

FITJEE INTERNAL TEST

IIT – JEE 2020

PHASE – II_PAPER – I_SET – A

Time: 3 hours

Maximum Marks: 180

INSTRUCTIONS:

A. General

1. This booklet is your Question Paper containing 60 questions.
2. Blank papers, clipboards, log tables, slide rules, calculators, cellular phones, pagers and electronic gadgets in any form are not allowed to be carried inside the examination hall.
3. Fill in the boxes provided for Name and Enrolment No.
4. The answer sheet, a machine-readable Objective Response (ORS), is provided separately.
5. DO NOT TAMPER WITH / MULTILATE THE ORS OR THE BOOKLET.

B. Filling in the OMR:

6. The instructions for the OMR sheet are given on the OMR itself.

C. Question paper format:

7. The question paper consists of **3 parts (Physics, Chemistry and Mathematics)**. Each part consists of **two sections**.
8. **Section I** contains **10 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.
9. **Section II** contains **10 questions**. The answer to each question is a **single digit integer**, ranging from 0 to 9 (both inclusive).

D. Marking Scheme

10. For each question in **Section I**, you will be awarded **3 marks** if you darken ALL the bubble(s) corresponding to the correct answer(s) **ONLY**. In all other cases **zero (0) marks** will be awarded. **No negative marks** will be awarded for incorrect answers in this section.
11. For each question in **Section II**, you will be awarded **3 marks** if you darken the bubble corresponding to the correct answer **ONLY**. In all other cases **zero (0) marks** will be awarded. **No negative marks** will be awarded for incorrect answers in this section.

Don't write / mark your answers in this question booklet.

If you mark the answers in question booklet, you will not be allowed to continue the exam.

NAME:

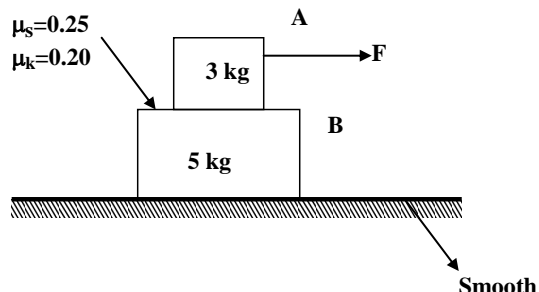
ENROLLMENT NO.:

PAPER-I PART I: PHYSICS

SECTION – I: (One or more than one options are correct)

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

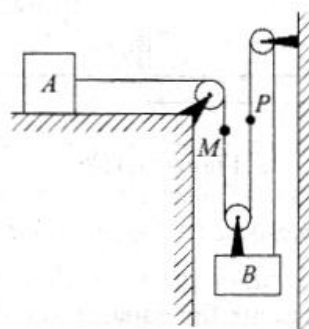
1. Consider two blocks A and B having masses 3 kg and 5 kg placed over one another. The coefficient of static friction and kinetic friction are 0.25 and 0.20 respectively between two blocks. The bottom horizontal surface is frictionless. Then
- (A) If $F = 8\text{ N}$ then frictional force acting between two blocks is 5 N
- (B) If $F = 15\text{ N}$ then acceleration of block of mass 5 kg is 1.5 m/s^2
- (C) If $F = 18\text{ N}$ then acceleration of block of mass 3 kg is 4 m/s^2
- (D) If $F > 9.6\text{ N}$, the two blocks start sliding over each other



2. Which of the following quantities may remain constant during the motion of an object along a curved path.
- (A) speed (B) velocity (C) acceleration (D) magnitude of acceleration

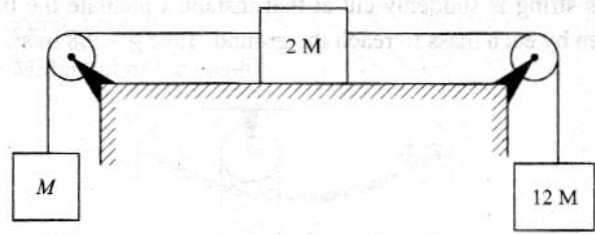
3. Two block A and B are shown in figure. Block A moves to the left with a constant velocity of 6 m/s. Then correct options are _____

- (A) Velocity of the block B w.r.t ground is 2 m/s upward
- (B) Velocity of the point P of the string w.r.t ground is 2 m/s downward
- (C) Relative velocity of the point M of the string with respect to the point P is 8 m/s upward
- (D) Relative velocity of the point M of the string with respect to the point P is 6 m/s upward

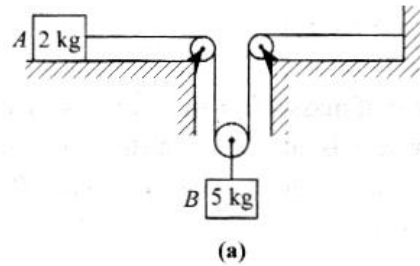


Space for rough work

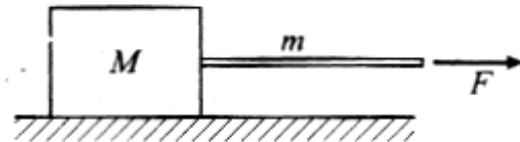
4. The three blocks in figure are released from rest and accelerate at the rate of 5 m/s^2 . If $M = 4 \text{ kg}$, what is the magnitude of the frictional force on the block that slides horizontally ? (Take $g = 10 \text{ m/s}^2$)
 (A) 70 N (B) 140 N
 (C) 80 N (D) Insufficient data



5. All the surface are smooth then
 (A) Acceleration of block A is $\frac{10g}{13}$ rightward
 (B) Acceleration of block B is $\frac{5g}{13}$ downward
 (C) Acceleration of block A is $\frac{5g}{13}$ rightward
 (D) Acceleration of block B is $\frac{5g}{26}$ downward



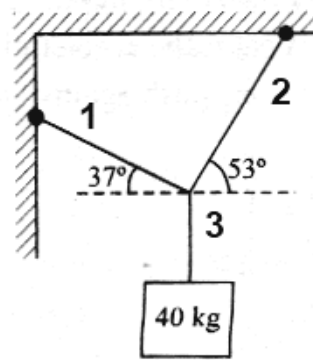
6. A block of mass M is pulled along a horizontal frictionless surface by a rope of mass m , as shown in figure. A horizontal force F is applied to one end of the rope. Then



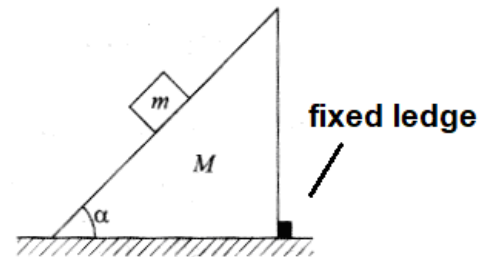
- (A) the force the rope exerts on the block is $\frac{MF}{M+m}$
 (B) the tension in the rope at its midpoint is $\frac{(M+m)F}{\left(M+\frac{m}{2}\right)}$
 (C) the tension in the rope at its midpoint is $\frac{\left(M+\frac{m}{2}\right)F}{(M+m)}$
 (D) acceleration of the block is $\frac{F}{M}$

Space for rough work

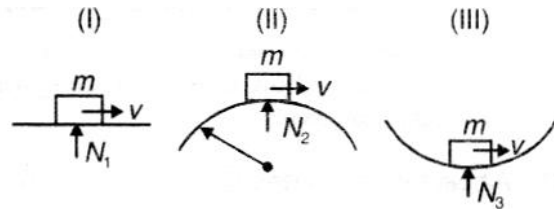
7. The object in figure weighs 40 kg and hangs at rest. Then which of the following options is / are correct.
 (A) Tension in string – 1 is 240 N
 (B) Tension in string – 2 is 360 N
 (C) Tension in string – 2 is 320 N
 (D) Tension in string – 3 is 400 N



8. A body with a mass m slides along the surface of a trihedral prism of mass M , whose upper plane is inclined at an angle α to the horizontal. The prism rests on a horizontal plane having a vertical ledge at the rear edge of the prism to keep it at rest as shown in figure. Then
 (A) the force exerted by the base of the prism on the plane is $(Mg + mg \cos^2 \alpha)$
 (B) the force exerted by the base of the prism on the plane is $(Mg + mg \sin \alpha \cos \alpha)$
 (C) the force exerted by ledge on prism is $mg \cos^2 \alpha$
 (D) the force exerted by ledge on prism is $mg \sin \alpha \cos \alpha$

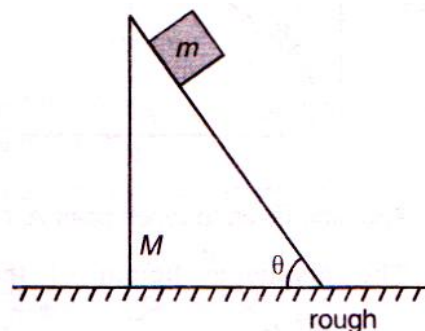


9. Choose the correct alternatives, The figure shows a block of mass m moving without friction along three tracks with same speed v
 (A) $N_1 = mg$
 (B) $N_2 = mg - \frac{mv^2}{R}$
 (C) $N_3 = mg + \frac{mv^2}{R}$
 (D) If fig (II), the block will leave path, if $V > \sqrt{gR}$



Space for rough work

10. A block of mass m is placed on a prism of mass M . The inclined surface is smooth and inclination with horizontal is θ . The horizontal surface is sufficiently rough to prevent slipping of prism. If the block of mass m slides down the inclined face then
- (A) Acceleration of block along the inclined surface is $g\sin\theta$
- (B) Frictional force offered by the ground on the prism is $\frac{1}{2}mg\sin 2\theta$
- (C) If θ can vary between 0° to 90° then Maximum possible frictional force between ground and prism is $\frac{mg}{2}$
- (D) Friction force will be maximum when $\theta = 45^\circ$



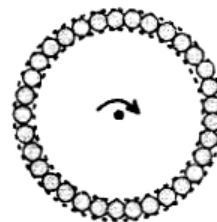
SECTION – II: (Integer value type)

This section contains **10 questions**. The answer to each of the questions is a **single digit integer**, ranging from 0 to 9 (both inclusive).

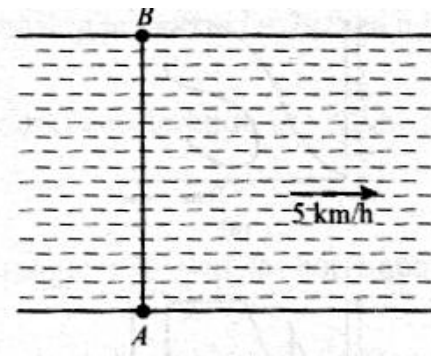
11. A block of mass $m = 1$ kg moves on a horizontal circle against the wall of a cylindrical room of radius $R = 2\sqrt{2}m$. The floor of the room on which the block moves is smooth but the friction coefficient between the wall and the block is $\mu=1$. The block is given an initial speed v_0 . If speed at a instant is $v = 2$ m/s then calculate resultant acceleration of block in m/s^2 at that instant.
12. A car goes on a horizontal circular road of radius $R = \sqrt{27}$ meter, the speed increasing at a constant rate $\frac{dv}{dt} = 1$ m/s^2 , starting from rest. The friction coefficient between the road and the tyre is $\mu=0.2$. Find the time (in sec) at which the car will skid.

Space for rough work

13. A uniform metallic chain in a form of circular loop of mass $m = 3\text{kg}$ with a length $\ell = 1\text{m}$ rotates at the rate of $n = 5$ revolutions per second. If T is the tension in the chain in Newton then value of $\left(\frac{T}{25} + 3\right)$ is _____



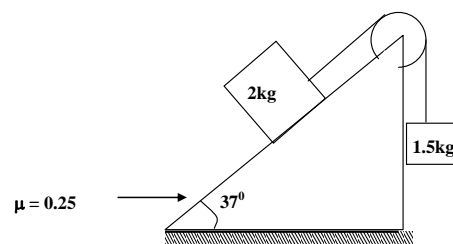
14. In the figure shown, a river of width 4 km is flowing with the speed of 5 km/h. A swimmer whose swimming speed relative to the water is 4 km/h, starts swimming from a point A on a bank. On the other bank B is a point which is directly opposite to A. What is the minimum drift (in km) which the swimmer can possibly achieve ?



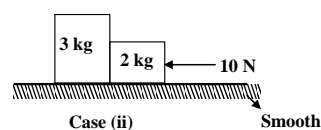
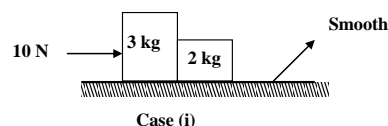
15. A river 500 m wide is flowing with a current of 4 kph. A boats starts from one bank of the river wishes to cross the river at right angle to stream direction. Boatman can row the boat at 8 kph. If the time taken by man to cross the river is $\frac{5n}{2\sqrt{3}}$ minutes then value of n is _____.
16. A particle starts from rest from origin such that its acceleration is given as $a = 5x$. Find out its position at $t = 1$ sec
17. Six particles are placed at the vertices of a regular hexagon of side 10 m at $t = 0$. Each particles starts moving with a constant speed 4 m/s such that the velocity of each particle is always directed towards the particle just ahead of it. Find the time (in seconds) particles will take to meet each other.

Space for rough work

18. The inclined surface of the wedge shown is rough ($\mu = 0.25$) while its vertical surface is smooth. Calculate the force of friction (in newton) which will act on the 2 kg block (Take $g = 10 \text{ m/s}^2$)



19. If normal force between the blocks is N_1 in 1st case and N_2 in the 2nd case then $\frac{6N_2}{N_1}$ is _____



20. A circular track is having banking angle $\theta = 60^\circ$ and radius $R = 100 \text{ m}$. If μ is the minimum value of coefficient of friction required to make the track safe for any value of speed of the vehicle then find the value of $3\mu^2$ will be _____ (Take $g = 10 \text{ m/s}^2$)

PART II: CHEMISTRY

SECTION – I: (One or more than one options are correct)

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

21. For the anhydride of H_2SO_4 , which of the following statements are correct?
- (A) The molecule is trigonal planar
 - (B) The molecule is non-polar
 - (C) The molecule contains $p_\pi-p_\pi$ bonds
 - (D) The molecule contains $d_\pi-p_\pi$ bonds

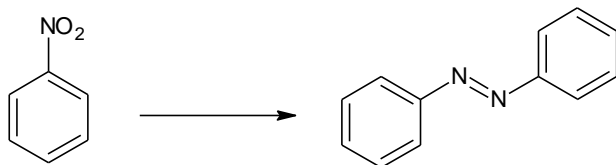
Space for rough work

28. 100 ml of 0.1 M $\text{Ca}(\text{MnO}_4)_2$ in acidic medium can be completely oxidized by ?
 (A) 100 ml of 1M FeSO_4 solution (B) $\frac{100}{3}$ ml of 1 M FeC_2O_4 solution
 (C) 25 ml of 1 M $\text{K}_2\text{Cr}_2\text{O}_7$ solution (D) 50 ml of 1 M $\text{Na}_2\text{C}_2\text{O}_4$ solution
29. Which of the following statements are correct?
 (A) The oxidation state of S in H_2SO_5 is +6 (B) The oxidation state of S in H_2SO_4 is +6
 (C) The oxidation state of S in $\text{H}_2\text{S}_2\text{O}_7$ is +6 (D) The oxidation state of S in $\text{H}_2\text{S}_2\text{O}_8$ is +6
30. Which of the following solutions contain 23 g of HCOOH ?
 (A) 46 g of 70% (w/v) HCOOH ($\rho_{\text{solution}} = 1.4 \text{ g/ml}$)
 (B) 50 ml of 10 M HCOOH ($\rho_{\text{solution}} = 1 \text{ g/ml}$)
 (C) 50 gm of 25% (w/w) HCOOH
 (D) 46 g of 5 M HCOOH ($\rho_{\text{solution}} = 1 \text{ g/ml}$)

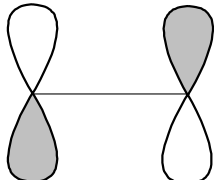
SECTION – II: (Integer value type)

This section contains **10 questions**. The answer to each of the questions is a **single digit integer**, ranging from 0 to 9 (both inclusive).

31. The equivalent weight of $\text{Ba}(\text{SCN})_2$ when it reacts with an oxidizing agent, in basic medium and forms SO_4^{2-} , CO_3^{2-} & NO_3^- can be expressed as $\frac{\text{Molecular weight}}{X}$. What is the value of $\frac{X}{4}$ (consider sulphur to be more electronegative than carbon)?
32. Consider the following balanced equation with one missing product which contains nitrogen. What is the oxidation state of nitrogen in this product? Consider that the oxidation state of oxygen remains constant.
 $16\text{K}_4[\text{Fe}(\text{CN})_6] + 61\text{Co}(\text{ClO}_3)_3 + 117\text{H}_2\text{SO}_4 \rightarrow 32\text{K}_2\text{SO}_4 + 8\text{Fe}_2(\text{SO}_4)_3 + 61\text{CoSO}_4 + 96\text{CO}_2 + 69\text{H}_2\text{O} + \frac{183}{2} \text{Cl}_2 + \dots\dots\dots$
33. The number of electrons gained in the following reduction reaction is equal to?



Space for rough work

34. In the following reaction, what is the stoichiometric coefficient of $K_2Cr_2O_7$?
 $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O + H_2SO_4 + K_2Cr_2O_7 = K_2SO_4 + Cr_2(SO_4)_3 + Fe_2(SO_4)_3 + (NH_4)_2SO_4 + H_2O$
35. 2 g of polybasic organic acid (molecular weight = 600) requires 100 ml of M/6 NaOH solution for complete neutralization. What is the basicity of the acid?
36. How many p-orbitals are involved in hybridization of central atom in PH_3 ?
37. How many electrons reside in the molecular orbital formed by the linear combination of the given atomic orbitals in a O_2^{2-} species?
- 
38. In how many of the following molecules or ions, d-orbital is utilized in hybridization?
 PCl_4^+ , PCl_6^- , IF_4^- , IF_5 , XeO_3F_2 , ICl_2^+ , SiF_4 , AsF_4^+ , $(CN)_2-SO-F_2$
39. Bond angle in P_4 if is x° then what is $x/10$?
40. Among all p-orbitals and all d-orbitals how many can overlap with s-orbital to form a π -bond?

Space for rough work

PART III: MATHEMATICS

SECTION – I: (One or more than one options are correct)

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

41. If $\begin{pmatrix} 1 & -\tan\theta \\ \tan\theta & 1 \end{pmatrix} \begin{pmatrix} 1 & \tan\theta \\ -\tan\theta & 1 \end{pmatrix}^{-1} = \begin{bmatrix} a & -b \\ b & a \end{bmatrix}$, then
 (A) $a = \cos 2\theta$ (B) $a = 1$ (C) $b = \sin 2\theta$ (D) $b = -1$
42. If the point P(x, y) be equidistant from the points A(a + b, a – b) and B(a – b, a + b), then
 (A) $ax = by$ (B) $bx = ay$ (C) $x^2 - y^2 = 2(ax + by)$ (D) P can be (a, b)
43. If one of the lines of $my^2 + (1 - m^2)xy - mx^2 = 0$ is a bisector of the angle between the lines $xy = 0$, then m is
 (A) 1 (B) 2 (C) $-\frac{1}{2}$ (D) -1
44. In a ΔABC , the equation of the perpendicular bisector of AC is $3x - 2y + 8 = 0$. If the coordinates of the points A and B are (1, -1) and (3, 1) respectively, then
 (A) equation of line BC is $x + 4y - 7 = 0$ (B) equation of line BC is $4x - y + 6 = 0$
 (C) coordinates of circumcentre is $\left(\frac{4}{5}, -\frac{14}{5}\right)$ (D) coordinates of circumcentre is $\left(-\frac{4}{5}, \frac{14}{5}\right)$
45. If A and B are square matrices of same order such that $A^2 = A$, $B^2 = B$, $AB = BA = O$, then
 (A) $(A + B)^2 = A + B$ (B) $AB^2 = O$ (C) $(A - B)^2 = A - B$ (D) none of these
46. If A is the area and 2s the sum of the sides of a triangle then:
 (A) $A \leq \frac{s^2}{4}$ (B) $A \leq \frac{s^2}{3\sqrt{3}}$ (C) $A < \frac{s^2}{\sqrt{3}}$ (D) none of these
47. If $x + y + z = \pi$, $\tan x \cdot \tan y = 2$, $\tan x + \tan y + \tan z = 6$, then
 (A) $x = m\pi + \tan^{-1}\left(\frac{1}{2}\right) \forall m \in I$ (B) $y = n\pi + \tan^{-1}(2) \forall n \in I$
 (C) $z = \ell\pi + \tan^{-1}(3) \forall \ell \in I$ (D) all are correct ($\ell, m, n \in I$)

Space for rough work

48. If $a, b, \angle A$ be given in the triangle and c_1 and c_2 two possible values of third side such that $c_1^2 + c_1c_2 + c_2^2 = a^2$, then $\angle A$ can be
 (A) 30° (B) 60° (C) 90° (D) 120°
49. Let $A_1, A_2, A_3, \dots, A_n$ be vertices of n sides regular polygon inscribed in a circle of radius unity. If P_i be a point lying on the circle of radius i and concentric with regular polygon, then
 (A) $\prod_{i=1}^{n-1} A_i A_{i+1} = n$ (B) $\sum_{i=1}^n (AA_i) = 1$
 (C) $\sum_{i=1}^n (P_i A_i)^2 = 2n$ (D) $\sum_{k=1}^n \sum_{i=1}^n (P_k A_i)^2 = n + \frac{n(n+1)(2n+1)}{6}$
50. Point A lies on x -axis and point B lies on $y = x$. If $PA \cdot PB$ is minimum where P divides the segment AB internally, then (given P is $(1, 2 - \sqrt{3})$ and 'O' is origin)
 (A) $OA = 2\sqrt{2} - \sqrt{6} + \sqrt{3} - 1$ (B) $OB = 2\sqrt{2} - \sqrt{6} + \sqrt{3} - 1$
 (C) $\angle OAB = 45^\circ$ (D) $\angle OBA = 22.5^\circ$

SECTION – II: (Integer value type)

This section contains **10 questions**. The answer to each of the questions is a **single digit integer**, ranging from 0 to 9 (both inclusive).

51. If r_1, r_2, r_3 are radii of escribed circles of $\triangle ABC$ and if ' r ' is the radius of its incircle, then $r_1 r_2 r_3 - r(r_1 r_2 + r_2 r_3 + r_3 r_1)$ is equal to
52. Consider three matrices $A = \begin{bmatrix} 2 & 1 \\ 4 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 3 & 4 \\ 2 & 3 \end{bmatrix}$ and $C = \begin{bmatrix} 3 & -4 \\ -2 & 3 \end{bmatrix}$, then the value of the sum $\text{tr}(A) + \text{tr}\left(\frac{ABC}{2}\right) + \text{tr}\left(\frac{A(BC)^2}{4}\right) + \text{tr}\left(\frac{A(BC)^3}{8}\right) + \dots + \infty$ is
53. A straight line L with negative slope passes through the point $(8, 2)$ and cuts the positive co-ordinate axes at the points P and Q . As L varies, the absolute minimum value of $\left(\frac{OP + OQ}{2}\right)$ (O is origin) is

Space for rough work

54. The number of real solutions of the equation $\sin 2^x \cdot \cos 2^x = 2^x + 2^{-x}$ is/are
55. The number of points of intersection of the two curves $y = 2 \sin x$ and $y = 5x^2 + 2x + 3$ is
56. In ΔABC , if $\tan \frac{A}{2} = \frac{5}{6}$, $\tan \frac{B}{2} = \frac{20}{37}$, then $a + c = 2mb$. The value of 'm' is
57. If A is a square matrix of order 3 such that $|A| = 2$, then $|(\text{adj } A^{-1})^{-1}|$ is
58. The number of solutions of the equation $|\cos x - \sin x| = 2 \cos x$ in $[0, 2\pi]$ is
59. The line joining $A(b \cos \alpha, b \sin \alpha)$ and $B(a \cos \beta, a \sin \beta)$ is produced to the point $M(x, y)$ so that $AM : MB = b : a$, then the value of $x \cos\left(\frac{\alpha + \beta}{2}\right) + y \sin\left(\frac{\alpha + \beta}{2}\right) =$
60. $P_1, P_2, P_3, \dots, P_n$ are points on the line $y = x$ lying in the positive quadrant such that $\frac{OP_n}{OP_{n-1}} = n$, O being the origin. If $OP_1 = 1$, then the coordinates of P_8 are $(3a\sqrt{2}, 3a\sqrt{2})$, then the value of $\frac{a}{2240}$ is

Space for rough work

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PHASE – II_PAPER – I_SET-A

ANSWERS

PHYSICS

1. A,C	2. A,C,D	3. A,B,C	4. B
5. A,B	6. A,C	7. A,C,D	8. A,D
9. A,B,C,D	10. A,B,C,D	11. 2	12. 3
13. 6	14. 3	15. 3	16. 0
17. 5	18. 3	19. 9	20. 9

CHEMISTRY

21. (Bonus)	22. A, B, C, D	23. A, B, C, D	24. ABCD
25. A, B, C, D	26. A, B, C	27. A, B, D	28. A, B, D
29. A, B, C, D	30. A, B	31. 8	32. 5
33. 8	34. 1	35. 5	36. 0
37. 2 or 4	38. 5	39. (Bonus)	40. 0

MATHEMATICS

41. AC	42. BD (Bonus)	43. AD	44. AD
45. AB	46. B	47. BC	48. BD
49. CD	50. AB	51. 0	52. 6
53. 9	54. 0	55. 0	56. 1
57. 4	58. 2	59. 0	60. 3

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14. **Section II** contains **3 paragraphs**. Each describing theory, experiment, data etc., **Six questions** related to three paragraphs with two questions on each paragraph. Each question to a particular passage should have **ONLY ONE correct answer** among the four given choices (A), (B), (C) and (D).
15. **Section III** contains **4 Multiple choice questions**. Each question has two lists (List-1: P, Q, R and S; List-2: 1, 2, 3 and 4). The options for the correct match are provided as (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

D. Marking Scheme

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If you mark the answers in question booklet, you will not be allowed to continue the exam.

NAME:

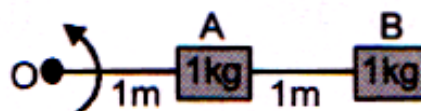
ENROLLMENT NO.:

PAPER – II PART I: PHYSICS

SECTION – I: Single Correct Answer Type

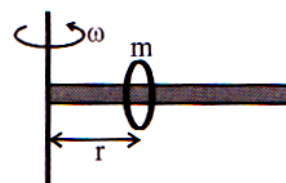
The section contains **10 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

1. Small blocks A and B connected with a string are rotated with angular velocity ω about point O as shown in the figure. Breaking strength of both the strings is 75 N. The maximum angular velocity by which system can be rotated on a horizontal smooth plane.



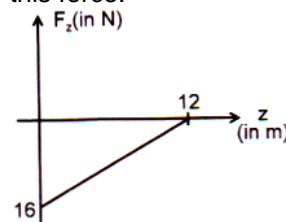
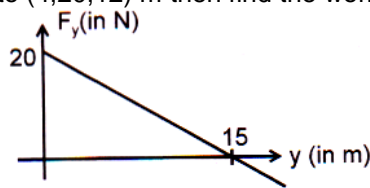
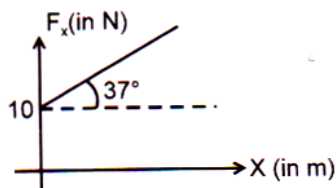
- (A) 4 rad /sec (B) 5 rad / sec
(C) 6 rad /sec (D) $\frac{4}{3}$ rad/sec

2. A rod is rotating in a horizontal circle. If a bead of mass 'm' is just released from axis of rotation of rod, find out speed of bead when it is at a distance 'r' from axis. The arrangement is placed in a gravity free space.



- (A) ωr (B) $2\omega r$ (C) $\sqrt{2}\omega r$ (D) None of these

3. The components of a force acting on a particle are varying according to the graphs shown. When the particle moves from (0,5,0) m to (4,20,12) m then find the work done by this force.

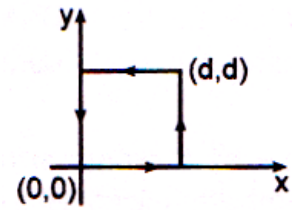


- (A) 192 J (B) $400 / 3$ J (C) 0 (D) 96 J

Space for rough work

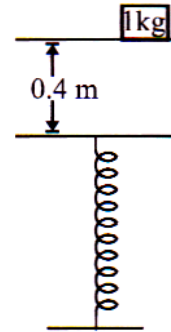
4. The work done by the force $\vec{F} = A(y^2\hat{i} + 2x^2\hat{j})$, where A is a constant and x and y are in meters around the path shown is :

(A) zero (B) $A d$
(C) $A d^2$ (D) $A d^3$



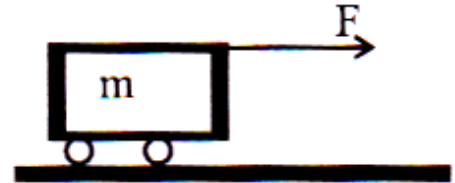
5. A block of mass of $m = 1$ kg falls from a height $h = 0.4$ m on a massless spring of stiffness constant $k=300 \text{ Nm}^{-1}$. If $g = 10 \text{ m/s}^2$, then.

(A) maximum compression in the spring is 0.1 m
(B) maximum compression in the spring is 0.3 m
(C) maximum compression in the spring is 0.4 m
(D) maximum compression in the spring is 0.2 m



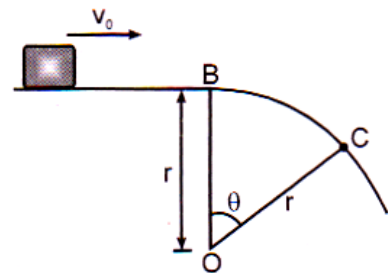
6. A car (treat it as particle) of mass m is accelerating on a level smooth road under the action of single force F . The power delivered to car is constant equal to P . If the velocity of the car at an instant is v , then after traveling how much distance velocity becomes double ?

(A) $\frac{7mv^3}{3P}$ (B) $\frac{4mv^3}{3P}$
(C) $\frac{mv^3}{P}$ (D) $\frac{18mv^3}{7P}$



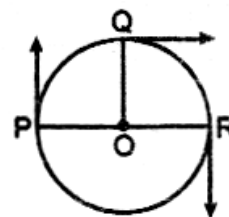
7. A small block slides with velocity $0.5\sqrt{gr}$ on the horizontal frictionless surface as shown in the figure. The block leaves the surface at point C. The angle θ in the figure is .

(A) $\cos^{-1}(4/9)$ (B) $\cos^{-1}(3/4)$
(C) $\cos^{-1}(1/2)$ (D) None of the above



Space for rough work

8. Three point particles P,Q,R move in a circle of radius 'r' with different but constant speeds. They start moving at $t = 0$ from their positions as shown in the figure. The angular velocities (in rad/sec) of P,Q and R are 5π , 2π and 3π respectively, in the same sense. The time at which they all meet for the first time is ____.
- (A) $2/3$ sec (B) $1/6$ sec (C) $1/2$ sec (D) $3/2$ sec



9. The potential energy of a particle of mass $m = 8$ kg is given by $U(x) = (2x - x^2)$ where x is in meter and U is in joule. If total mechanical energy of the particle is 37 J then which of the following statement is Incorrect.
- (A) Minimum possible kinetic energy of particle is 36 J
 (B) At $x = 1$ m, particle is in unstable equilibrium
 (C) At $x = 5$ m, acceleration of the particle is 1 m/s^2
 (D) At $x = 1$ m, the speed of the particle is 2 m/s
10. A stone is projected from level ground with speed u and at an angle θ with horizontal. Somehow the acceleration due to gravity (g) becomes double (that is $2g$) immediately after the stone reaches the maximum height and remains same thereafter. Assume direction of acceleration due to gravity always vertically downwards. Then the total time of flight of particle will be ____
- (A) $\frac{3u \sin \theta}{2g}$ (B) $\frac{u \sin \theta}{g} \left(1 + \frac{1}{\sqrt{2}}\right)$ (C) $\frac{\sqrt{2}u \sin \theta}{g}$ (D) $\frac{2u \sin \theta}{g}$

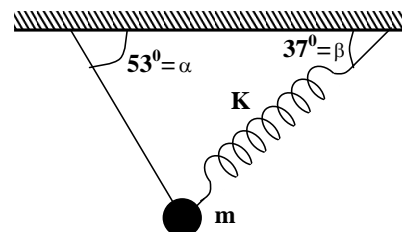
SECTION – II: Paragraph Type

This section contains **3 paragraphs** each describing theory, experiment, data etc., **Six questions** relate to three paragraphs with two question on each paragraph. Each question of a paragraph has **only one correct answer** among the four choices (A), (B), (C) and (D).

Paragraph For Questions 11 & 12

Consider a particle of mass m which is tied with a string and a spring as shown in fig. The string and spring are ideal and massless. Initially the system is in equilibrium with $\alpha = 53^\circ$ and $\beta = 37^\circ$.

Then Answer the following questions



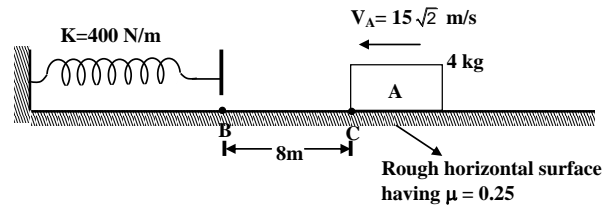
11. If spring is cut then tension in the string just after cutting will be
- (A) $\frac{4mg}{5}$ (B) $\frac{3mg}{5}$ (C) zero (D) $\frac{5mg}{4}$

Space for rough work

12. If string is cut then the magnitude of acceleration of the particle just after cutting is
 (A) $\frac{3g}{5}$ (B) $\frac{4g}{5}$ (C) $\frac{16g}{25}$ (D) $\frac{12g}{25}$

Paragraph For Questions 13 & 14

In the shown arrangement, a block A of mass 4 kg is placed on a rough horizontal surface having coefficient of kinetic friction $\mu = 0.25$. There is an ideal spring which is initially in relaxed position and has spring constant $k = 400 \text{ N/m}$. Initially the block is at a distance of 8 m (i.e. $BC = 8 \text{ m}$) from free end of the spring and moving with a speed of $V_A = 15\sqrt{2} \text{ m/s}$ towards left. Take $g = 10 \text{ m/s}^2$. Answer the following questions.

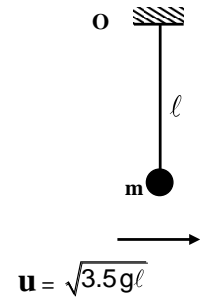


13. What is the maximum compression of the spring when the block strikes the spring ?
 (A) 1.5 m (B) 2 m (C) 3 m (D) 2.5 m
14. Displacement of the block when it completely stops is
 (A) 72 m (B) 90 m (C) 70 m (D) None of these

Space for rough work

Paragraph For Questions 15 & 16

A small particle of mass 'm' is tied with an ideal string of length 'l' and hanging as shown in fig. Now the particle is given an initial horizontal speed of $\sqrt{3.5g\ell}$. Then



15. Tension in the string when the string becomes horizontal
 (A) mg (B) $\frac{3mg}{2}$ (C) $\frac{mg}{2}$ (D) $\frac{3mg}{4}$
16. Speed of the particle, at an instant when the particle is at its highest point from the point of suspension 'O' during its subsequent motion, will be _____
 (A) $\sqrt{\frac{g\ell}{2}}$ (B) $\sqrt{\frac{g\ell}{8}}$ (C) $\frac{\sqrt{g\ell}}{2}$ (D) None of these

SECTION – III: (Matching List Type)

This section contains **4 questions, each having two matching lists.** Choices for the correct combination of elements from List-I and List-II are given as option (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

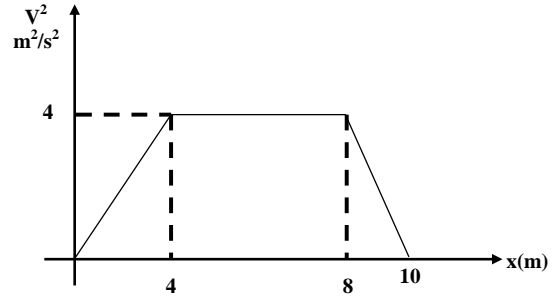
17. Four variable forces are given in List I. All forces are given in Newton. Work done by these variable forces on a particle if the particle moves from point A(1,1) m to B(2,2) m along the path $y=x$ has been given in List – II. Match List – I with List – II and select the correct answer using the code given below the Lists.

	List – I		List – II
(P)	$\vec{F} = x\hat{j}$	(1)	$\frac{14}{3} \text{ J}$
(Q)	$\vec{F} = x\hat{i} + y\hat{j}$	(2)	3J
(R)	$\vec{F} = x^2\hat{i} + y^2\hat{j}$	(3)	$\frac{20}{3} \text{ J}$
(S)	$\vec{F} = (y^2 + 2)\hat{i} + x^2\hat{j}$	(4)	$\frac{3}{2} \text{ J}$

	P	Q	R	S
(A)	2	4	1	3
(B)	1	2	3	1
(C)	4	2	3	1
(D)	4	2	1	3

Space for rough work

18. V^2 vs x graph of a particle moving along x –axis is shown. The mass of the particle is 1 kg and it is initially at origin in a state of rest. Here x is displacement and v is velocity. Match List – I with List – II and select the correct answer using the code given below the Lists.



	List – I		List – II
(P)	Magnitude of acceleration (in m/s^2) of the particle at $x = 9$ m is	(1)	$\frac{1}{2}$
(Q)	Work done (in joule) by all the forces acting on the block from $x = 0$ m to $x = 8$ m is	(2)	0
(R)	Magnitude of net force (in newton) acting on the block at $x = 2$ m is	(3)	1
(S)	Acceleration (in m/s^2) of the block at $x = 6$ m is	(4)	2

	P	Q	R	S
(A)	4	3	1	2
(B)	4	3	2	1
(C)	3	4	1	2
(D)	3	4	2	1

Space for rough work

19. In List - I different graphs of a particle moving along x – axis is shown. List – II gives the information regarding dependency of velocity of the particle on time.

Here x is position, v is velocity and 'a' is acceleration of the particle

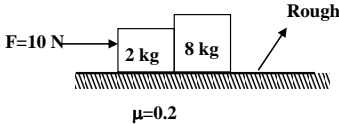
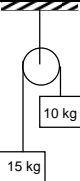
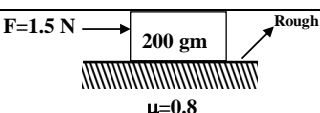
Match List – I with List – II and select the correct answer using the code given below the Lists.

	List – I		List – II
(P)		(1)	V is independent of t
(Q)		(2)	$V \propto \frac{1}{\sqrt{t}}$
(R)		(3)	$V \propto t^2$
(S)		(4)	$V \propto \frac{1}{t^2}$

- | | | | | |
|-----|---------------|---|---|---|
| | P | Q | R | S |
| (A) | 4 | 2 | 1 | 3 |
| (B) | 2 | 4 | 1 | 3 |
| (C) | 4 | 2 | 3 | 1 |
| (D) | None of these | | | |

Space for rough work

20. In all cases, Take $g = 10 \text{ m/s}^2$
Match List – I with List – II and select the correct answer using the code given below the Lists.

	List – I		List – II
(P)	 <p>In shown fig, the normal reaction (in Newton) between the two blocks is</p>	(1)	2
(Q)	 <p>Acceleration of each block in m/s^2 is</p>	(2)	2.5
(R)	 <p>The contact force (in Newton) between the block and the horizontal surface is</p>	(3)	6
(S)	A particle is projected vertically upward from ground with speed 45 m/s . The distance (in meter) traveled by it in the last second of its ascend journey is.	(4)	5

	P	Q	R	S
(A)	3	1	2	4
(B)	3	1	4	2
(C)	2	1	4	3
(D)	2	4	3	1

Space for rough work

PART II: CHEMISTRY

SECTION – I: Single Correct Answer Type

The section contains 10 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

21. In a reaction $\text{Cr}_2\text{O}_7^{2-}$ was reduced to Cr^{+3} in acidic solution. The concentration of 0.1 M $\text{Cr}_2\text{O}_7^{2-}$ expressed in equivalent per litre is ----
 (A) 0.3 (B) 0.4 (C) 0.2 (D) 0.6
22. If one third mole of aluminium permanganate oxidizes 1.67 moles of M^{x+} as per the given reaction then the value of x in the metal ion is

$$\text{MnO}_4^- + \text{M}^{x+} \longrightarrow \text{Mn}^{2+} + \text{MO}_3^- + \frac{1}{2}\text{O}_2$$

 (A) 1 (B) 2 (C) 3 (D) 5
23. 2 moles of N_2H_4 loses 16 moles of electrons is being converted to a new compound X. Assuming that all the 'N' appears in the new compound. What is the oxidation state of N in X.
 (A) -1 (B) -2 (C) +2 (D) +4
24. Identify the pair of species in which first species has more polarising power than the second
 (A) $\text{Fe}^{+2}, \text{Fe}^{+3}$ (B) $\text{Cu}^+, \text{Ca}^{+2}$ (C) $\text{Li}^+, \text{Be}^{+2}$ (D) $\text{Sn}^{+2}, \text{Sn}^{+4}$
25. The correct order of increasing s-character (in percentage) in the hybrid orbitals of following molecules/ions is:
 (I) CO_3^{2-} (II) XeF_4 (III) I_3^-
 (IV) NCl_3 (V) BeCl_2
 (A) II<III<IV<I<V (B) II<IV<III<V<I (C) III<II<I<V<IV (D) II<IV<III<I<V
26. Select the incorrect statement(s) about the compound $\text{NO}^+ [\text{BF}_4]^-$:
 (A) it has 5 σ and 2 π bonds
 (B) nitrogen-oxygen bond length in $\text{NO}^+ [\text{BF}_4]^-$ is higher than nitric oxide (NO)
 (C) it is a diamagnetic species
 (D) B-F bond length in $\text{NO}^+ [\text{BF}_4]^-$ is lower than B-F bond length in BF_3

Space for rough work

27. Which of the following molecules has $\mu = 0$?
 (A) ClF_3 (B) PCl_3F_2 (C) PF_3Cl_2 (D) XeF_6
28. Which of the following pairs have identical values of Bond order ?
 (A) $\text{N}_2^{(+)}$ & $\text{O}_2^{(+)}$ (B) O_2^{2+} & B_2^{2-} (C) F_2 & N_2 (D) C_2^{2-} & N_2^+
29. The reaction
 $3\text{ClO}^{(-)}(\text{aq}) \rightarrow \text{ClO}_3(\text{aq}) + 2\text{Cl}^{(-)}(\text{aq})$
 is an example of
 (A) Oxidation (B) Reduction (C) Disproportionation (D) Decomposition
30. Maximum oxidation state is present in
 (A) CrO_2Cl_2 and $\text{MnO}_2^{(-)}$ (B) MnO_2
 (C) $[\text{Fe}(\text{CN})_6]^{3-}$ and $[\text{Co}(\text{CN})_6]^{3-}$ (D) MnO

SECTION – II: Paragraph Type

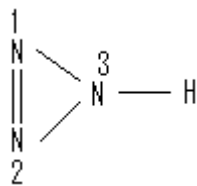
This section contains **3 paragraphs** each describing theory, experiment, data etc., **Six questions** relate to three paragraphs with two question on each paragraph. Each question of a paragraph has **only one correct answer** among the four choices (A), (B), (C) and (D).

Paragraph For Questions 31 & 32

Redox reactions are those in which oxidation and reduction take place simultaneously. Oxidising agent can gain electron whereas reducing agent can lose electron easily. The oxidation state of any element can never be in fraction. If oxidation number of any element comes out be in fraction, it is average oxidation number of that element which is present in different oxidation states.

31. The oxidation state/s of Fe in Fe_3O_4 is
 (A) 2 and 3 (B) 8/3 (C) 2 (D) 3

32.



- , In this compound HN_3 (hydrazoic acid), oxidation state of N^1 , N^2 and N^3 are :
 (A) 0, 0, 3 (B) 0, 0, -1 (C) 1, 1, -3 (D) -3, -3, -3

Space for rough work

Paragraph For Questions 33 & 34

A covalent bond in which electrons are shared unequally & the bonded atoms acquire a partial positive and negative charge is called a polar covalent bond, bond polarity is described in terms of ionic character similarly in ionic bond some covalent character is introduced because of the tendency of the cation to polarize the anion the magnitude of covalent character in the ionic bond depends upon the extent of polarization caused by cation.

In general

(I) smaller the size of cation larger is its polarizing power

(II) larger the anion more will be its polarisability .

33. Arrange the following compound in increasing order of ionic character ?

(A) $\text{SnF}_2 < \text{SnCl}_2 < \text{SnF}_4 < \text{SnCl}_4 < \text{SiCl}_4$

(B) $\text{SnF}_2 < \text{SnCl}_4 < \text{SnF}_4 < \text{SiCl}_4 < \text{SnCl}_2$

(C) $\text{SiCl}_4 < \text{SnCl}_4 < \text{SnF}_4 < \text{SnCl}_2 < \text{SnF}_2$

(D) $\text{SnCl}_4 < \text{SnF}_4 < \text{SnCl}_2 < \text{SnF}_2 < \text{SiCl}_4$

34. Which is the correct order of covalent character.

(A) $\text{BeF}_2 < \text{BeCl}_2 < \text{BeBr}_2 < \text{BeI}_2$

(B) $\text{BeCl}_2 < \text{BeF}_2 < \text{BeI}_2 < \text{BeBr}_2$

(C) $\text{BeI}_2 < \text{BeBr}_2 < \text{BeCl}_2 < \text{BeF}_2$

(D) $\text{BeI}_2 < \text{BeCl}_2 < \text{BeBr}_2 < \text{BeF}_2$

Paragraph For Questions 35 & 36

VSEPR theory predicts the shapes of the molecules. The other methods of determining the shapes of the molecules are by hybridizations technique and dipole moment of the molecules.

If Q represents the total number of hybrid orbitals, P represents total number of valence electrons, then $Q = P - 3$

(number of atoms surrounding the central atom excluding H-atom)

The number of bond pairs (B) = number of atoms surrounding the central atom)

Then the total number of lone pairs of electrons $n = Q - B$

The VSEPR notations of a molecule can be written as AX_bE_n

Where A = Central atom; X_b = Number of bond pairs; E_n = Number of lone pairs

35. Hence a molecule of ClF_3 can be represented as

(A) AXE

(B) AX_3E_2

(C) AX_2E_3

(D) AX_4E_2

36. The increasing order of dipole moments for the following three compounds SO_2 , H_2O , CO_2

(A) $Z < X < Y$

(B) $Z < Y < X$

(C) $Y < Z < X$

(D) $\overset{(X)}{Z} < \overset{(Y)}{Y} \sim \overset{(Z)}{X}$

Space for rough work

SECTION – III: (Matching List Type)

This section contains 4 questions, each having two matching lists. Choices for the correct combination of elements from List-I and List-II are given as option (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

37. Match the species given in column I with those given in column II

Column – I		Column – II (number of lone pairs on central atom)	
(P)	XeF ₂	(1)	2
(Q)	ClF ₃	(2)	3
(R)	SF ₆	(3)	1
(S)	PCl ₃	(4)	0

Code :

	P	Q	R	S
(A)	1	2	3	4
(B)	2	1	3	4
(C)	2	1	4	3
(D)	2	3	4	1

38. Match column I compounds (underlined> with their equivalent weights (E) in column (II)

Column – I		Column – II	
(P)	<u>Na₂S₂O₃</u> + 4Cl ₂ + 5H ₂ O → Na ₂ SO ₄ + H ₂ SO ₄ + 8HCl	(1)	E = $\frac{3M}{4}$
(Q)	<u>I₂</u> → I ⁻ + IO ₃ ⁻	(2)	E = $\frac{3M}{5}$
(R)	MnO ₄ ⁻ + Mn ²⁺ + H ₂ O → <u>Mn₃O₄</u> + H ⁺	(3)	E = $\frac{15M}{26}$
(S)	<u>H₃PO₂</u> → PH ₃ + H ₃ PO ₃	(4)	E = $\frac{M}{8}$

Code :

	P	Q	R	S
(A)	1	2	3	4
(B)	3	1	4	2
(C)	2	3	1	4
(D)	4	2	3	1

Space for rough work

39. Match the following column I with column II.

Column – I		Column – II	
(P)	XeO ₃ , XeF ₂ , ClF ₃ , PCl ₅	(1)	All are sp ³ d except one
(Q)	CH ₄ , XeO ₃ , ClO ₄ ⁽⁻⁾ , POCl ₃	(2)	All are sp ³ except one
(R)	BF ₄ ⁽⁻⁾ , SO ₄ ⁽²⁻⁾ , CO ₃ ⁽²⁻⁾ , POCl ₃	(3)	All are sp ³
(S)	SO ₂ , SnCl ₂ , SO ₃ , SO ₂ Cl ₂	(4)	All are sp ³ except one

Code :

	P	Q	R	S
(A)	1	2	3	4
(B)	1	3	2	4
(C)	3	4	2	1
(D)	4	3	2	1

40.

Column – I		Column – II	
(P)	0.5 mole of SO ₂ (g)	(1)	Occupy 11.2 L at STP
(Q)	1g of H ₂ (g)	(2)	Weighs 24g
(R)	0.5 mole of O ₃ (g)	(3)	Total no. of atoms = 1.5 x N _A
(S)	1 g molecule of O ₂ (g)	(4)	Weighs 32g

Code :

	P	Q	R	S
(A)	1,3,4	1	1,2,3	4
(B)	4	1,2,3	1	1,3,4
(C)	4	3	2	1,3,4
(D)	1,3,4	1,2	1,2	4

Space for rough work

PART III: MATHEMATICS
SECTION – I: Single Correct Answer Type

The section contains **10 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

41. Find the equation of the straight line passing through $(-2, -7)$ and having intercept of length 3 unit between the straight line $4x + 3y = 12$ and $4x + 3y = 3$
 (A) $x + y + 9 = 0$ (B) $y - x + 5 = 0$ (C) $7x + 24y + 182 = 0$ (D) $y - 2x + 3 = 0$
42. Find the point P on the line $2x + 3y + 1 = 0$ such that $|PA - PB|$ is maximum where A is $(2, 0)$ and $B(0, 2)$
 (A) $\left(0, -\frac{1}{3}\right)$ (B) $\left(-\frac{1}{2}, 0\right)$ (C) $(1, -1)$ (D) $(7, -5)$
43. If $\begin{bmatrix} 2 & 1 \\ 3 & 2 \end{bmatrix} A \begin{bmatrix} -3 & 2 \\ 5 & -3 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, then $A =$
 (A) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ (B) $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$ (C) $\begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}$ (D) $\begin{bmatrix} 0 & 1 \\ 0 & 1 \end{bmatrix}$
44. Let A be an orthogonal matrix and B is a matrix such that $AB = BA$, then
 (A) $A^T = B^T A^T$ (B) $AB = B^T A^T$ (C) $A^T B^T = B^T$ (D) $AB^T = B^T A$
45. Let O be a point inside a triangle ABC such that $\angle OAB = \angle OBC = \angle OCA = \theta$, then $\cot A + \cot B + \cot C$ is
 (A) $\tan \theta$ (B) $\cot \theta$ (C) $-\cot \theta$ (D) $-\tan \theta$
46. In triangle ABC, the angle are in AP with common difference α such that $\cos \alpha = \frac{21}{22}$. If the triangle is inclined in a circle of radius 11 units and H is the orthocenter of $\triangle ABC$, then the value of $\frac{HA + HB + HC}{16}$ is
 (A) 4 (B) 2 (C) 8 (D) 16

Space for rough work

47. The orthocenter of the excentral triangle $I_1 I_2 I_3$ of the triangle formed by the lines $x + 1 = 0$, $3x - 4y = 5$, and $5x + 12y = 27$
- (A) $\left(\frac{1}{2}, \frac{2}{3}\right)$ (B) $\left(\frac{2}{3}, \frac{1}{3}\right)$ (C) $\left(\frac{1}{2}, \frac{1}{3}\right)$ (D) none of these
48. In a triangle ABC, $\angle B = 45^\circ$, $\angle C = 60^\circ$, AD is altitude. Assuming AD is as diameter a circle is drawn which cuts side AB and AC at P and Q respectively, then PQ is equal to
- (A) $\frac{5\sqrt{3}}{2}$ (B) $\frac{15}{2\sqrt{6}}$ (C) $\frac{5\sqrt{2}}{2\sqrt{3}}$ (D) none of these
49. In a triangle ABC, $\angle B = \frac{\pi}{3}$ and $\angle C = \frac{\pi}{4}$. Let D divide the BC internally in the ratio of 1 : 3, then $\frac{\sin \angle CAD}{\sin \angle BAD}$ is
- (A) $\frac{1}{\sqrt{6}}$ (B) $\frac{1}{\sqrt{3}}$ (C) $\sqrt{6}$ (D) $\frac{1}{\sqrt{2}}$
50. The perimeter of a triangle right angled at C is 70 and inradius is 6, then $|a + b|$ is
- (A) 1 (B) 41 (C) 21 (D) none of these

SECTION – II: Paragraph Type

This section contains **3 paragraphs** each describing theory, experiment, data etc., **Six questions** relate to three paragraphs with two question on each paragraph. Each question of a paragraph has **only one correct answer** among the four choices (A), (B), (C) and (D).

Paragraph For Questions 51 & 52

If we have $\cos \theta = \cos \alpha$, then the general solution of this equation is $\theta = 2n\pi \pm \alpha$, where $n \in I$ and the general solution of $\sin \theta = \sin \alpha$ is $\theta = n\pi + (-1)^n \alpha$, and $n \in I$

51. The one of the general solution of the equation $2(\sin x - \cos 2x) - \sin 2x(1 + 2 \sin x) + 2 \cos x = 0$
- (A) $2n\pi + \frac{\pi}{6}$ (B) $n\pi + (-1)^n \frac{\pi}{2}$ (C) $n\pi + (-1)^n \frac{\pi}{6}$ (D) $2n\pi + \frac{\pi}{2}$
52. The equation $2^{\cos \sec^2 \pi x} \cdot \sqrt{x^2 - 2x + 17} \leq 8$ has how many solution in the interval $[0, 4\pi]$
- (A) 2 (B) 4 (C) 0 (D) none of these

Space for rough work

Paragraph For Questions 53 & 54

ABC is a triangle in which $a = 6$, $b = 3$ and $\cos(A - B) = \frac{4}{5}$

53. Area of triangle ABC is
 (A) 9 sq. units (B) 12 sq. units (C) 18 sq. units (D) 30 sq. units
54. Radius of the circumcircle of triangle ABC is
 (A) $3\sqrt{5}$ (B) $\frac{3\sqrt{5}}{2}$ (C) 3 (D) $\frac{3}{2}$

Paragraph For Questions 55 & 56

Let $\triangle ABC$ be any triangle and let D, E, F feet of perpendicular from vertices A, B, C on opposite side BC, CA, AB respectively. Then the $\triangle DEF$ is known as pedal \triangle of ABC. H is orthocenter of the $\triangle ABC$. We note that $\angle HDC = \angle HEC = 90^\circ$, so the points H, D, C and E are concyclic. In question triangle ABC is assumed an acute angled triangle. In case $\triangle ABC$ be obtuse angled with A as obtuse angle. Then angle of pedal \triangle will be $2A - 180^\circ$, $2B$, $2C$ and side will be represented by $-a \cos A$, $b \cos B$, $c \cos C$.

55. If ℓ , m , n denote the side of a pedal triangle, then $\frac{\ell}{a^2} + \frac{m}{b^2} + \frac{n}{c^2} =$
 (A) $\frac{a^2 + b^2 + c^2}{a^3 + b^3 + c^3}$ (B) $\frac{a^2 + b^2 + c^2}{2abc}$ (C) $\frac{a^3 + b^3 + c^3}{abc(a + b + c)}$ (D) $\frac{1}{a} + \frac{1}{b} + \frac{1}{c}$
56. If R be circumradius of a \triangle , then circumradius of pedal \triangle is
 (A) R (B) $\frac{2R}{3}$ (C) $\frac{R}{3}$ (D) $\frac{R}{2}$

Space for rough work

SECTION – III: (Matching List Type)

This section contains 4 questions, each having two matching lists. Choices for the correct combination of elements from List-I and List-II are given as option (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

57. Match the following

Column – I		Column – II	
(P)	If in a triangle ABC sec A, sec B, sec C in HP, then	(1)	$\cot \frac{A}{2}, \cot \frac{B}{2}, \cot \frac{C}{2}$ are in HP
(Q)	If $\cot A, \cot B, \cot C$ are in A.P, then	(2)	a^2, b^2, c^2 are in AP
(R)	If $\cot \frac{A}{2}, \cot \frac{B}{2}, \cot \frac{C}{2}$ are in A.P, then	(3)	a, b, c are in AP
(S)	If the lengths of tangents from A, B and C to the incircle are in A.P, then	(4)	a, b, c are in HP

Code:

	P	Q	R	S
(A)	2	4	3	1
(B)	3	4	2	1
(C)	1	2	3	4
(D)	2	1	4	3

58. Observe the following columns :

Column - I		Column - II	
(P)	If the ratio of sides of triangle ABC is $1 : \sqrt{3} : 2$, then $\angle B$ equals	(1)	60°
(Q)	A man standing on a horizontal plane, observes the angle of elevation of the top of the to be α . After walking a distance equal to twice the height of the tower, the angle of elevation becomes 2α , then 3α equals	(2)	90°
(R)	In a triangle ABC, AD is the altitude from A to BC. If $\angle C = 15^\circ$ and $AD = \frac{abc}{b^2 - c^2}$ with $b > c$, then $\angle B$ equals	(3)	105°
(S)	The ex-radii of a triangle are $r_1 = 5$ cm, $r_2 = 7.5$ cm and $r_3 = 15$ cm. Then $\angle C$ equals	(4)	45°

Code:

	P	Q	R	S
(A)	1	2	4	3
(B)	4	3	1	2
(C)	1	4	3	2
(D)	3	1	2	4

Space for rough work

59. Match the following

Column – I		Column – II	
(P)	The inverse of a diagonal matrix is	(1)	Null matrix
(Q)	If A is symmetric as well as skew symmetric matrix then A is	(2)	A diagonal matrix
(R)	If A and B are two symmetric matrix, then $AB - BA$ is a	(3)	Skew symmetric matrix
(S)	If A and B are two skew symmetric matrix, then $AB + BA$	(4)	Symmetric matrix

Code:

	P	Q	R	S
(A)	1	2	4	3
(B)	1	2	3	4
(C)	2	1	4	3
(D)	2	1	3	4

60. Match the following

Column – I		Column – II	
(P)	$(3 \cos \theta + 2 \sin \theta, 4 \cos \theta + 7 \sin \theta)$; $\theta \in \mathbb{R}$	(1)	$y^2 = x^3 - x^2$
(Q)	$(t + 1, t^2 + t)$	(2)	$x^2 - y^2 - 4x = 0$
(R)	$2^{\sec \theta + \tan \theta}, 2^{\sec \theta - \tan \theta}$	(3)	$\left(\frac{4x - 3y}{13}\right)^2 + \left(\frac{7x - 3y}{13}\right)^2 = 1$
(S)	$(\sec^2 \theta + \operatorname{cosec}^2 \theta, \operatorname{cosec}^2 \theta - \sec^2 \theta)$	(4)	$(\log_4 x^2)(\log_4 y^2) = 1$

Code:

	P	Q	R	S
(A)	4	2	1	2
(B)	3	4	1	2
(C)	3	1	4	2
(D)	4	1	2	3

Space for rough work

FITJEE INTERNAL TEST

IIT – JEE 2020

PHASE – II_PAPER – II_SET - A

ANSWERS

PHYSICS

1.	B	2.	C	3.	C	4.	D
5.	D	6.	A	7.	B	8.	D
9.	D	10.	B	11.	A	12.	B
13.	B	14.	C	15.	B	16.	B
17.	D	18.	C	19.	B	20.	A

CHEMISTRY

21	D	22.	B	23.	C	24.	B
25.	A	26.	B or D	27.	B	28.	A
29.	C	30.	Bonus	31.	A	32.	B
33.	C	34.	A	35.	B	36.	A
37.	C	38.	D	39.	Bonus	40.	A

MATHEMATICS

41.	C	42.	D	43.	C	44.	D
45.	B	46.	B	47.	A	48.	D
49.	C	50.	B	51.	C	52.	C
53.	A	54.	D	55.	B	56.	D
57.	C	58.	C	59.	D	60.	C

FITJEE INTERNAL TEST

IIT – JEE 2020

PHASE – II_PAPER – I_SET – B

Time: 3 hours

Maximum Marks: 180

INSTRUCTIONS:

A. General

1. This booklet is your Question Paper containing 60 questions.
10. Blank papers, clipboards, log tables, slide rules, calculators, cellular phones, pagers and electronic gadgets in any form are not allowed to be carried inside the examination hall.
11. Fill in the boxes provided for Name and Enrolment No.
12. The answer sheet, a machine-readable Objective Response (ORS), is provided separately.
13. DO NOT TAMPER WITH / MULTILATE THE ORS OR THE BOOKLET.

B. Filling in the OMR:

6. The instructions for the OMR sheet are given on the OMR itself.

C. Question paper format:

17. The question paper consists of **3 parts (Physics, Chemistry and Mathematics)**. Each part consists of **two sections**.
18. **Section I** contains **10 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.
19. **Section II** contains **10 questions**. The answer to each question is a **single digit integer**, ranging from 0 to 9 (both inclusive).

D. Marking Scheme

20. For each question in **Section I**, you will be awarded **3 marks** if you darken ALL the bubble(s) corresponding to the correct answer(s) **ONLY**. In all other cases **zero (0) marks** will be awarded. **No negative marks** will be awarded for incorrect answers in this section.
21. For each question in **Section II**, you will be awarded **3 marks** if you darken the bubble corresponding to the correct answer **ONLY**. In all other cases **zero (0) marks** will be awarded. **No negative marks** will be awarded for incorrect answers in this section.

Don't write / mark your answers in this question booklet.

If you mark the answers in question booklet, you will not be allowed to continue the exam.

NAME:

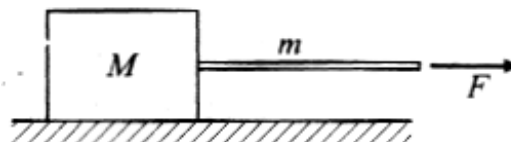
ENROLLMENT NO.:

PAPER-I
PART I: PHYSICS

SECTION – I: (One or more than one options are correct)

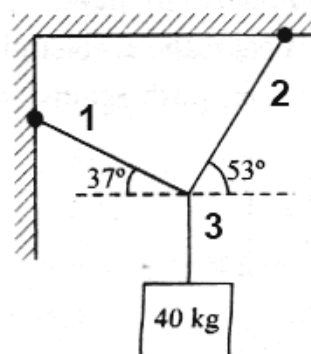
This section contains **10 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE THAN ONE** are correct.

1. A block of mass M is pulled along a horizontal frictionless surface by a rope of mass m , as shown in figure. A horizontal force F is applied to one end of the rope. Then



- (A) the force the rope exerts on the block is $\frac{MF}{M+m}$
- (B) the tension in the rope at its midpoint is $\frac{(M+m)F}{\left(M+\frac{m}{2}\right)}$
- (C) the tension in the rope at its midpoint is $\frac{\left(M+\frac{m}{2}\right)F}{(M+m)}$
- (D) acceleration of the block is $\frac{F}{M}$

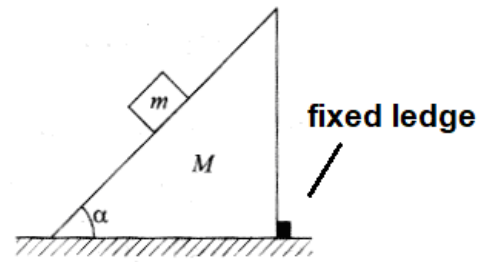
2. The object in figure weighs 40 kg and hangs at rest. Then which of the following options is / are correct.



- (A) Tension in string – 1 is 240 N
- (B) Tension in string – 2 is 360 N
- (C) Tension in string – 2 is 320 N
- (D) Tension in string – 3 is 400 N

Space for rough work

3. A body with a mass m slides along the surface of a trihedral prism of mass M , whose upper plane is inclined at an angle α to the horizontal. The prism rests on a horizontal plane having a vertical ledge at the rear edge of the prism to keep it at rest as shown in figure. Then
- (A) the force exerted by the base of the prism on the plane is $(Mg + mg\cos^2\alpha)$
- (B) the force exerted by the base of the prism on the plane is $(Mg + mg\sin\alpha\cos\alpha)$
- (C) the force exerted by ledge on prism is $mg\cos^2\alpha$
- (D) the force exerted by ledge on prism is $mg\sin\alpha\cos\alpha$



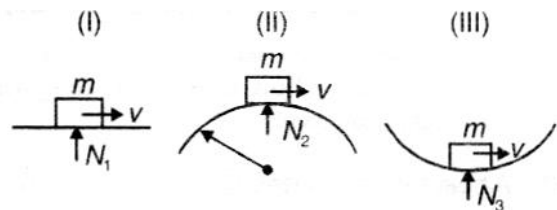
4. Choose the correct alternatives, The figure shows a block of mass m moving without friction along three tracks with same speed v

(A) $N_1 = mg$

(B) $N_2 = mg - \frac{mv^2}{R}$

(C) $N_3 = mg + \frac{mv^2}{R}$

(D) If fig (II), the block will leave path, if $V > \sqrt{gR}$



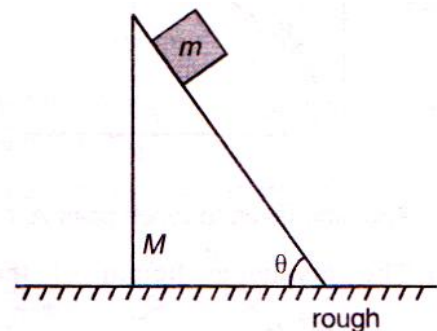
5. A block of mass m is placed on a prism of mass M . The inclined surface is smooth and inclination with horizontal is θ . The horizontal surface is sufficiently rough to prevent slipping of prism. If the block of mass m slides down the inclined face then

(A) Acceleration of block along the inclined surface is $g\sin\theta$

(B) Frictional force offered by the ground on the prism is $\frac{1}{2}mg\sin 2\theta$

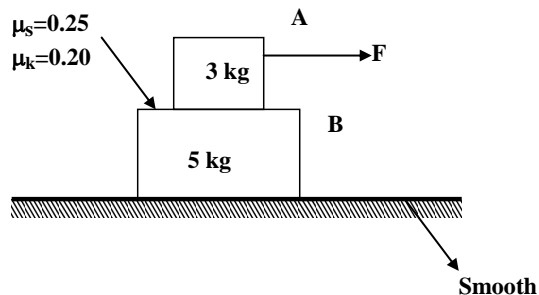
(C) If θ can vary between 0° to 90° then Maximum possible frictional force between ground and prism is $\frac{mg}{2}$

(D) Friction force will be maximum when $\theta = 45^\circ$



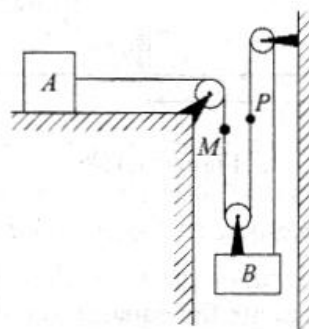
Space for rough work

6. Consider two blocks A and B having masses 3 kg and 5 kg placed over one another. The coefficient of static friction and kinetic friction are 0.25 and 0.20 respectively between two blocks. The bottom horizontal surface is frictionless. Then
- (A) If $F = 8\text{ N}$ then frictional force acting between two blocks is 5 N
 - (B) If $F = 15\text{ N}$ then acceleration of block of mass 5 kg is 1.5 m/s^2
 - (C) If $F = 18\text{ N}$ then acceleration of block of mass 3 kg is 4 m/s^2
 - (D) If $F > 9.6\text{ N}$, the two blocks start sliding over each other



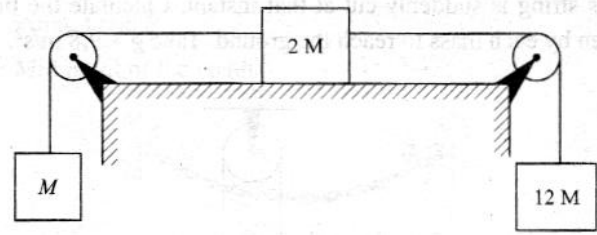
7. Which of the following quantities may remain constant during the motion of an object along a curved path
- (A) speed
 - (B) velocity
 - (C) acceleration
 - (D) magnitude of acceleration
8. Two block A and B are shown in figure. Block A moves to the left with a constant velocity of 6 m/s. Then correct options are

- (A) Velocity of the block B w.r.t ground is 2 m/s upward
- (B) Velocity of the point P of the string w.r.t ground is 2 m/s downward
- (C) Relative velocity of the point M of the string with respect to the point P is 8 m/s upward
- (D) Relative velocity of the point M of the string with respect to the point P is 6 m/s upward

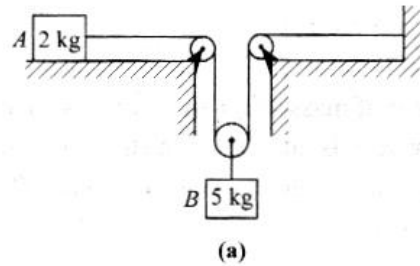


Space for rough work

9. The three blocks in figure are released from rest and accelerate at the rate of 5 m/s^2 . If $M = 4 \text{ kg}$, what is the magnitude of the frictional force on the block that slides horizontally? (Take $g = 10 \text{ m/s}^2$)
 (A) 70 N (B) 140 N
 (C) 80 N (D) Insufficient data



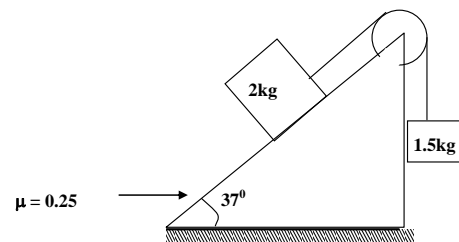
10. All the surface are smooth then
 (A) Acceleration of block A is $\frac{10g}{13}$ rightward
 (B) Acceleration of block B is $\frac{5g}{13}$ downward
 (C) Acceleration of block A is $\frac{5g}{13}$ rightward
 (D) Acceleration of block B is $\frac{5g}{26}$ downward



SECTION – II: (Integer value type)

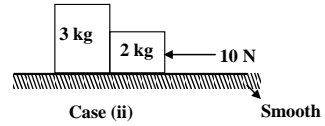
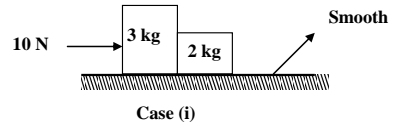
This section contains **10 questions**. The answer to each of the questions is a **single digit integer**, ranging from 0 to 9 (both inclusive).

11. A particle starts from rest from origin such that its acceleration is given as $a = 5x$. Find out its position at $t = 1 \text{ sec}$
12. Six particles are placed at the vertices of a regular hexagon of side 10 m at $t = 0$. Each particles starts moving with a constant speed 4 m/s such that the velocity of each particle is always directed towards the particle just ahead of it. Find the time (in seconds) particles will take to meet each other.
13. The inclined surface of the wedge shown is rough ($\mu = 0.25$) while its vertical surface is smooth. Calculate the force of friction (in newton) which will act on the 2 kg block (Take $g = 10 \text{ m/s}^2$)

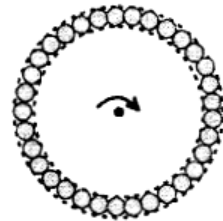


Space for rough work

14. If normal force between the blocks is N_1 in 1st case and N_2 in the 2nd case then $\frac{6N_2}{N_1}$ is _____

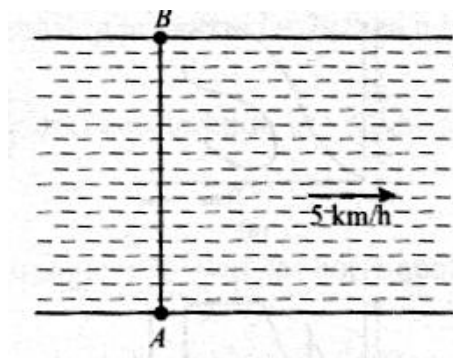


15. A circular track is having banking angle $\theta = 60^\circ$ and radius $R = 100$ m. If μ is the minimum value of coefficient of friction required to make the track safe for any value of speed of the vehicle then find the value of $3\mu^2$ will be _____ (Take $g = 10$ m/s²)
16. A block of mass $m = 1$ kg moves on a horizontal circle against the wall of a cylindrical room of radius $R = 2\sqrt{2}$ m. The floor of the room on which the block moves is smooth but the friction coefficient between the wall and the block is $\mu = 1$. The block is given an initial speed v_0 . If speed at a instant is $v = 2$ m/s then calculate resultant acceleration of block in m/s² at that instant.
17. A car goes on a horizontal circular road of radius $R = \sqrt{27}$ meter, the speed increasing at a constant rate $\frac{dv}{dt} = 1$ m/s², starting from rest. The friction coefficient between the road and the tyre is $\mu = 0.2$. Find the time (in sec) at which the car will skid.
18. A uniform metallic chain in a form of circular loop of mass $m = 3$ kg with a length $\ell = 1$ m rotates at the rate of $n = 5$ revolutions per second. If T is the tension in the chain in Newton then value of $\left(\frac{T}{25} + 3\right)$ is _____



Space for rough work

19. In the figure shown, a river of width 4 km is flowing with the speed of 5 km/h. A swimmer whose swimming speed relative to the water is 4 km/h, starts swimming from a point A on a bank. On the other bank B is a point which is directly opposite to A. What is the minimum drift (in km) which the swimmer can possibly achieve ?



20. A river 500 m wide is flowing with a current of 4 kph. A boats starts from one bank of the river wishes to cross the river at right angle to stream direction. Boatman can row the boat at 8 kph. If the time taken by man to cross the river is $\frac{5n}{2\sqrt{3}}$ minutes then value of n is _____.

PART II: CHEMISTRY

SECTION – I: (One or more than one options are correct)

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

21. For the following reaction which of the following statements are correct?
 $\text{NaOH} + \text{Br}_2 = \text{NaBr} + \text{NaBrO}_3 + \text{H}_2\text{O}$
 (A) It is a disproportionation reaction (B) The equivalent weight of Br_2 is 96
 (C) The equivalent weight of NaOH is 48 (D) The equivalent weight of NaOH is 40
22. Which of the following statements are correct?
 (A) The n-factor for ferrous oxalate when it reacts with KMnO_4 in acidic medium is 3
 (B) The n-factor for KClO_3 when it decomposes to KCl and O_2 is 6
 (C) The n-factor for H_2O_2 during it's disproportionation is 1
 (D) The n-factor for H_2O_2 during it's reduction to H_2O is 2

Space for rough work

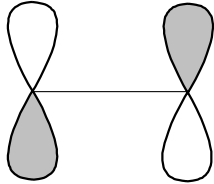
23. 100 ml of 0.1 M $\text{Ca}(\text{MnO}_4)_2$ in acidic medium can be completely oxidized by ?
 (A) 100 ml of 1M FeSO_4 solution (B) $\frac{100}{3}$ ml of 1 M FeC_2O_4 solution
 (C) 25 ml of 1 M $\text{K}_2\text{Cr}_2\text{O}_7$ solution (D) 50 ml of 1 M $\text{Na}_2\text{C}_2\text{O}_4$ solution
24. Which of the following statements are correct?
 (A) The oxidation state of S in H_2SO_5 is +6 (B) The oxidation state of S in H_2SO_4 is +6
 (C) The oxidation state of S in $\text{H}_2\text{S}_2\text{O}_7$ is +6 (D) The oxidation state of S in $\text{H}_2\text{S}_2\text{O}_8$ is +6
25. Which of the following solutions contain 23 g of HCOOH ?
 (A) 46 g of 70% (w/v) HCOOH ($\rho_{\text{solution}} = 1.4 \text{ g/ml}$)
 (B) 50 ml of 10 M HCOOH ($\rho_{\text{solution}} = 1 \text{ g/ml}$)
 (C) 50 gm of 25% (w/w) HCOOH
 (D) 46 g of 5 M HCOOH ($\rho_{\text{solution}} = 1 \text{ g/ml}$)
26. For the anhydride of H_2SO_4 , which of the following statements are correct?
 (A) The molecule is trigonal planar
 (B) The molecule is non-polar
 (C) The molecule contains $p_\pi-p_\pi$ bonds
 (D) The molecule contains $d_\pi-p_\pi$ bonds
27. Which of the following properties of compounds is correctly matched?
 (A) Thermal stability: - $\text{AlN} > \text{MgO} > \text{NaF}$
 (B) Solubility in water: - $\text{NaCl} > \text{MgCl}_2 > \text{BCl}_3$
 (C) Lattice energy: - $\text{BeO} > \text{MgO} > \text{CaO} > \text{BaO}$.
 (D) Covalent character: - $\text{BeCl}_2 > \text{MgCl}_2 > \text{CaCl}_2 > \text{BaCl}_2$.
28. Which of the following statements are correct?
 (A) According to molecular orbital theory, O_2 is paramagnetic
 (B) Bond angles in CH_2Cl_2 are non alike
 (C) The bond strength of C-H bond in C_2H_6 , C_2H_4 & C_2H_2 varies in the order $\text{C}_2\text{H}_6 < \text{C}_2\text{H}_4 < \text{C}_2\text{H}_2$
 (D) N-N bond length in N_2F_4 is less than as compared to N_2H_4

Space for rough work

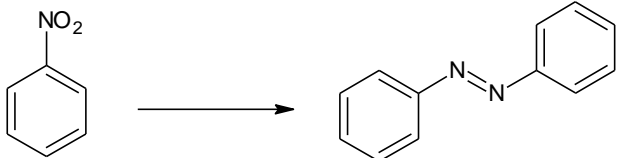
29. How many of the following statements are incorrect?
 (A) Hydrogen bonding involves dipole dipole interaction & the force of interaction varies inversely to the sixth power of distance between two dipoles.
 (B) B_2 as well as C_2 are considered diamagnetic due to electronic arrangement resulting from s-p mixing.
 (C) The number of 90° bond angles in the least stable form of ClF_3 is zero and there are only three lone pair bond pair repulsions occurring at an angle of 90°
 (D) The number of nodes in π^* molecular orbital formed due to p-p overlap is more than the number of nodes in σ^* molecular orbital, which is formed due to p-p overlap
30. In which of the following pairs of compounds the 1st has more dipole moment than the 2nd ?
 (A) $P(CH_3)_2(CF_3)_3$ & $P(CH_3)_3(CF_3)_2$ (B) CH_3-Cl & CH_3-F
 (C) NH_3 & NF_3 (D) CH_3-Cl & CH_2Cl_2

SECTION – II: (Integer value type)

This section contains **10 questions**. The answer to each of the questions is a **single digit integer**, ranging from 0 to 9 (both inclusive).

31. How many p-orbitals are involved in hybridization of central atom in PH_3 ?
32. How many electrons reside in the molecular orbital formed by the linear combination of the given atomic orbitals in a O_2^{2-} species?
- 
33. In how many of the following molecules or ions, d-orbital is utilized in hybridization?
 PCl_4^+ , PCl_6^- , IF_4^- , IF_5 , XeO_3F_2 , ICl_2^+ , SiF_4 , AsF_4^+ , $(CN)_2-SO-F_2$
34. Bond angle in P_4 if is x° then what is $x/10$?

Space for rough work

35. Among all p-orbitals and all d-orbitals how many can overlap with s-orbital to form a π -bond?
36. The equivalent weight of $\text{Ba}(\text{SCN})_2$ when it reacts with an oxidizing agent, in basic medium and forms SO_4^{2-} , CO_3^{2-} & NO_3^- can be expressed as $\frac{\text{Molecular weight}}{X}$. What is the value of $\frac{X}{4}$ (consider sulphur to be more electronegative than carbon)?
37. Consider the following balanced equation with one missing product which contains nitrogen. What is the oxidation state of nitrogen in this product? Consider that the oxidation state of oxygen remains constant.
 $16\text{K}_4[\text{Fe}(\text{CN})_6] + 61\text{Co}(\text{ClO}_3)_3 + 117\text{H}_2\text{SO}_4 \rightarrow 32\text{K}_2\text{SO}_4 + 8\text{Fe}_2(\text{SO}_4)_3 + 61\text{CoSO}_4 + 96\text{CO}_2 + 69\text{H}_2\text{O} + \frac{183}{2}\text{Cl}_2 + \dots\dots\dots$
38. The number of electrons gained in the following reduction reaction is equal to?
- 
39. In the following reaction, what is the stoichiometric coefficient of $\text{K}_2\text{Cr}_2\text{O}_7$?
 $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O} + \text{H}_2\text{SO}_4 + \text{K}_2\text{Cr}_2\text{O}_7 = \text{K}_2\text{SO}_4 + \text{Cr}_2(\text{SO}_4)_3 + \text{Fe}_2(\text{SO}_4)_3 + (\text{NH}_4)_2\text{SO}_4 + \text{H}_2\text{O}$
40. 2 g of polybasic organic acid (molecular weight = 600) requires 100 ml of M/6 NaOH solution for complete neutralization. What is the basicity of the acid?

Space for rough work

PART III: MATHEMATICS

SECTION – I: (One or more than one options are correct)

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

41. If A is the area and $2s$ the sum of the sides of a triangle then:
 (A) $A \leq \frac{s^2}{4}$ (B) $A \leq \frac{s^2}{3\sqrt{3}}$ (C) $A < \frac{s^2}{\sqrt{3}}$ (D) none of these
42. If $x + y + z = \pi$, $\tan x \cdot \tan y = 2$, $\tan x + \tan y + \tan z = 6$, then
 (A) $x = m\pi + \tan^{-1}\left(\frac{1}{2}\right) \forall m \in I$ (B) $y = n\pi + \tan^{-1}(2) \forall n \in I$
 (C) $z = \ell\pi + \tan^{-1}(3) \forall \ell \in I$ (D) all are correct ($\ell, m, n \in I$)
43. If $a, b, \angle A$ be given in the triangle and c_1 and c_2 two possible values of third side such that $c_1^2 + c_1c_2 + c_2^2 = a^2$, then $\angle A$ can be
 (A) 30° (B) 60° (C) 90° (D) 120°
44. Let $A_1, A_2, A_3, \dots, A_n$ be vertices of n sides regular polygon inscribed in a circle of radius unity. If P_i be a point lying on the circle of radius i and concentric with regular polygon, then
 (A) $\prod_{i=1}^{n-1} A_i A_{i+1} = n$ (B) $\sum_{i=1}^n (AA_i) = 1$
 (C) $\sum_{i=1}^n (P_i A_i)^2 = 2n$ (D) $\sum_{k=1}^n \sum_{i=1}^n (P_k A_i)^2 = n + \frac{n(n+1)(2n+1)}{6}$
45. Point A lies on x -axis and point B lies on $y = x$. If $PA \cdot PB$ is minimum where P divides the segment AB internally, then (given P is $(1, 2 - \sqrt{3})$ and 'O' is origin)
 (A) $OA = 2\sqrt{2} - \sqrt{6} + \sqrt{3} - 1$ (B) $OB = 2\sqrt{2} - \sqrt{6} + \sqrt{3} - 1$
 (C) $\angle OAB = 45^\circ$ (D) $\angle OBA = 22.5^\circ$

Space for rough work

46. If $\begin{pmatrix} 1 & -\tan\theta \\ \tan\theta & 1 \end{pmatrix} \begin{pmatrix} 1 & \tan\theta \\ -\tan\theta & 1 \end{pmatrix}^{-1} = \begin{bmatrix} a & -b \\ b & a \end{bmatrix}$, then
 (A) $a = \cos 2\theta$ (B) $a = 1$ (C) $b = \sin 2\theta$ (D) $b = -1$
47. If the point $P(x, y)$ be equidistant from the points $A(a + b, a - b)$ and $B(a - b, a + b)$, then
 (A) $ax = by$ (B) $bx = ay$ (C) $x^2 - y^2 = 2(ax + by)$ (D) P can be (a, b)
48. If one of the lines of $my^2 + (1 - m^2)xy - mx^2 = 0$ is a bisector of the angle between the lines $xy = 0$, then m is
 (A) 1 (B) 2 (C) $-\frac{1}{2}$ (D) -1
49. In a ΔABC , the equation of the perpendicular bisector of AC is $3x - 2y + 8 = 0$. If the coordinates of the points A and B are $(1, -1)$ and $(3, 1)$ respectively, then
 (A) equation of line BC is $x + 4y - 7 = 0$ (B) equation of line BC is $4x - y + 6 = 0$
 (C) coordinates of circumcentre is $\left(\frac{4}{5}, -\frac{14}{5}\right)$ (D) coordinates of circumcentre is $\left(-\frac{4}{5}, \frac{14}{5}\right)$
50. If A and B are square matrices of same order such that $A^2 = A$, $B^2 = B$, $AB = BA = O$, then
 (A) $(A + B)^2 = A + B$ (B) $AB^2 = O$ (C) $(A - B)^2 = A - B$ (D) none of these

Space for rough work

SECTION – II: (Integer value type)

This section contains **10 questions**. The answer to each of the questions is a **single digit integer**, ranging from 0 to 9 (both inclusive).

51. In ΔABC , if $\tan \frac{A}{2} = \frac{5}{6}$, $\tan \frac{B}{2} = \frac{20}{37}$, then $a + c = 2mb$. The value of 'm' is
52. If A is a square matrix of order 3 such that $|A| = 2$, then $|(\text{adj } A^{-1})^{-1}|$ is
53. The number of solutions of the equation $|\cos x - \sin x| = 2 \cos x$ in $[0, 2\pi]$ is
54. The line joining $A(b \cos \alpha, b \sin \alpha)$ and $B(a \cos \beta, a \sin \beta)$ is produced to the point $M(x, y)$ so that $AM : MB = b : a$, then the value of $x \cos \left(\frac{\alpha + \beta}{2} \right) + y \sin \left(\frac{\alpha + \beta}{2} \right) =$
55. $P_1, P_2, P_3, \dots, P_n$ are points on the line $y = x$ lying in the positive quadrant such that $\frac{OP_n}{OP_{n-1}} = n$, O being the origin. If $OP_1 = 1$, then the coordinates of P_8 are $(3a\sqrt{2}, 3a\sqrt{2})$, then the value of $\frac{a}{2240}$ is
56. If r_1, r_2, r_3 are radii of escribed circles of ΔABC and if 'r' is the radius of its incircle, then $r_1 r_2 r_3 - r(r_1 r_2 + r_2 r_3 + r_3 r_1)$ is equal to
57. Consider three matrices $A = \begin{bmatrix} 2 & 1 \\ 4 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 3 & 4 \\ 2 & 3 \end{bmatrix}$ and $C = \begin{bmatrix} 3 & -4 \\ -2 & 3 \end{bmatrix}$, then the value of the sum $\text{tr}(A) + \text{tr}\left(\frac{ABC}{2}\right) + \text{tr}\left(\frac{A(BC)^2}{4}\right) + \text{tr}\left(\frac{A(BC)^3}{8}\right) + \dots + \infty$ is
58. A straight line L with negative slope passes through the point (8, 2) and cuts the positive co-ordinate axes at the points P and Q. As L varies, the absolute minimum value of $\left(\frac{OP + OQ}{2}\right)$ (O is origin) is
59. The number of real solutions of the equation $\sin 2^x \cdot \cos 2^x = 2^x + 2^{-x}$ is/are
60. The number of points of intersection of the two curves $y = 2 \sin x$ and $y = 5x^2 + 2x + 3$ is
-

Space for rough work

FITJEE INTERNAL TEST

IIT – JEE 2020

PHASE – II_PAPER – I_SET-B

ANSWERS

PHYSICS

1.	A,C	2.	A,C,D	3.	A,D	4.	A,B,C,D
5.	A,B,C,D	6.	A,C	7.	A,C,D	8.	A,B,C
9.	B	10.	A,B	11.	0	12.	5
13.	3	14.	9	15.	9	16.	2
17.	3	18.	6	19.	3	20.	3

CHEMISTRY

21.	A, B, C	22.	A, B, D	23.	A, B, D	24.	A, B, C, D
25.	A, B	26.	Bonus	27.	A, B, C, D	28.	A, B, C, D
29.	ABCD	30.	ABCD	31.	0	32.	2 or 4
33.	5	34.	Bonus	35.	0	36.	8
37.	5	38.	8	39.	1	40.	5

MATHEMATICS

41.	B	42.	BC	43.	BD	44.	CD
45.	AB	46.	AC	47.	B	48.	AD
49.	AD	50.	AB	51.	1	52.	4
53.	2	54.	0	55.	3	56.	0
57.	6	58.	9	59.	0	60.	0

FITJEE INTERNAL TEST

IIT – JEE 2020

PHASE – II_PAPER – II_SET – B

Time: 3 hours

Maximum Marks: 180

INSTRUCTIONS:

A. General

1. This booklet is your Question Paper containing 60 questions.
14. Blank papers, clipboards, log tables, slide rules, calculators, cellular phones, pagers and electronic gadgets in any form are not allowed to be carried inside the examination hall.
15. Fill in the boxes provided for Name and Enrolment No.
16. The answer sheet, a machine-readable Objective Response (ORS), is provided separately.
17. DO NOT TAMPER WITH / MULTILATE THE ORS OR THE BOOKLET.

B. Filling in the OMR:

6. The instructions for the OMR sheet are given on the OMR itself.

C. Question paper format:

22. The question paper consists of **3 parts (Physics, Chemistry and Mathematics)**. Each part consists of **three sections**.
23. **Section I** contains **10 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE** is correct.
24. **Section II** contains **3 paragraphs**. Each describing theory, experiment, data etc., **Six questions** related to three paragraphs with two questions on each paragraph. Each question to a particular passage should have **ONLY ONE correct answer** among the four given choices (A), (B), (C) and (D).
25. **Section III** contains **4 Multiple choice questions**. Each question has two lists (List-1: P, Q, R and S; List-2: 1, 2, 3 and 4). The options for the correct match are provided as (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

D. Marking Scheme

26. For each question in **Section 1, 2 and 3** you will be awarded **3 marks** if you darken the bubble corresponding to the correct answer and **zero mark** if no bubble is darkened. In all other cases, **minus one (-1) mark** will be awarded.

Don't write / mark your answers in this question booklet.

If you mark the answers in question booklet, you will not be allowed to continue the exam.

NAME:

ENROLLMENT NO.:

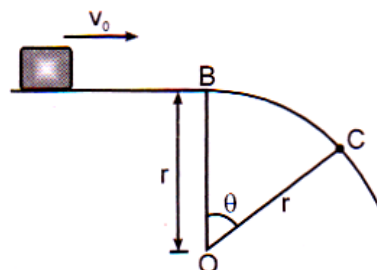
PAPER – II
PART I: PHYSICS

SECTION – I: Single Correct Answer Type

The section contains **10 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

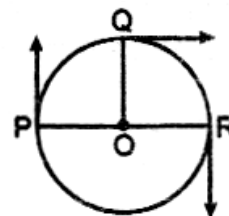
1. A small block slides with velocity $0.5\sqrt{gr}$ on the horizontal frictionless surface as shown in the figure. The block leaves the surface at point C. The angle θ in the figure is .

(A) $\cos^{-1}(4/9)$ (B) $\cos^{-1}(3/4)$
(C) $\cos^{-1}(1/2)$ (D) None of the above



2. Three point particles P, Q, R move in a circle of radius 'r' with different but constant speeds. They start moving at $t = 0$ from their positions as shown in the figure. The angular velocities (in rad/sec) of P, Q and R are 5π , 2π and 3π respectively, in the same sense. The time at which they all meet for the first time is _____.

(A) $2/3$ sec (B) $1/6$ sec (C) $1/2$ sec (D) $3/2$ sec



3. The potential energy of a particle of mass $m = 8$ kg is given by $U(x) = (2x - x^2)$ where x is in meter and U is in joule. If total mechanical energy of the particle is 37 J then which of the following statement is Incorrect.
- (A) Minimum possible kinetic energy of particle is 36 J
(B) At $x = 1$ m, particle is in unstable equilibrium
(C) At $x = 5$ m, acceleration of the particle is 1 m/s²
(D) At $x = 1$ m, the speed of the particle is 2 m/s

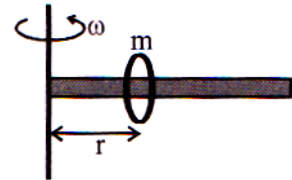
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4. A stone is projected from level ground with speed u and at an angle θ with horizontal. Somehow the acceleration due to gravity (g) becomes double (that is $2g$) immediately after the stone reaches the maximum height and remains same thereafter. Assume direction of acceleration due to gravity always vertically downwards. Then the total time of flight of particle will be _____

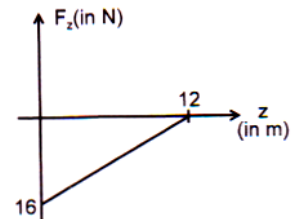
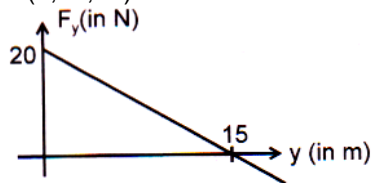
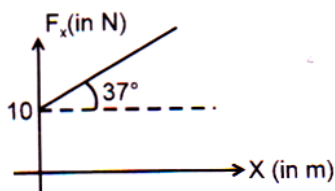
(A) $\frac{3u \sin \theta}{2g}$ (B) $\frac{u \sin \theta}{g} \left(1 + \frac{1}{\sqrt{2}} \right)$ (C) $\frac{\sqrt{2} u \sin \theta}{g}$ (D) $\frac{2u \sin \theta}{g}$

5. A rod is rotating in a horizontal circle. If a bead of mass ' m ' is just released from axis of rotation of rod, find out speed of bead when it is at a distance ' r ' from axis. The arrangement is placed in a gravity free space.

(A) ωr (B) $2\omega r$ (C) $\sqrt{2}\omega r$ (D) None of these



6. The components of a force acting on a particle are varying according to the graphs shown. When the particle moves from $(0,5,0)$ m to $(4,20,12)$ m then find the work done by this force.



(A) 192 J

(B) $400/3$ J

(C) 0

(D) 96 J

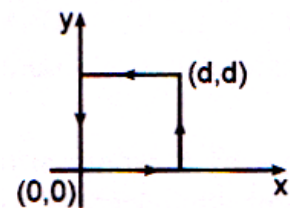
7. The work done by the force $\vec{F} = A(y^2\hat{i} + 2x^2\hat{j})$, where A is a constant and x and y are in meters around the path shown is :

(A) zero

(B) $A d$

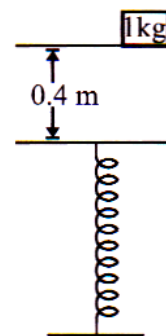
(C) $A d^2$

(D) $A d^3$

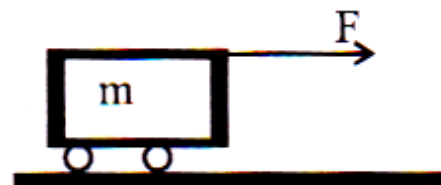


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8. A block of mass of $m = 1 \text{ kg}$ falls from a height $h = 0.4 \text{ m}$ on a massless spring of stiffness constant $k=300 \text{ Nm}^{-1}$. If $g = 10 \text{ m/s}^2$, then.
- (A) maximum compression in the spring is 0.1 m
 (B) maximum compression in the spring is 0.3 m
 (C) maximum compression in the spring is 0.4 m
 (D) maximum compression in the spring is 0.2 m

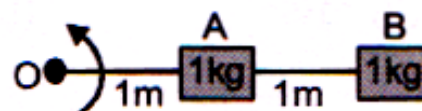


9. A car (treat it as particle) of mass m is accelerating on a level smooth road under the action of single force F . The power delivered to car is constant equal to P . If the velocity of the car at an instant is v , then after traveling how much distance velocity becomes double ?



- (A) $\frac{7mv^3}{3P}$ (B) $\frac{4mv^3}{3P}$
 (C) $\frac{mv^3}{P}$ (D) $\frac{18mv^3}{7P}$

10. Small blocks A and B connected with a string are rotated with angular velocity ω about point O as shown in the figure. Breaking strength of both the strings is 75 N . The maximum angular velocity by which system can be rotated on a horizontal smooth plane.



- (A) 4 rad/sec (B) 5 rad/sec
 (C) 6 rad/sec (D) $\frac{4}{3} \text{ rad/sec}$

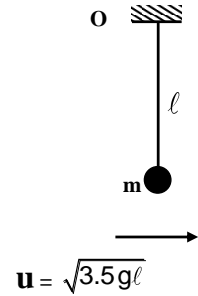
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SECTION – II: Paragraph Type

This section contains **3 paragraphs** each describing theory, experiment, data etc., **Six questions** relate to three paragraphs with two question on each paragraph. Each question of a paragraph has **only one correct answer** among the four choices (A), (B), (C) and (D).

Paragraph For Questions 11 & 12

A small particle of mass 'm' is tied with an ideal string of length ' ℓ ' and hanging as shown in fig. Now the particle is given an initial horizontal speed of $\sqrt{3.5g\ell}$. Then

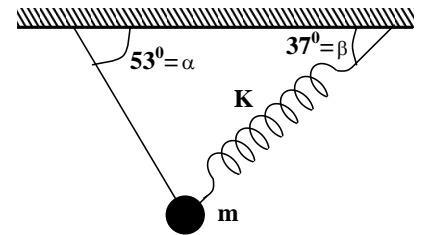


11. Tension in the string when the string becomes horizontal
 (A) mg (B) $\frac{3mg}{2}$ (C) $\frac{mg}{2}$ (D) $\frac{3mg}{4}$
12. Speed of the particle, at an instant when the particle is at its highest point from the point of suspension 'O' during its subsequent motion, will be _____
 (A) $\sqrt{\frac{g\ell}{2}}$ (B) $\sqrt{\frac{g\ell}{8}}$ (C) $\frac{\sqrt{g\ell}}{2}$ (D) None of these

Paragraph For Questions 13 & 14

Consider a particle of mass m which is tied with a string and a spring as shown in fig. The string and spring are ideal and massless. Initially the system is in equilibrium with $\alpha = 53^\circ$ and $\beta = 37^\circ$.

Then Answer the following questions

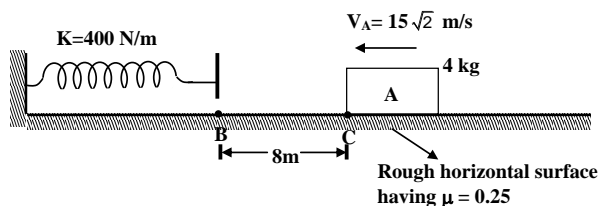


13. If spring is cut then tension in the string just after cutting will be
 (A) $\frac{4mg}{5}$ (B) $\frac{3mg}{5}$ (C) zero (D) $\frac{5mg}{4}$
14. If string is cut then the magnitude of acceleration of the particle just after cutting is
 (A) $\frac{3g}{5}$ (B) $\frac{4g}{5}$ (C) $\frac{16g}{25}$ (D) $\frac{12g}{25}$

Space for rough work

Paragraph For Questions 15 & 16

In the shown arrangement, a block A of mass 4 kg is placed on a rough horizontal surface having coefficient of kinetic friction $\mu = 0.25$. There is an ideal spring which is initially in relaxed position and has spring constant $k = 400 \text{ N/m}$. Initially the block is at a distance of 8 m (i.e $BC = 8 \text{ m}$) from free end of the spring and moving with a speed of $V_A = 15\sqrt{2} \text{ m/s}$ towards left. Take $g = 10 \text{ m/s}^2$. Answer the following questions.



15. What is the maximum compression of the spring when the block strikes the spring ?
 (A) 1.5 m (B) 2 m (C) 3 m (D) 2.5 m

16. Displacement of the block when it completely stops is
 (A) 72 m (B) 90 m (C) 70 m (D) None of these

Space for rough work

SECTION – III: (Matching List Type)

This section contains **4 questions, each having two matching lists**. Choices for the correct combination of elements from List-I and List-II are given as option (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

17. In List - I different graphs of a particle moving along x – axis is shown. List – II gives the information regarding dependency of velocity of the particle on time.

Here x is position, v is velocity and 'a' is acceleration of the particle

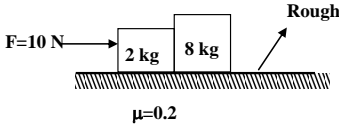
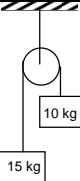
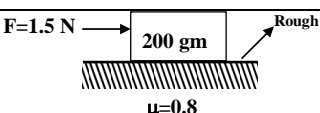
Match List – I with List – II and select the correct answer using the code given below the Lists.

	List – I		List – II
(P)		(1)	V is independent of t
(Q)		(2)	$V \propto \frac{1}{\sqrt{t}}$
(R)		(3)	$V \propto t^2$
(S)		(4)	$V \propto \frac{1}{t^2}$

- | | | | | |
|-----|---------------|---|---|---|
| | P | Q | R | S |
| (A) | 4 | 2 | 1 | 3 |
| (B) | 2 | 4 | 1 | 3 |
| (C) | 4 | 2 | 3 | 1 |
| (D) | None of these | | | |

Space for rough work

18. In all cases, Take $g = 10 \text{ m/s}^2$
 Match List – I with List – II and select the correct answer using the code given below the Lists.

	List – I		List – II
(P)	 <p>In shown fig, the normal reaction (in Newton) between the two blocks is</p>	(1)	2
(Q)	 <p>Acceleration of each block in m/s^2 is</p>	(2)	2.5
(R)	 <p>The contact force (in Newton) between the block and the horizontal surface is</p>	(3)	6
(S)	<p>A particle is projected vertically upward from ground with speed 45 m/s. The distance (in meter) traveled by it in the last second of its ascend journey is.</p>	(4)	5

	P	Q	R	S
(A)	3	1	2	4
(B)	3	1	4	2
(C)	2	1	4	3
(D)	2	4	3	1

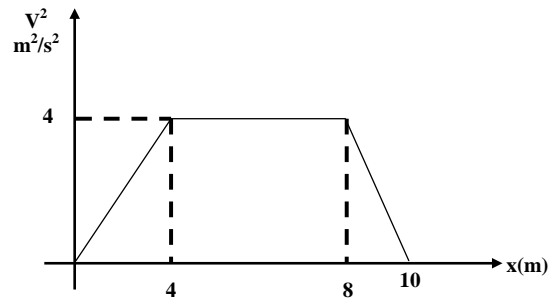
Space for rough work

19. Four variable forces are given in List I. All forces are given in Newton. Work done by these variable forces on a particle if the particle moves from point A(1,1) m to B(2,2) m along the path $y = x$ has been given in List – II. Match List – I with List – II and select the correct answer using the code given below the Lists.

List – I		List – II	
(P)	$\vec{F} = x\hat{j}$	(1)	$\frac{14}{3} \text{ J}$
(Q)	$\vec{F} = x\hat{i} + y\hat{j}$	(2)	3J
(R)	$\vec{F} = x^2\hat{i} + y^2\hat{j}$	(3)	$\frac{20}{3} \text{ J}$
(S)	$\vec{F} = (y^2 + 2)\hat{i} + x^2\hat{j}$	(4)	$\frac{3}{2} \text{ J}$

- | | P | Q | R | S |
|-----|---|---|---|---|
| (A) | 2 | 4 | 1 | 3 |
| (B) | 1 | 2 | 3 | 1 |
| (C) | 4 | 2 | 3 | 1 |
| (D) | 4 | 2 | 1 | 3 |

20. V^2 vs x graph of a particle moving along x –axis is shown. The mass of the particle is 1 kg and it is initially at origin in a state of rest. Here x is displacement and v is velocity. Match List – I with List – II and select the correct answer using the code given below the Lists.



List – I		List – II	
(P)	Magnitude of acceleration (in m/s^2) of the particle at $x = 9 \text{ m}$ is	(1)	$\frac{1}{2}$
(Q)	Work done (in joule) by all the forces acting on the block from $x = 0 \text{ m}$ to $x = 8 \text{ m}$ is	(2)	0
(R)	Magnitude of net force (in newton) acting on the block at $x = 2 \text{ m}$ is	(3)	1
(S)	Acceleration (in m/s^2) of the block at $x = 6 \text{ m}$ is	(4)	2

- | | P | Q | R | S |
|-----|---|---|---|---|
| (A) | 4 | 3 | 1 | 2 |
| (B) | 4 | 3 | 2 | 1 |
| (C) | 3 | 4 | 1 | 2 |
| (D) | 3 | 4 | 2 | 1 |

Space for rough work

PART II: CHEMISTRY
SECTION – I: Single Correct Answer Type

The section contains **10 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

21. Which of the following molecules has $\mu = 0$?
 (A) ClF_3 (B) PCl_3F_2 (C) PF_3Cl_2 (D) XeF_6
22. Which of the following pairs have identical values of Bond order ?
 (A) $\text{N}_2^{(+)}$ & $\text{O}_2^{(+)}$ (B) O_2^{2+} & B_2^{2-} (C) F_2 & N_2 (D) C_2^{2-} & N_2^+
23. The reaction
 $3\text{ClO}^{(-)}(\text{aq}) \rightarrow \text{ClO}_3(\text{aq}) + 2\text{Cl}^{(-)}(\text{aq})$
 is an example of
 (A) Oxidation (B) Reduction (C) Disproportionation (D) Decomposition
24. Maximum oxidation state is present in
 (A) CrO_2Cl_2 and $\text{MnO}_2^{(-)}$ (B) MnO_2
 (C) $[\text{Fe}(\text{CN})_6]^{3-}$ and $[\text{Co}(\text{CN})_6]^{3-}$ (D) MnO
25. If one third mole of aluminium permanganate oxidizes 1.67 moles of M^{x+} as per the given reaction then the value of x in the metal ion is

$$\text{MnO}_4^- + \text{M}^{x+} \longrightarrow \text{Mn}^{2+} + \text{MO}_3^- + \frac{1}{2}\text{O}_2$$

 (A) 1 (B) 2 (C) 3 (D) 5
26. 2 moles of N_2H_4 loses 16 moles of electrons is being converted to a new compound X. Assuming that all the 'N' appears in the new compound. What is the oxidation state of N in X.
 (A) -1 (B) -2 (C) +2 (D) +4
27. Identify the pair of species in which first species has more polarising power than the second
 (A) $\text{Fe}^{+2}, \text{Fe}^{+3}$ (B) $\text{Cu}^+, \text{Ca}^{+2}$ (C) $\text{Li}^+, \text{Be}^{+2}$ (D) $\text{Sn}^{+2}, \text{Sn}^{+4}$

Space for rough work

28. The correct order of increasing s-character (in percentage) in the hybrid orbitals of following molecules/ions is:
 (I) CO_3^{2-} (II) XeF_4 (III) I_3^-
 (IV) NCl_3 (V) BeCl_2
 (A) II<III<IV<I<V (B) II<IV<III<V<I (C) III<II<I<V<IV (D) II<IV<III<I<V
29. Select the incorrect statement(s) about the compound $\text{NO}^+ [\text{BF}_4]^-$:
 (A) it has 5σ and 2π bonds
 (B) nitrogen-oxygen bond length in $\text{NO}^+ [\text{BF}_4]^-$ is higher than nitric oxide (NO)
 (C) it is a diamagnetic species
 (D) B–F bond length in $\text{NO}^+ [\text{BF}_4]^-$ is lower than B–F bond length in BF_3
30. In a reaction $\text{Cr}_2\text{O}_7^{2-}$ was reduced to Cr^{+3} in acidic solution. The concentration of 0.1 M $\text{Cr}_2\text{O}_7^{2-}$ expressed in equivalent per litre is ----
 (A) 0.3 (B) 0.4 (C) 0.2 (D) 0.6

SECTION – II: Paragraph Type

This section contains **3 paragraphs** each describing theory, experiment, data etc., **Six questions** relate to three paragraphs with two question on each paragraph. Each question of a paragraph has **only one correct answer** among the four choices (A), (B), (C) and (D).

Paragraph For Questions 31 & 32

VSEPR theory predicts the shapes of the molecules. The other methods of determining the shapes of the molecules are by hybridizations technique and dipole moment of the molecules.

If Q represents the total number of hybrid orbitals, P represents total number of valence electrons, then $Q = P - 3$

(number of atoms surrounding the central atom excluding H-atom)

The number of bond pairs (B) = number of atoms surrounding the central atom)

Then the total number of lone pairs of electrons $n = Q - B$

The VSEPR notations of a molecule can be written as AX_bE_n

Where A = Central atom; X_b = Number of bond pairs; E_n = Number of lone pairs

31. Hence a molecule of ClF_3 can be represented as
 (A) AXE (B) AX_3E_2 (C) AX_2E_3 (D) AX_4E_2
32. The increasing order of dipole moments for the following three compounds SO_2 , H_2O , CO_2
 (A) $Z < X < Y$ (B) $Z < Y < X$ (C) $Y < Z < X$ (D) $Z < Y \sim X$
 (X) (Y) (Z)

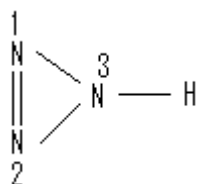
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Paragraph For Questions 33 & 34

Redox reactions are those in which oxidation and reduction take place simultaneously. Oxidising agent can gain electron whereas reducing agent can lose electron easily. The oxidation state of any element can never be in fraction. If oxidation number of any element comes out to be in fraction, it is average oxidation number of that element which is present in different oxidation states.

33. The oxidation state/s of Fe in Fe_3O_4 is
 (A) 2 and 3 (B) 8/3 (C) 2 (D) 3

34.



- , In this compound HN_3 (hydrazoic acid), oxidation state of N^1, N^2 and N^3 are :
 (A) 0, 0, 3 (B) 0, 0, -1 (C) 1, 1, -3 (D) -3, -3, -3

Paragraph For Questions 35 & 36

A covalent bond in which electrons are shared unequally & the bonded atoms acquire a partial positive and negative charge is called a polar covalent bond, bond polarity is described in terms of ionic character similarly in ionic bond some covalent character is introduced because of the tendency of the cation to polarize the anion the magnitude of covalent character in the ionic bond depends upon the extent of polarization caused by cation.

In general

- (I) smaller the size of cation larger is its polarizing power
 (II) larger the anion more will be its polarisability .

35. Arrange the following compound in increasing order of ionic character ?
 (A) $SnF_2 < SnCl_2 < SnF_4 < SnCl_4 < SiCl_4$
 (B) $SnF_2 < SnCl_4 < SnF_4 < SiCl_4 < SnCl_2$
 (C) $SiCl_4 < SnCl_4 < SnF_4 < SnCl_2 < SnF_2$
 (D) $SnCl_4 < SnF_4 < SnCl_2 < SnF_2 < SiCl_4$
36. Which is the correct order of covalent character.
 (A) $BeF_2 < BeCl_2 < BeBr_2 < BeI_2$ (B) $BeCl_2 < BeF_2 < BeI_2 < BeBr_2$
 (C) $BeI_2 < BeBr_2 < BeCl_2 < BeF_2$ (D) $BeI_2 < BeCl_2 < BeBr_2 < BeF_2$

Space for rough work

SECTION – III: (Matching List Type)

This section contains **4 questions, each having two matching lists**. Choices for the correct combination of elements from List-I and List-II are given as option (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

37. Match the following column I with column II.

Column – I		Column – II	
(P)	XeO ₃ , XeF ₂ , ClF ₃ , PCl ₅	(1)	All are sp ³ d except one
(Q)	CH ₄ , XeO ₃ , ClO ₄ ⁽⁻⁾ , POCl ₃	(2)	All are sp ³ except one
(R)	BF ₄ ⁽⁻⁾ , SO ₄ ⁽²⁻⁾ , CO ₃ ⁽²⁻⁾ , POCl ₃	(3)	All are sp ³
(S)	SO ₂ , SnCl ₂ , SO ₃ , SO ₂ Cl ₂	(4)	All are sp ³ except one

Code :

	P	Q	R	S
(A)	1	2	3	4
(B)	1	3	2	4
(C)	3	4	2	1
(D)	4	3	2	1

38.

Column – I		Column – II	
(P)	0.5 mole of SO ₂ (g)	(1)	Occupy 11.2 L at STP
(Q)	1g of H ₂ (g)	(2)	Weighs 24g
(R)	0.5 mole of O ₃ (g)	(3)	Total no. of atoms = 1.5 x N _A
(S)	1 g molecule of O ₂ (g)	(4)	Weighs 32g

Code :

	P	Q	R	S
(A)	1,3,4	1	1,2,3	4
(B)	4	1,2,3	1	1,3,4
(C)	4	3	2	1,3,4
(D)	1,3,4	1,2	1,2	4

Space for rough work

39. Match the species given in column I with those given in column II

Column – I		Column – II (number of lone pairs on central atom)	
(P)	XeF ₂	(1)	2
(Q)	ClF ₃	(2)	3
(R)	SF ₆	(3)	1
(S)	PCl ₃	(4)	0

Code :

	P	Q	R	S
(A)	1	2	3	4
(B)	2	1	3	4
(C)	2	1	4	3
(D)	2	3	4	1

40. Match column I compounds (underlined> with their equivalent weights (E) in column (II)

Column – I		Column – II	
(P)	<u>Na₂S₂O₃</u> + 4Cl ₂ + 5H ₂ O → Na ₂ SO ₄ + H ₂ SO ₄ + 8HCl	(1)	$E = \frac{3M}{4}$
(Q)	<u>I₂</u> → I ⁻ + IO ₃ ⁻	(2)	$E = \frac{3M}{5}$
(R)	MnO ₄ ⁻ + Mn ²⁺ + H ₂ O → <u>Mn₃O₄</u> + H ⁺	(3)	$E = \frac{15M}{26}$
(S)	<u>H₃PO₂</u> → PH ₃ + H ₃ PO ₃	(4)	$E = \frac{M}{8}$

Code :

	P	Q	R	S
(A)	1	2	3	4
(B)	3	1	4	2
(C)	2	3	1	4
(D)	4	2	3	1

Space for rough work

PART III: MATHEMATICS
SECTION – I: Single Correct Answer Type

The section contains **10 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

41. The orthocenter of the excentral triangle $I_1 I_2 I_3$ of the triangle formed by the lines $x + 1 = 0$, $3x - 4y = 5$, and $5x + 12y = 27$
 (A) $\left(\frac{1}{2}, \frac{2}{3}\right)$ (B) $\left(\frac{2}{3}, \frac{1}{3}\right)$ (C) $\left(\frac{1}{2}, \frac{1}{3}\right)$ (D) none of these
42. In a triangle ABC, $\angle B = 45^\circ$, $\angle C = 60^\circ$, AD is altitude. Assuming AD is as diameter a circle is drawn which cuts side AB and AC at P and Q respectively, then PQ is equal to
 (A) $\frac{5\sqrt{3}}{2}$ (B) $\frac{15}{2\sqrt{6}}$ (C) $\frac{5\sqrt{2}}{2\sqrt{3}}$ (D) none of these
43. In a triangle ABC, $\angle B = \frac{\pi}{3}$ and $\angle C = \frac{\pi}{4}$. Let D divide the BC internally in the ratio of 1 : 3, then $\frac{\sin \angle CAD}{\sin \angle BAD}$ is
 (A) $\frac{1}{\sqrt{6}}$ (B) $\frac{1}{\sqrt{3}}$ (C) $\sqrt{6}$ (D) $\frac{1}{\sqrt{2}}$
44. The perimeter of a triangle right angled at C is 70 and inradius is 6, then $|a + b|$ is
 (A) 1 (B) 41 (C) 21 (D) none of these
45. Find the point P on the line $2x + 3y + 1 = 0$ such that $|PA - PB|$ is maximum where A is (2, 0) and B(0, 2)
 (A) $\left(0, -\frac{1}{3}\right)$ (B) $\left(-\frac{1}{2}, 0\right)$ (C) (1, -1) (D) (7, -5)
46. If $\begin{bmatrix} 2 & 1 \\ 3 & 2 \end{bmatrix} A \begin{bmatrix} -3 & 2 \\ 5 & -3 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, then A =
 (A) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ (B) $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$ (C) $\begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}$ (D) $\begin{bmatrix} 0 & 1 \\ 0 & 1 \end{bmatrix}$

Space for rough work

47. Let A be an orthogonal matrix and B is a matrix such that $AB = BA$, then
 (A) $A^T = B^T A^T$ (B) $AB = B^T A^T$ (C) $A^T B^T = B^T$ (D) $AB^T = B^T A$
48. Let O be a point inside a triangle ABC such that $\angle OAB = \angle OBC = \angle OCA = \theta$, then $\cot A + \cot B + \cot C$ is
 (A) $\tan \theta$ (B) $\cot \theta$ (C) $-\cot \theta$ (D) $-\tan \theta$
49. In triangle ABC, the angle are in AP with common difference α such that $\cos \alpha = \frac{21}{22}$. If the triangle is inclined in a circle of radius 11 units and H is the orthocenter of $\triangle ABC$, then the value of $\frac{HA + HB + HC}{16}$ is
 (A) 4 (B) 2 (C) 8 (D) 16
50. Find the equation of the straight line passing through $(-2, -7)$ and having intercept of length 3 unit between the straight line $4x + 3y = 12$ and $4x + 3y = 3$
 (A) $x + y + 9 = 0$ (B) $y - x + 5 = 0$ (C) $7x + 24y + 182 = 0$ (D) $y - 2x + 3 = 0$

SECTION – II: Paragraph Type

This section contains **3 paragraphs** each describing theory, experiment, data etc., **Six questions** relate to three paragraphs with two question on each paragraph. Each question of a paragraph has **only one correct answer** among the four choices (A), (B), (C) and (D).

Paragraph For Questions 51 & 52

Let $\triangle ABC$ be any triangle and let D, E, F feet of perpendicular from vertices A, B, C on opposite side BC, CA, AB respectively. Then the $\triangle DEF$ is known as pedal \triangle of ABC. H is orthocenter of the $\triangle ABC$. We note that $\angle HDC = \angle HEC = 90^\circ$, so the points H, D, C and E are concyclic. In question triangle ABC is assumed an acute angled triangle. In case $\triangle ABC$ be obtuse angled with A as obtuse angle. Then angle of pedal \triangle will be $2A - 180^\circ$, $2B$, $2C$ and side will be represented by $-a \cos A$, $b \cos B$, $c \cos C$.

51. If ℓ , m , n denote the side of a pedal triangle, then $\frac{\ell}{a^2} + \frac{m}{b^2} + \frac{n}{c^2} =$
 (A) $\frac{a^2 + b^2 + c^2}{a^3 + b^3 + c^3}$ (B) $\frac{a^2 + b^2 + c^2}{2abc}$ (C) $\frac{a^3 + b^3 + c^3}{abc(a + b + c)}$ (D) $\frac{1}{a} + \frac{1}{b} + \frac{1}{c}$
52. If R be circumradius of a \triangle , then circumradius of pedal \triangle is
 (A) R (B) $\frac{2R}{3}$ (C) $\frac{R}{3}$ (D) $\frac{R}{2}$

Space for rough work

Paragraph For Questions 53 & 54

If we have $\cos \theta = \cos \alpha$, then the general solution of this equation is $\theta = 2n\pi \pm \alpha$, where $n \in I$ and the general solution of $\sin \theta = \sin \alpha$ is $\theta = n\pi + (-1)^n \alpha$, and $n \in I$

53. The one of the general solution of the equation $2(\sin x - \cos 2x) - \sin 2x (1 + 2 \sin x) + 2 \cos x = 0$
- (A) $2n\pi + \frac{\pi}{6}$ (B) $n\pi + (-1)^n \frac{\pi}{2}$ (C) $n\pi + (-1)^n \frac{\pi}{6}$ (D) $2n\pi + \frac{\pi}{2}$
54. The equation $2^{\operatorname{cosec}^2 \pi x} \cdot \sqrt{x^2 - 2x + 17} \leq 8$ has how many solution in the interval $[0, 4\pi]$
- (A) 2 (B) 4 (C) 0 (D) none of these

Paragraph For Questions 55 & 56

ABC is a triangle in which $a = 6$, $b = 3$ and $\cos(A - B) = \frac{4}{5}$

55. Area of triangle ABC is
- (A) 9 sq. units (B) 12 sq. units (C) 18 sq. units (D) 30 sq. units
56. Radius of the circumcircle of triangle ABC is
- (A) $3\sqrt{5}$ (B) $\frac{3\sqrt{5}}{2}$ (C) 3 (D) $\frac{3}{2}$

SECTION – III: (Matching List Type)

This section contains **4 questions, each having two matching lists**. Choices for the correct combination of elements from List-I and List-II are given as option (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

57. Match the following

Column – I		Column – II	
(P)	The inverse of a diagonal matrix is	(1)	Null matrix
(Q)	If A is symmetric as well as skew symmetric matrix then A is	(2)	A diagonal matrix
(R)	If A and B are two symmetric matrix, then $AB - BA$ is a	(3)	Skew symmetric matrix
(S)	If A and B are two skew symmetric matrix, then $AB + BA$	(4)	Symmetric matrix

- Code:
- | | | | | |
|-----|---|---|---|---|
| | P | Q | R | S |
| (A) | 1 | 2 | 4 | 3 |
| (B) | 1 | 2 | 3 | 4 |
| (C) | 2 | 1 | 4 | 3 |
| (D) | 2 | 1 | 3 | 4 |

Space for rough work

58. Match the following

Column – I		Column – II	
(P)	$(3 \cos \theta + 2 \sin \theta, 4 \cos \theta + 7 \sin \theta); \theta \in \mathbb{R}$	(1)	$y^2 = x^3 - x^2$
(Q)	$(t + 1, t^2 + t)$	(2)	$x^2 - y^2 - 4x = 0$
(R)	$2^{\sec \theta + \tan \theta}, 2^{\sec \theta - \tan \theta}$	(3)	$\left(\frac{4x - 3y}{13}\right)^2 + \left(\frac{7x - 3y}{13}\right)^2 = 1$
(S)	$(\sec^2 \theta + \operatorname{cosec}^2 \theta, \operatorname{cosec}^2 \theta - \sec^2 \theta)$	(4)	$(\log_4 x^2)(\log_4 y^2) = 1$

Code:

	P	Q	R	S
(A)	4	2	1	2
(B)	3	4	1	2
(C)	3	1	4	2
(D)	4	1	2	3

59. Match the following

Column – I		Column – II	
(P)	If in a triangle ABC sec A, sec B, sec C in HP, then	(1)	$\cot \frac{A}{2}, \cot \frac{B}{2}, \cot \frac{C}{2}$ are in HP
(Q)	If cot A, cot B, cot C are in A.P, then	(2)	a^2, b^2, c^2 are in AP
(R)	If $\cot \frac{A}{2}, \cot \frac{B}{2}, \cot \frac{C}{2}$ are in A.P, then	(3)	a, b, c are in AP
(S)	If the lengths of tangents from A, B and C to the incircle are in A.P, then	(4)	a, b, c are in HP

Code:

	P	Q	R	S
(A)	2	4	3	1
(B)	3	4	2	1
(C)	1	2	3	4
(D)	2	1	4	3

Space for rough work

60. Observe the following columns :

Column - I		Column - II	
(P)	If the ratio of sides of triangle ABC is $1 : \sqrt{3} : 2$, then $\angle B$ equals	(1)	60°
(Q)	A man standing on a horizontal plane, observes the angle of elevation of the top of the to be α . After walking a distance equal to twice the height of the tower, the angle of elevation becomes 2α , then 3α equals	(2)	90°
(R)	In a triangle ABC, AD is the altitude from A to BC. If $\angle C = 15^\circ$ and $AD = \frac{abc}{b^2 - c^2}$ with $b > c$, then $\angle B$ equals	(3)	105°
(S)	The ex-radii of a triangle are $r_1 = 5$ cm, $r_2 = 7.5$ cm and $r_3 = 15$ cm. Then $\angle C$ equals	(4)	45°

Code:	P	Q	R	S
(A)	1	2	4	3
(B)	4	3	1	2
(C)	1	4	3	2
(D)	3	1	2	4

Space for rough work

FITJEE INTERNAL TEST

IIT – JEE 2020

PHASE – II_PAPER – II_SET - B

ANSWERS

PHYSICS

1.	B	2.	D	3.	D	4.	B
5.	C	6.	C	7.	D	8.	D
9.	A	10.	B	11.	B	12.	B
13.	A	14.	B	15.	B	16.	C
17.	B	18.	A	19.	D	20.	C

CHEMISTRY

21.	B	22.	A	23.	C	24.	Bonus
25.	B	26.	C	27.	B	28.	A
29.	B or D	30.	D	31.	B	32.	A
33.	A	34.	B	35.	C	36.	A
37.	Bonus	38.	A	39.	C	40.	D

MATHEMATICS

41.	A	42.	D	43.	C	44.	B
45.	D	46.	C	47.	D	48.	B
49.	B	50.	C	51.	B	52.	D
53.	C	54.	C	55.	A	56.	D
57.	D	58.	C	59.	C	60.	C