FIITJEE **Phase Test (JEE-Advanced)**

BATCHES –1920

PHYSICS, CHEMISTRY & MATHEMATICS

SET - A

CPT-1 | **CODE:** | **PAPER - 2**

Time Allotted: 3 Hours **Maximum Marks: 183**

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

INSTRUCTIONS

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. All the section can be filled in **PART-A** of OMR.
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 Only One Part.

(i) **Part-A (01-07) –** Contains seven (07) multiple choice questions which have **One or More** correct answer.
Full Marks: **+4** If only the bubble(s) corresponding to all the correct options(s) is (are) darkened.
Partial Marks: **+1** For darkening a bubble corresponding **to each correct option,** provided NO incorrect option is darkened.
***Zero Marks*: 0** If none of the bubbles is darkened. ***Negative Marks*: –2** In all other cases.
For example, if **(A), (C) and (D)** are all the correct options for a question, darkening all these three will result in **+4 marks**; darkening only **(A) and (D)** will result in **+2 marks**; and darkening **(A) and (B)** will result in **–1** marks, as a wrong option is also darkened.

(ii) **Part-A (08-14) –** Contains seven (07) multiple choice questions which have ONLY ONE CORRECT answer Each question carries **+3 marks** for correct answer and **-1 marks** for wrong answer.

(iii) **Part-A (15-18) -** This section contains Two paragraphs. Based on each paragraph, there are Two multiple choice questions. Each question has only one correct answer and carries **+3 marks** for the correct answer. **There is no negative marking.**

Name of the Candidate :_____

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

Enrolment Number :_____

Useful Data

PHYSICS

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

CHEMISTRY

Gas Constant	R	=	$8.314\ J\ K^{-1}\ mol^{-1}$
		=	0.0821 Lit atm $K^{-1}\ mol^{-1}$
		=	$1.987 \approx 2$ Cal $K^{-1}\ mol^{-1}$
Avogadro's Number	N_a	=	6.023×10^{23}
Planck's Constant	h	=	6.626×10^{-34} Js
		=	6.25×10^{-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, Na=11, Mg=12, Al = 13,
Si = 14, 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, Si = 21, Sn = 50, Ti = 22,I = 53, Xe = 54, Ba = 56, Pb = 82, U = 92, V = 50.

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

SECTION - I : PHYSICS

PART – A : (One or more than one Options Correct Type)

This section contains **7 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONE** or **MORE THAN ONE is correct.**

1. A man who can swim at a speed v relative to the water wants to cross a river of width d, flowing with a speed u The point opposite him across the river is P.

(A) The minimum time in which he can cross the river is $\frac{d}{v}$

(B) He can reach the point P in time $\frac{d}{v}$

(C) He can reach the point P in time $\frac{d}{\sqrt{v^2-u^2}}$

(D) He cannot reach P if u > v

2. A particle moves in the xy plane with a constant acceleration 'g' in the negative y-direction. Its equation of motion is $y = ax - bx^2$, where a and b are constants. Which of the following are correct ?

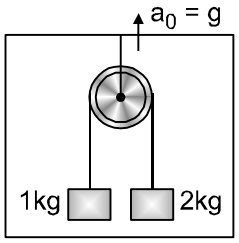
(A) The x-component of its velocity is constant

(B) At the origin, the y-component of its velocity is a $\sqrt{\frac{g}{2b}}$

(C) At the origin, its velocity makes an angle $\tan^{-1}$ (a) with the x-axis

(D) The particle moves exactly like a projectile

3. The figure shows a pulley mass system (assume mass of pulley and string is negligible) which is kept in an elevator that is moving upward with an acceleration a = g. Then



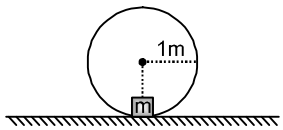
(A) tension in string is $\frac{8}{3}g$

(B) tension in string is $\frac{7}{3}g$

(C) acceleration of 1 kg mass with respect to ground is $\frac{4}{3}g$

(D) acceleration of 1 kg mass with respect to ground is $\frac{5}{3}g$

4. A particle of mass m is given an initial speed v inside a smooth fixed spherical shell of radius R = 1 m that is just able to complete the circle as shown in the figure



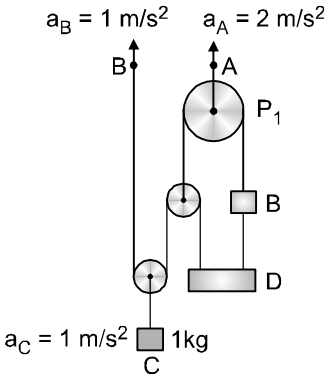
(A) Acceleration of the particle when its velocity become vertical is $g\sqrt{10}$

(B) Normal contact force when its velocity become vertical 3mg

(C) Speed of the particle when its velocity become vertical is $\sqrt{3g}$

(D) Contact force at the bottom is 5 mg

5. In the arrangement shown in figure pulley and strings are ideal. End A of string connected to pulley P_1 is moved upwards with acceleration a_A = 2 m/s^2 while end B of another string shown in figure is moved up with acceleration a_B = 1 m/s^2. Block C of mass 1 kg is moving up with acceleration 1 m/s^2. If block D to which string are connected symmetrically moves such that its orientations remains same then (assume g = 10 m/s^2)



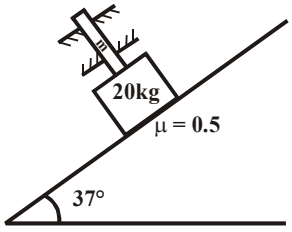
(A) acceleration of block D is ½ m/s^2 upwards

(B) end A is pulled with force of 22 N

(C) mass of block B is 1/2 kg

(D) acceleration of block B is 7/3 m/s^2 upwards

6. Mass m of the rod so that the block of mass M = 20 kg remains stationary on the inclined plane.



(A) Minimum value of m is 10 kg

(B) Minimum normal force required to keep it stationary between m and M is 100N

(C) Maximum static frictional force between M and surface is 120 N

(D) Maximum static frictional force between M and m is 80 N

7. Water coming out of a horizontal tube at a speed v strikes normally a vertically wall close to the mouth of the tube and falls down vertically after impact. When the speed of water is increased to 2v

(A) the thrust exerted by the water on the wall will be doubled

(B) the thrust exerted by the water on the wall will be four times

(C) the energy lost per second by water strike up the wall will also be four times

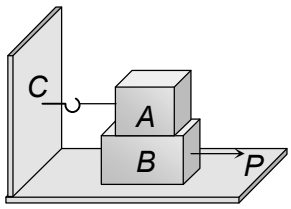
(D) the energy lost per second by water striking the wall be increased eight times.

space for rough work

Single Correct Answer Type

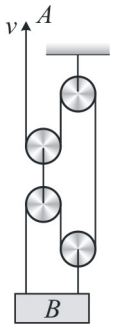
This section contains **7 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE is correct.**

8. Block A weighing 100 kg rests on a block B and is tied with a horizontal string to the wall at C. Block B weighs 200 kg. The coefficient of friction between A and B is 0.25 and between B and the surface is 1/3. The horizontal force P necessary to move the block B should be $(g = 10\ m/s^2)$



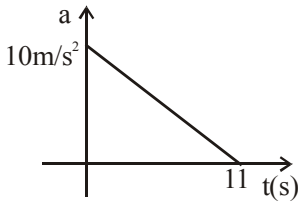
(A) 1150 N (B) 1250 N
(C) 1300 N (D) 1420 N

9. In the arrangement shown, end A of light inextensible string is pulled with constant velocity v. The velocity of block B is V_b. The ratio of $\frac{V}{V_b}$ is:



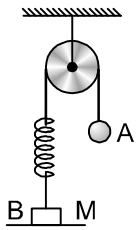
(A) 1 (B) 4
(C) 3 (D) 1.5

10. A particle starts from rest. Its acceleration (a) versus time t is as shown in the figure. The maximum speed of the particle will be



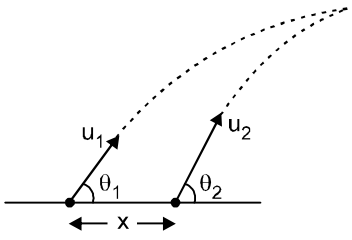
(A) 110 m/s (B) 55 m/s
(C) 550 m/s (D) 660 m/s

11. In the adjoining diagram, the ball A is released from rest when the spring is at its natural length (neither stretched nor compressed). For the block B of mass M to leave contact with the ground at same time, the minimum mass of A must be



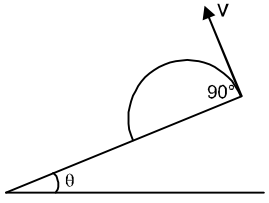
(A) M/2
(B) M
(C) 2M
(D) A function of M and force constant k of spring

12. Two particles are projected simultaneously from the level ground as shown in figure. They may collide after a time :



(A) $\frac{x\sin\theta_2}{u_1}$ (B) $\frac{x\cos\theta_2}{u_2}$
(C) $\frac{x\sin\theta_2}{u_1\sin(\theta_2-\theta_1)}$ (D) $\frac{x\sin\theta_1}{u_2\sin(\theta_2-\theta_1)}$

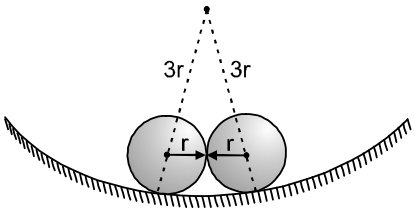
13. A projectile is fired with a velocity v at right angle to the slope which is inclined at an angle θ with the horizontal. The range of the projectile along the inclined plane is :



(A) $\frac{2v^2}{g}\tan\theta$ (B) $\frac{2v^2}{g}\tan\theta\sin\theta$
(C) $\frac{2v^2}{g}\tan\theta\sec\theta$ (D) $\frac{v^2}{g}\tan\theta\sec\theta$

14. Two equal heavy spheres, each of radius r, are in equilibrium within a smooth cup of radius 3r. The ratio of reaction between the cup and one sphere and that between the two sphere is :

(A) 1 (B) 2
(C) 3 (D) None

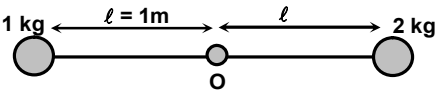


Paragraph Type

This section contains **2 paragraph**s. Based upon each paragraph, there are **2 questions**. Each question has 4 choices (A), (B) , (C) and (D), out of which **ONLY ONE** is correct.

Paragraph for Question Nos. 15 to 16

Two balls of mass 1 kg and 2 kg are tied with massless inextensible strings. The other end of string is tied at same point O. The two strings are made horizontal as shown. The length of string is 1m. The coefficient of restitution between the balls is 1. The balls are released at the same instant.



15. If t_1 and t_2 are the time taken by ball of mass 1 kg and 2 kg respectively to reach at the bottom most point vertically below then

(A) $t_1 > t_2$ (B) $t_1 = t_2$
(C) $t_1 < t_2$ (D) none of these

16. The height attained by 2 kg ball after the collision from the point of collision is

(A) 1/9 m (B) 16/9 m
(C) 13/9 m (D) 5/9 m

Paragraph for Question Nos. 17 to 18

Two particles A and B masses 2kg and 1 kg moving towards each other with speeds 8 m/s. and 6 m/s. respectively, on a rough horizontal surface. The friction coefficient between A and surface is 0.2 and between B and surface is 0.3. Initially the distance between A and B is 21 m.

17. After how much time the particles will collide

(A) 1 sec (B) 2 sec
(C) 3 sec (D) 4 sec

18. If the collision is elastic what will be the velocity of COM just after the collision?

(A) $\frac{4}{3}$ m/s (B) $\frac{2}{3}$ m/s
(C) $\frac{10}{3}$ m/s (D) Zero

space for rough work

SECTION - II : CHEMISTRY

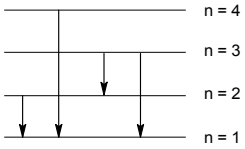
PART – A : (One or more than one Options Correct Type)

This section contains **7 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONE** or **MORE THAN ONE is correct.**

1. Which of the following statement(s) is/are correct about the ionic product of water?
   (A) K_i (ionization constant of water) < K_w (ionic product of water)
   (B) $pK_i > pK_w$
   (C) at 25^o, $K_i = 1.8 \times 10^{-14}$
   (D) ionic product of water at 10^oC is 10^{-14}

2. Which of the following statements are correct about sulphur hexa fluoride?
   (A) All S – F bonds are equivalent
   (B) SF_6 is a planar molecule
   (C) Oxidation number of sulphur is the same as number of valence shell electrons of sulphur involved in bonding
   (D) Sulphur has acquired the electronic structure of the gas argon

3. Suppose that a hypothetical atom gives four transitions in its spectrum, which jump according to figure would give off second line from the red end in the spectrum?



   (A) 3 → 1
   (B) 2 → 1
   (C) 4 → 1
   (D) 3 → 2

4. Select the correct statement(s) regarding $3P_y$ orbital:
   (A) total no. of nodes are 2
   (B) number of maxima in the curve $4\pi r^2R^2(r)$ Vs r is two
   (C) quantum number n, l and m for orbital may be 3, 1 and -1 respectively
   (D) the magnetic quantum number may have a positive value

5. The correct order among the following is/are
   (A) $CO < CO_2 < CO_3^{2-}$ (C – O bond length)
   (B) $O_2^{2-} < O_2^- < O_2 < O_2^+$ (Stability)
   (C) $O_2 < O_3 < H_2O_2$ (O – O bond length)
   (D) $NH_4^+ < NH_3 < NH_2^-$ (Bond angle)

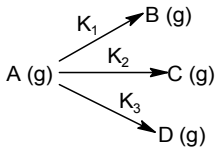
6. Sodium sulphate is soluble in water whereas barium sulphate is sparingly soluble because
   (A) The hydration energy of sodium sulphate is more than its lattice energy
   (B) The lattice energy of barium sulphate is more than its hydration energy
   (C) The lattice energy has no role to play in solubility
   (D) The hydration energy of sodium sulphate is less than its lattice energy

7. The precipitate of CaF_2 ($K_{sp} = 1.7 \times 10^{-10}$) is not obtained when equal volumes of the following are mixed.
   (A) 10^{-4} M $[Ca^{++}]$ + 10^{-4} M $[F^-]$
   (B) 10^{-2} M $[Ca^{++}]$ + 10^{-3} M $[F^-]$
   (C) 10^{-5} M $[Ca^{++}]$ + 10^{-3} M $[F^-]$
   (D) 10^{-3} M $[Ca^{++}]$ + 10^{-5} M $[F^-]$

Single Correct Answer Type

This section contains **7 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE is correct.**

8. A gaseous compound A reacts by three independent first order processes with rate constants
2×10^{-3}, 3×10^{-3} and 1.93×10^{-3} sec^{-1} for products B, C and D respectively. If initially pure A was taken in a closed container with P = 8 atm, then the partial pressure of B (in atm) after 100 sec from start of experiment:



(A) 0.288 (B) 0.5277
(C) 1.154 (D) none of these

9. Which is incorrect statement?
(A) The heats of hydration of the dipositive alkaline earth metal ions decrease with an increase in their ionic size.
(B) $NaNO_3$ forms Na_2O on heating.
(C) Hydration of alkali metal ions is less than that of IIA group.
(D) Alkaline earth metal ions, because of their larger charge to size ratio, exert a much stronger electrostatic attraction on the oxygen of water molecule surrounding them, when compared to alkali metal ions.

10. The pH at which a 0.01 M Al^{+3} solution is 99.99% precipitated is : (K_{sp} $Al(OH)_3 = 1 \times 10^{-18}$ at 25°C)
(A) 6.67 (B) 7.67
(C) 8.67 (D) 10

11. A diatomic molecule has a dipole moment of 1.2 D. If its bond distance is 1.0 Å, what fraction of an electronic charge, exists on each atom?
(A) 25% (B) 0.25%
(C) 50% (D) 12.5%

12. A first order reaction is 50% completed in 30 minutes at 27°C and in 10 minutes at 47°C. The energy of activation of the reaction is
(A) 43.84 kJ/mol (B) 34.84 kJ/mol
(C) 84.00 kJ/mol (D) 30.00 kJ/mol

13. Match list – I with list – II and select the correct answer using the codes given below:

List – I	**List – II**
a. CH_3COONa	1. Strong electrolyte with pH > 7
b. NH_4Cl	2. Strong electrolyte with the pH < 7
c. Bi_2S_3	3. Weak electrolyte with $K_{sp} = S^2$
d. CdS	4. Weak electrolyte with $K_{sp} = 108S^5$

Codes

	a	b	c	d
(A)	2	3	1	4
(B)	1	2	4	3
(C)	1	3	2	4
(D)	1	3	4	2

14. Which of the following about SF_4, SOF_4, CH_2SF_4 and OCF_2 molecules is correct-
(A) Equatorial FSF bond angle in SOF_4 will be less than that in SF_4 molecule
(B) The two hydrogens, carbon, sulphur and two flourines (of axial positions) in molecule CH_2SF_4 will be lying in the same plane

(C) The bond angle FCO will be < 120° in molecule OCF_2
(D) The axial FSF bond angle in SF_4 = 180°

PART – A
Paragraph Type

This section contains **2 paragraph**s. Based upon each paragraph, there are **2 questions**. Each question has 4 choices (A), (B) , (C) and (D), out of which **ONLY ONE** is correct.

Paragraph for Question Nos. 15 to 16

Salt hydrolysis is an acid-base reaction of a cation or anion or both ions of a salt with water. The resultant solution after hydrolysis may be acidic, basic or neutral. The anion X^- which is a weaker base than OH^- and which has its conjugate acid HX stronger than water but weaker than H_3O^+ shows the phenomenon of hydrolysis. e.g. CH_3COO^-, NO_2^-, CN^- etc.
The cation M^+ which is weaker acid than H_3O^+ and which has its conjugate base MOH stronger than water but weaker than OH^- shows the phenomenon of hydrolysis, e.g. $N_2H_5^+$, $C_6H_5NH^+$, NH_4^+. etc.
Answer, the following questions:

15. When pure ammonium chloride is dissolved in pure water, the pH of the resulting solution is not 7. This is because:
(A) Ammonium ions accept protons from water molecules leaving free OH^- ions in solution
(B) Ammonia accepts a proton from water
(C) Ammonium ions combine with water molecule to give weak base ammonium hydroxide
(D) Chloride ions made the solution acidic

16. The degree of hydrolysis of a salt of weak acid (HA) and weak base (BOH) in its 0.1 M solution is found to be 0.1. If the molarity of the solution is 0.05 M, the percentage hydrolysis of salt should be:
(A) 5% (B) 10%
(C) 20% (D) none of these

Paragraph for Question Nos. 17 to 18

In an orbital electrons are filled accounting to Aufbau principle, Pauli exclusion principle and Hund's rule of maximum multiplicity.
Aufbau states that the orbital are filled in order of their increasing energies. The order of increase of energy of orbitals can be calculated from $(n+\ell)$ rule. Lower the value of $(n+\ell)$ for an orbital the lower its energy. Hence orbital are filled in order of increasing $(n+\ell)$ value. If two orbital have same $(n+\ell)$ value, the orbital with lower value of n has lower energy and hence is filled first.
According to Pauli exclusion principle, an orbital can have maximum two electrons and these must have four different quantum numbers.
According to Hund's rule pairing of electron in the orbitals belongs to the same sub shell does not take place until each orbital belonging to that such shell has got one electron each i.e. singly occupied.

17. The electronic configuration of an element is $1s^2\,2s^2\,2p^6$, $3s^2\,3p^6\,3d^5$, $4s^1$. This represents
(A) excited state (B) ground state
(C) cationic state (D) anionic state

18. If the nitrogen atom had electronic configuration $1s^7$, it would have energy lower than that of the normal ground state configuration $1s^2\ 2s^2\ 2p^3$ because the electron would be close to the nucleus yet $1s^7$ is not observed because it violates
(A) Heisenberg's uncertainty principle (B) Hund's rule
(C) Pauli exclusion principle (D) Bohr's postulate of stationary orbitals

SECTION - III : MATHEMATICS

PART – A : (One or more than one Options Correct Type)

This section contains **7 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONE** or **MORE THAN ONE is correct.**

1. Consider, and $g(x)=\begin{cases}\sin x-1, & 0\le x<\frac{\pi}{2}\\ [x]-\cos(x-2), & \frac{\pi}{2}\le x\le\pi\end{cases}$ and $f(x)=\begin{cases}2-|x|; & -1\le x\le 1\\ |x-2|-x; & 1<x\le 3\end{cases}$

where [k] denotes greatest integer function of k. Identify the correct statement(s).

(A) $\lim\limits_{x\to 1^+} g(f(x))=-1$ (B) $\lim\limits_{x\to\frac{\pi}{2}^-} g(f(g(x)))=0$

(c) $\lim\limits_{x\to 2^+}\frac{f(g(x))}{f(x)-2}=\frac{1}{2}$ (D) $\lim\limits_{x\to 0^+}\frac{g(f(x))}{(f(x)-2)^2}=\frac{1}{2}$

2. If $\phi(x)=f(x)+f(2a-x)$ and $f''(x)>0, a>0, 0\le x\le 2a$ then :

(A) ϕ (x) increases in (a, 2a) (B) ϕ (x) increases in (0, a)

(C) ϕ (x) decreases in (0, a) (D) ϕ (x) decreases in (a, 2a)

3. $f(x)=\frac{[x]+1}{\{x\}+1}$ for $f:\left[0,\frac{5}{2}\right)\to\left(\frac{1}{2},3\right]$, where [.] represents the greatest integer function and {.} represents the fractional part of x. Then which of the following is true?

(A) f(x) is injective discontinuous function. (B) f(x) is surjective non–differentiable function

(C) min $\left(\lim\limits_{x\to 1^-} f(x), \lim\limits_{x\to 1^+} f(x)\right)=f(1)$. (D) max (x values of point of discontinuity) = f(1)

4. Let $f(x)=\begin{cases}\tan^{-1}x, & |x|<\frac{\pi}{4}\\ \frac{\pi}{2}-|x|, & |x|\ge\frac{\pi}{4}\end{cases}$. Which of the following is NOT correct?

(A) Range of $f(x)$ is $\left(-\infty,\tan^{-1}\frac{\pi}{4}\right)$ (B) f(x) is a many – one function

(C Number of solutions of the equation f(x) = $\frac{\pi}{4}$ are 2 (D) f(x) is an odd function

5. $f:R\to[-1,\infty)$ and $f(x)=\ln([|\sin 2x|+|\cos 2x|])$ (where [.] is the greatest integer function.) Then,

(A) f(x) has range Z (B) f(x) is periodic with fundamental period $\pi/4$

(C) f(x) is invertible in $\left[0,\frac{\pi}{4}\right]$ (D) f(x) is into function

6. If $f(x)=\left(\frac{|x|}{|x|+2}\right)^{-x}$, then

(A) $\lim\limits_{x\to-\infty} f(x)=0$ (B) $\lim\limits_{x\to 0} f(x)=1$

(C) $\lim\limits_{x\to\infty} f(x)=e^2$ (D) $\lim\limits_{x\to-\infty} f(x)=e^{-2}$

7. If $f(x)=\begin{cases}x^2\,\text{sgn}[x]+\{x\}, & 0<x<2\\ \sin x+|x-3|, & 2\le x<4\end{cases}$, where [x] and {x} are greater integer function & fractional function respectively, then

(A) f(x) is continuous at x = 1 but discontinuous at x = 2

(B) f(x) is continuous at x = 2 & x = 3

(C) f(x) is continuous at x = 1 & x = 3
(D) f(x) is continuous at x = 2 but discontinuous at x = 3

Single Correct Answer Type

This section contains **7 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE is correct.**

8. If g (x) = $x^2 + x - 2$ and $\frac{1}{2}$ gof (x) = $2x^2 - 5x + 2$, then f (x) may be

(A) $2x - 3$ (B) $2x + 3$
(C) $2x^2 + 3x + 1$ (D) $2x^2 - 3x - 1$

9. Let f : R $\to$ R be a differential function and f (5) = 2, then $\lim\limits_{x\to 5} \int\limits_{2}^{f(x)} \frac{t^2 - 2t}{2x - 10} dt$ is equal to

(A) 8f′ (5) (B) $\frac{1}{2} f'(5)$
(C) $\frac{1}{4} f'(5)$ (D) 0

10. f (x) is a polynomial of degree four having relative maximum/minimum at x = 0, x = $\pm$ 1, f (0) = 3 and $\int\limits_{-2}^{2} f(x)dx = \frac{212}{15}$. The function f (x) is

(A) $x^4 - 2x^2 + 3$ (B) $\frac{1}{6}\left(x^4 - 2x^2 + 18\right)$
(C) $\frac{x^5}{10} - \frac{x^3}{3} + 3$ (D) $\frac{1}{4}\left(x^4 - 2x^2 + 12\right)$

11. Polynomial function f (x) satisfying the condition $f(x)f\left(\frac{1}{x}\right) = f(x) + f\left(\frac{1}{x}\right)$. If f (10) = 1001, then f (20) is
(A) 7001 (B) 8001
(C) 8000 (D) none of these

12. If $I_p = \int\limits_{1}^{e} (\ln x)^p dx$, then $I_p + pI_{p-1}$ is less than
(A) 1 (B) 2
(C) 3 (D) none of these

13. If $\int \frac{\left(x^2 - 1\right)}{\left(x^4 + 3x^2 + 1\right)\tan^{-1}\left(\frac{x^2+1}{x}\right)} dx = \frac{k}{5}\log\left|\tan^{-1}\frac{x^2+1}{x}\right| + c$, then k is equal to
(A) 1 (B) 2
(C) 3 (D) 5

14. The points of contact of tangents drawn from the origin to the curve $y = \sin x$ will lie on the curve
(A) $x^2 - y^2 = xy$ (B) $x^2 + y^2 = xy$
(C) $x^2 - y^2 = x^2y^2$ (D) $x^2 + y^2 = x^2y^2$

PART – A

Paragraph Type

This section contains **2 paragraph**s. Based upon each paragraph, there are **2 questions**. Each question has 4 choices (A), (B) , (C) and (D), out of which **ONLY ONE** is correct.

Paragraph for Question Nos. 15 to 16

Given an even function f defined and integrable every where and periodic with period 4.

Let $g(x)=\int_0^x f(t)dt$ and g(2) = A.

Given data

f(–x) = f(x) ($\because$ f is even)

f(x + 4) = f(x) ($\because$ f period 4)

g(x) = $\int_0^x f(t)dt$ and g(2) = A.

15. Which of the following is true?
(A) g is even function
(B) g is odd function
(C) g is periodic if $A \neq 0$
(D) none of these

16. For what value of A the function g is periodic with period 4
(A) 1
(B) 2
(C) zero
(D) 3

Paragraph for Question Nos. 17 to 18

If $y=f(x)$ satisfies the relation $\int_2^x f(t)dt=\frac{x^2}{2}+\int_x^2 t^2 f(t)dt-2,\ \forall\ x\in R,$ then answer the following questions.

17. The range of y = f(x) is
(A) $[0,\ \infty)$
(B) R
(C) $(-\infty,\ 0]$
(D) $\left[-\frac{1}{2},\ \frac{1}{2}\right]$

18. The set of values of x for which f(x) is increasing will be
(A) $(-\infty,\ 1]$
(B) $[-1,\ \infty)$
(C) $(-1, 1)$
(D) None of these

space for rough work

FIITJEE COMMON TEST

BATCHES: CPA [A LOT]
PHASE TEST – 1 (PAPER – 2)
ANSWER KEY
SET - A
PHYSICS

1	ACD	2	ABCD	3	AD	4	ABC	5	BD	6	AC
7	BD	8	B	9	C	10	B	11	A	12	C
13	C	14	B	15	B	16	A	17	C	18	A

CHEMISTRY

1.	AB	2.	AC	3.	D	4.	ABCD	5.	ABC	6.	AB
7.	ACD	8.	C	9.	B	10.	D	11.	A	12.	A
13.	B	14.	B	15.	C	16.	B	17.	B	18.	C

MATHS

1.	BC	2.	AC	3.	ABD	4.	AD	5.	D	6.	BCD
7.	AC	8.	A	9.	D	10.	A	11.	B	12.	C
13.	D	14.	C	15.	B	16.	C	17.	D	18.	C

SOLUTIONS
PHYSICS
SECTION – A

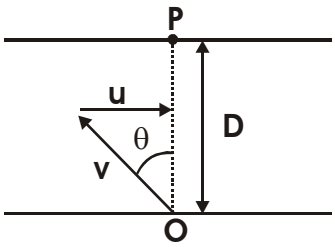
Sol.1. (A, C, D)

$$t = \frac{d}{v\cos\theta}$$

$$t_{min} = \frac{d}{v}$$

Time to reach the point $P = \frac{d}{\sqrt{v^2 - u^2}}$

If v > u than only the person will reach point P.



Sol.2. (A, B, C, D)

If v < u time is not define.

$$\frac{u}{v} = \tan\theta = a \qquad \ldots\ldots (1)$$

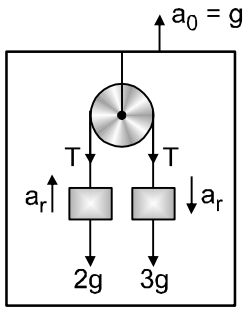
$$\frac{1}{2}\frac{g}{v^2} = b$$

$$v = a\sqrt{\frac{g}{2b}}$$

$$v = \sqrt{\frac{g}{2b}}$$

$$\theta = \tan^{-1}$$

Sol.3. (A & D)



$$\left(\frac{4g-2g}{3}\right)=a_r$$

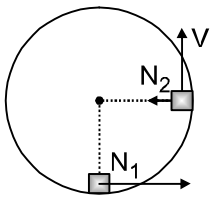
$$a_r=\frac{2g}{3}$$

Acceleration of 1 kg block w.r.t to ground $=a_0+a_r$

$$=\frac{2g}{3}+g=\frac{5g}{3}$$

$$T=2g+1\times\frac{2g}{3}=\frac{8g}{3}$$

Sol.4. (A, B, C) $\sqrt{5g}=u \quad V=\sqrt{u^2-2g}=\sqrt{5g-2g}=\sqrt{3g}$



$$a_r=\frac{v^2}{R}=3g \;;\; N_2=m.3g=3mg$$

$$a_t=g$$

$$\therefore\ a=\sqrt{a_r^2+a_t^2}=g\sqrt{10}$$

Sol.5. (B,D)

$$a_B + 4a_A = 2a_C + 3a_D$$

$$\Rightarrow \qquad a_D = \frac{7}{3}m/s^2$$

$$2T - 10 = 1 \ \Rightarrow\ T = 11/2\ N$$

Sol.6. (A, C)

$$20\times10\times\frac{3}{5}=(x+20)\times10\times\frac{4}{5}\times0.5$$

7. B, D

$$F_T = \square Av^2 \text{ and } \frac{dK}{dt}=\frac{1}{2}\rho Av^3$$

So, if $v \to 2v$, $F_T \to 4F_T$ and $\frac{dK}{dt}\to 8\frac{dK}{dt}$.

Sol. 8. (B)

Friction between block A and block B & between block B and surface will oppose the P

$$\therefore\ P=F_{AB}+F_{BS}=\mu_{AB}m_Ag+\mu_{BS}(m_A+m_B)g$$

$$=0.25\times100\times10+\frac{1}{3}(100+200)\times10=1250\ N$$

Sol. 9. (C)

$\because$ Length of string must be constant

Hence $x_A = 3x_B \Rightarrow v_A = 3v_B$

Sol.10. (B)

$$\frac{a}{10}+\frac{t}{11}=1$$

$$\Rightarrow \qquad a=\frac{10}{11}(11-t)$$

$$\Rightarrow \qquad a=\frac{10}{11}(11-t)=0\Rightarrow t=11\ sec$$

$$\frac{dv}{dt}=\frac{10}{11}(11-t)\Rightarrow v=55m/sec$$

Sol.11.(A)

$mgx = \frac{1}{2}Kx^2$ ..... (1)

$Kx = Mg$ ..... (2)

$m = \frac{M}{2}$

Sol.12.(C)

$x + u_2 \cos\theta_2 t = u_1 \cos\theta_1 t$

$\therefore$ $t = \frac{x}{u_1\cos\theta_1 - u_2\cos\theta_2}$ ....(i)

Also $u_1 \sin\theta_1 = u_2 \sin\theta_2$ ....(ii)

After solving above equations, we get

$t = \frac{x\sin\theta_2}{u_1\sin(\theta_2 - \theta_1)}$

Sol.13.(C)

If t is the time of flight, then

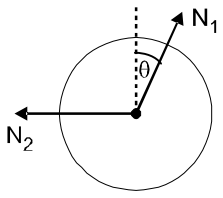
$0 = vt - \frac{1}{2}(g\cos\theta)t^2$

$\therefore$ $t = \frac{2v}{g}g\cos\theta$

Range, $R = 0 + \frac{1}{2}(g\sin\theta)t^2 = \frac{1}{2}g\sin\theta\left(\frac{2v}{g\cos\theta}\right)^2$

$= \frac{2v^2}{g}\tan\theta\sec\theta$

Sol.14.(B)



$\sin\theta = \frac{1}{2}$

Thus, $N_1 \sin\theta$

$\therefore$ $\frac{N_1}{N_2} = \frac{1}{\sin\theta} = 2$

15. B
Time will remain same for both.

16. A
Use momentum conservation and relation of 'e'.

$v_2 = \frac{\sqrt{20}}{3}$ $\frac{1}{2}m\left(\frac{\sqrt{20}}{3}\right)^2 = mgh$ [m = 2kg]

$h = \frac{1}{9}$

17. C

For B, a = –3 m/s^2 so it will stop after 2 sec and cover 6m.
For A, a = –2 m/s^2 so it will stop after 4 sec and cover 16m.
So, collision will occur when A covers 15m i.e., at t = 3 sec.

18. A

Just before collision $u_B = 0$ and $u_A = 2$ m/s, v_{CM} doesn't change during collision.

So, $v_{CM} = \frac{2\times 2+0}{3} = \frac{4}{3}$m / s

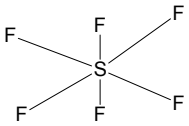
CHEMISTRY

1. A, B

K_i (water) (298 K) = 1.8×10^{-16}
K_w (298 K) = 10^{-14}

2. A, C

SF_6 is octahedral shaped with sp^3d^2 hybridisation.
Oxidation state of sulphur is +6.



3. D

The wavelengths are in the following order
$4 \rightarrow 1 > 3 \rightarrow 1 > 2 \rightarrow 1 > 3 \rightarrow 2$
Violet end red end
So the second line from the red end will be corresponding to transition $2 \rightarrow 1$.

4. A, B, C, D

For $3P_y$ orbital
Total nodes = n – 1 = 2
= number of maxima in curve $4\pi r^2R^2(r)$ vs r

5. **A, B, C**

The correct bond angle order is
$NH_2^- < NH_3 < NH_4^+$

6. **A, B**

7. **A, C, D**

. Equal volumes $\Rightarrow$ Final volumes would be double
$\Rightarrow$ Final concentration would be half of original

(A) Ionic product (Q)

$= \left[Ca^{2+}\right]\left[F^-\right]^2 \quad \left(CaF_2(s) \rightleftharpoons Ca^{2+}(aq) + 2F^-(aq)\right)$

$= \left(\frac{10^{-4}}{2}\right)\left(\frac{10^{-4}}{2}\right)^2 = \frac{1}{8}\times 10^{-12}$

(B) Ionic product (Q)

$= \left(\frac{10^{-2}}{2}\right)\left(\frac{10^{-3}}{2}\right)^2 = \frac{1}{8}\times 10^{-8}$

(C) $Q = \left(\frac{10^{-5}}{2}\right)\left(\frac{10^{-3}}{2}\right)^2 = \frac{1}{8}\times 10^{-11}$

(D) $Q = \left(\frac{10^{-3}}{2}\right)\left(\frac{10^{-5}}{2}\right)^2 = \frac{1}{8}\times 10^{-13}$

$K_{sp} < Q$ only in (B)

$\Rightarrow$ Precipitation in A, C, D

8. C

Overall rate constant

$K = K_1 + K_2 + K_3 = 6.93 \times 10^{-3}$ sec^{-1}

$t_{1/2} = \frac{0.693}{6.93\times 10^{-3}} = 100$ sec.

After half life, $P_B + P_C + P_D = 4$ atm

or, $\frac{P_B}{P_B + P_C + P_D} = \frac{K_1}{K_1 + K_2 + K_3} = \frac{200}{693}$

$\therefore P_B = 4 \times \frac{200}{693}$ = 1.154 atm

9. B

10. **D**

$[Al^{+3}] [OH^-]^3 = 1 \times 10^{-18}$

$10^{-6} [OH^-]^3 = 1 \times 10^{-18}$

$[OH^-] = 10^{-4}$

pOH = 4

pH = 10

11. **A**

$\mu = q \times d$

$q = \frac{\mu}{d} = \frac{1.2\text{ D}}{1.0\times 10^{-8}\text{ cm}} = \frac{1.2\times 10^{-18}\text{ esu cm}}{1.0\times 10^{-8}\text{ cm}} = 1.2\times 10^{-10}\text{ esu}$

The fraction of an electronic charge is

$\frac{1.2\times 10^{-10}\text{ esu}}{4.8\times 10^{-10}\text{ esu / e}} = 0.25\ e^- = 25\%\text{ of } e^-$

12. **A**

$K_1 = \frac{0.693}{30} = 2.31\times 10^{-2}$ minute^{-1} at 27°C

$K_2 = \frac{0.693}{10} = 6.93\times 10^{-2}$ minute^{-1} at 47°C

$2.303 \log_{10}\frac{K_2}{K_1} = \frac{E_a}{R}\left(\frac{T_2 - T_1}{T_1T_2}\right)$

$2.303\log_{10} = \frac{6.93\times 10^{-2}}{2.31\times 10^{-2}} = \frac{E_a}{8.314}\times\frac{(320-300)}{320-300}$

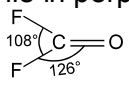
$E_a = 43840$ J mol^{-1}

$E_a = 43.84$ kJ mol^{-1}

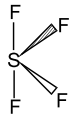
13. **B**

14. (B)

Generally lone pair causes more distortion than a double bond so equatorial $\angle FSF$ in SOF_4 > equatorial $\angle FSF$ in SF_4 in CH_2SF_4 two axial fluorine atoms SC & two hydrogen will be lying in one plane. The π-bond and two equatorial fluorine along with C & S will lie in perpendicular plane.

OCF_2 : 

due to low bond pair bond pair repulsion because of fluorine & large repulsion due to double bond.

SF_4  axial FSF < 180° due to lone pair.

15. C

16. B

Degree of hydrolysis of a salt of weak acid and weak base does not depend upon concentration.

17. **B**
(i) 4p; (ii) 4s; (iii) 3d; (iv) 3p

18. **C**

MATHS

1. (BC)

$$\lim_{x\to 1^+} g(f(x)) = \lim_{x\to 1^+} g(-x+2-x) = \lim_{x\to 1^+} g(2-2x)$$

$$= \lim_{x\to 1^+} g(0^-) \text{ (which is not defined)}$$

$$\lim_{x\to \pi/2^-} g(f(g(x))) = \lim_{x\to \pi/2^-} g(f(\sin x-1))$$

$$= \lim_{x\to \pi/2^-} g(f(0^-)) = \lim_{x\to \pi/2^-} g(2^-)$$

$$= 1 - \cos 0 = 0$$

$$\lim_{x\to 2^+} \frac{f(g(x))}{f(x)-2} = \lim_{x\to 2^+} \frac{f(2-\cos(x-2)}{(x-2)-x-2} = \frac{1}{2}$$

2. (AC)

$\phi(x) = f(x) + f(2a-x)$

$\phi'(x) = f'(x) - f'(2a-x)$

since, $f''(x) > 0 \Rightarrow$ f'(x) is an increasing function

Hence, f'(x) > f'(2a–x)

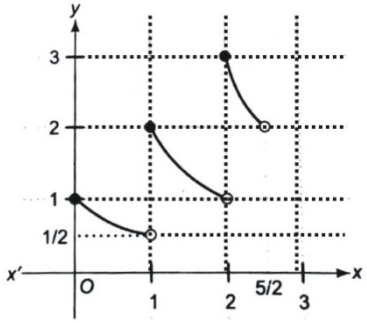
$\Rightarrow$ x > 2a – x

$\Rightarrow$ x > a

$\therefore$ f(x) is $\uparrow$ in (a, 2a) and $\downarrow$ in (0, a)

3. ABD

$$f(x) = \begin{cases} \frac{1}{x+1}, & 0 \le x < 1 \\ \frac{2}{x}, & 1 \le x < 2 \\ \frac{3}{x-1}, & 2 \le x < 5/2 \end{cases}$$



Clearly, f(x) is discontinuous and bijective function

$$\lim_{x\to 1^-} f(x) = \frac{1}{2}; \quad \lim_{x\to 1^+} f(x) = 2$$