FIITJEE JEE (Advanced), 2013

CONCEPT RECAPITULATION TEST (Set – V)

Paper 2

Time Allotted: 3 Hours **Maximum Marks: 198**

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

INSTRUCTIONS

A. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains Three Parts.
3. **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
4. Each part has only one section: **Section-A**.
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

B. 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 black pen for each character of your Enrolment No. and write your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Three Parts.

(i) **Section-A (01 to 08)** contains 8 multiple choice questions which have only one correct answer. Each question carries **+3 marks** for correct answer and **– 1 mark** for wrong answer.

Section-A (09 to 14) contains 3 paragraphs with each having 2 questions. Each question carries **+3 marks** for correct answer and **– 1 mark** for wrong answer.

Section-A (15 to 20) contains 6 multiple choice questions which have more than one correct answer. Each question carries **+4 marks** for correct answer. There is no negative marking.

Name of the Candidate	
Enrolment No.	

Useful Data

PHYSICS

Acceleration due to gravity	$g = 10\ m/s^2$
Planck constant	$h = 6.6 \times 10^{-34}$ J-s
Charge of electron	$e = 1.6 \times 10^{-19}$ C
Mass of electron	$m_e = 9.1 \times 10^{-31}$ kg
Permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N\text{-}m^2$
Density of water	$\rho_{water} = 10^3\ kg/m^3$
Atmospheric pressure	$P_a = 10^5\ N/m^2$
Gas constant	$R = 8.314\ J\ K^{-1}\ mol^{-1}$

CHEMISTRY

Gas Constant	R	=	$8.314\ J\ K^{-1}\ mol^{-1}$
		=	0.0821 Lit atm $K^{-1}\ mol^{-1}$
		=	$1.987 \approx 2$ Cal $K^{-1}\ mol^{-1}$
Avogadro's Number	N_a	=	6.023×10^{23}
Planck's constant	h	=	6.625×10^{-34} J·s
		=	6.625×10^{-27} erg·s
1 Faraday		=	96500 coulomb
1 calorie		=	4.2 joule
1 amu		=	1.66×10^{-27} kg
1 eV		=	1.6×10^{-19} J

Atomic No: H=1, He = 2, Li=3, Be=4, B=5, C=6, N=7, O=8, N=9, Na=11, Mg=12, Si=14, Al=13, P=15, S=16, Cl=17, Ar=18, K =19, Ca=20, Cr=24, Mn=25, Fe=26, Co=27, Ni=28, Cu = 29, Zn=30, As=33, Br=35, Ag=47, Sn=50, I=53, Xe=54, Ba=56, Pb=82, U=92.

Atomic masses: H=1, He=4, Li=7, Be=9, B=11, C=12, N=14, O=16, F=19, Na=23, Mg=24, Al = 27, Si=28, P=31, S=32, Cl=35.5, K=39, Ca=40, Cr=52, Mn=55, Fe=56, Co=59, Ni=58.7, Cu=63.5, Zn=65.4, As=75, Br=80, Ag=108, Sn=118.7, I=127, Xe=131, Ba=137, Pb=207, U=238.

Physics

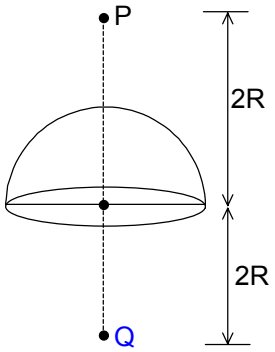
PART – I

SECTION – A

Single Correct Answer Type

This section contain **8 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

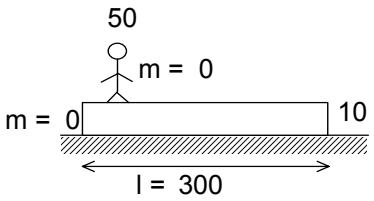
1. If the electric field due to uniform thin hemispherical shell at point P is E, then the magnitude of electric field at Q is (charge on the hemisphere is q_o and radius R)



(A) $\frac{q_o}{8\pi\varepsilon_o R^2} - E$ (B) $\frac{q_o}{4\pi\varepsilon_o R^2} - E$

(C) $\frac{q_o}{8\pi\varepsilon_o R^2} - 2E$ (D) $\frac{q_o}{4\pi\varepsilon_o R^2} - 2E$

2. A man of mass 50 kg is standing on one end of a stationary wooden plank resting on a frictionless surface. The mass of the plank is 10 kg, its length is 300 m and the coefficient of friction between the man and the plank is 0.2. Find the shortest time (in sec) in which the man can reach the other end of the plank starting from rest and stopping at the other end



(A) 10 sec (B) 8 sec

(C) 6 sec (D) 12 sec

Rough work

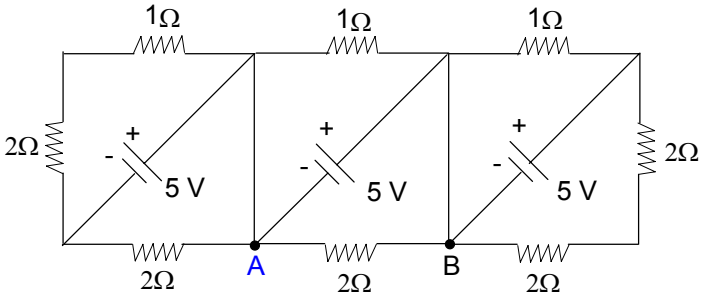
3. A vessel, having a hole of diameter d in its bottom, is hanging from a lift moving upward with acceleration a. The vessel contains mercury of surface tension T and height h, but it does not pour out from the hole. The maximum acceleration a so that mercury will not pour out, is (density of Hg is ρ, assume d<<h).

(A) $\frac{2T}{\rho dh} - g$ (B) $\frac{2T}{\rho dh}$

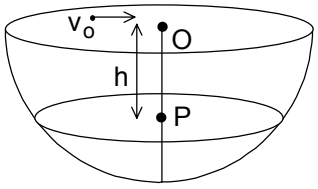
(C) $\frac{2T}{\rho dh} + g$ (D) $\frac{4T}{\rho dh} - g$

4. In the diagram shown, the current through 2Ω resistor connecting between A and B

(A) 1 amp
(B) 1.5 amp
(C) 2 amp
(D) 2.5 amp



5. A particle is projected horizontally with velocity $v_o = \sqrt{2ga}$ along the smooth inside surface of a fixed hollow hemisphere of inner radius 'a' at the level of the centre 'O'. The subsequent motion of the particle is confined between the horizontal planes one through the centre and the other at a depth h. Find the value of h

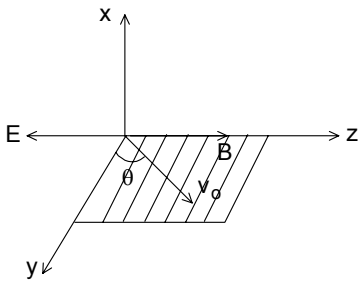


(A) $\frac{\sqrt{3}}{2}a$ (B) $\frac{\sqrt{3}-1}{3}a$

(C) $\frac{\sqrt{5}-1}{2}a$ (D) $\frac{\sqrt{5}}{2}a$

Rough work

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



(A) $\frac{mv_o}{qE}$ (B) $\frac{mv_o \sin\theta}{qE}$

(C) $\frac{mv_o \cos\theta}{qE}$ (D) $\frac{2\pi m}{qB}$

7. Radiation from hydrogen gas excited to first excited state is used for illuminating certain photoelectric plate. When the radiation from some unknown hydrogen like gas excited to the same level is used to expose the same plate, it is found that the de-Broglie wavelength of the fastest photoelectron has decreased 2.3 times of its previous value. It is given that the energy corresponding to the longest wavelength of the Lyman series of the unknown gas is 3 times the ionization energy of hydrogen gas (13.6 eV). The work function of photoelectric plate in eV is: (Take $(2.3)^2 = 5.25$)

(A) 1 eV (B) 2 eV

(C) 3 eV (D) 4 ev

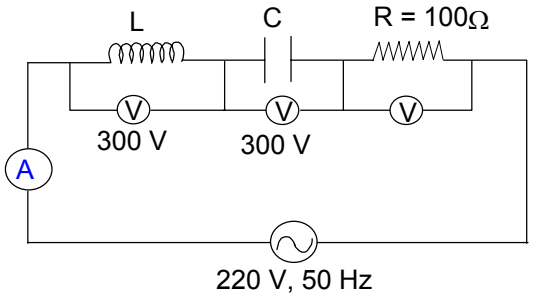
8. In the circuit shown below, what will be the readings of the voltmeter connected across R and ammeter?

(A) 800 V, 2 A

(B) 300 V, 2 A

(C) 220 V, 2.2 A

(D) 100 V, 2 A



Rough work

Comprehension Type

This section contains **3 paragraphs**. Based upon paragraphs **3 multiple choice questions** have to be answered. Each of these questions has four choices (A), (B), (C) and (D) out of **which ONLY ONE** is correct.

Paragraph for Questions 9 and 10

A student of mass m is standing at the edge of a horizontal disc of mass M and radius R. The disc is free to rotate about a frictionless vertical axis passing through its centre. Initially, the student and the disc are at rest. At time t = 0, the student starts to run at his maximum velocity v relative to the disc. He runs rightwards on the periphery of the disc, towards his friend who is waiting impatiently across the disc. He is not standing on the disc itself, but is besides it. On the basis of given information answer the following questions:

9. The time needed for the student to reach his friend is:

(A) $\frac{\pi R}{v}\left(1+\frac{2m}{M}\right)$ (B) $\frac{2\pi R}{v}\left(1+\frac{2m}{M}\right)$

(C) $\frac{\pi R}{v}\left(2+\frac{2m}{M}\right)$ (D) none of these

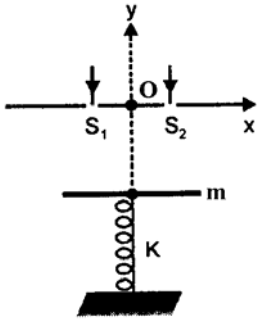
10. If the disc is massless than the time required for the student to reach his friend

(A) $\frac{\pi R}{v}$ (B) same time

(C) he will never reach (D) instantly

Rough work

Paragraph for Questions 11 and 12



Two slits S_1 and S_2 on the x-axis and symmetric with respect to y-axis are illuminated by a parallel monochromatic light beam of wavelength λ as shown in fig. The distance between the slits is $d(>>\lambda)$. 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 attached to one end of a vertical spring of spring constant K. The other end of the spring is fixed to ground. At t = 0 the plate is at a distance D (>>d) below the plane of slits and the spring is in its natural length. The plate is left from rest from its initial position. Assume that spring is light and plate always remains horizontal.

11. The rate at which fringe width is changing when plate crosses mean position is

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

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

12. The x co-ordinates of the 2nd maxima on the plate as a function of time is given by

(A) $\pm\frac{2\lambda}{d}\left(D+\frac{mg}{k}\sin\omega t\right)$ (B) $\pm\frac{2\lambda}{d}\left(D+\frac{mg}{k}(1-\sin\omega t)\right)$

(C) $\pm\frac{2\lambda}{d}\left(D+\frac{mg}{k}\cos\omega t\right)$ (D) $\pm\frac{2\lambda}{d}\left(D+\frac{mg}{k}(1-\cos\omega t)\right)$

Rough work

Paragraph for Questions 13 and 14

In a standing wave experiment a 1.2kg horizontal rope is fixed in place at its two ends ($x = 0$ and $x = 2.0m$) and made to oscillate up and down in the fundamental mode, at frequency 5.0Hz. At $t = 0$ the point at $x = 1.0m$ has zero displacement and is moving upward in the positive direction of y-axis with a transverse velocity $3.14ms^{-1}$.

13. Amplitude of the motion of the particle at $x = 1.0m$ is
(A) 0.16m (B) 0.1m
(C) 0.08m (D) 0.05m

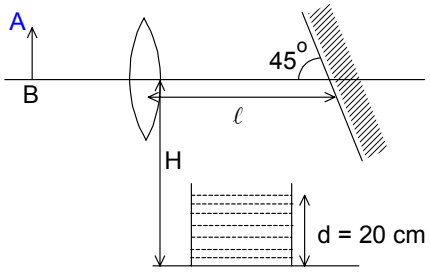
14. Displacement of the particle at $x = 0.5m$ and time $t = 0.15\sec$ is
(A) $\frac{1}{5\sqrt{2}}m$ (B) $-\frac{1}{5\sqrt{2}}m$
(C) $-\frac{1}{10\sqrt{2}}m$ (D) $-\frac{1}{20\sqrt{2}}m$

Rough work

Multiple Correct Answer(s) Type

The section contains **6 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE are correct.**

15. A linear object AB is at a distance of 36 cm from an equi convex lens of focal length 30 cm. In front of lens there is a plane mirror which is inclined at an angle 45^o with the principal axis of the lens at a distance λ = 1 m from the lens as shown in figure.
A container with water layer d = 20 cm is placed as shown in the figure. Than choose the correct statement(s). Take the refractive index of water as $\frac{4}{3}$

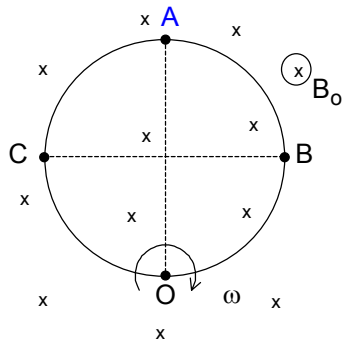


(A) after reflection from the mirror the image of AB will be parallel to principal axis of the lens.
(B) after reflection from the mirror the image of AB will be perpendicular to principal axis of the lens.
(C) the value of H for which the sharp image of AB can be obtained at the bottom of the container is 80 cm.
(D) the value of H for which the sharp image of AB can be obtained at the bottom of the container is 85 cm.

16. Two particles of equal mass are projected simultaneously from the roof of a tower of height 20 m with same speed 20 m/s, one horizontally and the other vertically upwards, choose the correct alternative(s).
(A) the acceleration of center of mass is g/2 downward.
(B) the acceleration of center of mass is g downward
(C) the maximum height of center of mass form the ground is 25 m.
(D) the maximum height of center of mass form the ground is 40 m.

Rough work

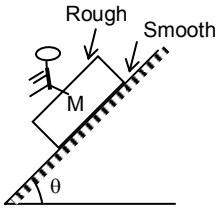
17. In the figure, there is a conducting ring having resistance R placed in the plane of paper in a uniform magnetic field B_o. If the ring is rotating about an axis passing through point O and perpendicular to the plane of paper with constant angular speed ω in clockwise direction.



(A) point A will be at higher potential than O.
(B) the potential of point B and C will be same.
(C) the current in ring will be zero.
(D) the current in the ring will be $\frac{2B_o\omega r^2}{R}$.

18. In a standing wave on a string rigidly fixed at both ends:
(A) all the particles must be at their positive extremes simultaneously once in half of the time period.
(B) all the particles must be at their positive extremes simultaneously once in a time period.
(C) in one time period all the particles are simultaneously at rest twice.
(D) all the particle are never at rest simultaneously.

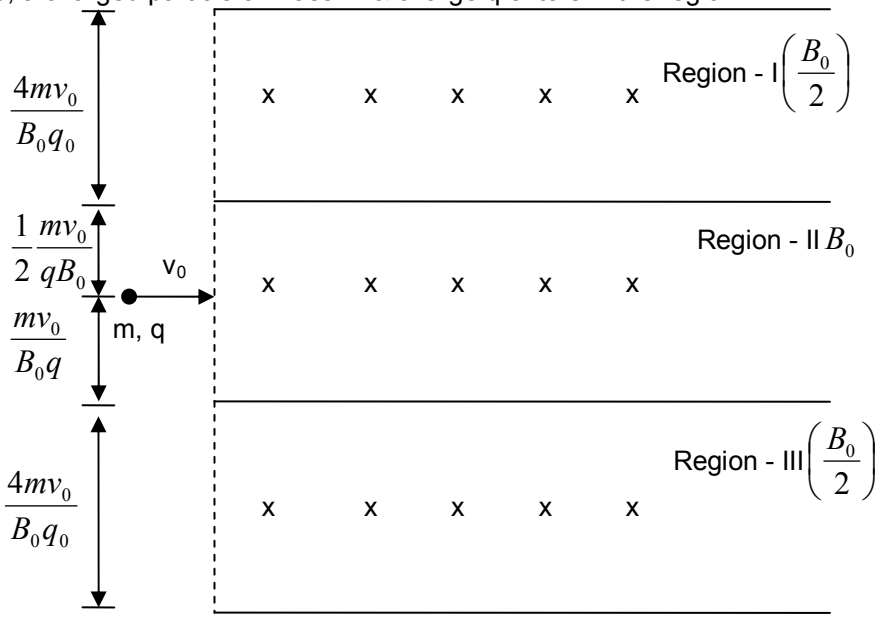
19. The figure shows a plank of mass M kept on a smooth inclined plane of inclination θ with the horizontal. A man (mass = m) starts running on the rough surface of the plank such that plank remains stationary w.r.t. ground.



(A) The acceleration of the man will be $\frac{(M+m)g\sin\theta}{m}$
(B) acceleration of the man will be $\frac{Mg\sin\theta}{m}$
(C) the man has to move down the incline to keep the plank stationary
(D) the man has to move up the incline to keep the plank stationary.

Rough work

20. At t = 0, a charged particle of mass m & charge q enters in the region – II.



(A) If q > 0, particle will enter into region – I after leaving region – II.

(B) If q < 0 the particle will leave region – II at $t = \frac{\pi m}{2|q|B_0}$

(C) If q > 0 particle re-enter in region – II at $t = \frac{3\pi m}{B_0 q}$

(D) Particle will not leave region – II.

Rough work

Chemistry

PART – II

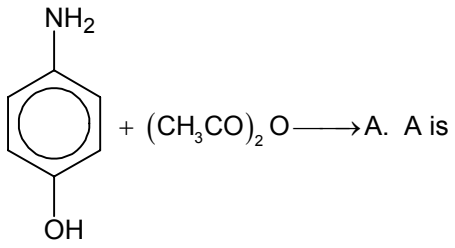
SECTION – A

Straight Objective Type

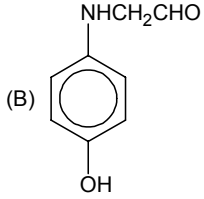
This section contains 8 multiple choice questions numbered 1 to 8. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

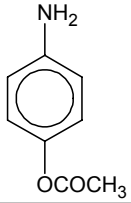
1. How much water vapour is contained in a cubic room 4 m along an edge if the relative humidity is 50% and temperature is 27°C? The vapour pressure of water at 27°C is 26.7 torr.
   (A) 0.82 kg (B) 0.24 kg
   (C) 0.5 kg (D) 23.7 kg

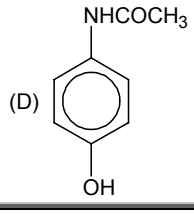
2. Following compounds are used as Lewis acid catalyst in EAS. What is the correct order of their reactivity?
   (A) $AlCl_3 > FeCl_3 > SnCl_4 > BCl_3$ (B) $AlCl_3 > BCl_3 > FeCl_3 > SnCl_4$
   (C) $BCl_3 > AlCl_3 > SnCl_4 > FeCl_3$ (D) $BCl_3 > AlCl_3 > FeCl_3 > SnCl_4$

3. 

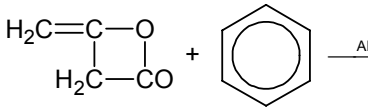
   (A) No reaction

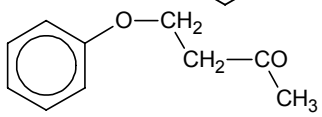
   (B) 

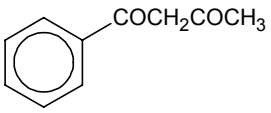
   (C) 

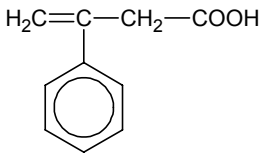
   (D) 

Rough Work

4. 

(A) 

(B) 

(C) 

(D) None of these

5. In borax bead test the glassy mass containing (Y + Z) is obtained by heating X. X, Y and Z are
(A) Borax, $NaBO_2$ and B_2O_3 (B) Borax, Na_3BO_3 and B_3O_3
(C) B_2H_6, O_2, $B(OH)_3$ (D) None of these

6. Which of the following is correct for pKa?
(A) $HSO_4^- > PhOH > HC \equiv CH > AcOH$ (B) $HSO_4^- < AcOH < NH_4^+ < PhOH$
(C) $HSO_4^- < AcOH < PhOH < NH_4^+$ (D) $HSO_4^- < PhOH < AcOH < HC \equiv CH$

7. $FeS_2 + O_2 \longrightarrow Fe_2O_3 + SO_3$
$SO_3 + H_2O \longrightarrow H_2SO_4$
If all the S present in 2 gm eq. of FeS_2 is converted into SO_3 and finally into H_2SO_4, find the number of moles of NaOH required to completely neutralize the H_2SO_4.
(A) 56 (B) $\frac{8}{15}$
(C) 14 (D) $\frac{2}{7}$

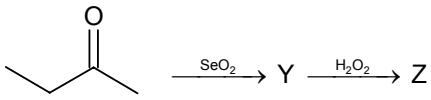
8. An electron and a proton are separated by a large distance, the electron approaches the proton with a K.E. of 3 eV. This electron is captured by the proton to form a hydrogen atom in ground state and energy is released in the form of photon. If this photon striked an electron in first excited state in hydrogen atom, then the K.E. of electron will be
(A) 20 eV (B) 13.2 eV
(C) 2 eV (D) 16.6 eV

Rough Work

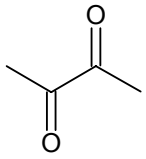
Comprehension Type

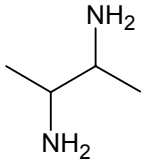
This section contains 3 groups of questions. Each group has 2 multiple choice question based on a paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

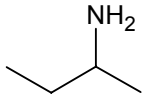
Paragraph for Question Nos. 9 to 10



9. Y is

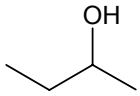
(A) 

(B) 

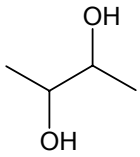
(C) 

(D) None of these

10. Z is

(A) 

(B) CH_3COOH

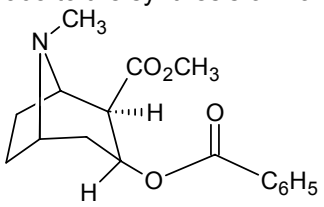
(C) 

(D) CH_3CH_2-COOH

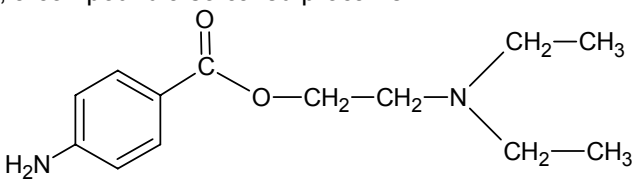
Rough Work

Paragraph for Question Nos. 11 to 12

Cocaine is a local anesthetic and for a time it was used medically in that capacity. In small doses it decreases fatigue, increases mental activity and gives a general feeling of well being. Prolonged use of cocaine, however, leads to physical addiction was recognized and to periods of deep depression. When its tendency to cause addiction was recognized efforts were made to develop other local anesthetics. This led in 1905 to the synthesis of Novocaine, a compound also called procaine.



Cocaine



Novocaine

11. Which of the following is correct
(A) Both contain benzoic ester groups
(B) 3^0 amino group is present only in procaine
(C) Both contain ether group
(D) Cocaine has more carbons than procaine

12. Identify the incorrect statement in the following
(A) The number of sp^2 carbons is same in both
(B) Both have same number of 1^0 hydrogens
(C) Both contain benzene rings
(D) Both are basic in nature

Rough Work

Paragraph for Question Nos. 13 to 14

Temporary hardness of water can be removed either by simply heating the hard water to remove off Ca^{++} and Mg^{++} or treating it by exact calculated amount of lime ($Ca(OH)_2$) as any extra lime again cause Ca^{++} hardness. So hardness of water is determined separately using titration technique both for magnesium ion and calcium ion individually in each case. Among anion bicarbonates are culprit for temporary while sulphate and chloride for permanent hardness of water.

13. A hard water sample has temporary hardness due to both Ca^{++} and Mg^{++} each of 100 ppm of $CaCO_3$ individually. What amount of lime is required to soften (remove temporary hardness of Ca^{++} and Mg^{++}) from 100 litre of the sample water
(A) 14.8 gm (B) 22.2 gm
(C) 29.6 gm (D) 7.4 gm

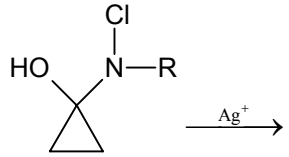
14. 10 liters sample of the water is heated to remove temporary hardness. The residue left as precipitate has mass
(A) 1.58 gm (B) 1.84 gm
(C) 1.68 gm (D) 2.0 gm

Rough Work

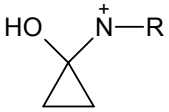
Multiple Correct Choice Type

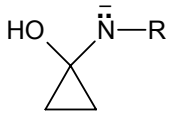
This section contains 6 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out which **ONE OR MORE** is/are correct.

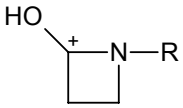
15. Which of the following complexes can't exist as optical isomers (enantiomers)?
(A) $[Fe(Ox)_3]^3$ (B) $[Co(NH_3)_4(en)]^{3+}$
(C) $[Co(NH_3)_2(en)_2]^{3+}$ (D) $[Cr(H_2O)_4Cl_2]^{2+}$

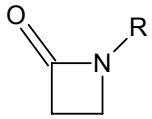
16. 

Which are involved in this reaction?

(A) 

(B) 

(C) 

(D) 

17. Which of the following is incorrect statement(s)?
(A) Borazine has same structure as graphite
(B) Boron nitride has same structure as benzene
(C) B_2H_6 reacts with Cl_2 to form BCl_3 and HCl
(D) B_2H_6 reacts with H_2O and produces O_2

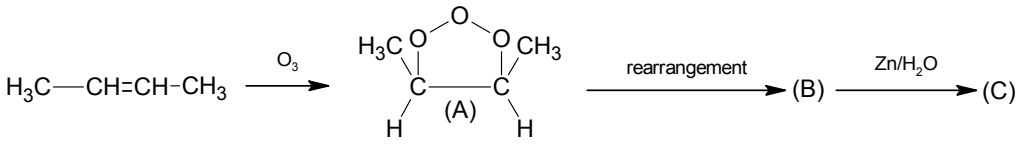
Rough Work

18. Consider the reaction mixture $K_2Cr_2O_7 + H_2SO_4 + H_2O_2$ in ether medium and select the correct statements
(A) the organic layer turns deep blue.
(B) thecolour of reaction mixture fades away gradually due to decomposition of product.
(C) the reaction is non redox.
(D) ether also participates in reaction.

19. $ZnCl_2 \xrightarrow{NaOH} 'P' \xrightarrow{CH_3COOH} 'Q' \xrightarrow{K_4[Fe(CN)_6]} 'R'$.

Select correct statements
(A) compound 'P' gives white precipitate with H_2S.
(B) compound 'R' is a white precipitate.
(C) the reaction P $\rightarrow$ Q & Q $\rightarrow$ R is a non redox process..
(D) P $\rightarrow$ Q is a non redox process but Q $\rightarrow$ R is redox process.

20.



Select correct statements.
(A) formation of (A) is an example of electrophilic addition reaction.
(B) rearrangement of (A) to (B) involves nucleophilic addition reaction.
(C) compound (B) can have three stereoisomers.
(D) compound (B) doesn't exhibit stereoisomerism.

Rough Work

Mathematics PART – III

SECTION – A

Single Correct Choice Type

This section contains **8 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

1. Two circles are given as $x^2 + y^2 + 14x - 6y + 40 = 0$ and $x^2 + y^2 - 2x + 6y + 7 = 0$ with their centres as C_1 and C_2. If equation of another circle whose centre C_3 lies on the line $3x + 4y - 16 = 0$ and touches the circle C_1 externally and also $C_1C_2 + C_2C_3 + C_3C_1$ is minimum is $x^2 + y^2 + ax + by + c = 0$ then the value of $(a + b + c)$ is
(A) 2 (B) 8
(C) 16 (D) 0

2. Three positive numbers a, b, c constitute an increasing A.P. whose sum is 15. If p, q, r are the number of lines which are at a distance of a, b and c respectively from the point (1, 1) and is concurrent with the family of lines.
$x(2\cos\theta + 3\sin\theta) - y(3\cos\theta + \sin\theta) + 7(\cos\theta - \sin\theta) = 0$ then the numbers p, q, r are
(A) 3, 2, 0 (B) 2, 1, 0
(C) 1, 2, 0 (D) 1, 0, 2

3. $\lim\limits_{x\to 0} \dfrac{e^{(x^x-1)} - x^x}{\left((x^2)^x - 1\right)^2}$

(A) 1 (B) $\dfrac{1}{8}$

(C) $\dfrac{3}{2}$ (D) does not exist

4. Let $A = \left\{ \begin{bmatrix} x & -y & z \\ 3 & 5 & 2 \\ 1 & 2 & 1 \end{bmatrix};\ x, y, z \in I^+ \cup \{0\} \right\}$, $B = \left\{ \begin{bmatrix} p & 1 & 0 \\ 0 & q & 0 \\ 0 & 1 & r \end{bmatrix};\ p, q, r \in I^+ \right\}$ and a and b are two random element of A and B respectively and $\det(\text{adj}(\text{adj}(A(\text{adj } B)))) = 2^8\, 3^4$ then the total number of ordered pairs in $S = A \times B$ is
(A) 121 (B) 125
(C) 119 (D) 91

Rough work

5. Let α be the 4^{th} root of unity and ($\alpha \neq 1$). If a fair dice is rolled four times and the number obtained are k_1, k_2, k_3 and k_4 then the probability that $\alpha^{k_1} + \alpha^{k_2} + \alpha^{k_3} + \alpha^{k_4} = 0$ and $k_1 \neq k_2 \neq k_3 \neq k_4$ is

(A) $\frac{2}{27}$ (B) $\frac{4}{27}$

(C) $\frac{5}{27}$ (D) $\frac{4}{81}$

6. A triangle has vertices as $A(x_1, y_1)$, $B(x_2, y_2)$ and $C(x_3, y_3)$. An expression is given as $f(x, y) = \begin{vmatrix} x & y & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix} - (n-1)\begin{vmatrix} x & y & 1 \\ x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \end{vmatrix}$ then f(x, y) = 0 represents

(A) a line passing through A and dividing BC in a ratio of (n – 1) : 1
(B) a line passing through B and dividing AC in a ratio of 1 : (n – 1)
(C) a line passing through B and dividing AC in a ratio of (n – 1) : 1
(D) a line passing through B and dividing AC in a ratio of 1 : n

7. Let f : R $\rightarrow$ R be a thrice differentiable function satisfying f(3) = 2, and f′(x) is having a point of extreme at x = 3 also $\lim_{h\to 0} \frac{f(3+2h)-f(3)}{h} = 5$ and $\int_3^4 (x-4)^2 f'''(x)\,dx = 9$ then the value of f(4) lies in the interval

(A) (1, π) (B) $\left(\sqrt{\pi}, e^2\right)$

(C) (π, π^2) (D) (π^2, π^3)

8. $\int_0^{\pi/2} (\sin x)^{2013} (\cos x)^{2013}\,dx = 4^{-k} \int_0^{\pi/2} \left((\sin x)^{2013} + (\cos x)^{2013}\right) dx$ then the value of k is

(A) –1006 (B) $\frac{2013}{2}$

(C) 1006 (D) 1007

Rough work

Comprehension Type

This section contains **3 paragraphs**. Based upon paragraphs **3 multiple choice questions** have to be answered. Each of these questions has four choices (A), (B), (C) and (D) out of **which ONLY ONE** is correct.

Paragraph for Question Nos. 9 to 10

Read the following write up carefully and answer the following questions:
A ray of light get into the circle $x^2 + y^2 = 25$ and after three reflections comes out of the same point. If after first reflection, it goes along the line $7x - y = 25$ and the third reflection occurs in the third quadrant then

9. If the equation of incident ray is $ax + by + c = 0$ then the value of $\left[\left|\frac{a+b+c}{5}\right|\right]$ (where [.] denotes the greatest integer function) is
   (A) 2 (B) 3
   (C) 4 (D) 6

10. Total number of integral points lying inside the circle which touches the incident and all reflected rays
   (A) 25 (B) 20
   (C) 22 (D) 18

Paragraph for Question Nos. 11 to 12

Read the following write up carefully and answer the following questions:
Consider the two quadratic polynomials as $P(x) = x^2 - 2x + (a^2 - 5a + 5)$ and
$Q(x) = x^2 - (b - 3)x + b$ where $a, b \in R$ and roots of $P(x) = 0$ are x_1 and x_2 and $Q(y) = 0$ are y_1 and y_2

11. If the graph of P(x) lies above and below the x–axis and graph of Q(x) lies completely above the x–axis then total number of integral order pairs (a, b) is
   (A) 12 (B) 24
   (C) 14 (D) 15

12. A circle is drawn with (x_1, y_1) and (x_2, y_2) as end of the diameter. If line $2x + y = 0$ is a normal to that circle and its radius is one unit then the maximum value of a is
   (A) 0 (B) 2
   (C) 4 (D) 5

Rough work

Paragraph for Question Nos. 13 to 14

Read the following write up carefully and answer the following questions:

Let P and Q be the points on the lines $L_1 : \vec{r} = 6\hat{i} + 7\hat{j} + 4\hat{k} + \lambda(3\hat{i} - \hat{j} + \hat{k})$ and $L_2 : \vec{r} = -9\hat{i} + 2\hat{k} + \mu(-3\hat{i} + 2\hat{j} + 4\hat{k})$ respectively. Which are nearest to each other and O be the origin then

13. Equation of the plane OPQ is
(A) 2x + y + 7z = 0 (B) 23x – 9y + z = 0
(C) 23x + 9y + z = 0 (D) 23x + 9y + 10z = 0

14. The volume of parallelopiped formed by $\overline{OP}$, $\overline{OQ}$ and $\overline{OR}$ where R (1, –1, 0) is equal to
(A) 46 (B) 92
(C) 96 (D) 36

Multiple Correct Answer(s) Type

This section contains **6 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE are correct**.

15. For three positive integers a, b and c and $\sqrt{4+\sqrt{8-\sqrt{32+\sqrt{768}}}} = a\sqrt{2}\cos\left(\frac{\pi b}{c}\right)$ where b and c are co–prime to each other. Then the value of (a + b + c) is not a multiple of
(A) 3 (B) 7
(C) 11 (D) 13

16. Which of the following statements is/are correct
(A) probability that the square of a randomly selected integer ends in 4 is $\frac{2}{5}$
(B) probability that the square of a randomly selected integer ends in 4 is $\frac{1}{5}$
(C) probability that the 4^{th} power of a randomly selected integer ends in 1 is $\frac{2}{5}$
(D) probability that square of a randomly selected integer ends in 3 or 7 is zero

Rough work

17. Equation of the plane; passing through the line of intersection of the two planes $\bar{r}\cdot\bar{n}_1 = q_1$ and $\bar{r}\cdot\bar{n}_2 = q_2$ and parallel to the line of intersection of $\bar{r}\cdot\bar{n}_3 = q_3$ and $\bar{r}\cdot\bar{n}_4 = q_4$ is
(A) dependent on $\bar{n}_1$, $\bar{n}_3$ (B) dependent on $\vec{n}_3$, $\vec{n}_4$
(C) independent of q_1 and q_2 (D) independent of q_3 and q_4

18. Let y = f(x) satisfies the differential equation $(1+x^2)\frac{dy}{dx} + 2xy = 3x$ and f(0) = 2 then the correct statement about y = f(x) is
(A) it is differentiable in the entire domain (B) it has exactly two points of inflections
(C) if has exactly one integer in its range (D) it is a monotonic function in the domain

19. If $2xydy = \left(x^2 + y^2 + 1\right)dx$, $y(1) = 0$ and $y(\alpha) = \sqrt{3}$ then α can be
(A) 2 (B) –2
(C) 5 (D) –5

20. Consider the locus of the complex number z in the argand plane is given by
Re(z) – 2 = |z – 7 + 2i|
Let $P(z_1)$ and $Q(z_2)$ be two complex number satisfying the given locus and also satisfying $\arg\left(\frac{z_1-(2+\alpha i)}{z_2-(2+\alpha i)}\right) = \frac{\pi}{2}(\alpha \in R)$ then the minimum value of PQ is divisible by
(A) 3 (B) 5
(C) 7 (D) 2

Rough work