JEE-2015 JEE ADVANCED-1	Vidyamandir Classes Gurukul for IITJEE Preparation	CODE AEGC

06/10/2013	PAPER - 1	MAX. MARKS : 180
10:00 AM - 01:00 PM		TIMING : 3.0 Hrs

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ROLL NO. : IOHS.HJ.0142

Read the following Instructions very carefully before you proceed.

1. The question paper consists of 3 parts (Part I : Chemistry, Part II : Physics, Part III : Mathematics). Each Part has 3 sections (Section I, Section II & Section III).
2. Section I contains **10 Straight Objective type Questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE is correct.**
3. Section II contains **5 Multiple Objective type Questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONE or MORE may be correct.**
4. Section III contains **5 Integer (Subjective) type Questions.** Each question has an integer answer lying between 0 and 9.
5. For answering a question, an ANSWER SHEET (OMR SHEET) is provided separately. Please fill your **Test Code, Roll No.** and **Group** properly in the space given in the ANSWER SHEET.
6. For each question in **Section I,** you will be given **2 Marks** if you have darkened only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. There is **NO NEGATIVE MARKING.**
7. For each question in **Section II,** you will be given **4 Marks** if you have darkened only the bubbles corresponding to the correct answers and zero mark if no bubble is darkened. In all other cases, **minus one (–1) marks (NEGATIVE MARKING)** will be given.
8. For each question in **Section III,** you will be given **4 Marks** if you have darkened only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. In all other cases, **minus one (–1) marks (NEGATIVE MARKING)** will be given.
9. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc., except the Admit Card inside the examination hall/room.
10. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall. However, the candidates are allowed to take away this Test Booklet with them.
11. **No one will be permitted to leave the test room before the end of the test, i.e. 01.00 PM**

PART - I (CHEMISTRY) | **60 MARKS**

SECTION - I

SINGLE CORRECT ANSWER TYPE

This section contains 10 Single Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. The number of photons emitted in 10 hours by a 60 W sodium lamp emitting radiations of wavelength 6000 Å is :

(A) 6.5×10^{24} **(B)** 6.5×10^{34} **(C)** 1.8×10^{31} **(D)** 1.8×10^{21}

2. 1.0 gm each of Mg (Atomic weight = 24) and 'O_2' (Molecular weight = 32) are reacted to form compound MgO. Then :

I. Mg is the limiting reagent.
II. O_2 is the limiting reagent.
III. No reactant is left over.
IV. Mass of MgO formed is same as the mass of Mg taken.
V. Moles of reagent in excess are 1/96.
VI. Moles of product formed are 1/24.

The correct choice is :

(A) II, IV, V **(B)** I, IV, V **(C)** III, VI **(D)** I, V, VI

3. A solution contains x mmol Na_2CO_3 and y mmol $NaHCO_3$, 10 mL of the solution requires 2.5 mL of 0.1 M H_2SO_4 for neutralization using phenolphthalein as the indicator. Methyl orange is then added when a further 2.5 ml of 0.2 M H_2SO_4 was required. Find mole ratio of Na_2CO_3 and $NaHCO_3$ $\left(\frac{x}{y}\right)$:

(A) 1 **(B)** 0.5 **(C)** 2 **(D)** None of these

SPACE FOR ROUGH WORK

4. Which of the following is(are) correct ?

I. The order of repulsion between different pair of electron is $lp - lp > lp - bp > bp - bp$.

II. In general, as the number of lone pair of electrons on central atom increases, value of bond angle from normal bond angle also increases.

III. The number of lone pair on O in H_2O is 2 while on N in NH_3 is 1.

IV. In cumulated diene, $CH_2 = C = CH - CH_3$; there are 2 sp^2, 1 sp and 1 sp^3 hybrid carbon atoms.

The correct option is :

(A) I, II, IV (B) I, III, IV (C) II, III, IV (D) I, II, III, IV

5. The first ionisation potential of Al is smaller than that of Mg because:

(A) The atomic size of Al > Mg

(B) The atomic size of Al < Mg

(C) Al has one unpaired electron in p-orbital

(D) The atomic number of Al > Mg

6. A sample of water is found to contain 244 ppm of HCO_3^- ions, 192 ppm of SO_4^{2-} ions and 71 ppm of Cl^- ions. Assuming the source of these ions to be their respective calcium salts, what is the concentration of Ca^{2+} ions in terms of ppm ?

(A) 320 (B) 560 (C) 200 (D) 280

SPACE FOR ROUGH WORK

7. The minimum and maximum wavelengths of Lyman series for hydrogen atoms are respectively (R ≡ Rydberg constant)

(A) $\frac{1}{R}, \frac{4}{3R}$ (B) $\frac{1}{2R}, \frac{4}{3R}$ (C) $\frac{1}{R}, \frac{4}{R}$ (D) None of these

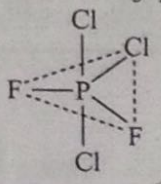
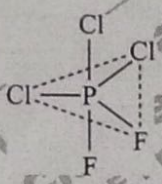
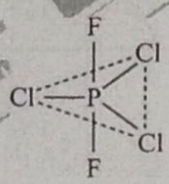
For Questions 8 - 9

(A) Statement-1 is True, Statement-2 is True and Statement-2 is a correct explanation for Statement-1
(B) Statement-1 is True, Statement-2 is True and Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

8. **Statement : 1** Absolute zero is the lowest possible temperature.
Statement : 2 A lower temperature would correspond to negative volume of gas which is physically meaningless.

9. **Statement : 1** LiCl is essentially a covalent compound.
Statement : 2 For covalent character, cation size should be smaller; anion size should be larger which results in greater polarization.

10. The struture of PCl_3F_2 is :

(A)  (B)  (C)  (D) All are correct

SPACE FOR ROUGH WORK

SECTION - II

MULTIPLE CORRECT ANSWERS TYPE

This section contains 5 Multiple Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

11. Which of the following statements(s) is(are) correct ?

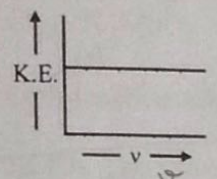
(A) 0.2 moles of $KMnO_4$ will oxidise one moles of ferrous ions to ferric in acidic medium

(B) 1.5 moles of $KMnO_4$ will oxidise 1 mole of ferrous oxalate of ferric oxalate in acidic medium

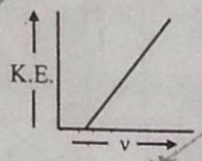
(C) 0.6 moles of $KMnO_4$ will oxidise 1 mole of ferrous oxalate to one mole of ferric ion and carbon dioxide in acidic medium

(D) 1 moles of $K_2Cr_2O_7$ will oxidise 2 moles of ferrous oxalate to ferric ions and carbon dioxide in acidic medium

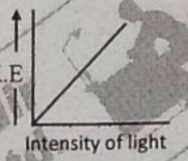
12. Which of the graphical representation based on photoelectric effect is(are) correct ?



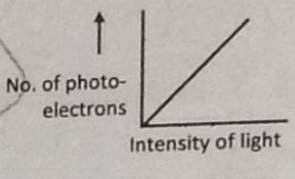
(A)



(B)



(C)



(D)

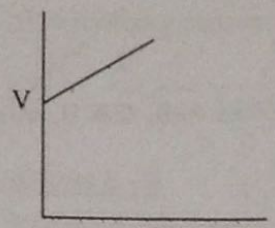
13. Mark out the correct options.

(A) First ionisation energy : Ca > K **(B)** Second ionisation energy : Mg > Al

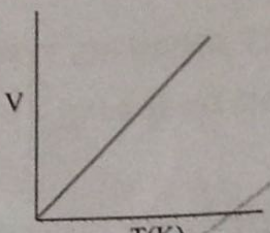
(C) Electron affinity : S > O **(D)** Ionic radius : $Sc^{3+} > K^+$

SPACE FOR ROUGH WORK

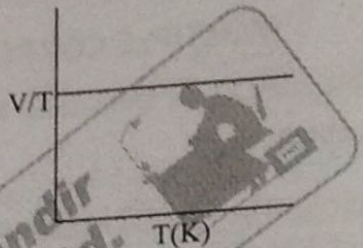
14. For a fixed mass of gas and constant pressure, which of the following graphs is/are correct?



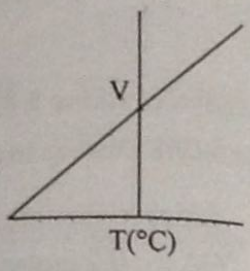
(A)



(B)



(C)



(D)

15. Which of the following is(are) true for quantum numbers ?

(A) The azimuthal quantum number (ℓ) determines the shape of the electron cloud

(B) The spin quantum number determines the orientation of an orbital in space

(C) The magnetic quantum number may have values from $+\ell$ to $-\ell$ (including zero)

(D) The magnetic quantum number determines orientation of an orbital in space

SPACE FOR ROUGH WORK

SECTION - III

SUBJECTIVE INTEGER TYPE

This section contains 5 Subjective Questions. Each question has an integer answer between 0 and 9. Fill the answer bubbles in the OMR Sheet appropriately and CAREFULLY.

16. In the Bohr's model of the hydrogen atom, the ratio of the potential energy of an electron to the total energy of the electron is _____.

17. A gaseous mixture containing 5 mL of a gaseous hydrocarbon (C_xH_y) and 30 mL O_2 was exploded. The volume of reaction mixture obtained was found to be 25 mL. If all the volume measurements are at NTP, then value of y is _____.

18. The difference in the oxidation numbers of the two types of sulphur atoms in $Na_2S_4O_6$ is _____.

19. $MnO_2 + 2KClO_3 \longrightarrow K_2MnO_4 + Cl_2 + 2O_2$

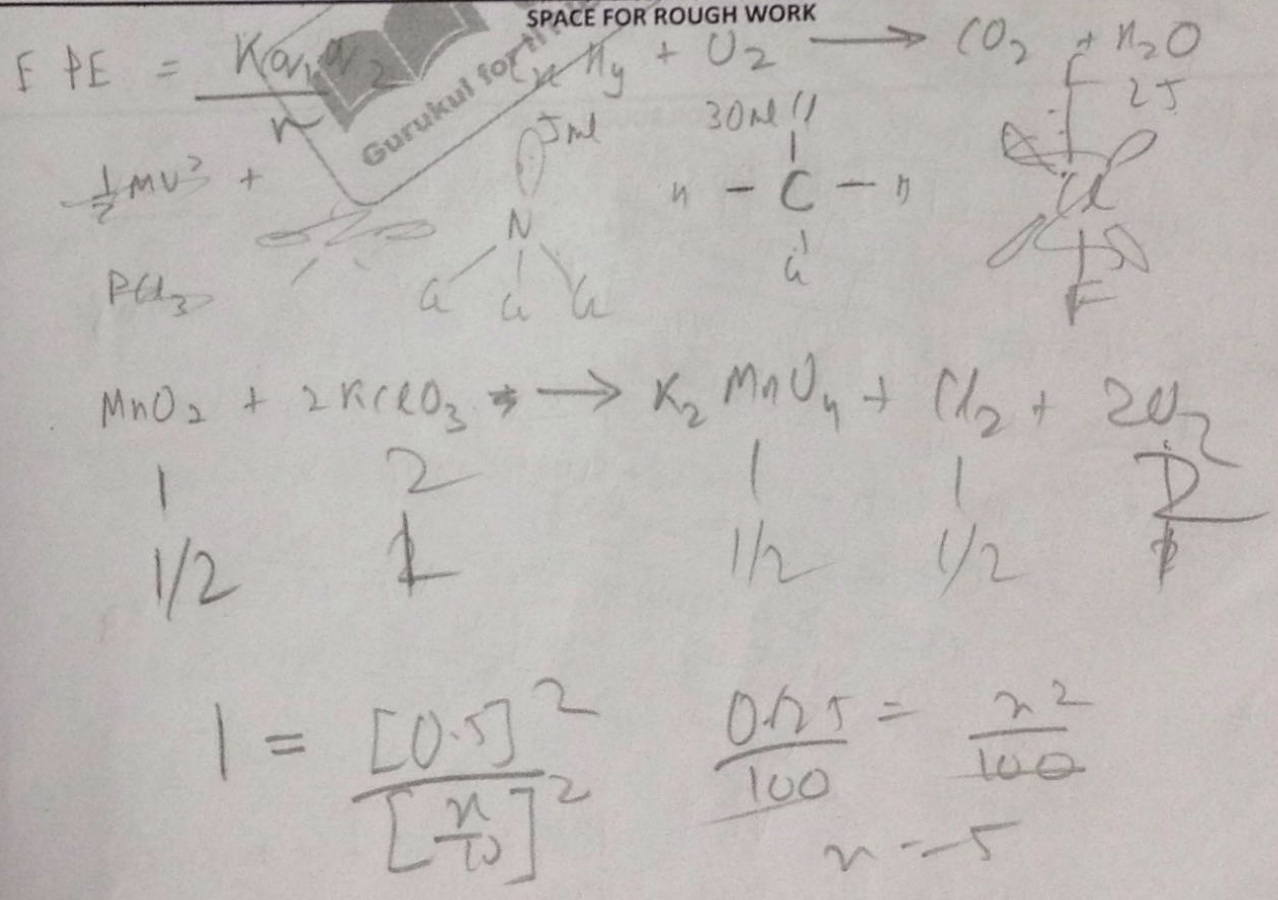
$Cl_2 + K_2MnO_4 \longrightarrow 2KCl + MnO_2 + O_2$

Each reaction takes place to the extent of 50%. 11.2 L of O_2 at STP is obtained from $\frac{X}{10}$ moles of $KClO_3$. The value of X is _____.

20. How many of the following have sp^3 hybridization

PCl_3, NCl_3, NF_3, NH_3, ClF_3, CH_2Cl_2, BCl_3, BBr_3

SPACE FOR ROUGH WORK



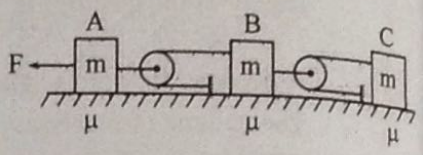
PART - II (PHYSICS) | **60 MARKS**

SECTION - I

SINGLE CORRECT ANSWER TYPE

This section contains 10 Single Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

21. On a table, three blocks are placed as shown in the figure. Mass of each block is m and coefficient of friction for each block is μ. A force F is applied on block A so as to move the system. The minimum value of F should be :

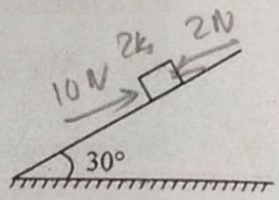


(A) $8\mu mg$ **(B)** $9\mu mg$ **(C)** $7\mu mg$ **(D)** $5\mu mg$

22. 'A' and 'B' are moving along same straight line in opposite direction, each with speed 4 m/s with respect to ground. 'A' sees that the rain drops are falling vertically while 'B' sees the rain drops falling at an angle 45° with the vertical. The speed of rain w.r.t. ground, is :

(A) $4\sqrt{2}m/s$ **(B)** $4\sqrt{5}ms$ **(C)** $4m/s$ **(D)** $8\sqrt{2}m/s$

23. Figure shows a block of mass $2kg$ kept on a rough inclined plane. The maximum external force down the inclined plane for which the block remains at rest is $2N$ while the maximum external force up the incline for which the block is at rest is $10N$. The coefficient of static friction μ is:



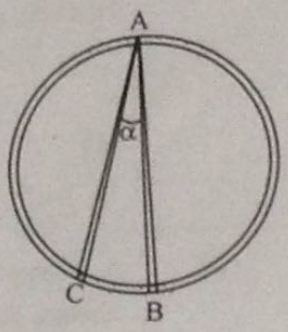
(A) $\frac{\sqrt{3}}{5}$ **(B)** $\frac{1}{\sqrt{6}}$ **(C)** $\sqrt{3}$ **(D)** $\frac{1}{\sqrt{3}}$

SPACE FOR ROUGH WORK

24. A particle is projected form the ground at an angle of $60°$ with horizontal at speed $u = 20\ m/s$. The radius of curvature of the path of the particle, when its velocity makes an angle of $30°$ with horizontal is nearly : $(g = 10 m/s^2)$

(A) $10.6\ m$ (B) $12.8\ m$ (C) $15.4\ m$ (D) $24.2\ m$

25. In a vertical disc two grooves are made as shown in figure. AB is a diameter. Two balls are dropped at A one in each groove, simultaneously. Then :



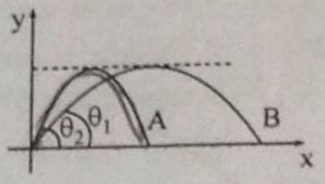
(A) Time to each at C is less than that to reach at B

(B) Time to reach at C is greater than that to reach at B

(C) Time to reach at C is equal to that to reach at B

(D) The difference in time to reach at C and to reach at B may be positive, negative or zero depending on α

26. Two particles are thrown from the same point in the same vertical plane, as shown in figure simultaneously. Then indicate the incorrect statement.



(A) Time of flight for B is less than that of A

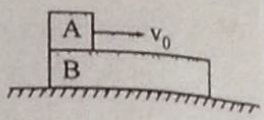
(B) Projection speed of B is greater than that of A

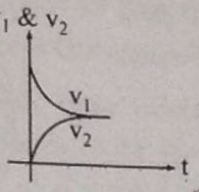
(C) Horizontal component of velocity for B is greater than that of A

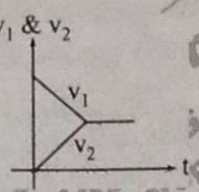
(D) The vertical component of velocities of both A and B are always equal throughout the duration for which both the particles are in air

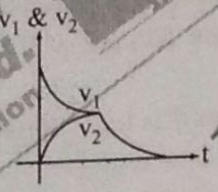
SPACE FOR ROUGH WORK

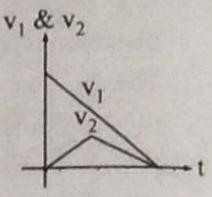
27. A block A is placed over a long rough plank B same mass as shown below. The plank is placed over a smooth horizontal surface. At time $t=0$, block A is given a velocity v_0 in horizontal direction. Let v_1 and v_2 be the velocity of A and B at time 't'. Then choose the correct graph between v_1 or v_2 and t.



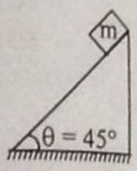
(A) 

(B) 

(C) 

(D) 

28. A wedge of mass $2m$ and a cube of mass m are shown in figure. Between cube and wedge, there is no friction. The minimum coefficient of friction between wedge and ground so that wedge does not move is :

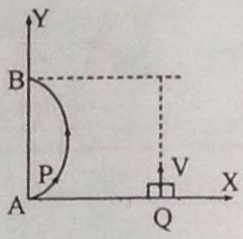


(A) 0.20 (B) 0.25 (C) 0.10 (D) 0.50

29. A particle is projected at an angle 53° to the horizontal at speed of 10 m/s. Find its tangential acceleration at $t = 1.4$ sec. (Take $g = 10\ m/s^2$)

(A) $5m/s^2$ (B) $5\sqrt{2}m/s^2$ (C) $10\sqrt{2}m/s^2$ (D) $10m/s^2$

30. A particle P starts from origin as shown and moves along a circular path. Another particle Q crosses x-axis at the instant particle P leaves origin. Q moves with constant speed v parallel to y-axis and is all the time having y-coordinate same as that of P. When P reaches diametrically opposite to point B, its average speed is :



(A) πV (B) $\frac{\pi V}{2}$ (C) $\frac{V}{2}$ (D) None of these

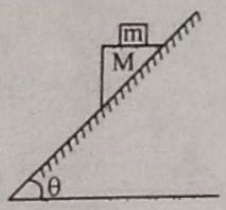
SPACE FOR ROUGH WORK

SECTION - II

MULTIPLE CORRECT ANSWERS TYPE

This section contains 5 Multiple Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

31. A wedge of mass M and a block of mass m are kept on an incline of inclination θ. The system is released from rest. The surface of the wedge on which the block rests is horizontal. all the surfaces are smooth then :



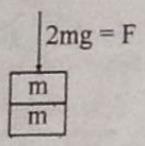
(A) The acceleration of the block is along the incline

(B) The acceleration of the block is in vertical direction

(C) The acceleration of the wedge is greater than g $\sin\theta$

(D) Normal force exerted by inclined plane on wedge is less than $(M+m)$ g $\cos\theta$

32. Two blocks of mass m each are moving vertically downward under influence of an external force of magnitude 2 mg as shown in figure :

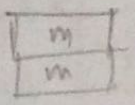


(A) Contact between blocks will break and normal reaction between block becomes zero

(B) Both blocks move in combination with common acceleration $a = 2g$

(C) Contact force between blocks is mg

(D) Both blocks move in combination with common acceleration $a = g$



33. Mark the incorrect options :

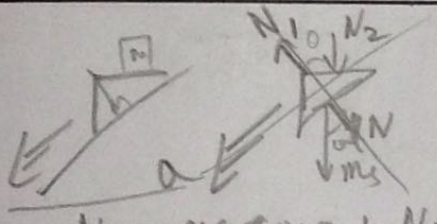
(A) If $\vec{d} - \vec{e} = \vec{f}$ and $f = d + e$ than $\vec{d}$ and $\vec{e}$ are opposite in direction.

(B) If $\vec{d} + \vec{e} = \vec{f}$ and $f = \sqrt{2}d$; $d = e$ than $\vec{d}$ and $\vec{e}$ are perpendicular.

(C) If $\vec{d} - \vec{e} = \vec{f}$ and $f = d + e$ than $\vec{d}$ and $\vec{e}$ are perpendicular.

(D) If $\vec{d} + \vec{e} = \vec{f}$ and $f = \sqrt{2}d$; $d = e$ than $\vec{d}$ and $\vec{e}$ are at angle 45°

SPACE FOR ROUGH WORK

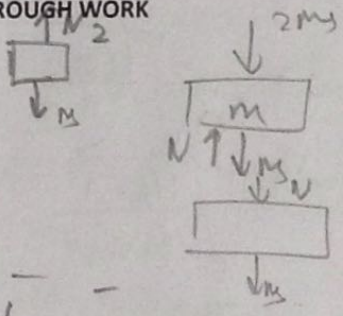


$N_1 = mg\cos\theta + N_2\cos\theta$

$a = mg\sin\theta + N_2\sin\theta$

$N_1 = mg\cos\theta + Mg\cos\theta$

$= (M+m)\,g\cos\theta$



$\vec{d} - \vec{e} = \vec{f}$

$f = \vec{d} + \vec{e}$

$d^2 + e^2$ $\quad d^2 + d^2$ $\quad \sqrt{2}d$

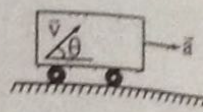
$ma = 2mg + mg + N$

$ma = 3mg + N$

$N = mg$

$a = 2g$

34. A particle is projected with a velocity $\vec{v}$ relative to a cart moving with an acceleration $\vec{a}$ towards right. At the instant of projection cart is moving with velocity $\vec{v_c}$. Which of the following remains same in both ground and cart reference frame? Assume that particle does not collide with ceiling and any wall



(A) Time of flight (B) Horizontal component of velocity
(C) Horizontal range (D) Maximum height attained

35. A heavy particle is tied to the end A of a string of length 1.6 m. Its other end O is fixed. It revolves as conical pendulum with the string making 60° with the vertical. Then :

(A) Its period of revolution is $\frac{4\pi}{7} sec$

(B) the tension in the string is double the weight of the particle

(C) the velocity of the particle $= 2\sqrt{6} m/s$

(D) the centripetal acceleration of the particle is $10\sqrt{3} m/s^2$

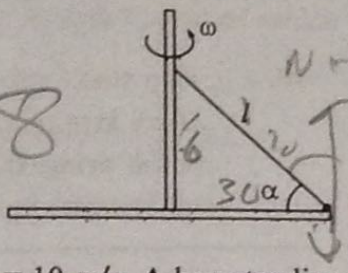
SPACE FOR ROUGH WORK

SECTION - III

SUBJECTIVE INTEGER TYPE

This section contains 5 Subjective Questions. Each question has an integer answer between 0 and 9. Fill the answer bubbles in the OMR Sheet appropriately and CAREFULLY.

36. A circular platform rotates around a vertical axis with angular velocity $\omega = 10\,rad/sec$. On the platform is a ball of mass 1 kg, attached to the long axis of the platform by a thin rod of length 10 cm ($\alpha = 30°$). Find normal force exerted by the ball on the platform (in newton). Friction is absent.

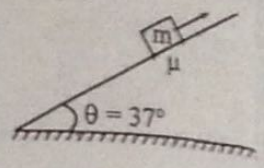


37. An open lift is coming down from the top of a building at a constant speed $v = 10\ m/s$. A boy standing on the lift throws a stone vertically upwards at a speed of 30 m/s w.r.t. himself. Find the time after which he will catch the stone in seconds. (Take $g = 10\ m/s^2$)

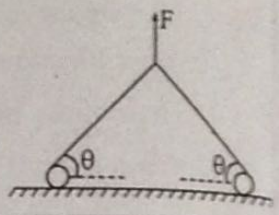
38. A plane flies horizontally at a height of 2 km at a constant speed of 112 m/s. From the airplane we want to drop a cargo on a ship moving on a parallel path on the surface of water with speed of 40 m/s. The path of plane and the ship are in the same vertical plane. If the horizontal distance from the ship so that cargo falls on ship is S(in m) then the value of S/144 is _____.

SPACE FOR ROUGH WORK

39. A block of mass m is being pulled up the rough incline, inclined at an angle $37°$ with horizontal by an agent delivering constant power P. The coefficient of friction between the block and the incline is μ. Find the maximum speed (in m/s) of the block during the course of ascent.)
[Take : P = 60 W, m = 1 kg, $\mu = 0.5$]



40. Two small spheres each of same mass m connected by a string of length $2l$ are kept on a smooth surface. A vertical force F is applied at the middle of the string. If the maximum value of F for which the spheres do not lose contact with the surface is kmg then the value of K is _____.



SPACE FOR ROUGH WORK

PART - III (MATHEMATICS) | **60 MARKS**

SECTION - I

SINGLE CORRECT ANSWER TYPE

This section contains 10 Single Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

41. For any real value of $\theta \neq \pi$, the value of expression $\frac{\cos^2\theta - 1}{\cos^2\theta + \cos\theta} \in R - (a, b]$ then $(b-a)$ is :

(A) 0 **(B)** 1 **(C)** 2 **(D)** None of these

42. Set of all real values of 'a' such that $f(x) = \frac{(2a-1)x^2 + 2(a+1)x + (2a-1)}{x^2 - 2x + 40}$ always negative is :

(A) $(-\infty, 0)$ **(B)** $(0, \infty)$ **(C)** $\left(-\infty, \frac{1}{2}\right)$ **(D)** $(2, \infty)$

43. Consider the following statements :

S_1 : $\sin 1 > \cos 1 > \sin 3$

S_2 : If $\tan^2\theta = 2\tan^2\phi + 1$, then the value of $\cos 2\theta$ lies in $[-1, 0)$

S_3 : Solution set of $|x^2 + x + 1| > |x + 1|$ is $(-\infty, 0) \cup (0, \infty)$

State in order whether S_1, S_2 and S_3 are true (T) or false (F) :

(A) FFT **(B)** TFF **(C)** TFT **(D)** TTT

SPACE FOR ROUGH WORK

$\frac{\cos^2\theta - 1}{\cos^2\theta + \cos\theta} = \frac{(\cos\theta+1)(\cos\theta-1)}{\cos\theta(\cos\theta+1)} = \frac{\cos\theta - 1}{\cos\theta}$

$\cos\theta \neq \frac{n\pi}{2}, \pi$ $\quad \theta \neq \frac{\pi}{2}$

$\sin + \cos\theta + \tan\theta + 1 = \sec^2\theta$

$(2a-1)x^2 + 2(a+1)x + (2a-1) < 0$ $\quad x^2 - 2x + 40 > 0$

$a < 0$ $\quad 2a - 1 < 0$

$D \leq 0$ $\quad a < 1/2$

$\tan^2\theta = 2\tan^2\phi + 1$

$-2(a+1) \leq \sqrt{4(a+1)^2 - 4(2a-1)^2}$

$\cos\theta - 1 \geq 2\cos\theta$

$-1 \geq \cos\theta$

$D = (a+1)^2 - (2a-1)^2 < 0$

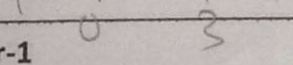
$a^2 + 1 + 2a - (4a^2 + 1 - 4a) < 0$

$-3a^2 + 6a < 0$ $\quad (2, \infty)$

$-a^2 + 2a < 0$

$a^2 - 2a > 0$

$a(a-3) > 0$



44. Set of values of 'm' for which two points P and Q lies on the line $y = mx + 8$ such tha $\angle APB = \angle AQB = \frac{\pi}{2}$ where $A \equiv (-4, 0)$, $B \equiv (4, 0)$ is :

(A) $(-\infty, -\sqrt{3}) \cup (\sqrt{3}, \infty) - \{-2, 2\}$ **(B)** $[-\sqrt{3}, \sqrt{3}] - \{-2, 2\}$

(C) $(-\infty, -1) \cup (1, \infty) - \{-2, 2\}$ **(D)** $\{-\sqrt{3}, \sqrt{3}\}$

45. P is a point (a, b) in the first quadrant. If the two circles which pass through P and touch both the co-ordinate axes and intersect each other at right angles, then :

(A) $a^2 - 6ab + b^2 = 0$ **(B)** $a^2 + 2ab - b^2 = 0$

(C) $a^2 - 4ab + b^2 = 0$ **(D)** $a^2 - 8ab + b^2 = 0$

46. Consider the following statements :

S_1 : If both the roots $x^2 - 2ax + a^2 + a - 2 = 0$ are less than '2' then $a < 1$.

S_2 : If roots of the quadratic equation $x^2 - x\log(a^2 - 3a + 2) + a^2 - 9 = 0$ are of opposite sign then $-3 < a < 3$.

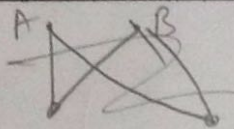
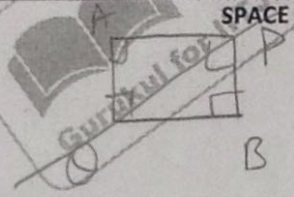
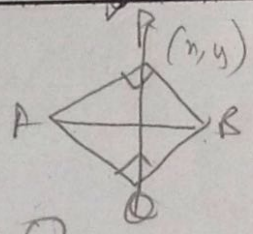
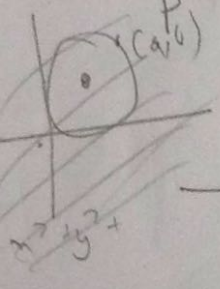
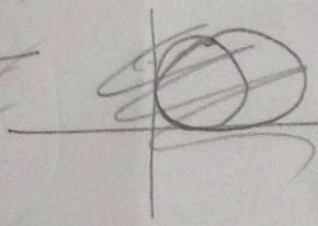
S_3 : $\cot 123° \cdot \cot 133° \cdot \cot 137° \cdot \cot 147° = 1$.

S_4 : Number of values of 'x' lying in the interval $(0, \pi)$ satisfying the equation $\tan x + \sec x = 2\cos x$ is 2.

State in order whether S_1, S_2, S_3 and S_4 are true (T) or false (F) :

(A) FTFT **(B)** FFTT **(C)** TTFT **(D)** TFTT

SPACE FOR ROUGH WORK

47. If θ be the angle between two tangents which are drawn to the circle $x^2+y^2-6\sqrt{3}x-6y+27=0$ from the origin, then $2\sqrt{3}\tan\theta$ is :

(A) 5 (B) 1 (C) 7 (D) 6

48. $\sqrt{23}\sin 2x+\sqrt{2}\cos 2x=-a^2+4a-9$ has infinitely many solutions for x, if :

(A) $a=1$ (B) $a<1$ (C) $a=2$ (D) $a>2$

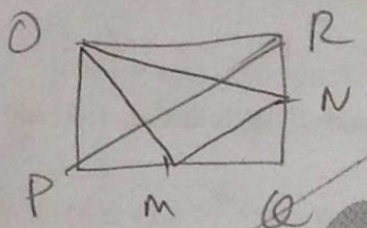
49. $OPQR$ is a square and M, N are the mid points of the sides PQ and QR respectively. If the ratio of the areas of the square and the triangle OMN is $\frac{\lambda}{6}$ then $\frac{\lambda}{4}$ is :

(A) 2 (B) 4 (C) 12 (D) 16

50. Let the equation $x^3-4x^2+5x-1.9=0$ has real roots r, s and t. If the area of the triangle with sides r, s and t can be expressed in the form $\left(\frac{1}{\sqrt{N}}\right)$, then the value of N is :

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

SPACE FOR ROUGH WORK



SECTION - II

MULTIPLE CORRECT ANSWERS TYPE

This section contains 5 Multiple Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

51. The value of $\frac{\sin x - \cos x}{\sin^3 x}$ is equal to :

(A) $\operatorname{cosec}^2 x(1-\cot x)$ **(B)** $\operatorname{cosec}^2 x - \cot x - \cot^3 x$

(C) $1-\cot x+\cot^2 x-\cot^3 x$ **(D)** $\frac{1-\cot x}{\sin^2 x}$

52. The locus of the point of intersection of the tangents at the extremities of a chord of the circle $x^2+y^2=a^2$ which touches the circle $x^2+y^2-2ax=0$ passes through the point :

(A) $\left(\frac{a}{2}, 0\right)$ **(B)** $\left(0, \frac{a}{2}\right)$ **(C)** $(0, a)$ **(D)** $(a, 0)$

53. If the area of the triangle with vertices $(m^2, 2m)$, $(mm', m+m')$ and $(m'^2, 2m')$ is 32, then :

(A) $m-m'=4$ **(B)** $m'-m=4$ **(C)** $m+m'=4$ **(D)** $m+m'=2$

54. If the equation $ax^2+bx+c=0\ (a>0)$ has two distinct roots α and β such that $\alpha<-2$ and $\beta>2$ then :

(A) $b^2-4ac>0$ **(B)** $c<0$ **(C)** $a+|b|+c<0$ **(D)** $4a+2|b|+c<0$

55. If $\tan\frac{t}{2}$ is the root of quadratic equation $ax^2+bx+1=0$, where $b, c \in R$ and $\sin t+\cos t=\frac{4}{3}$ then :

(A) $a+b=1$ **(B)** $a+b=8$ **(C)** $2a+3b=3$ **(D)** $2a+b=8$

SPACE FOR ROUGH WORK

SECTION - III

SUBJECTIVE INTEGER TYPE

This section contains 5 Subjective Questions. Each question has an integer answer between 0 and 9. Fill the answer bubbles in the OMR Sheet appropriately and CAREFULLY.

56. The absolute value of the difference of the real roots of the equation $x^2 - 2^{2010}x + \left|x - 2^{2009}\right| + 2\left(2^{4017} - 1\right) = 0$ is _____.

57. If α and β are the roots of the equation $x^2 - p(x+1) - q = 0$, then the value of $\frac{\alpha^2+2\alpha+1}{\alpha^2+2\alpha+q} + \frac{\beta^2+2\beta+1}{\beta^2+2\beta+q}$ is _____. (**Hint**: You may use $(1+\alpha)(1+\beta) = 1+\alpha+\beta+\alpha\beta$)

58. The value of the expression $x^4 - 8x^3 + 18x^2 - 8x + 2$ when $x = 2+\sqrt{3}$ is _____.

59. If x and y are the real numbers satisfying the equation $12\sin x + 5\cos x = 2y^2 - 8y + 21$, then the value of $12\cot\left(\frac{xy}{2}\right)$ is _____.

60. In a triangle ABC, the bisector of angles B and C lie along the lines $x = y$ and $y = 0$. If A is $(1, 2)$ then $\sqrt{10}d(A, BC)$ where $d(A, BC)$ represents the perpendicular distance of point A from side BC is _____.

SPACE FOR ROUGH WORK

$x^2 - x\left(2^{2010}+1\right) - 2^{2009} + 2^{4017} - 2 = 0$

$\alpha + \beta = 2^{2010} + 1$

$\alpha\beta = -2^{2009} + 2^{4017} - 2$

$x^2 - p(x+1) - q = 0$

$x^2 - px - p - q$

$\alpha + \beta = p$

$\alpha\beta = -(p+q)$

$\frac{(\alpha+1)^2}{\alpha^2+2\alpha+q} + \frac{(\beta+1)^2}{\beta^2+2\beta+q}$

$\frac{(\alpha^2+2\alpha+1)(\beta^2+2\beta+q) + (2\beta+\beta^2+1)(\alpha^2+2\alpha+q)}{(\alpha^2+2\alpha+q)(\beta^2+2\beta+q)}$

$\alpha^2\beta^2 + 2\alpha\beta^2 + \beta^2 + 2\beta\alpha^2 + 4\alpha\beta + 2\beta + \alpha^2 q + 2\alpha q + q + 2\beta\alpha^2 + 4\alpha\beta + 2\beta$
$+ \alpha^2\beta^2 + 2\alpha\beta^2 + \beta^2 q + \alpha^2 + 2\alpha\beta + q$

$2\left(\alpha^2\beta^2 + 2\alpha\beta^2 + \alpha^2 + \beta^2 + 2\alpha^2\beta + 8\alpha\beta + 2\alpha + 2\beta\right)$