# FIITJEE INTERNAL TEST

## Batch: All 1719
## IIT- JEE 2019
## Paper – III
## QP CODE: 120233

**Time:** ***3 hours*** **Maximum Marks: 264**

- ***Please read the instructions carefully. You are allotted 5 minutes specially for this purpose.***
- ***You are not allowed to leave the examination hall before end of the test.***
- ***Use Blue/Black Ball Point Pen only*** *for writing particulars on* ***Side–1 and Side–2*** *of the Answer Sheet.* ***Use to Pencil is strictly prohibited.***

## Instructions

**Note:**

**1.** The question paper contains 3 sections (Sec-1, Chemistry, Sec-II, Physics & Sec-III, Mathematics.)

**2.** Each section is divided into two parts, **Part-A & C**.

**3.** **Part – A** contains 16 questions which are further divided as follows:

❖ **PART – A** (**01 – 10)** contains 10 Multiple Choice Questions which have **One or More Correct** answer.

For each question in the group **Q. 1 – 10** of **PART – A** you will be awarded
*Full Marks*: **+4** If only the bubble(s) corresponding to all the correct options(s) is (are) darkened.
*Partial Marks*: **+1** For darkening a bubble corresponding **to each correct option,** provided NO incorrect option is darkened.
*Zero Marks*: **0** If none of the bubbles is darkened.
*Negative Marks*: **–2** In all other cases.

For example, if **(A), (C) and (D)** are all the correct options for a question, darkening all these three will result in **+4 marks**; darkening only **(A) and (D)** will result in **+2 marks**; and darkening **(A) and (B)** will result in **–2** marks, as a wrong option is also darkened.

❖ **PART – A** (**11 – 16)** contains 2 Paragraphs. Based upon each paragraph, 3 Multiple Choice Questions. Each question has four choices (A), (B), (C) and (D), out of which **only one is correct**. Each question carries **+4 marks** for correct answer and zero marks if no bubble is darkened. In all other cases, **minus one(–1) mark will be awarded.**

**4.** **PART-C (1 – 6)** contains 6 Numerical Based questions with Single Digit Integer as answer, ranging from 0 to 9 and each question carries **+4 marks** for correct answer and zero marks if no bubble is darkened. In all other cases, **minus two (–2) mark will be awarded.**

**Filling of OMR Sheet**

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with ***Blue/Black Ball Point Pen*** for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.
4. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
5. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

***Name of the Candidate*** **:** ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

***Enrolment Number*** **:** ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

# Section – I (Chemistry)

## PART – A

### (Multiple Correct Choice Type)

This section contains 10 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

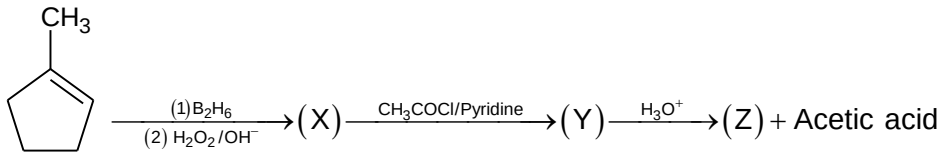
1. Which of them can act as oxidizing agent in acidic as well as in alkaline medium?
   (A) $KMnO_4$ (B) $K_2Cr_2O_7$ (C) $H_2O_2$ (D) $Cl_2$

2. Which of the following statements about ozo dye coupling reaction is true?
   (A) It is electrophilic substitution reaction
   (B) Electron withdrawing group at Benzene diazonium salt increase the rate of reaction
   (C) Electron donating group at phenol increases the rate of reaction
   (D) Extended conjugate system through –N = N– bond is responsible for colour

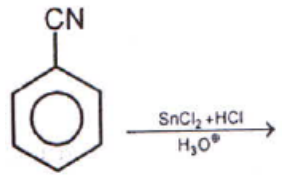
3. $(NH_4)_2Cr_2O_7$ on heating gives a gas/vapour, which is also produced in significant quantity by
   (A) heating $NH_4ClO_4$ (B) heating $CuSO_4.5\ H_2O$
   (C) heating $Ba(N_3)_2$ (D) treating $NaNO_3$ with Zn in basic medium

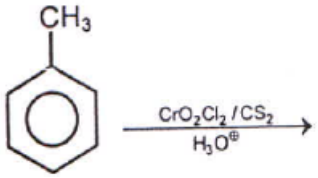
4. Which of the molecules can have such a plane, which contain only 3 atoms on it?
   (A) $SF_6$ (B) $IF_7$ (C) $PCl_5$ (D) $BF_3$

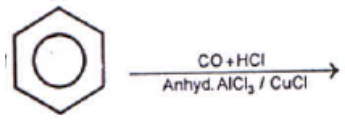
5. The correct statements about the following reaction are

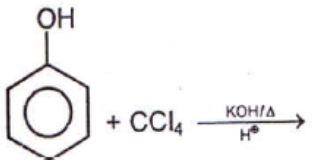



   (A) (X) is transisomer of 2-Methylcyclopentan-1-ol
   (B) (Y) is Cis isomer of ester
   (C) (Z) is geometrical isomers of (X)
   (D) (X) and (Z) have identical boiling point

6. In which of the following reactions benzaldehyde will form in final product.
   (A)


   (B)


   (C)


   (D)



7. Two moles of ideal gas expands adiabatically in vaccum, which of the following is/are true for given process?
   (A) q = 0 (B) w = 0 (C) $T_{initial} = T_{final}$ (D) $\Delta E = 0$

***space for rough work***

8. A dilute solution contains 't' moles of solute X in 1 kg of solvent with molal elevation constant $K_b$. The solute dimerises in the solution according to the following equation. The degree of association is $\alpha$.

$$2X \rightleftharpoons X_2$$

(A) The degree of association $\alpha = \dfrac{2(K_b t - \Delta T_b)}{K_b T}$

(B) The molecular mass observed will be lesser than actual molecular mass

(C) The colligative properties observed will be $\Delta T_{b\ obs} < \Delta T_{b\ theoretical}$ ; $\Delta T_{f\ obs} < \Delta T_{f\ theoretical}$; $\Delta P_{obs} < \Delta P_{theoretical}$

(D) The equilibrium constant for the process can be expressed as: $K = \dfrac{K_b(K_b t - \Delta T_b)}{[2\Delta T_b - K_b t]^2}$

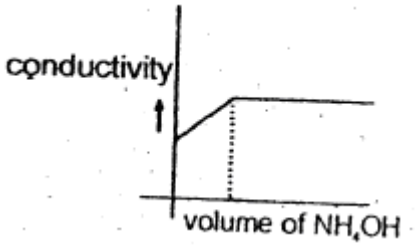
9. Which one will not give significant $Fe^{3+}$ ions in solution?
(A) $[Fe(CN)_6]^{3-}$ (B) $Fe_2(SO_4)_3$
(C) $[Fe(CN)_6]^{4-}$ (D) $NH_4(SO_4)_2.FeSO_4.6H_2O$

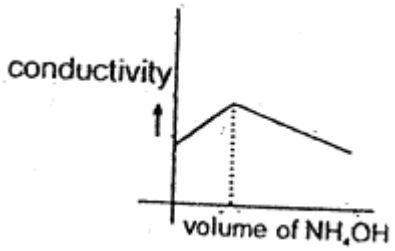
10. Which of the following is/are correct for critical temperature?
(A) It is the highest temperature at which liquid and vapour can coexist.
(B) Above the critical temperature gas cannot be liquefied by compression.
(C) At critical temperature, the surface tension of the system is zero.
(D) At critical temperature enthalpy of vapourisation becomes zero.

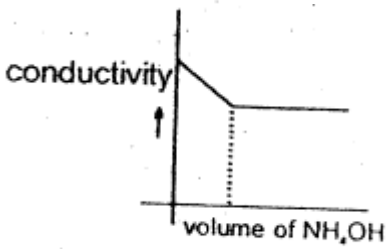
## PART – A
### (Single Correct Choice Type Q. No. 11 - 16)
### Comprehension Type
**Paragraph for question nos. 11 – 12**

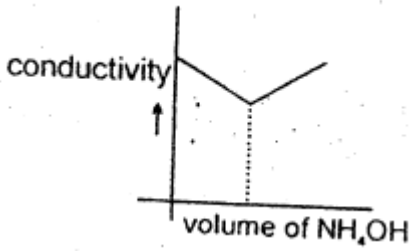
Conductometric titration is a type of titration in which electrolytic conductivity of reaction mixture is continuously monitored as one reactant is added. The equivalence point at which the conductivity undergoes a sudden change.

11. Which is correct graph for titration of $CH_3COOH$ vs $NH_4OH$?

(A)



(B)



(C)



(D)
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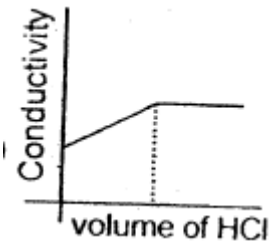
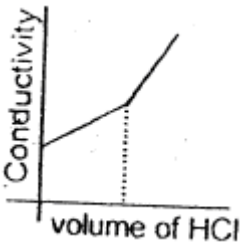
12. Which is correct graph for titration of $NH_4OH$ vs HCl?

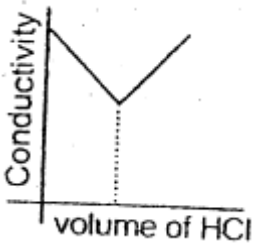
(A)



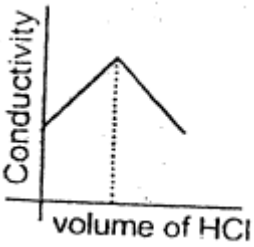

(B)




(C)




(D)




**Paragraph for question nos. 13 – 14**

The cell potential($E_{cell}$) of the reaction is related to $\Delta G = -nFE_{cell}$, where $\Delta G$ represented max useful electrical work, n = no, of moles of $e^-$ exchanged during this reaction

For reversible reaction

$d(\Delta G) = (\Delta_r V)dP - (\Delta_r S)dT$

At constant pressure,

$d(\Delta G) = (\Delta_r V)dP - (\Delta_r S)dT$

$\Delta G = \Delta H - T\Delta S$ ……. (1)

$$\Delta G = \Delta H + T\left(\frac{d(\Delta G)}{dT}\right)_P \quad \text{……. (2)}$$

$\left(\frac{dE_{cell}}{dT}\right)_P$ is known as temperature coefficient of the emf of the cell

13. $Zn(s) + 2AgCl(aq) \longrightarrow ZnCl_2(aq) + 2Ag(s)$

At 300 K, $\Delta H$ for reaction is -218 kJ/mole, EMF of the cell is 1.015 V $\left(\frac{dE}{dT}\right)_P$ of the cell is

(A) $-4.2 \times 10^{-4}\ VK^{-1}$ (B) $-3.81 \times 10^{-4}\ VK^{-1}$ (C) $0.11\ VK^{-1}$ (D) none of these

14. Find $\Delta S$ for this reaction

(A) -73.53 J/Kmol (B) 83.53 J/Kmol (C) 100 J/Kmol (D) none of these

***space for rough work***

**Paragraph for question nos. 15 – 16**

$$\underset{(X)}{C_7H_{12}} \xrightarrow[(ii)\ \Delta,\ Heat]{(i)\ Hot\ acidic/KMnO_4} Y + 3CO_2 + 2H_2O \xrightarrow{\overset{-}{O}H} Z$$

X is optically active and non cyclic

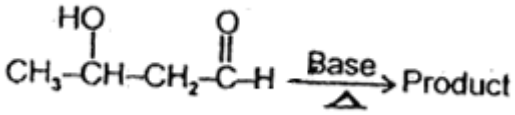
15. No. of chiral carbon in X
(A) 1 (B) 2 (C) 3 (D) 4

16. No. of alpha hydrogen in Y
(A) 4 (B) 5 (C) 6 (D) 2

## PART – C

This section contains 06 **multiple choice questions**. The answer to each question is a single digit integer, ranging from 0 to 9 (both inclusive)

1. $R-NH_2 \xrightarrow[KOH/\Delta]{CHCl_3} R-NC$
How many moles of KOH required for 1 mole of R – $NH_2$

2. 

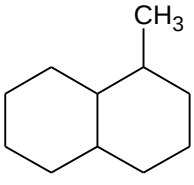
What is the sum of order and molecularity for above reaction?

3. Find total number of set(s) of species $x_1$, $x_2$, $x_3$ respectively which follow given reaction
$x_1 + x_2 \xrightarrow{Redox\ reaction} Product \xrightarrow{+x_3} Redox\ reaction$

(i) $I^-(aq)$, $Fe^{3+}(aq)$, $S_2O_3^{2-}(aq)$
(ii) $Cu^{2+}(aq)$, $I^-(aq)$, $S_2O_3^{2-}(aq)$
(iii) $Br^-(aq)$, conc.$H_2SO_4$, $I^-(aq)$
(iv) $F_2$, $Cl^-(aq)$, $Br^-(aq)$
(v) $Na_2CO_3$, $Br_2$, $Sn^{2+}(aq)$
(vi) NO, $O_2$, $H_2O$
(vii) $K_4Fe(CN)_6$, $H_2O_2/OH^-(aq)$, $H_2O_2/H^+(aq)$
(viii) Cu turning, conc. $HNO_3$, KCN
(ix) $PbO_2$, $I^-(aq)$, $Cl^-(aq)$

4. Consider hydrolysis of $H_2S_2O_8$ : $H_2S_2O_8 + H_2O \xrightarrow{RT} P + Q$
Where compound 'P' has 'open book' like structure, then find out value of |x - y|
Where, x = maximum number of atom(s) that can lie in a plane of a molecule of $H_2S_2O_8$ = 5
y = maximum number or oxygen atom(s) that can lie in a plane of a molecule of 'Q' = 3

5. How many of the following oxides are anhydrides of dibasic oxy-acid?
(i) $SO_2$ (ii) $P_4O_{10}$ (iii) $NO_2$
(iv) $CO_2$ (v) $Li_2O$ (vi) CO
(vii) $ClO_2$ (viii) $Cl_2O$ (ix) $I_2O_5$

6. How many geometrical isomers are possible for 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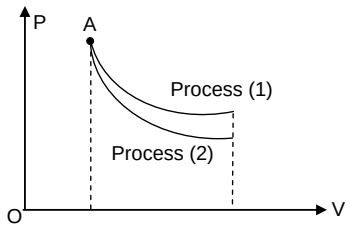
# Section – II (Physics)

## PART – A

### (Multiple Correct Choice Type)

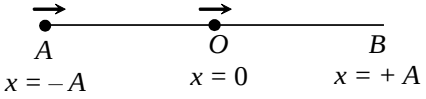
This section contains 10 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. The indicator diagram for two processes 1 and 2 carrying on an ideal gas as shown in figure. If $m_1$ and $m_2$ be the slopes of the P – V curve for process (1) and process (2) respectively at position A. Also it is given that one of the process is isothermal, then



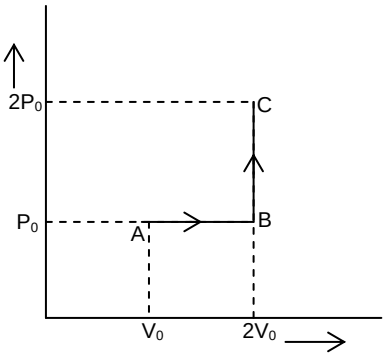

(A) $m_1 = m_2$ (B) $m_1 > m_2$ (C) $m_1 < m_2$ (D) $m_2C_V = m_1C_p$

2. Two particles undergo SHM along the same line with the same time period ($T$) and equal amplitudes ($A$). At a particular instant one particle is at $x = -A$ and the other is at $x = 0$. They move in the same direction. They will cross each other at time $t$ and at position $x$ then




(A) $t = \frac{4T}{3}$ (B) $t = \frac{3T}{8}$ (C) $x = \frac{A}{2}$ (D) $x = \frac{A}{\sqrt{2}}$

3. One mole of an ideal monoatomic gas is taken from A to C along the path ABC. The temperature of the gas at A is $T_0$. For the process ABC (where R is gas constant)




(A) Heat absorbed by the gas is $\frac{11}{12}RT_0$

(B) Heat absorbed by the gas is $\frac{11}{2}RT_0$

(C) Work done by the gas = $RT_0$

(D) Change in internal energy of gas is $\frac{9}{2}RT_0$

4. A wave pulse in a horizontal string is represented by a function $y(x,t) = \frac{6}{2+(x-3t)^2}$ (c. g .s system) then

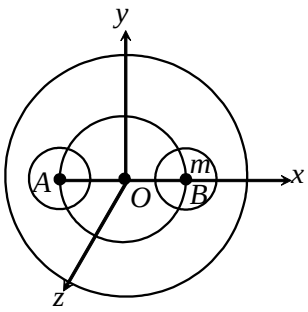
(A) wave is propagating along '+x' axis (B) amplitude of the wave is 4 cm
(C) velocity of the wave is 3 cm/sec (D) amplitude of wave is 6 cm

5. $C_v$ and $C_p$ denote the molar specific heat capacities of a gas at constant volume and constant pressure respectively. Then

(A) $C_P - C_V$ is larger for a diatomic ideal gas than for a monatomic ideal gas
(B) $C_P + C_V$ is larger for a diatomic ideal gas than for a monatomic ideal gas
(C) $C_P / C_V$ is larger for a diatomic ideal gas than for a monatomic ideal gas
(D) $C_P . C_V$ is larger for a diatomic ideal gas than for a monatomic ideal gas

***space for rough work***

6. A solid sphere of uniform density and radius 4 units is located with its centre at the origin *O* of co-ordinates. Two spheres of equal radii 1 units, with their centres at *A*(–2,0,0) and *B* (2, 0 ,0) respectively, are taken out of the solid leaving behind spherical cavities as shown in figure. Then



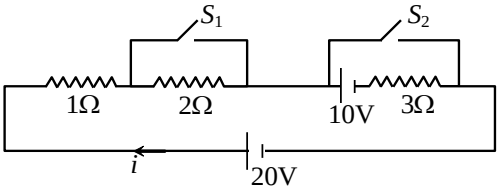

(A) the gravitational field due to this object at the origin is zero.

(B) the gravitational field at the point *B*(2, 0, 0)is zero

(C) the gravitational potential is same at all points on the circle $y^2 + z^2 = 36$

(D) the gravitational potential is same at all points on the circle $y^2 + z^2 = 4$

7. In the circuit shown in figure:



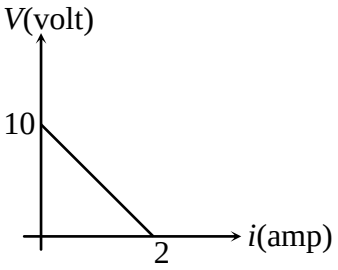

(A) $i = 2.5$ A when $S_1$ is closed and $S_2$ is open.

(B) $i = \frac{20}{3}$ A when $S_1$ is open and $S_2$ is closed.

(C) $i = \frac{5}{3}$ A when $S_1$ and $S_2$ both are open.

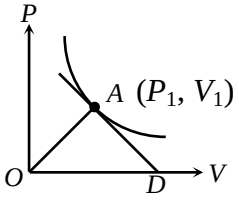
(D) $i = 20$ A when both $S_1$ and $S_2$ are closed.

8. A battery of emf E and internal resistance *r* is connected across a resistance *R*. Resistance *R* can be adjusted to any value greater than or equal to zero. A graph is plotted between the current passing through the resistance (*i*) and potential difference across the terminals of the battery (V). Select the correct alternative (s)




(A) internal resistance of the battery is 5 Ω
(B) emf of the battery is 10 V
(C) maximum current which can be taken from the battery is 2A
(D) V-*i* graph can never be a straight line as shown in the figure

9. *n* moles of an ideal gas undergo an isothermal process at temperature *T*. P-V graph of the process is as shown in the figure. A point *A* ($V_1$, $P_1$) is located on the P-V curve. Tangent at point *A*, cuts the *V*-axis at point *D*. *AO* is the line joining the point *A* to the origin *O* of PV diagram. Then,




(A) coordinates of points *D* is $\left(\frac{3V_1}{2}, 0\right)$

(B) coordinates of points *D* is $(2V_1, 0)$

(C) area of the triangle *AOD* is *nRT*

(D) area of the triangle *AOD* is $\frac{3}{4}$nRT

***space for rough work***

10. Capacitor $C_1$ of capacitance 1 μF and capacitor $C_2$ of capacitance 2 μF are separately charged fully by a common battery. The two capacitors are then separately allowed to discharge through equal resistors at time t = 0.

(A) The current in each of the two discharging circuits is zero at t = 0.

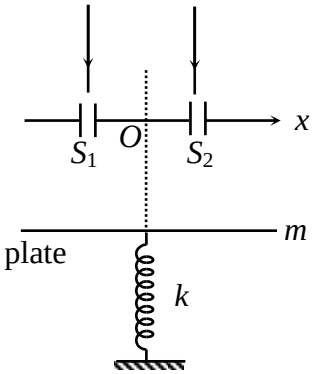
(B) The current in two discharging circuits at t = 0 are equal but not zero.

(C) The current in two discharging circuits at t = 0 are unequal.

(D) Capacitor $C_1$ loses 50% of its initial charge sooner than $C_2$ loses 50% of its initial charge.

## PART – A
### (Single Correct Choice Type Q. No. 11 - 16)
### Comprehension Type
**Paragraph for question nos. 11 – 13**

Two slits $S_1$ and $S_2$ lie on the *x*-axis and symmetric with respect to *y*-axis are illuminated by a parallel monochromatic light beam of wavelength λ as shown. The distance between slits is *d* (>> λ). Point *O* is the mid point of the line $S_1S_2$ and this point is considered as the origin. The slits are in horizontal plane. The interference pattern is observed on a horizontal plate (acting as screen) of mass *m* which is connected to one end of a vertical massless spring of spring constant *k*. The other end of the spring fixed to ground. At *t* = 0, the plate is at a distance *D* (>> *d*) below the plane of slits and spring is in its natural length. The plate is released from rest from its initial position.




11. The rate by which fringe, width will increase when acceleration of plate is zero, is

(A) $\frac{\lambda g}{d}\sqrt{\frac{m}{k}}$ (B) $\frac{\lambda g}{3d}\sqrt{\frac{m}{k}}$ (C) $\frac{\lambda g}{4d}\sqrt{\frac{m}{k}}$ (D) $\frac{\lambda g}{2d}\sqrt{\frac{m}{k}}$

12. The difference between two fringe widths when plate is at rest for a moment is

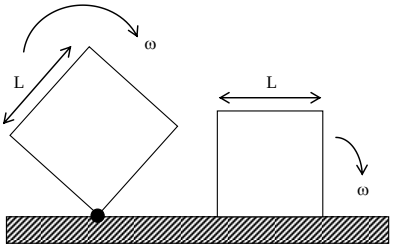
(A) $\frac{2\lambda}{d}$ (B) $\frac{\lambda mg}{dk}$ (C) $\frac{2\lambda mg}{dk}$ (D) $\frac{mg}{k}\frac{d}{\lambda}$

13. A thin slab of refractive index μ is kept in front of one of slits such that position of first maxima shift to the position of central maxima at the instant when plate has been held at rest initially. The thickness of slab is

(A) $\frac{d}{(\mu-1)}$ (B) $\frac{d\lambda}{D(\mu-1)}$ (C) $\frac{D\lambda}{d(\mu-1)}$ (D) $\frac{\lambda}{\mu-1}$

**Paragraph for question nos. 14 – 16**

There is a cube of mass M and side L. It is hinged at one of its edge as shown in figure. If initially it is kept as shown in figure, and a very slight clockwise impulse is given to it so that it first starts toppling (w = 0) about hinged edge, it begins to rotate clockwise. When the face of the cube strikes the ground, it immediately comes to rest. Then




14. The angular velocity of the cube just before it strikes the ground is

(A) $\sqrt{\frac{2g}{3L}\left(\sqrt{2}-1\right)}$ (B) $\sqrt{\frac{1}{3}\frac{g}{L}\left(\sqrt{2}-1\right)}$ (C) $\sqrt{\frac{3}{2}\frac{g}{L}\left(\sqrt{2}-1\right)}$ (D) $\sqrt{\frac{g}{L}\left(\sqrt{2}-1\right)}$

***space for rough work***

15. The total impulsive reaction in the vertical direction that has acted on the cube during the collision with the ground.

(A) $M\sqrt{\frac{3gL}{5}(\sqrt{2}-1}$ (B) $M\sqrt{\frac{3gL\left(\sqrt{2}-1\right)}{8}}$ (C) $M\sqrt{\frac{gL}{5}\left(\sqrt{2}-1\right)}$ (D) $M\sqrt{\frac{gL}{8}(\sqrt{2}-1}$

16. The impulsive torque about the hinged edge that has acted on the cube during the collision

(A) $\sqrt{\frac{2M^2L^3g\left(\sqrt{2}-1\right)}{3}}$ (B) $\sqrt{\frac{M^2L^3g\left(\sqrt{2}-1\right)}{3}}$ (C) $\sqrt{\frac{4}{3}M^2L^3g\left(\sqrt{2}-1\right)}$ (D) $\sqrt{\frac{3}{8}M^2L^3g\left(\sqrt{2}-1\right)}$

## PART – C

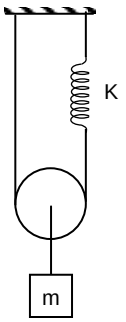
This section contains 06 **multiple choice questions**. The answer to each question is a single digit integer, ranging from 0 to 9 (both inclusive)

1. Three particles, each of mass m, are situated at the vertices of an equilateral triangle of side length a. The only forces acting on the particles are their mutual gravitational forces. It is desired that each particle moves in a circle while maintaining the original mutual separation a. Find the initial velocity that should be given to each particle. $\left(\text{take a} = \frac{GM}{16}\right)$

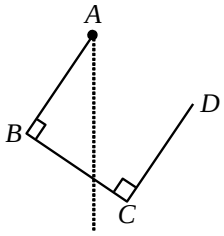
2. A bus is moving towards a huge wall with a velocity of 5 m/s. The driver sounds a horn of frequency 200Hz. The frequency of the beats heard by a passenger of the bus will be (In Hz) nearly (velocity of sound in air = $338\ m/s$)

3. A 20 cm long string, having a mass of 1.0 g, is fixed at both the ends. The tension in the string is 0.5 N. The string is set into vibrations using an external vibrator of frequency 100 Hz. Find the separation ( in cm) between the successive nodes on the string.

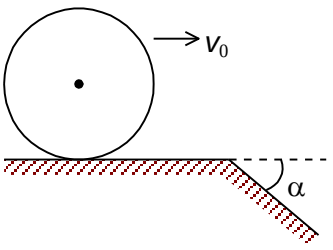
4. Figure below shows a massless pulley, a spring of constant K = 250 N/m and a mass 1 kg. On displacing the mass slightly, find its frequency (approximate) of its vertical oscillation




5. Three identical rods are joined and hinged at A as shown. If the angle made by the rod AB with the vertical in equilibrium is $\tan^{-1}\left(\frac{k}{4}\right)$, find 'k'.




6. A uniform solid cylinder of radius, $R$ = 15 cm rolls over a horizontal plane passing into an inclined plane forming an angle $\alpha$ = 30° with the horizontal as in Figure. Find the maximum value of the velocity $v_0$ which still permits the cylinder to roll on to the inclined plane section without a jump. The sliding is assumed to be absent.

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# Section – III (Mathematics)

## PART – A

### (Multiple Correct Choice Type)

This section contains 10 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. If f : [0, 1] $\to$ R is continuous function satisfying $\int_0^1 f(x)\,dx = \frac{1}{3} + \int_0^1 \left(f\left(x^2\right)\right)^2 dx$, then which of the following is/are coreect

(A) $f\left(\frac{1}{4}\right) = 2$

(B) $\int_0^1 f(x)\,dx = \frac{2}{3}$

(C) Area bound by $y = f(x)$, y = 0 and x = 4 is $\frac{16}{3}$

(D) $f\left(\frac{1}{4}\right) = 3$

2. If $f(x) = \left(a^2 + a + 1\right)x^2 + bx + c$ and $f(x)$ is symmetrical about the line x = 1, then

(A) $f\left(1-\sqrt{3}\right) < f\left(\sqrt{3}\right) < f\left(2+\sqrt{3}\right) < f(4)$ (B) $f\left(\sqrt{3}\right) < f\left(1-\sqrt{3}\right) < f\left(2+\sqrt{3}\right) < f(4)$

(C) $f\left(2+\sqrt{3}\right) > f(4) > f\left(\sqrt{3}\right) > f\left(1-\sqrt{3}\right)$ (D) $f(4) > f\left(2+\sqrt{3}\right) > f\left(-\sqrt{2}\right) > f\left(\sqrt{2}\right)$

3. A function f from integers to integers is defined as f(x) = $\begin{cases} n+3 & n \in \text{odd} \\ n/2 & n \in \text{even} \end{cases}$ suppose k $\in$ odd and f(f(f(k))) = 27 then

(A) k can be 45
(B) sum of the digit of k is 6
(C) sum of the digit of k is 9
(D) k can be 105

4. In triangle ABC, a=4 and $b = c = 2\sqrt{2}$. A point P moves with the triangle such that the square of its distance from BC is half the rectangle contained by its distances from the other two sides. If D be the centre of P, then

(A) locus of P is an ellipse with eccentricity $\sqrt{\frac{2}{3}}$ (B) locus of P is a hyperbola with eccentricity $\sqrt{\frac{3}{2}}$

(C) area of the quadrilateral ABCD= $\frac{16}{3}$ sq.units (D) area of the quadrilateral ABCD= = $\frac{32}{3}$ sq.units

***space for rough work***

5. If three planes $P_1 \equiv 2x + y + z - 1 = 0$, $P_2 \equiv x - y + z - 2 = 0$ and $P_3 \equiv \alpha x - y + 3z - 5 = 0$ intersects each other at point P on XOY plane and at point Q on YOZ plane, where O is the origin then identify the correct statement(s)?
(A) The value of $\alpha$ is 4
(B) Straight line perpendicular to plane $P_3$ and passing through P is $\frac{x-1}{4} = \frac{y+1}{-1} = \frac{z}{3}$
(C) The length of projection of $\overrightarrow{PQ}$ on x-axis is 1
(D) Centroid of the triangle OPQ is $\left(\frac{1}{3}, \frac{-1}{2}, \frac{1}{2}\right)$

6. Let $u(x)$ be a twice differentiable function defined in $0 \le x \le 1$, holds the relation $u''(x) = e^x u(x)$ in $x \in [0,1]$. if $0 < x_0 < 1$, then
(A) u(x) can't have a positive local maximum at $x_0$
(B) u(x) can have a negative local maximum at $x_0$
(C) u(x) can't have a negative local maximum at $x_0$
(D) u(x) can have a positive local minimum at $x_0$

7. Let $S_2 = 0$ is the mirror image of $S_1 : x^2 + y^2 - 4x - 6y + 12 = 0$ w.r.t the line $L_1 : 10^4 x + (10^4 + 10)y + (10^4 + 20) = 0$. Let $L_2 : 2^{11}x + (2^{11} + 2^{12})y + (2^{11} + 2^{13}) = 0$ be a line then the equations of line passing through the point of intersection of the line $L_2 = 0$ with radical axes of $S_1 = 0, S_2 = 0$ and making equal intercept with the coordinate axes is/are
(A) $x - y - 3 = 0$ (B) $x + y + 1 = 0$ (C) $2x - 2y + 1 = 0$ (D) $2x + 2y + 3 = 0$

8. If $f : R \to [2, 4]$ be a periodic function such that the equation $f(x) = g(x)$ has a unique solution, if $g(x) = 1 - \cos \pi x$ then period of $f(x)$ can be
(A) e (B) $\sqrt{3}$ (C) $\pi$ (D) 2017

9. The equation $a_8 x^8 + a_7 x^7 + ..... + a_0 = 0$ has all its roots positive and real (where $a_8 = 1, a_7 = -4, a_0 = 1/2^8$), then
(A) $a_3 = \frac{-7}{2^3}$ (B) $a_1 = -\frac{1}{2^4}$ (C) $a_2 = \frac{7}{2^4}$ (D) $a_3 = -\frac{7}{2^2}$

***space for rough work***

10. Let $\alpha$ and $f(\alpha)$ be the eccentricity of the ellipse $\frac{x^2}{3b^2-2a^2}+\frac{y^2}{2b^2-a^2}=1,\left(3b^2>2a^2\right)$ and $\frac{x^2}{2b^2-a^2}+\frac{y^2}{b^2}=1,\left(2b^2>a^2\right)$ then

(A) $f(\alpha)=\frac{\alpha}{\sqrt{1-\alpha^2}}, b\in R-\{0\}$

(B) $\int_0^{1/2} ffff(\alpha)d\alpha=\frac{1}{4}$

(C) $\int e^{\alpha}\left(f(\alpha)-f''(\alpha)\right)d\alpha=e^{\alpha}\left[\frac{\alpha}{\sqrt{1-\alpha^2}}-\frac{1}{\left(1-\alpha^2\right)^{3/2}}\right]+C$

(D) $f(\alpha)=\frac{\alpha}{2\sqrt{1-\alpha^2}}, b\in R-\{0\}$

## PART – A
### (Single Correct Choice Type Q. No. 11 - 16)
### Comprehension Type
**Paragraph for question nos. 11 – 13**

Let f(x)=0 be one-one and onto function , such that $|f(x)-f^{-1}(x)|>0$ for $x\in(0,2)\cup(2,4)$ given f(2) = 2, f(4) = 0 and f(0) = 4. Let $g(x)=\sqrt{16-x^2}$. given $f(x)<g(x)\forall\, x\in(0,4)$ and graph of y = f(x) and $y = f^{-1}(x)$ are symmetrical about the line x + y = 4.

11. If $f(x)-f^{-1}(x)<0$ for $x\in(0,2)$ and $\int_0^2 f(x)dx=5$, then $\int_2^4 f^{-1}(x)dx$ is

(A) 2 (B) 3 (C) 5 (D) 7

12. If $f(x)-f'(x)>0$ for $x\in(0,2)$ and $\int_0^2\left(f(x)-f^{-1}(x)\right)dx=2$, $\int_2^4 f^{-1}(x)dx=3$, then $\int_0^4 g(x)-\max\left(f(x), f^{-1}(x)dx\right)$ is

(A) $4\pi$ - 12 (B) $8\pi$ - 12 (C) $4\pi$ - 10 (D) 8

13. $\int_0^4\left(g(x)-f(x)\right)dx=4\pi-8$, then $\int_0^4 f^{-1}(y)dy$ is

(A) $4\pi$ - 4 (B) 8 (C) 4 (D) $8-2\pi$

***space for rough work***

**Paragraph for question nos. 14 – 16**

Let $P(x) = x^5 - 9x^4 + px^3 - 27x^2 + qx + r (p,q,r \in R)$ be divisible by $x^2$ and $\alpha$, $\beta$ and $\gamma$ are the positive roots of the equation $\frac{P(x)}{x^2} = 0$.

14. The value of p + q + r =
(A) 3 (B) 9 (C) 27 (D) 81

15. If $\alpha$ - 1, $\beta$ + 3 and $\gamma$ + 7 are the first three terms of a sequence whose sum of first n terms is given by $S_n$ then $\sum_{n=2}^{\infty} \frac{1}{\sqrt{S_n \cdot S_{n-1}}}$ is equal to

(A) 1 (B) $\frac{1}{4}$ (C) $\frac{1}{2}$ (D) 2

16. The value of $\lim_{n\to\infty}\left(\frac{1}{p+q+r} + \frac{1}{p^2+q^2+r^2} + \frac{1}{p^3+q^3+r^3} + ..... + \frac{1}{p^n+q^n+r^n}\right)$ is equal to

(A) $\frac{1}{26}$ (B) $\frac{1}{27}$ (C) $\frac{25}{26}$ (D) $\frac{26}{27}$

## PART – C

This section contains 06 **multiple choice questions**. The answer to each question is a single digit integer, ranging from 0 to 9 (both inclusive)

1. Considering the curve $xy = 15!$. Let n be the number of points $(\alpha,\beta)$ lying on it, where $\alpha,\beta \in I^+$ and $HCF(\alpha,\beta) = 1$ then $\left[\frac{n}{13}\right]$ equals (where $[.]$ represents g.i.f.)

2. The area of the largest rectangle whose base is on x – axis and two of its vertices lie on the curve $y = \frac{8}{1+x^2}$ is

3. Let f be a continuous function and $f(x) = f(2\alpha),\ x \in R$. If f(x) = 3 then $\int_{-1}^{+1} f(f(f(x)))\,dx$ is equal to

4. Let x be any positive number then minimum value of $(1+x)^3\left(1+\frac{16}{x^3}\right)$ is $10k+1$ then k is equal to

5. Through the point P(1,1,1) a line L is drawn to intersect $L_1 \equiv \frac{x-1}{1} = \frac{y-2}{2} = \frac{z-3}{3}$ and $L_2 \equiv \frac{x+1}{3} = y+2 = \frac{z+3}{2}$. The point of intersection of L and $L_2$ is $(\alpha,\beta,-\gamma)$ then $\alpha+\beta+\gamma$ equals

6. A differentiable function y = f(x) is such that its graph cuts line y = mx + c at 5 distinct points. Then the minimum number of points at which f''(x) = 0 is/are

***space for rough work***