in the first four seconds is 200J

- Q.8** Temperature of 1000 grams of nitrogen is raised from  $-20^{\circ}\text{C}$  to  $100^{\circ}\text{C}$  at constant pressure. Given: specific heat at constant volume  $C_v = 5 \text{ cal/mole } ^{\circ}\text{C}$  and  $R = 2 \text{ Cal/mole } ^{\circ}\text{C}$
- (A) Heat required in the process is 30 K Cal  
 (B) Increase in the internal energy of gas is 21 Kcal  
 (C) If process is at constant volume then heat required is 21 Kcal  
 (D) external work done is 10 KCal

- Q.9** A transverse sinusoidal wave of amplitude  $a$ , wavelength  $\lambda$  and frequency  $f$  is traveling on a stretched string. The maximum speed of any point on the string is  $v/10$ , where  $v$  is the speed of propagation of the wave. If  $a = 10^{-3} \text{ m}$  and  $v = 10 \text{ m/s}$ , then  $\lambda$  and  $f$  are given by-
- (A)  $\lambda = 2\pi \times 10^{-2} \text{ m}$       (B)  $\lambda = 10^{-3} \text{ m}$   
 (C)  $f = \frac{10^3}{2\pi} \text{ Hz}$       (D)  $f = 10^4 \text{ Hz}$

- Q.10** In a modified YDSE experiment if point source of monochromatic light O is placed in such a manner that  $OS_1 - OS_2 = \frac{\lambda}{4}$  where  $\lambda$  is wavelength of light and  $S_1, S_2$  are slits separated by distance  $2\lambda$ . Then value/s of  $\theta$  for which a maxima is obtained will be -



- (A)  $\sin^{-1}(1/8)$       (B)  $\sin^{-1}(-1/4)$   
 (C)  $\sin^{-1}(5/6)$       (D)  $\sin^{-1}(-7/8)$

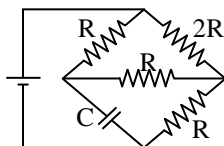
**Section – II [Q.1 to Q.10]**

**This section contains 10 questions (Q.1 to 10). +3 marks will be given for each correct answer and No Negative mark for wrong answer. The answer to each of the questions is a SINGLE-DIGIT INTEGER, ranging from 0 to 9. The appropriate bubbles below the respective question numbers in the OMR have to be darkened. For example, if the correct answers to question numbers X, Y, Z and W (say) are 6, 0, 9 and 2, respectively, then the correct darkening of bubbles will look like the following :**

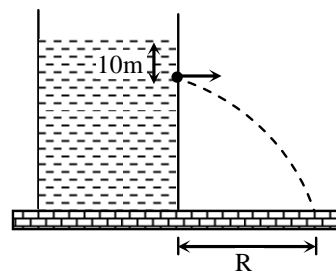
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	X	Y	Z	W
①	①	①	①	①
②	②	②	②	②
③	③	③	③	③
④	④	④	④	④
⑤	⑤	⑤	⑤	⑤
⑥	⑥	⑥	⑥	⑥
⑦	⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨

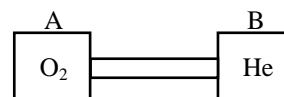
- Q.1** In the circuit shown,  $R = 1 \text{ k}\Omega$ ,  $C = 10 \text{ mF}$ . The terminal voltage of the battery is  $a \times 10$  if the condenser stores  $4.5 \text{ J}$  energy after it was charged in steady state, determine the value of  $a$ .



- Q.2** A large tank is filled with water (density =  $10^3 \text{ kg/m}^3$ ). A small hole is made at a depth  $10 \text{ m}$  below water surface. The range of water issuing out of the hole is  $R$  on ground. What extra pressure (in atm) must be applied on the water surface so that the range becomes  $2R$  :  
(take  $1 \text{ atm} = 10^5 \text{ Pa}$  and  $g = 10 \text{ m/s}^2$ )



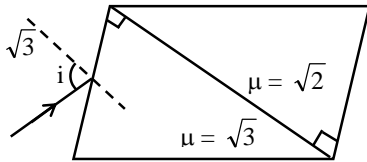
- Q.3** Two containers A and B are connected by a conducting solid cylindrical rod of length  $\frac{242}{7}$  cm and radius  $\sqrt{8.3}$  cm. Thermal conductivity of the rod is  $693 \text{ watt/mole-K}$ . The container A contains two mole of oxygen gas and the container B contains four mole of helium gas. At time  $t = 0$  temperature difference of the containers is  $50^\circ\text{C}$ , after what time (in seconds) temperature difference between them will be  $25^\circ\text{C}$ . Transfer of heat takes place through the rod only. Neglect radiation loss. Take  $R = 8.3 \text{ J/mole-K}$  and  $\pi = \frac{22}{7}$ .



*Space for rough work*

**Q.4** An observer is moving towards a source with speed 15 m/s. The source is moving with speed 5 m/s in the same direction. Air is blowing with speed 10 m/s from observer to source. If frequency of sound emitted is 325 Hz then frequency (in Hz) of sound heard by observer (velocity of sound in air = 330 m/s) minus 330 Hz will be equal to –

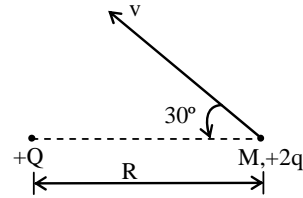
**Q.5** A ray of light from a liquid ( $\mu = \sqrt{3}$ ) is incident on a system of two right angled prism of refractive indices  $\sqrt{3}$  &  $\sqrt{2}$  as shown. The ray suffers zero deviation when emerges into air from CD. The angle of incidence  $i$  is ....  $\times 9^\circ$ .



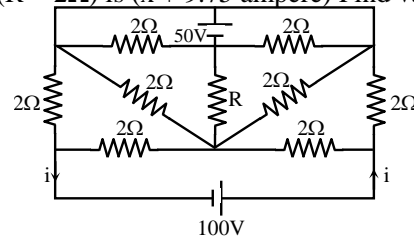
**Q.6**  $^{23}\text{Ne}$  decays to  $^{23}\text{Na}$  by negative beta emission. Mass of  $^{23}\text{Ne}$  is 22.994465 amu mass of  $^{23}\text{Na}$  is 22.989768 amu. The maximum kinetic energy of emitted electrons neglecting the kinetic energy of recoiling product nucleus is .....MeV

**Q.7** A 100 eV electron collides with a stationary helium ion ( $\text{He}^+$ ) in its ground state and exits to a higher level. After the collision,  $\text{He}^+$  ions emits two photons in succession with wavelength 1085 Å and 304 Å. Calculate the energy of the electron after the collision (in  $10^{-1}$  eV). Given  $h = 6.63 \times 10^{-34}$  Js.

**Q.8** In the diagram shown, the charge + Q is fixed. Another charge +2q, is projected from a distance R from the fixed charge. Minimum separation between two charges if the velocity becomes  $\frac{1}{\sqrt{3}}$  times of the projected velocity at this moment is (assume gravity to be present) in cm (R = 10cm given)-



**Q.9** Each resistance is of  $2\Omega$ . Current in resistance R ( $R = 2\Omega$ ) is  $(x + 9.75 \text{ ampere})$  Find value of x.



**Q.10** A swimmer jumps from a bridge over a canal and swims 1 km up stream. After that first km, he passes a floating cork. He continues swimming for half an hour and then turns around and swims back to the bridge. The swimmer and the cork reach the bridge at the same time. The swimmer has been swimming at a constant speed. How fast does the water in the canal flow in km/hr.

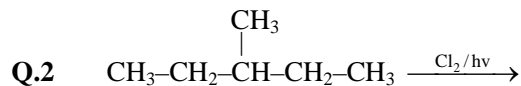
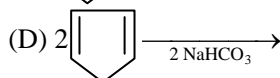
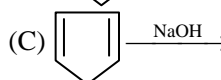
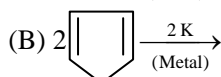
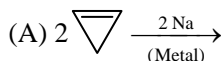
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# CHEMISTRY

## Section – I [Q.1 to Q.10]

Questions 1 to 10 are multiple choice questions. Each question has four choices (A), (B), (C) and (D), out of which ONE or MORE may be correct. Mark your response in OMR sheet against the question number of that question. +3 marks will be given for each correct answer and NO NEGATIVE marks for wrong answer.

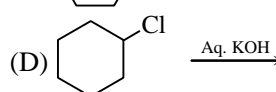
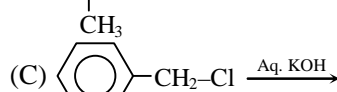
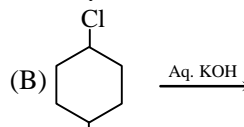
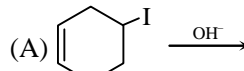
**Q.1** In which of the following reactions H<sub>2</sub> gas is liberated -



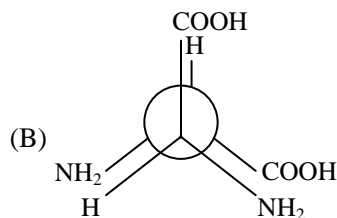
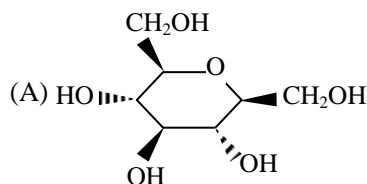
What is correct -

- (A) total four products are formed including stereoisomer
- (B) total 8 product are formed including stereoisomer
- (C) 4 Enantiomeric pair are formed
- (D) major product is 2° halide

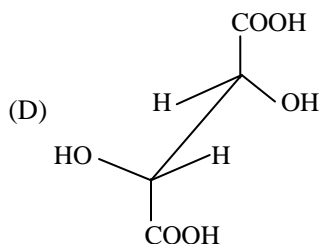
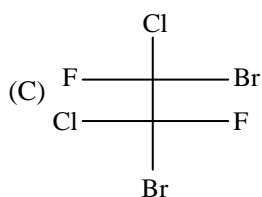
**Q.3** Which of the following gives same product with SN<sub>1</sub> & SN<sub>2</sub> reaction (including stereo product) -



**Q.4** Which of the following is/are a meso compound



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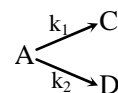
- Q.5** Indicate the **correct** statements:
- (A) Conductivity cells have cell constant values independent of the solution filled into the cell.
  - (B) DC (direct current) is not used for measuring the resistance of a solution.
  - (C) Kohlrausch law is valid both for strong and weak electrolytes.
  - (D) The  $k$  decreases but  $\lambda_M$  and  $\lambda_E$  increase on dilution.

- Q.6** A 1 litre solution of  $\text{pH} = 1$  diluted upto 10 times. What volume of a solution with  $\text{pH} = 2$  is to be added in diluted solution so that  $\text{pH}$  does not change :
- (A) 1 litre
  - (B) 10 litre
  - (C) 100 litre
  - (D) 25 litre

- Q.7** Two liquids A and B form an ideal solution. The solution has a vapor pressure of 700 Torr at  $80^\circ\text{C}$ . It is distilled till  $2/3^{\text{rd}}$  of the solution is collected as condensate. The composition of the condensate is  $x'_A = 0.75$  and that of the residue is  $x''_A = 0.30$ . If the vapor pressure of the residue at  $80^\circ\text{C}$  is 600 Torr, which of the following is/ are true?

- (A) The composition of the original liquid was  $x_A = 0.6$ .
- (B) The composition of the original liquid was  $x_A = 0.4$ .
- (C)  $P_A^\circ = \frac{2500}{3}$  Torr.
- (D)  $P_B^\circ = 500$  Torr.

- Q.8** Consider the following case of competing 1<sup>st</sup> order reactions



After the start of the reaction at  $t = 0$  with only A, the  $[C]$  is equal to the  $[D]$  at all times. The time in which all three concentrations will be equal is given by

- (A)  $t = \frac{1}{2k_1} \ln 3$
- (B)  $t = \frac{1}{2k_2} \ln 3$
- (C)  $t = \frac{1}{3k_1} \ln 2$
- (D)  $t = \frac{1}{3k_2} \ln 2$

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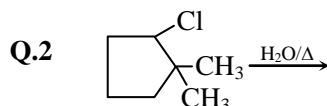
- Q.9** Chloride of an element is given by the formula  $MCl_x$  and it is 100% ionised in 0.01 M aqueous solution. Then
- (A) if  $[Cl^-] = 0.03$  M then the value of x is 3  
 (B) if  $[Cl^-] = 0.05$  M then the value of x is 5  
 (C)  $[M^{x+}] = 0.01$  M, irrespective of  $[Cl^-]$   
 (D)  $[M^{x+}]$  depends on  $[Al^-]$

- Q.10** Solid ammonium carbamate,  $NH_4CO_2NH_2(s)$  dissociates into ammonia and carbon dioxide when it evaporates as shown by
- $$NH_4CO_2NH_2(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$$
- At  $25^\circ C$ , 'the total pressure of the gases in equilibrium with the solid is 0.116 atm. If 0.1 atm of  $CO_2$  is introduced after equilibrium is reached then :
- (A) final pressure of  $CO_2$  will be less than 0.1 atm  
 (B) final pressure of  $CO_2$  will be more than 0.1 atm  
 (C) pressure of  $NH_3$  will decrease due to addition of  $CO_2$   
 (D) pressure of  $NH_3$  will increase due to addition of  $CO_2$

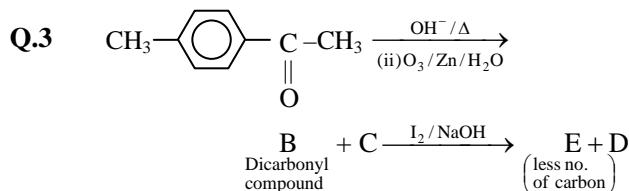
## Section – II [Q.1 to Q.10]

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**Q.1** Total possible structural isomers of  $C_3H_6O$  are



How many  $3^\circ$  alcohol are obtain as product (including stereoisomer) ?

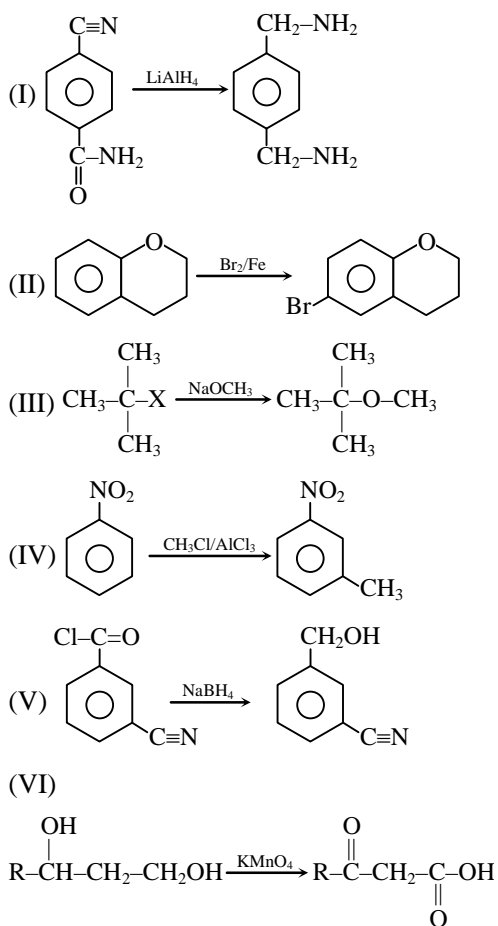


How many statement are correct for this sequence

(i) Reactant can give bisulphite adduct.  
 (ii) D is also one of the product of cannizaro reaction of Benzaldehyde  
 (iii) B give Tollen's reagent Test.  
 (iv) C gives iodoform test.

*Space for rough work*

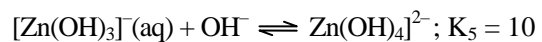
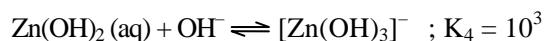
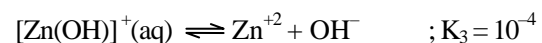
**Q.4** How many reaction are correctly matched for major product



**Q.5** The electrolysis of cold sodium chloride solution produces NaOH and Cl<sub>2</sub>. The Cl<sub>2</sub> produced, disproportionates into NaOH solution to give sodium hypochlorite (NaClO) and sodium chloride. How long will a cell operate to produce 1.00 × 10<sup>3</sup> L of 7.45 % (w/w) solution of NaClO if the cell current is 9.65 ampere? Assume that the density of solution is 1.00 gm/ml.

[Fill your answer by multiplying it with 10<sup>-7</sup>]

**Q.6** Given :

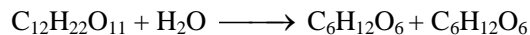


Find out the negative of logarithm of the solubility of solid Zn(OH)<sub>2</sub> at 25°C at pH = 6.

Consider Zn(OH)<sub>2</sub> makes saturated solution at 25°C.

*Space for rough work*

**Q.7** 0.0125 mole of sucrose is dissolved in 100 gm of water and it undergo inversion according to following equation



If elevation in boiling point of solution is

0.104°C. Calculate  $\left(\frac{1}{10}\right)^{\text{th}}$  of mole percentage

of sugar inverted ( $K_b$  for  $\text{H}_2\text{O} = 0.52$ ).

**Q.8** The graph between  $\log k$  and  $\frac{1}{T}$  [ $K$  is rate constant ( $\text{sec}^{-1}$ ) and  $T$  the temperature (K)] is a straight line with  $OX = 5$  and  $\theta = \tan^{-1}\left(\frac{-1}{2.303}\right)$ . Calculate the value of  $E_a$  is.....cal.

**Q.9** Polychlorinated biphenyls, PCBs, known to be dangerous environmental pollutants, are a group of compounds with the general empirical formula  $\text{C}_{12}\text{H}_m\text{Cl}_{10-m}$  where  $m$  is an integer. What is the value of  $m$ , if percentage of carbon atom in the compound is 40 ?

**Q.10** How many P–O–P bonds are present in tricyclometaphosphoric acid,  $(\text{HPO}_3)_3$ ?

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*Space for rough work*

# MATHEMATICS

## Section – I [Q.1 to Q.10]

Questions 1 to 10 are multiple choice questions. Each question has four choices (A), (B), (C) and (D), out of which ONE or MORE may be correct. Mark your response in OMR sheet against the question number of that question. +3 marks will be given for each correct answer and NO NEGATIVE marks for wrong answer.

**Q.1**  $f(x) = \frac{[x]+1}{\{x\}+1}$  for  $f : \left[0, \frac{5}{2}\right) \rightarrow \left(\frac{1}{2}, 3\right]$ , where

[.] represents greatest integer function and {.} represents fractional part of x, then which of the following is true.

- (A) f(x) is injective discontinuous function
- (B) f(x) is surjective non differentiable function
- (C)  $\min\left(\lim_{x \rightarrow 1^-} f(x), \lim_{x \rightarrow 1^+} f(x)\right) = f(1)$
- (D)  $\max(x \text{ values of point of discontinuity}) = f(1)$

**Q.2** Let e be eccentricity of a hyperbola  $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$  and f(e) be eccentricity of conjugate hyperbola  $-\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  then  $\int_1^3 \underbrace{fff \dots f(e)}_{n \text{ times}} de$  is equal to

- (A) 2 if n is even
- (B) 4 if n is even
- (C)  $2\sqrt{2}$  if n is odd
- (D)  $4\sqrt{2}$  if n is odd

**Q.3** If the tangent to the ellipse  $x^2 + 4y^2 = 16$  at P( $\theta$ ) is a normal to circle  $x^2 + y^2 - 8x - 4y = 0$ . Then  $\theta$  equals -

- (A)  $\frac{\pi}{2}$
- (B)  $\frac{\pi}{4}$
- (C) 0
- (D)  $-\frac{\pi}{4}$

**Q.4** The solution to differential equation  $\sin\left(x \frac{dy}{dx}\right) \cos y = \frac{dy}{dx} + \sin y \cos\left(x \frac{dy}{dx}\right)$  is

- (A)  $y = 0$
- (B)  $cx^2 - y = \sin^{-1}x$
- (C)  $cx - y = \sin^{-1}c$
- (D)  $y = \sqrt{x^2 - 1} - \sin^{-1} \frac{\sqrt{x^2 - 1}}{x}$

Space for rough work

**Q.5** Let  $f(x)$  is a real valued function defined by  
 $f(x) = x^2 + x^2 \int_{-1}^1 t f(t) dt + x^3 \int_{-1}^1 f(t) dt$  then  
 which of following hold(s) good ?

- (A)  $\int_{-1}^1 t f(t) dt = \frac{10}{11}$   
 (B)  $f(1) + f(-1) = \frac{30}{11}$   
 (C)  $\int_{-1}^1 t f(t) dt > \int_{-1}^1 f(t) dt$   
 (D)  $f(1) - f(-1) = \frac{20}{11}$

**Q.6** Let the unit vector  $\vec{a}$  &  $\vec{b}$  are perpendicular and the unimoduli vector  $\vec{c}$  inclined at an angle  $\alpha$  to  $\vec{a}$  &  $\vec{b}$ . If  $\vec{c} = \ell \vec{a} + m \vec{b} + n(\vec{a} \times \vec{b})$  then

- (A)  $\ell = m$   
 (B)  $n^2 = 1 - 2\ell^2$   
 (C)  $n^2 = -\cos 2\alpha$   
 (D)  $m^2 = \frac{1 + \cos 2\alpha}{2}$

**Q.7** The sides of a right triangle  $T_1$  are 20,  $x$  and hypotenuse  $y$ . The sides of another right triangle  $T_2$  are 30,  $x - 5$  and hypotenuse  $y + 5$ . If  $P_1$  and  $P_2$  are the radii of the circles inscribed and  $\Delta_1$  and  $\Delta_2$  are the areas of the triangles  $T_1$  and  $T_2$  respectively then which of the following hold good ?

- (A)  $6\Delta_1 = 5\Delta_2$                       (B)  $8\Delta_1 = 7\Delta_2$   
 (C)  $P_1 = P_2$                               (D)  $2P_1 = P_2$

**Q.8** If two concentric ellipses be such that the foci of one be on the other and their major axes are equal. Let  $e_1$  and  $e_2$  be their eccentricities, then

- (A) the quadrilateral formed by joining the foci of the 2 ellipses is a parallelogram  
 (B) the angle  $\theta$  between their axes is given by,

$$\cos \theta = \sqrt{\frac{1}{e_1^2} + \frac{1}{e_2^2} - \frac{1}{e_1^2 e_2^2}}$$

- (C) if  $e_1^2 + e_2^2 = 1$  then the angle between the axes of the 2 ellipses is  $90^\circ$   
 (D) none of these

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*Space for rough work*

**Q.9** If  $f(x) = \lim_{n \rightarrow \infty} e^{x \tan(1/n) \ln(1/n)}$  and

$$\int \frac{f(x)}{\sqrt[3]{(\sin^{11} x \cos x)}} dx = g(x) + c, \text{ then}$$

(A)  $g\left(\frac{\pi}{4}\right) = \frac{3}{2}$

(B)  $g(x)$  is continuous for all  $x$

(C)  $g\left(\frac{\pi}{4}\right) = -\frac{15}{8}$

(D)  $g(x)$  is non differentiable at infinitely many points

**Q.10** Let  $f_1(x) = x, f_2(x) = 1 - x; f_3(x) = \frac{1}{x}$ ,

$$f_4(x) = \frac{1}{1-x}; f_5(x) = \frac{x}{x-1}; f_6(x) = \frac{x-1}{x}.$$

Suppose that  $f_6(f_m(x)) = f_4(x)$  and  $f_n(f_4(x)) = f_3(x)$  then

(A)  $m = 5$                       (B)  $n = 5$

(C)  $m = 6$                       (D)  $n = 6$

**Section – II [Q.1 to Q.10]**

This section contains 10 questions (Q.1 to 10). +3 marks will be given for each correct answer and No Negative mark for wrong answer. The answer to each of the questions is a SINGLE-DIGIT INTEGER, ranging from 0 to 9. The appropriate bubbles below the respective question numbers in the OMR have to be darkened. For example, if the correct answers to question numbers X, Y, Z and W (say) are 6, 0, 9 and 2, respectively, then the correct darkening of bubbles will look like the following :

	X	Y	Z	W
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

**Q.1** If  $\vec{a}' = \hat{i} + \hat{j}, \vec{b}' = \hat{i} - \hat{j} + 2\hat{k}$  &  $\vec{c}' = 2\hat{i} + \hat{j} - \hat{k}$ . Then altitude of the parallelopiped formed by the vectors  $\vec{a}, \vec{b}, \vec{c}$  having base formed by  $\vec{b}$  &  $\vec{c}$  is  $\frac{1}{\sqrt{k}}$  then k is ( $\vec{a}, \vec{b}, \vec{c}$  and  $\vec{a}', \vec{b}', \vec{c}'$  are reciprocal systems of vectors)

*Space for rough work*

**Q.2** Let  $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$  and  $B = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$  are two matrices such that  $AB = BA$  and  $c \neq 0$ , then value of  $\frac{d-a}{3b-c}$  is

**Q.3** Let  $E(n)$  denotes sum of even digits of  $N$ , for example  $E(5681) = 6 + 8 = 14$ . Find  $\frac{E(1) + E(2) + E(3) + \dots + E(100)}{100}$

**Q.4**  $\lim_{x \rightarrow \infty} \frac{\sum_{r=1}^{10} (x+r)^{2010}}{(x^{1006} + 1)(2x^{1004} + 1)}$

**Q.5**  $\lim_{x \rightarrow 0} \frac{\sin x^4 - x^4 \cos x^4 + x^{20}}{x^4 (e^{2x^4} - 1 - 2x^4)}$  is equal to  $N$  then  $18N$  is

**Q.6** Urn A contains 9 red balls and 11 white balls. Urn B contains 12 red ball and 3 white balls. One is to roll a single fair die. If the result is a one or a two, then one is to randomly select a ball from urn A. Otherwise one is to randomly select a ball form urn B. The probability of obtaining a red ball, is  $\frac{41}{30K}$  then  $K$  is

**Q.7** Let  $f(x)$  be defined as

$$f(x) = \begin{cases} \tan^{-1} \alpha - 5x^2, & 0 < x < 1 \\ -6x, & x \geq 1 \end{cases}$$

$f(x)$  can have a maximum at  $x = 1$  if  $\alpha < -\tan k$  then  $k$  is

**Q.8** If the parabola  $y^2 = 4x$  and circle  $(x-6)^2 + y^2 = r^2$  will have no common tangent then greatest integer value of  $r$  is

**Q.9** Let  $f(x) = \frac{e^x - e^{-x}}{2}$  and if  $f(g(x)) = x = g[f(x)]$  then  $\frac{1}{167} g\left(\frac{e^{1002} - 1}{2e^{501}}\right)$  is equal to

**Q.10** The plane containing two lines  $\frac{x-3}{1} = \frac{y-2}{-4} = \frac{z-1}{5}$  and  $\frac{x-2}{1} = \frac{y+3}{-4} = \frac{z+1}{5}$  is  $11x + my + nz = 28$ . Then find the value of  $|m + n|$ .

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*Space for rough work*

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