FIITJEE COMMON TEST (PHASE - I)

PHYSICS, CHEMISTRY & MATHEMATICS

CPT1 - 1	CODE:	SET: A	PAPER - 1

Time Allotted: 3 Hours **Maximum Marks: 210**

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

BATCHES – 1820

INSTRUCTIONS

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

A. General Instructions

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

B. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with **blue / black ball point pen** for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Two Parts.

(i) **Part-A (01 – 10)** contains 10 multiple choice questions which have one or more than one correct answer. Each question carries **+4 marks** for correct answer and **–2 marks** for wrong answer.

(ii) **Part-C (01 – 10)** contains 10 Numerical based questions with single digit integer as answer, ranging from 0 to 9 (both inclusive) and each question carries **+3 marks** for correct answer and **–1 mark** for wrong answer.

Name of the Candidate :_____

Batch :_____ **Date of Examination :**_____

Enrolment Number :_____

USEFUL DATA

PHYSICS

Acceleration due to gravity	: g = 10 m/s^2
Planck constant	: h = 6.6 × 10^{-34} $J-s$
Charge of electron	: e = 1.6 × 10^{-19} C
Mass of electron	: $m_e = 9.1\times10^{-31}kg$
Permittivity of free space	: $\varepsilon_0 = 8.85\times10^{-12}C^2/N-m^2$
Density of water	: $\rho_{water} = 10^3 kg/m^3$
Atmospheric pressure	: $Pa = 10^5 N/m^2$
Gas constant	: R = 8.314 J
$K^{-1}\,mol^{-1}$	

CHEMISTRY

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

Atomic No: H = 1, He = 2, Li = 3, Be = 4, B = 5, C = 6, N = 7, O = 8, F = 9, Ne = 10, Na = 11, Mg = 12, Si = 14, Al = 13, P = 15, S = 16, Cl = 17, Ar = 18, K = 19, Ca = 20, Cr = 24, Mn = 25, Fe = 26, Co = 27, Ni = 28, Cu = 29, Zn = 30, As = 33, Br = 35, Ag = 47, Sn = 50, I = 53, Xe = 54, Ba = 56, Pb = 82, U = 92.

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

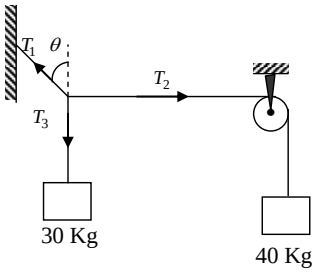
SECTION – I (PHYSICS)

PART – A

(Multi Correct Answer Type)

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

1. In the arrangement shown in the figure. If system is in equilibrium $\left(g = 10\,m/s^2\right)$:



(A) Tension $T_1 = 50N$

(B) Tension $T_1 = 500N$

(C) $Angle\,\theta = 37^0$

(D) $Angle\,\theta = 53^0$

2. Velocity of a particle moving in a curvilinear path varies with time as $\vec{V} = \left(2t\hat{i} + t^2\,j\right)m/s$. Then t is in sec.

At t = 1 sec

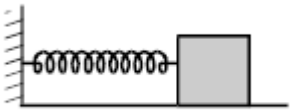
(A) acceleration of particle is $8m/s^2$

(B) tangential acceleration of particle is $\frac{6}{\sqrt{5}}m/s^2$

(C) Radial acceleration of particle is $\frac{2}{\sqrt{5}}m/s^2$

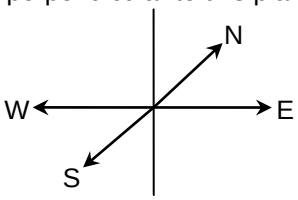
(D) Radius of curvature to the paths is $\frac{5\sqrt{5}}{2}m$

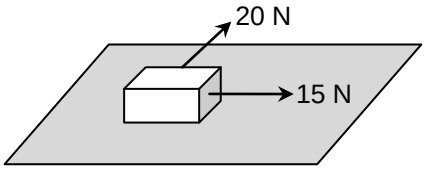
3. A spring block system is placed on a rough horizontal floor. The block is pulled towards right to give spring some elongation and released.



(A) The block may stop before the spring attains its mean position.
(B) The block must stop with spring having some compression.
(C) The block may stop with spring having some compression.
(D) It is not possible that the block stops at mean position.

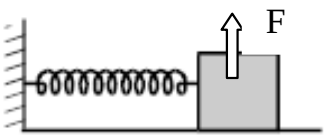
4. A 10 kg block is placed on a horizontal surface whose coefficient of friction is 0.25. A horizontal force P = 15 N first acts on it in the eastward direction. Later, in addition to P a second horizontal force Q = 20 N acts on it in the northward direction: (Both east and west are in the plane of the fig and the gravity acts perpendicular to this plane)





(A) The block will not move when only P acts, but will be about to move when both P and Q act
(B) If the block moves, the acceleration will be 0.5 m/s^2.
(C) When the block moves, its direction of motion will be $\tan^{-1}$ (4/3) east of north
(D) When both P and Q act, the direction of the force of friction acting on the block will be $\tan^{-1}$ (3/4) west of south

5. A block of mass m is attached to a horizontal spring of stiffness k. The other end of the spring is attached to a fixed wall. The entire system lies on a horizontal surface and the spring is at its natural length. The natural length of the spring is ℓ_0. If the block is slowly lifted up vertically to a height $\frac{5}{12}\ell_0$ from its initial position, which of the following is correct?



(A) The work done by the gravity = $\frac{5}{12}mg\ell_0$

(B) The work done by the spring force = $-\frac{k\ell_0^2}{288}$

(C) The work done by the lifting force = $\frac{5}{12}mg\ell_0+\frac{k\ell_0^2}{288}$

(D) The sum of works done by all the forces on the block is zero.

6. A stone is thrown upward from the top of a tower such that it covers 15 m during the third second. The average speed(s) of the stone during three seconds is

(A) $\frac{25}{3}m/\sec$ (B) $\frac{20}{3}m/\sec$

(C) $5m/\sec$ (D) $25m/\sec$

7. A particle moves under the action of a force which does not deliver any power. Then

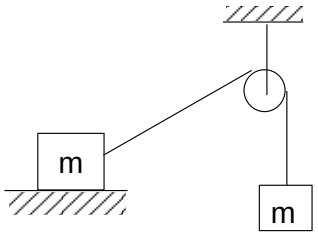
(A) motion is circular (B) velocity is constant

(C) Total mechanical energy is constant (D) Potential energy is constant

8. Two blocks are in equilibrium. Ignore the mass of string and friction at the pulley, the magnitude of friction between the block and ground is

(A) $mg\cos\theta$ (B) $\le \mu mg(1-\sin\theta)$

(C) $\frac{\mu mg}{\sin\theta+\mu\cos\theta}$ (D) zero



9. Which of the following represents that the particle is moving with velocity perpendicular to its position

(A) $x=A\sin\omega t,\ y=A\cos\omega t$ (B) $x=A\sin\omega t,\ y=B\cos\omega t$

(C) $x=e^t,\ y=e^{-t}$ (D) $x=At,\ y=Bt$

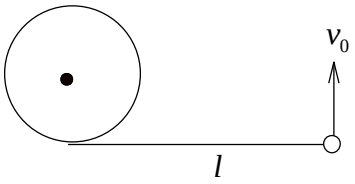
10. A bead is connected with a fixed disc by an inextensible massless sting in a smooth horizontal plane. If the bead is pushed with a velocity of v_0 perpendicular to the string, the bead moves in a curve and consequently collapses on the disc of the time t, then:

(A) Work done by the string is negative and speed of bead decreases

(B) Kinetic energy of bead remains constant

(C) Tension in the string will increase

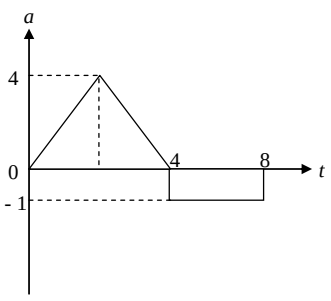
(D) Angular speed of bead will increase



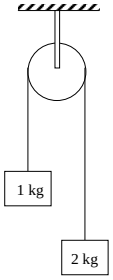
PART – C
Integer Answer Type

This part contains **10 questions**. The answer to each of the questions is a **single-digit integer**, ranging from 0 to 9.

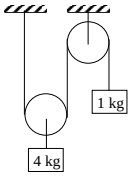
1. The acceleration time graph of a particle is shown in the figure. The velocity of the particle at $t=8s$ if its initial velocity of the particle is $3\,ms^{-1}$ (in ms^{-1})



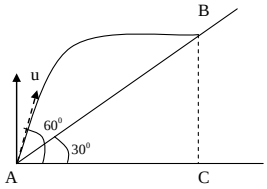
2. Two unequal masses 1 kg and 2 kg are connected by a string going over a clamped light smooth pulley as shown in figure. The system is released from rest. The larger mass is stopped for a moment 1 second after the system is set in motion. The time clasped before the string is tight again is $\frac{1}{B}\sec$ then $B =$ _____ sec



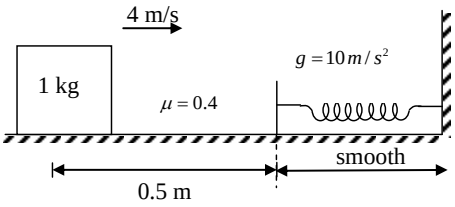
3. In the system shown below the acceleration of 1 kg mass is $\frac{g}{k}$ upwards then $k =$ _____



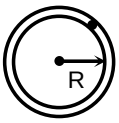
4. The time taken by a projectile to reach from A to B is t then the distance of AB is $\frac{ut}{\sqrt{k}}$ then $k =$ _____



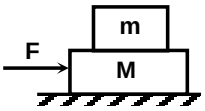
5. A body of mass 1 kg is given a horizontal velocity of 4 m/s along a horizontal surface, which has a coefficient of friction (both static and kinetic of 0.4. The particle strikes a fixed ideal spring of force constant 6 N/m after traveling a distance of 0.5 m. Assume acceleration due to gravity is $10\,m/s^2$. The compression of spring is $\sqrt{x}$ what is the value of x?



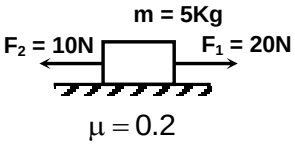
6. A small sphere of mass m = 2kg and radius r = 0.5cm is moving in a smooth horizontal circular groove of radius R = 10m with constant speed of 5m/s find the work done on the sphere by the normal force exerted by the groove in 1 minute.



7. A block of mass m = 1 kg is placed on the other block of mass M = 2 kg, which in turns placed on a smooth horizontal surface as shown in the figure. The coefficient of friction between the blocks is 0.4. A constant horizontal force F = 6N is applied on M at time t = 0. Find the magnitude of the work done (in joule) by friction on the block of mass m = 1kg in first one second in ground frame.



8. In the adjacent figure initially block is at rest and two horizontal forces F_1 and F_2 of magnitudes 20N and 10N respectively are applied simultaneously at time t = 0. The coefficient of friction between the block and the ground is $\mu = 0.2$. Calculate the work done by friction force on the block in first two second.



9. Two particles A and B are located at points (0, $-10\sqrt{3}$) and (0, 0) respectively in xy plane. They start moving simultaneously at time t = 0 with constant velocities $\vec{v}_A = 5\hat{i}$ m/s and $\vec{v}_B = -5\sqrt{3}\hat{j}$ m/s, respectively. Time when they are closest to each other is found to be K/2 second. Find K. All distances are given in meter.

10. Vectors $\vec{P}, \vec{Q}$ and $\vec{R}$ have magnitudes 5,12, and 13 units respectively and $\vec{P} + \vec{Q} = \vec{R}$. If angle between $\vec{Q}$ and $\vec{R}$ is θ. Then find $\frac{13}{2}\cos\theta$.

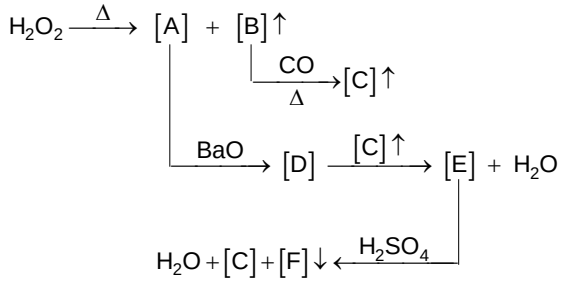
SECTION – II (CHEMISTRY)

PART – A

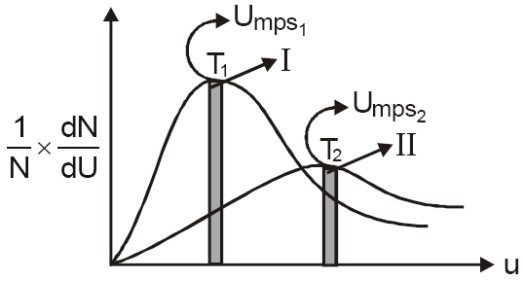
(Multi Correct Answer Type)

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

1. Which of the following is affected by the stable electron configuration of an atom?
(i) Electronegativity (ii) Ionisation enthalpy (iii) Electron gain enthalpy
Correct answer is:
(A) Only electronegativity
(B) only ionisation enthalpy
(C) both electron gain enthalpy and ionisation enthalpy
(D) all of the above

2. 

Choose correct statement(s) regarding the products of above reaction sequence.
(A) (F) is a white precipitate
(B) [E] produces gas (C) on thermal decomposition
(C) Gas (B) is a reducing agent
(D) Aqueous solution of (D) turns red litmus to blue.

3. Following represent the Maxwell distribution curve for an ideal gas at two temperature T_1 and T_2. Which of the following option(s) are true?


(A) Total area under the two curves is independent of moles of gas
(B) U_{mps} decreases as temperature decreases
(C) $T_1 > T_2$ and hence higher the temperature, sharper the curve
(D) The fraction of molecules having speed = U_{mps} decreases as temperature increases

4. When a sample of gas is compressed at constant temperature from 15 atm to 60 atm, its volume changes from 76.0 cm^3 to 20.5 cm^3. Which of the following statements are possible explanations of this behaviour?
(A) The gas behaves non-ideally.
(B) The gas dimerises.
(C) The gas is absorbed onto the vessel walls.
(D) Repulsive forces are dominating

5. Which of the following statements is correct about angular nodes?
(A) Theses nodes are directional in nature.
(B) These nodes are dependent on angle θ and ϕ
(C) These nodes are independent from the radial wave function (R)
(D) These nodes are dependent on the radial wave function

6. Which of the following statements are correct?

(A) F is the most electronegative and Cs is the most electropositive element
(B) The ionization energy of halogens decreases from F to I
(C) The electron affinity of Cl is higher than that of F but their electronegativities are in the reverse order
(D) The electron affinity of noble gases is almost zero

7. Limitations of octet rule include(s):
(A) Not always applicable for central atom with period number greater than or equal to 3
(B) odd electron species exist
(C) It doesn't comment about geometry of molecule
(D) None of these

8. Which of the following d – orbitals is/ are able to form π - bonding with p - orbitals on the neighbouring atoms?
(A) $dx^2 - y^2$ (B) dxy
(C) dyz (D) dz^2

9. The process(es) requiring the absorption of energy is/are:
(A) $Cl \rightarrow Cl^-$ (B) $O^- \rightarrow O^{2-}$
(C) $Fe^{3+} \rightarrow Fe^{2+}$ (D) $Ar \rightarrow Ar^-$

10. In which of the following compound(s) nitrogen exhibits positive oxidation state?
(A) NH_3 (B) NO
(C) NH_2OH (D) NO_2

PART – C
Integer Answer Type

This part contains **10 questions**. The answer to each of the questions is a **single-digit integer**, ranging from 0 to 9.

1. The radial wave equation for hydrogen atom is:

$$\psi = \frac{1}{16\sqrt{4}}\left(\frac{1}{a_0}\right)^{3/2}\left[(x-1)(x^2-8x+12)\right]e^{-r/2}$$

where $x = 2r/a_0; a_0 =$ radius of first Bohr orbit. The minimum and maximum position of radial nodes from nucleus are $\frac{a_0}{x}$ and ya_0. Find $(x+y)$.

2. 200 mL of 0.2 M acidified $KMnO_4$ solution completely oxidizes one gram of a metal. What is the equivalent mass of the metal?

3. Chloride samples are prepared for analysis by using NaCl, KCl and NH_4Cl separately or as mixture. What minimum weight of 5% by weight of $AgNO_3$ solution (sp. gr. 1.04 gm/ml) must be added to a sample of 1.07 gm in order to ensure complete precipitation of Cl^- in any possible case? Divide the required weight of solution by 17 and report that answer. (At. wt. of Ag = 108)

4. If the ratio of PV_m and RT for a real gas is $\frac{x}{24}$ at T_C, P_C and V_C, where $\left(\frac{\partial P}{\partial V_m}\right) = 0$, then find the value of x.

5. At STP the density of a gas X is three times that of gas Y while molecular mass of gas Y is twice that of X. The ratio of pressure of X and Y will be

6. What will be the maximum number of lines possible for Balmer series when a set of 8 hydrogen atoms are irradiated with light and all are excited to 6^{th} excited state and spectrum is obtained?

7. An element undergoes a reaction as shown $x + 2e^- \longrightarrow x^{2-}$ energy released = 30.876 eV/atom. If the energy released is used to dissociate 8 grams of H_2 molecules, equally into H^+ and H*, where H* is

an excited state of H atoms where the electron travels in orbit whose circumference equal to four times its de Broglie's wave length. Determine the least amount(mole) of X that would be required.
Given: 1E of H = 13.6eV/atom, Bond energy of H_2 = 4.526 eV/molecule

8. How many of the following molecule don't obey octet rule?
IF_7, PCl_5, BF_3, $BeCl_2$, $SiCl_4$, SCl_2

9. In how many of the following only two lone pair of electrons are present?
XeF_4, $\overset{+}{X}eF_3$, $XeOF_4$, XeF_2, OSF_4, SCl_2, ClF_3, $\ddot{N}H_2$, $\ddot{O}H$, ClO_2^-, ClO_2

10. A sample of a single electron excited species is taken. Find out the atomic number of species if de Broglie wavelength of electron in first excited state is 221.4 pm.

SECTION – III (MATHEMATICS)

PART – A

(Multi Correct Answer Type)

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

1. If $y = e^{\sqrt{x}} + e^{-\sqrt{x}}$, then $\frac{dy}{dx}$ is equal to

(A) $\frac{e^{\sqrt{x}} - e^{-\sqrt{x}}}{2\sqrt{x}}$ (B) $\frac{e^{\sqrt{x}} - e^{-\sqrt{x}}}{2x}$

(C) $\frac{1}{2\sqrt{x}}\sqrt{y^2 - 4}$ (D) $\frac{1}{2\sqrt{x}}\sqrt{y^2 + 4}$

2. The director circle of the circle $x^2 + y^2 = 25$ cut the line $x - y = 0$ at

(A) (1, 1) (B) (5, 5)

(C) (–1, –1) (D) (–5, –5)

3. An extreme value of $4\sin^2 x + 3\cos^2 x - 24\sin\frac{x}{2} - 24\cos\frac{x}{2}$, where $0 \le x \le \frac{\pi}{2}$, is

(A) $4 + \sqrt{2}$ (B) $4\left(1 - 6\sqrt{2}\right)$

(C) – 21 (D) 4

4. A straight line L drawn through the point A (1, 2) intersects the line $x + y = 4$ at a distance of $\frac{\sqrt{6}}{3}$ units from A. The angle made by L with positive direction of x-axis can be:

(A) $\frac{\pi}{12}$ (B) $\frac{\pi}{6}$

(C) $\frac{\pi}{3}$ (D) $\frac{5\pi}{12}$

5. The sides of a triangle are the straight lines $x + y = 1$, $7y = x$ and $\sqrt{3}y + x = 0$. Then which of the following is an interior point of the triangle:

(A) circumcenter (B) centroid

(C) incentre (D) orthocenter

6. The values of 'x' satisfies the equation $\frac{1 - 2(\log x^2)^2}{\log x - 2(\log x)^2} = 1$(is/are):

(where log is logarithm to the base 10)

(A) $\frac{1}{\sqrt{10}}$ (B) $\frac{1}{\sqrt{20}}$

(C) $\sqrt[3]{10}$ (D) $\sqrt{10}$

7. Circle(s) touching x-axis at a distance 3 from the origin and having an intercept of length $2\sqrt{7}$ on y-axis is (are):

(A) $x^2 + y^2 - 6x + 8y + 9 = 0$ (B) $x^2 + y^2 - 6x + 7y + 9 = 0$

(C) $x^2 + y^2 - 6x - 8y + 9 = 0$ (D) $x^2 + y^2 - 6x - 7y + 9 = 0$

8. Let $P(1, 2\sqrt{2})$ is a point on circle $x^2 + y^2 = 9$. Locate the points on the given circle, which are at 2 units distance from point P.

(A) $\left(-1,2\sqrt{2}\right)$ (B) $\left(2\sqrt{2},1\right)$

(C) $\left(\frac{23}{9},\frac{10\sqrt{2}}{9}\right)$ (D) (3, 0)

9. $3(\sin x-\cos x)^4+6(\sin x+\cos x)^2+4(\sin^6 x+\cos^6 x)$ is equal to

(A) 11 (B) 12

(C) 13 (D) 14

10. $\sec^2\theta=\frac{4xy}{(x+y)^2}$ is true if and only if

(A) $x+y\neq 0$ (B) $x=y, x\neq 0$

(C) x = y (D) $x\neq 0, y\neq 0$

PART – C
Integer Answer Type

This part contains **10 questions**. The answer to each of the questions is a **single-digit integer**, ranging from 0 to 9.

1. The orthocentre of triangle formed by lines $x+y-1=0, 2x+y-1=0$ and y = 0 is (h, k), then $\frac{1}{k^2}=$

2. Given that the three points where the curve $y = bx^2 - 2$ intersects the x-axis and y-axis form an equilateral triangle. Find the value of 2b.

3. If circles $x^2+y^2=c$ with radius $\sqrt{3}$ and $x^2+y^2+ax+by+c=0$ with radius $\sqrt{6}$ intersect at two points A and B. If length of $AB=2\sqrt{\ell}$. Find ℓ.

4. AB is any chord of the circle $x^2+y^2-6x-8y-11=0$ which subtends and angle $\frac{\pi}{2}$ at (1, 2). If locus of midpoint of AB is a circle $x^2+y^2-2ax-2by-c=0$; then find the value of (a + b + c).

5. Let $a=\log_3\log_3 2$. An integer k satisfying $1<2^{(-k+3^{-a})}<2$, must be less than_____.

6. The maximum value of $\cos^2(45^0+x)+(\sin x-\cos x)^2$ is _____.

7. The value of $\operatorname{cosec}10^0+\operatorname{cosec}50^0-\operatorname{cosec}70^0$ is _____.

8. Number of triangles ABC if $\tan A=x, \tan B=x+1,$ and $\tan C=1-x$ is_____.

9. Number of integers satisfying the inequality $\log_{1/2}|x-3|>-1$ is_____.

10. If $y=4\sin^2 x$ & $\frac{dy}{dx}=\frac{n}{2}\sin 2x$ then n is equal to_____.

FIITJEE COMMON TEST

TWO YEAR CRP (CTY - 1820)

BATCH: B - LOT

PCM (PAPER – I) PHASE - I

PAPER CODE: XXXX.X **DATE: DD.MM.YYYY**

ANSWER KEYS [SET – A]

Q. No.	Section - I (Physics)		Q. No.	Section - II (Chemistry)		Q. No.	Section - III (Maths)	
	Answer Key	Concept Code		Answer Key	Concept Code		Answer Key	Concept Code
Part - A			**Part - A**			**Part - A**		
1	**BD**	P110420	1	**C**	C110703, C110704, C110706	1	**AC**	M114103
2	**BCD**	P110317, P110318	2	**ABD**	C114305, C110904	2	**BD**	M110825
3	**AC**	P110502	3	**ABD**	C111206	3	**BC**	M111422
4	**AD**	P110410, P110411, P110412	4	**AD**	C111203	4	**AD**	M113321
5	**BCD**	P110502	5	**ABC**	C110113	5	**BC**	M113307
6	**AD**	P110303	6	**ABCD**	C110703, C110704, C110706	6	**AC**	M112403
7	**ACD**	P110513	7	**ABC**	C113601	7	**AC**	M113351
8	**AB**	P110412	8	**BC**	C113602	8	**AC**	M113338
9	**AC**	P111620	9	**BD**	C110704, C110703	9	**C**	M112404
10	**BCD**	P110513	10	**BD**	C111111	10	**B**	M112404
Part - C			**Part - C**			**Part - C**		
1	**7**	P110325	1	**5**	C110113	1	**4**	M113306
2	**3**	P110413	2	**5**	C111112	2	**2**	M113320
3	**2**	P110409	3	**4**	C111102, C110206	3	**2**	M113348
4	**3**	P110314	4	**9**	C111209	4	**8**	M113343
5	**2**	P110502	5	**6**	C111201	5	**1**	M112403
6	**0**	P110620	6	**5**	C110103	6	**3**	M112405
7	**2**	P110507	7	**4**	C110103	7	**6**	M112405
8	**0**	P110507	8	**4**	C113605	8	**0**	M112405
9	**3**	P110320	9	**1**	C110306, C113605	9	**2**	M112404
10	**6**	P110219	10	**3**	C110106, C110103	10	**8**	M112407