# SAMPLE PAPER FOR JEE ADVANCED 2018 (PAPER-I)

**Duration: 3 Hours.** **Maximum Marks: 264**

**[Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.]**

## INSTRUCTIONS FOR JEE ADV. (P-I)

**QUESTION PAPER FORMAT AND MARKING SCHEME :**

1. The question paper has three parts A to C (Physics, Chemistry and Mathematics). Each part consists of three sections.
2. Carefully read the instructures given at the beginning of each section.
3. **Section-1** contains **8 questions. The answer to each question is a single digit integer ranging from 0 to 9 (both inclusive)**.

   **Marking scheme :** +4 for correct answer and 0 in all other cases.
4. **Section-2** contains **10 multiple choice questions with one or more thane one correct option.**

   **Marking scheme :** +4 for correct answer, 0 if not attempted and –2 in all other cases.
5. **Section-3** contains **2 "match the following" type questions and you will have to match entires in column I with the entires in Column II**.

   **Marking scheme :** for each entry in column I, +2 for correct answer, 0 if not attempted and –1 in all other cases.

## PART-A : PHYSICS

### SECTION 1 (Maximum Marks : 32)

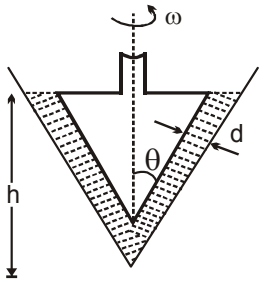
- This section contains **EIGHT** questions
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS
- Marking scheme :

  +4 If the bubble corresponding to the answer is darkened

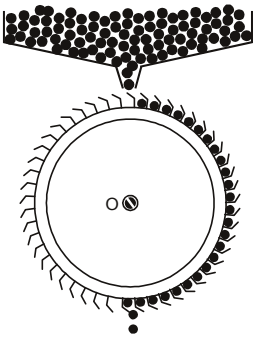
  0 If none of the bubbles is darkened

**1.** The given figure shows a conical shaft rotating on a bearing of very small clearance d. If the space between the shaft and bearing is filled with an oil of co-efficient of viscosity $\eta$ to height h, then the torque required to rotate the shaft with constant angular speed $\omega$ is $\frac{\pi\omega\eta h^4}{\sqrt{N}d}$.

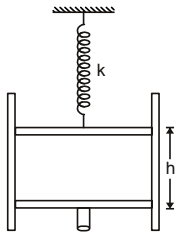
If $\theta = 45°$, then find the value of N.




**2.** A large wheel of radius R = 1.25 m can rotate about its fixed horizontal axle. There is a large number of special traps on its periphery. Small identical balls fall into a trap at the top with negligible velocity and leave the trap at the bottom. Collisions of balls at the top are perfectly inelastic. After some time, the balls start falling into the traps, the wheel acquires a steady angular velocity. Find suitable approximate value of this steady angular velocity $\omega$ (in rad/s). Acceleration due to gravity is g = 10 m/s$^2$.

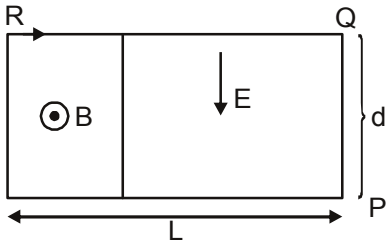


**3.** An ideal gas at NTP is enclosed in an adiabatic vertical cylinder having area of cross section A = 27 cm$^2$, between two light movable pistons as shown in the figure. Spring with force constant k = 3700 N/m is in a relaxed state initially. Now the lower piston is moved upwards a height h/2, h being the initial length of gas column. It is observed that the upper piston moves up by a distance h/16. Taking $\gamma$ for the gas to be 1.5, find $\frac{h}{0.81}$.

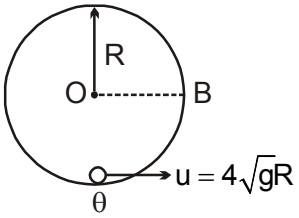


**4.** A particle of mass m and charge q enters with velocity $v_0$ perpendicular to a magnetic field B as shown in the figure. It moves in the magnetic field for time $t = \frac{\pi m}{4qB}$ and then enters into a constant electric field region. The electric and magnetic field are present only in a rectangular region of thickness d. The length of the rectangular region is L. The particle enters parallel and grazing to side RQ. The particle leaves the region at P. The value of (d – L) is given as $\frac{4n}{5}$. Find n.

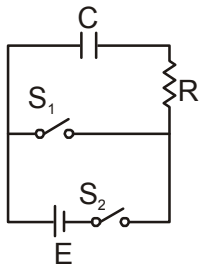
$\left(\text{Take } v_0 = \left(\sqrt{2}+1\right) \text{ m/s, } \frac{E}{B} = 8\text{m/s, } L = \frac{4\sqrt{2}v_0}{5}, \frac{m}{qB} = \frac{4}{5}\right)$




**5.** A small spherical ball of mass m is kept at the lowest point inside the sphere of radius R. The ball is projected horizontally with speed $u = \sqrt{4gR}$ at the lowest position. Time taken by ball in motion from A to B is $\sqrt{\frac{R}{g}}\log_e(\sqrt{n}+1)$, then the value of n is (surface of sphere is smooth)




**6.** The given R-C circuit has two switches $S_1$ and $S_2$. Switch $S_2$ is closed and $S_1$ is opened till capacitor is fully charged to $q_0$. Then $S_2$ is opened and $S_1$ is closed simultaneously till charge on capacitor remains $q_0/2$. It takes time $t_1$. Now $S_1$ is again opened and $S_2$ is closed till charge on capacitor becomes $3q_0/4$. It takes time $t_2$. Then the ratio $t_2/t_1$ is




**7.** The average power transmitted across a cross-section by two sound waves moving in the same direction are equal. The wave lengths of two sound waves are in the ratio 1 : 5, the find the ratio of their pressure amplitude.

**8.** $_{92}U^{238}$ changes to $_{85}At^{210}$ by a series of $\alpha$ and $\beta$ particles decays. Find the number of $\beta$-decay for a particle during disintegration.

**SECTION 2 (Maximum Marks : 40)**

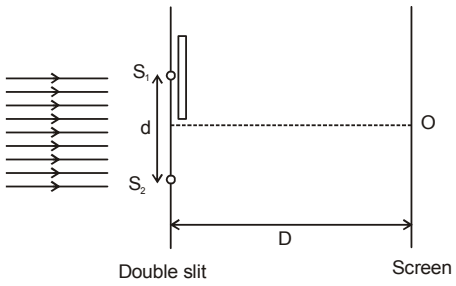
- This section contains **TEN** questions
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
- Marking scheme :

  +4 If only the bubble(s) corresponding to all the correct option(s) is (are) darkened

  0 If none of the bubbles is darkened

  –2 In all other cases

**9.** A double slit with slit width 'd' is kept parallel to a large screen. Screen lies at a distance D from the double slit. One of the slits is covered with a transparent and very thin slab as shown in figure. Refractive index of slab varies with time according to relation $\mu = \frac{3}{2}(1+\cos^2 2\pi t)$. The complete set up is situated in air $(\mu_{air} \approx 1)$. At t = 0 the double slit is illuminated with a parallel beam of monochromatic light of wavelength $\lambda$ as shown below and continues to fall for a very long time. Thickness of slab is equal to wavelength of light incident on the slits. Intensity of falling beam is $I_0$. Assume that d << D.



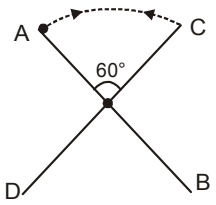

(A) Maximum distance of central maxima from O is $\frac{\lambda D}{d}$

(B) Maximum distance of central maxima from O is $\frac{2\lambda D}{d}$

(C) Maximum speed of central maxima along the screen is $\frac{3\pi\lambda D}{d}$

(D) Maximum speed of central maxima along the screen is $\frac{\pi\lambda D}{d}$

**10.** A uniform rod having length $10\sqrt{3}$ m is oscillating between positions AB and CD with constant angular speed about an horizontal axis passing through the centre of mass as shown in figure. Due to collision with a ball the ball bounces back between A and C again and again. The ball hits the rod always normally. Assume that all collisions are perfectly elastic.




(A) Angular speed of rod in radian per second is $\frac{\pi}{3}$

(B) Maximum speed of ball is 10 m/s

(C) The time interval between two successive collisions of ball at A is 2s

(D) The time interval between two successive collisions of ball at A is 1s

**11.** A standard cell of emf $E_0$ = 1.11 V is balanced against 72 cm length of a potentiometer. The same potentiometer is used to measure the potential difference across the standard resistance $R = 120\,\Omega$. When the ammeter (Measure current in standard resistance) shows a current of 7.8 mA, a balanced length of 60 cm is obtained on the potentiometer. Then,

(A) The current flowing through the resistor is 7.7 mA

(B) The current flowing through the resistor is 7.2 mA

(C) The error in measurement of the ammeter is 1.3 %.

(D) The error in measurement of the ammeter is 1.2 %

**12.** An electron of a stationary hydrogen atom de-excites from the fifth energy level to the fundamental state. (Express you answer in terms of Rydberg constant *R*, mass of hydrogen atom *M* and universal constants.). Then,

(A) the recoil energy of the atom is nearly $\frac{h^2R^2}{2M}$

(B) the recoil energy of the atom is nearly $\frac{2h^2R^2}{M}$

(C) the recoil speed of the atom is $\frac{24hR}{25M}$

(D) the recoil speed of the atom is $\frac{25hR}{24M}$

**13.** A time varying voltage $V = 10 - 2i$ (volt) is applied across an inductor of inductance $L = 2H$ where *i* is current at any time *t* with $i = 0$ at $t = 0$. Then

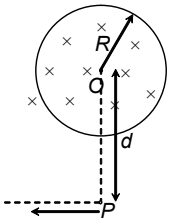
(A) current increases with time

(B) energy stored in magnetic field at $t = \ln 2$ sec is 6.25 J

(C) potential energy at time $t = \ln 2$ in magnetic field is increasing at a rate of 12.5 J/sec

(D) energy stored in magnetic field is zero all the time

**14.** In a cylindrical region of radius *R*, there exists a time varying magnetic field *B* such that $\frac{dB}{dt} = k(>0)$. A charged particle having charge *q* is placed at the point *P* at a distance *d* (> *R*) from its centre *O*. Now, the particle is moved in the direction perpendicular to *OP* (see figure) by an external agent upto infinity so that there is no gain in kinetic energy of the charged particle. Choose the correct statement/s.




(A) Work done by external agent is $\frac{q\pi R^2}{4}k$ if $d = 2R$

(B) Work done by external agent is $\frac{q\pi R^2}{8}k$ if $d = 4R$

(C) Work done by external agent is $\frac{q\pi R^2}{4}k$ if $d = 4R$

(D) Work done by external agent is $\frac{q\pi R^2}{4}k$ if $d = 6R$

**15.** A proton of mass *m* and charge *q* is released from origin in a region, where a uniform electric field $E\hat{j}$ and a uniform magnetic field $B\hat{k}$ exists. This particle makes a perfectly inelastic collision with a neutral particle of same mass at $\left(\frac{\pi Em}{qB^2}, \frac{2Em}{qB^2}, 0\right)$

(A) time after which collision occurs $\frac{\pi m}{qB}$

(B) velocity of the proton just before collision is $\frac{2E}{B}$

(C) velocity after collision is $\frac{E}{B}$

(D) after collision both particles move in a straight line

**16.** There are two concentric metallic spherical shells of radii *a* and *b* such that $a < b$. An ideal cell of emf $\in$ is connected across the two shells. The medium between the shells is

filled with a dielectric of dielectric constant $K$ and resistivity $\rho$. For a point $P$ at a distance $r$ from the common centre $C$ (where $a < r < b$)

(A) rate of fall of potential is $\frac{\in}{b-a}$

(B) electric field is $\frac{\in ab}{r^2(b-a)}$

(C) current density is $\frac{\in ab}{\rho r^2(b-a)}$

(D) net current supplied by the cell is $\frac{4\pi ab \in}{\rho(b-a)}$

**17.** Electric field intensity at a point $(x, y)$ is given by $\vec{I} = (12xy^3 - 4x)\hat{i} + 18x^2y^2\hat{j}$ where all parameters are in S.I. units. Then choose the correct statement(s) out of the following

(A) it represents a conservative electric field
(B) it represents a non-conservative electric field
(C) electric potential at point (1m, 1m) is –4$V$ if electric potential at origin is zero
(D) electric potential at point (1m, 1m) cannot be defined

**18.** A fish is rising up vertically inside a pond with velocity 4 cm/s, and notices a bird, which is diving vertically downward and its velocity appears to be 16 cm/s (to the fish). If refractive index of water is 4/3, then

(A) velocity of bird with respect to ground is 9 cm/s
(B) velocity of fish with respect to bird is 15 cm/s
(C) velocity of bird with respect to ground is 12 cm/s
(D) velocity of fish with respect to bird is 12 cm/s

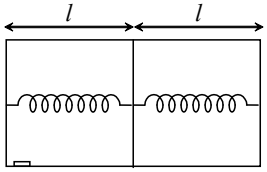
**SECTION – 3 (Maximum Marks : 16)**

- This section contains **TWO** questions
- Each question contains two columns, **Column I** and **Column II**
- **Column I** has **four** entires (A), (B), (C) and (D)
- **Column II** has **five** entires (P), (Q), (R), (S) and(T)
- Match the entires in **Column I** with the entires in **Column II**
- One or more entires in **Column I** may match with one or more entires in **Column II**
- The ORS contains a 4 × 5 matrix whose layout will be similar to the one shown below:

(A) (P) (Q) (R) (S) (T)
(B) (P) (Q) (R) (S) (T)
(C) (P) (Q) (R) (S) (T)
(D) (P) (Q) (R) (S) (T)

- For each entry in **Column I**, darken the bubbles of all the matching entires. For example, if entry (A) in **Column I** matches with entires (Q), (R), and (T), then darken these three bubbles in the ORS. Similarly, for entires (B), (C) and (D)
- Marking scheme :
  For each entry in **Column I**.
  +2 If only the bubble(s) corresponding to all the correct match(es) is(are) darkened
  0 If none of the bubbles is darkened
  –1 In all other cases

**19.** A horizontal thermally insulated cylinder of length 2$l$ is separated by a thin insulating piston dividing the cylinder in two equal parts. The piston is connected by ideal springs and initially springs are non-deformed. Left part contains 2 moles of $H_2$ and right part contains 2 moles of $O_2$ at same initial temperature. The left part of the cylinder is fitted with a thermostat which maintains the constant temperature of the gas and through which only heat transfer can take place. The following two processes are performed on the given system. After process I, the system is brought back to its initial state.




**Process I:** Heat $Q$ is supplied to the right part and piston is displaced to the left by a distance $l$/2.

**Process II:** Heat $Q$ is given to the right part and as a result piston displaces to the left by a distance $l$/2. The gas on the left dissociates into its atoms.

**Column – I**

**(A)** In process I

**(B)** In process I, if piston displaces to the right by same amount.

**(C)** In process II

**(D)** In process II if partial dissociation has taken place

**Column – II**

**(P)** Temperature of the gas on left remains constant.

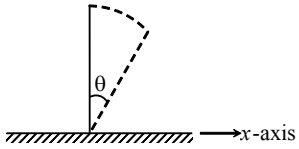
**(Q)** Heat is rejected by the gas on the left.

**(R)** Total work done by both the gases is positive.

**(S)** Heat is absorbed by the gas on the left.

**(T)** Internal energy of the gas on the left changes

**20.** One end of rod of mass $m$ and length 1 m is kept on a rough surface in a vertical plane as shown. It is slightly displaced. Friction is enough to prevent any slipping of the other end. Match the following




| Column – I | Column – II |
|---|---|
| **(A)** Friction is along +ve $x$-axis | **(P)** $\theta$ = 30° |
| **(B)** Friction is along –ve $x$-axis | **(Q)** $\theta$ = 37° |
| **(C)** Angular acceleration of rod is 9 rad /s$^2$ | **(R)** $\theta$ = 53° |
| **(D)** Centripetal acceleration of $CM$ is 6 m/s$^2$ | **(S)** $\theta$ = 60° |
| | **(T)** $\theta$ = 90° |

## PART-B : CHEMISTRY

### SECTION 1 (Maximum Marks : 32)

- This section contains **EIGHT** questions
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS
- Marking scheme :

  +4 If the bubble corresponding to the answer is darkened

  0 If none of the bubbles is darkened

**21.** $A \longrightarrow 2B + 3C$ is a first order reaction. Initial concentration of A was $C_0$. After n half lives sum of concentration of B and C becomes $\frac{75}{16}C_0$. Find the value of n.

**22.** A Daniel cell was constructed as follows Zn(s) | $Zn^{2+}$ (aq.), 1 M || $Cu^{2+}$ (aq.), 1 M | Cu(s) during the working of cell the emf of cell reduced to $\frac{19}{22}$th times of its initial value. Then ratio of concentration of zinc ion to copper ion $\frac{[Zn^{2+}]}{[Cu^{+2}]}$ at this instant of time is $10^x$. Find value of x. Given $E^0_{Zn^{+2}/Zn} = -0.76\,V$, $E^0_{Cu^{+2}/Cu} = 0.34\,V$, $2.303\frac{RT}{F} = 0.06$.

**23.** Find out total number of non-metal from the following which react with water :

$Cl_2$, $Br_2$, $I_2$, $F_2$, $P_4$, $N_2$, $S_8$, B, and Si

**24.** $(NH_4)_2Cr_2O_7$, $NH_4NO_2$, $NH_4NO_3$, $NH_4Cl$, $CH_3COONH_4$, $NH_4ClO_4$, $(NH_4)_2S$, $(NH_4)_2CO_3$

and $(NH_4)_2C_2O_4$. Number of molecules which on decomposition gives $NH_3$ is x and number of moleucles which on decomposition give $N_2$ is y. Report the value of (x + y).

**25.** Calculate total number of $H_2O$ molecule required (in moles) for complete hydrolyse of 1 mole of Marshall's acid and 1 mole $XeOF_4$ seprately.

**26.** For $P_4O_{10}$ molecule 'a' is number of POP bonds, b is number of $\pi$-bonds (back bonding) Find the the value of (a – b).

**27.** How many of the following are addition homopolymer?

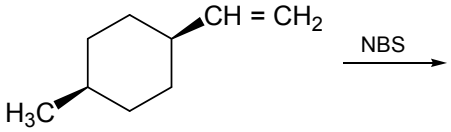
(a) Natural Rubber (b) Gutta Percha

(c) Bakelite (d) Glyptal

(e) Novalac (f) Neoprene (g) Buna-S (h) Teflon

(i) Nylon-6 (j) PAN (k) PMMA

**28.** Find the total number of possible monotrominated products obttained in the following reaction:




### SECTION 2 (Maximum Marks : 40)

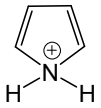
- This section contains **TEN** questions
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
- Marking scheme :

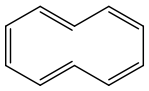
  +4 If only the bubble(s) corresponding to all the correct option(s) is (are) darkened

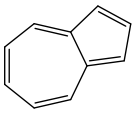
  0 If none of the bubbles is darkened

  –2 In all other cases

**29.** Which compound is neither aromatic nor anti aromatic?

(A) 

(B) 

(C) 

(D) 

**30.** Which of the following statements is/are not correct about corrosive sublimate

(A) Its aquesous solution gives red precipitate with KI (not in excess)

(B) It aqueous solution gives white precipitate with excess of $SnCl_4$.

(C) It forms grey precipitate with excess of $SnCl_2$ solution

(D) It decpmpose on heating to give $Hg_2Cl_2$ and $Cl_2$

**31.** On being heated with conc. $HNO_3$ and ammonium molybdate solution a salt solution gives a yellow ppts. The salt may be

(A) $Na_2HPO_4$ (B) $As_2O_3$ (C) $FeSO_4$ (D) $BaCl_2$

**32.** Which of the following are $sp^3$ hybridization in solid state?

(A) $AlCl_3$ (B) $SO_3$ (C) $BeCl_2$ (D) $XeO_3$

**33.** For a 0.1 M solution of weak base, the degree of ionisation is 0.01 at 300 K. If molal depression constant of water is 0.5 K-kgmol$^{-1}$. Which of the following is correct for the given solution? (Assume molarity = molality, $R = 0.08\frac{atm\text{-}L}{mol\text{-}K}$ and $k_w = 10^{-14}$)

(A) pH of solution is equal to 3.

(B) Dissocation constant of base is $10^{-5}$.

(C) Osmotic pressure of solution is 2.424 atm.

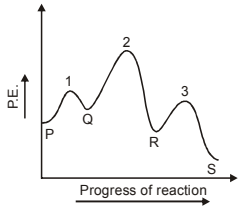
(D) Depression in freezing point of solution is 0.0505 K.

**34.** Energy profile diagram for an exothermic relation $P \longrightarrow S$ is shown below. The mechanism of reaction is

I $P \xrightarrow{1} Q$

II $Q \xrightarrow{2} R$

III $R \xrightarrow{3} S$

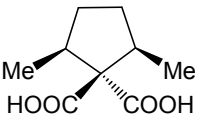


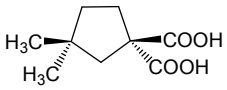

The steps which is/are not rate determining for forward reaction

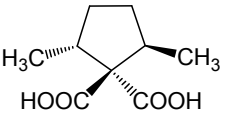
(A) $P \to Q$ (B) $Q \to R$

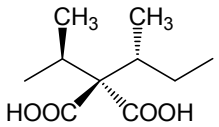
(C) $R \to S$ (D) Can't be predicted.

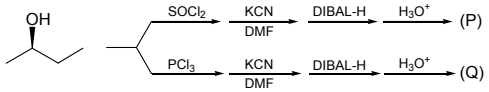
**35.** Which of the following dicarboxylic acids will give only one organic product on heating?

(A) 

(B) 

(C) 

(D) 

**36.** 

Choose the correct option(s)

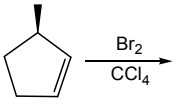
(A) Both (P) and (Q) will give ppt. with 2,4-DNP

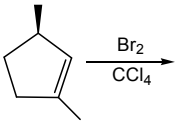
(B) Both (P) and (Q) will give crystalline solid with $NaHSO_3$.

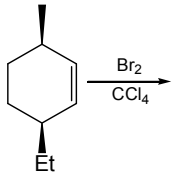
(C) Both (P) and (Q) will reduce Tollen's reagent as well as Fehling's soluion.

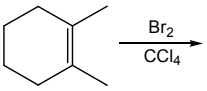
(D) (P) and (Q) are identical.

**37.** The reaction in which diastereomeric product obtained is/ are

(A) 

(B) 

(C) 

(D) 

**38.** $(P) \xrightarrow[(excess)]{R'-I} (Q) \xrightarrow[Ag_2O]{aq.} (R) \xrightarrow{\Delta} T + S$

is T is the simplest alkene & P is $R' - NH_2$ , then choose the correct options :

(A) $(P) \xrightarrow[+HCl]{NaNO_2} (Q) \xrightarrow[Py]{TsCl} (R) \xrightarrow[KOH]{alc.} T$

(B) In the above reaction, $R'$ is methyl group.

(C) P gives base soluble compound with Hinsberg's Reagent.

(D) Increasing order of basic strength in aqueous solution will be $NH_3 < P < S$

**SECTION – 3 (Maximum Marks : 16)**

- This section contains **TWO** questions
- Each question contains two columns, **Column I** and **Column II**
- **Column I** has **four** entires (A), (B), (C) and (D)
- **Column II** has **five** entires (P), (Q), (R), (S) and(T)
- Match the entires in **Column I** with the entires in **Column II**
- One or more entires in **Column I** may match with one or more entires in **Column II**
- The ORS contains a 4 × 5 matrix whose layout will be similar to the one shown below:

  (A) (P) (Q) (R) (S) (T)
  (B) (P) (Q) (R) (S) (T)
  (C) (P) (Q) (R) (S) (T)
  (D) (P) (Q) (R) (S) (T)

- For each entry in **Column I**, darken the bubbles of all the matching entires. For example, if entry (A) in **Column I** matches with entires (Q), (R), and (T), then darken these three bubbles in the ORS. Similarly, for entires (B), (C) and (D)
- Marking scheme :

  For each entry in **Column I**.

  +2 If only the bubble(s) corresponding to all the correct match(es) is(are) darkened

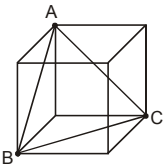
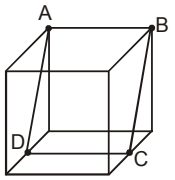
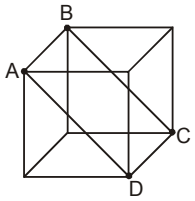
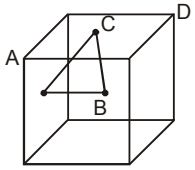
  0 If none of the bubbles is darkened

  –1 In all other cases

**39.**

| Column-I | Column-II |
|---|---|
| (A) Petalite | (p) An ore lithium |
| (B) Beryl | (q) Contains aluminium |
| (C) China clay | (r) Oxide ore |
| (D) Ruby copper | (s) An ore of beryllium |

**40.** a = edge length of cube

| Plane in cube Column-I | Surface area of plane Column-II |
|---|---|
| (A)  A, B and C are at corners. | (p) $\sqrt{2}a^2$ |
| (B)  A, B are at corners and C, D are at edge centres. | (q) $\frac{\sqrt{3}}{2}a^2$ |
| (C)  A, B, C and D are at corners. | (r) $\frac{\sqrt{3}}{8}a^2$ |
| (D)  A, B, C are at face centres. | (s) $\frac{\sqrt{5}}{2}a^2$ |
| | (t) $a^2$ |

## PART-C : MATHEMATICS

### SECTION 1 (Maximum Marks : 32)

- This section contains **EIGHT** questions
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS
- Marking scheme :
  +4 If the bubble corresponding to the answer is darkened
  0 If none of the bubbles is darkened

**41.** A function f is defined by $f(x)=\begin{cases} e^x, & x<1 \\ \log_e x + ax^2 + bx, & x \geq 1 \end{cases}$

and f(x) is differentiable at x = 1, then the value of $|a|$ = ?

**42.** If a, b, c are real numbers greater than 1. The value of

$$\frac{1}{1+\log_{a^2b}\left(\frac{c}{a}\right)}+\frac{1}{1+\log_{b^2c}\left(\frac{a}{b}\right)}+\frac{1}{1+\log_{c^2a}\left(\frac{b}{a}\right)} \text{ is}$$

**43.** Given that $a_1=2, a_2=3, a_n=a_{n-1}+2a_{n-2}$ and value of $a_{100}+a_{99}=k.2^{98}$, then value of k is

**44.** Let a, b, c, d be positive integers and $\log_a b = \frac{3}{2}, \log_c d = \frac{5}{4}$.

If a – c = 9 then the value of $\frac{b-d}{31}$ is equal to

**45.** Let k be a real number such that the inequalty $\sqrt{x-3}+\sqrt{6-x} \geq k$ has a solution .Then maximum value of $k^2$ is

**46.** Let f satisfy $x = f(x)e^{f(x)}$ and $\int_0^e f(x)\,dx = e - n$ ,then value of 'n' is

**47.** Let A and B be two given point, distance 1 apart, a point P on the line AB such that $\frac{1}{1+AP}+\frac{1}{1+BP}$ is maximum .

If $\max\left(\frac{1}{1+AP}+\frac{1}{1+BP}\right) = K$ ,then value of 2K is

**48.** The value of $2\left|\cos\left(\frac{2\pi}{7}\right)+\cos\left(3\cdot\frac{2\pi}{7}\right)+\cos\left(5\cdot\frac{2\pi}{7}\right)\right|$ is

### SECTION 2 (Maximum Marks : 40)

- This section contains **TEN** questions
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
- Marking scheme :
  +4 If only the bubble(s) corresponding to all the correct option(s) is (are) darkened
  0 If none of the bubbles is darkened
  –2 In all other cases

**49.** If $f:R \to R$ and f(x) = a + bx, f(f(f(1))) = 29, f (f(f(0))) = 2, then
(A) a = 2/13 (B) a = 1/13 (C) b = 3 (D) b = 1

**50.** Let $f_0(x) = xe^x$, and for $n \geq 1$. Define $f_n(x)=\int_n^x f_{n-1}(t)\,dt$ ,then
(A) $f_{2017}(2018) = e^{2018}$ (B) $f_{2016}(2016) = e^{2016}$
(C) $f_{2016}(2017) = e^{2017}$ (D) $f_{2016}(2016) = 0$

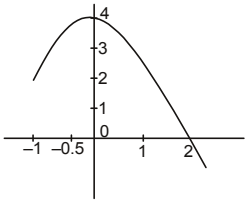
**51.** Suppose f'(x) exists for all x in (a, b) then which of the following is true
(A) f(x) is continuous on (a,b)
(B) f(x) is continuous at x = a
(C) f(x) is defined for all $x \in (a,b)$
(D) f'(x) is defferentiable on (a,b)

**52.** Suppose that there exist nonzero complex numbers a,b,c, and d such that k is a root of both the equations $ax^3 + bx^2 + cx + d = 0$ and $bx^3 + cx^2 + dx + a = 0$. Then possible values of k are
(A) 1 (B) –1 (C) $i$ (D) $-i$

**53.** If four fair six-sided dice are rolled, then
(A) Probability that lowest number appearing on any die is exactly 3 is $\frac{175}{1296}$
(B) Probability that lowest number appearing on any die is exactly 4 is $\frac{65}{1296}$
(C) Probability that lowest number appearing on any die is exactly 4 is $\frac{1}{16}$
(D) Probability that lowest number appearing on any die is exactly 3 is $\frac{16}{81}$

**54.** Below is graph of a function 'f'. Let $g(x) = \int_0^x f(t)dt$ ,then

(A) g(0) = 1; g'(0) = f(0) = 2; g'(2) = f(0)




(B) g(0) = 0; g'(0) = f(0) = 4; g'(2) = 0
(C) g(0) = 0; g'(0) = f'(0) = 2; g'(2) = f(1) = 3
(D) g(0) = 0 ; g'(2) = f(2) = 0, f(0) = 4

**55.** $f: [0,1] \to [0,1]$, $f(x)=\begin{cases} 2x & 0 \leq x \leq \frac{1}{2} \\ -2x+2 & \frac{1}{2} < x \leq 1 \end{cases}$. Let $f_1$ = f(x) and $f_n(x) = f(f_{n-1}(x))$ for n > 1, $n \in N$, then

(A) $\int_0^1 f_2(x)dx + \int_0^1 f_3(x)dx = \frac{1}{2}$ (B) $\int_0^1 f_2(x)dx + \int_0^1 f_3(x)dx = 1$

(C) $\int_0^1 f_1(x)dx + \int_0^1 f_2(x)dx = 1$ (D) $\int_0^1 f_2(x)dx + \int_0^1 f_4(x)dx = 1$

**56.** Let $f(x) = x^3 + ax^2 + bx + c$, suppose $f(2 + x) = -f(2 - x)$ for all x and $f(-1) = 0$, then

(A) $a + b = -3$ (B) $b + c = 13$ (C) $a + c = 4$ (D) $a + b + c = 7$

**57.** A line segment with legnth $3\sqrt{2}$ has its end points on the parabola $y = x^2 + 8x + 3$, and one of the trisection points of the segment lies on the axis of symmetry of the parabola, then slope of this segment can be

(A) 3 (B) $-3$ (C) 1 (D) $-1$

**58.** Suppose 'a' and 'b' are real numbers such that $\lim_{x\to 0}\frac{\sin^2 x}{e^{ax}-bx-1}=\frac{1}{2}$ then possible ordered pairs (a,b) is/are

(A) (1,2) (B) (2,2) (C) (–2, –2) (D) (– 1, –2)

## SECTION – 3 (Maximum Marks : 16)

- This section contains **TWO** questions
- Each question contains two columns, **Column-I** and **Column-II**
- **Column-I** has **four** entires (A), (B), (C) and (D)
- **Column-II** has **five** entires (P), (Q), (R), (S) and(T)
- Match the entires in **Column-I** with the entires in **Column-II**
- One or more entires in **Column-I** may match with one or more entires in **Column-II**
- The ORS contains a 4 × 5 matrix whose layout will be similar to the one shown below:

(A) (P) (Q) (R) (S) (T)
(B) (P) (Q) (R) (S) (T)
(C) (P) (Q) (R) (S) (T)
(D) (P) (Q) (R) (S) (T)

- For each entry in **Column-I**, darken the bubbles of all the matching entires. For example, if entry (A) in **Column-I** matches with entires (Q), (R), and (T), then darken these three bubbles in the ORS. Similarly, for entires (B), (C) and (D)
- Marking scheme :

For each entry in **Column-I**.

+2 If only the bubble(s) corresponding to all the correct match(es) is(are) darkened

0 If none of the bubbles is darkened

–1 In all other cases

**59. Match the column**

| **Column–I** | **Column–II** |
|---|---|
| (A) The value of $\lim_{n\to\infty}\frac{1.1!+2.2!+\ldots+n\cdot n!}{(n+1)!}$ | (P) 1 |
| (B) The number of roots of $5x^4 - 4x + 1 = 0$ in [0, 1] is k then value of (k + 3) is | (Q) 2 |
| (C) The number of values of a for which the equation $x^3 - x + a = 0$ has a double root is | (R) 3 |
| (D) The value of $\frac{1}{1+\tan^3 10^\circ}+\frac{1}{1+\tan^3 20^\circ}+\ldots..+\frac{1}{1+\tan^3 80^\circ}$ is | (S) 4 |
| | (T) 5 |

**60.** Match the column

| **Column–I** | **Column–II** |
|---|---|
| (A) $\frac{(x^5-1)(x^7-1)}{(x-1)^2}$ can be written in form of $a_0+a_1x+a_2x^2+\ldots+a_{10}x^{10}$ then the value of $\frac{a_0+a_1+a_2+\ldots+a_{10}}{7}$ is | (P) 1 |
| (B) The value of $2017\int_0^{\pi}\lvert\sin 2016x\rvert dx - 2016\int_0^{\pi}\lvert\sin 2017x\rvert dx$ is | (Q) 5 |
| (C) The value of $\sqrt{2}\left(\frac{\sum_{k=0}^{20}\cos\left(\pi\frac{(k-5)}{20}\right)}{\sum_{k=0}^{20}\sin\left(\frac{\pi k}{20}\right)}\right)$ is | (R) 2 |
| (D) Let $f(x) = 3x^2 + 2x + 6$ and two distinct lines $l_1$ and $l_2$ exist those are tangent to $y = f(x)$ and intersect at the origin. Given that $l_1$ is tangent to f(x) at $(x_1, f(x_1))$ and $l_2$ is tangent to f(x) at $(x_2, f(x_2))$ then value of $x_1x_2$ is | (S) 3 |
| | (T) –2 |

## ANSWER KEY

### [PAPER - I]

### PART-A : PHYSICS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | (2) | 2. | (4) | 3. | (2) | 4. | (3) |
| 5. | (2) | 6. | (3) | 7. | (1) | 8. | (7) |
| 9. | (B, C) | 10. | (A, B, C) | 11. | (A,C) | 12. | (A, C) |
| 13. | (A, B, C) | 14. | (A), (C) (D) | | | 15. | (A,B,C,D) |
| 16. | (B, C, D) | 17. | (A, C) | 18. | (A, D) | | |

19. (A – P, Q, R); (B – P, R, S) ; (C – P, Q, R, T) ; (D – P, Q, R, T)
20. (A – P, Q) ; (B – R, S, T) ; (C – Q) ; (D – R)

### PART-B : CHEMISTRY

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 21. | (4) | 22. | (5) | 23. | (3) | 24. | (8) |
| 25. | (4) | 26. | (2) | 27. | (6) | 28. | (4) |
| 29. | (A, B, D) | 30. | (B, D) | 31. | (A, B) | 32. | (A, B, C) |
| 33. | (B, C, D) | 34. | (A, C) | 35. | (C) | 36. | (A, B, C) |
| 37. | (A, B, C) | 38. | (A, C) | | | | |

39. (A-P, Q); (B-Q, S); (C-Q, R); (D-R)
40. (A - Q) ; (B - S) ; (C - P) ; (D - R)

### PART-C : MATHEMATICS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 41. | (1) | 42. | (3) | 43. | (5) | 44. | (3) |
| 45. | (6) | 46. | (1) | 47. | (3) | 48. | (1) |
| 49. | (A, C) | 50. | (A,C,D) | 51. | (A,C) | 52. | (A, B,C,D) |
| 53. | (A, B) | 54. | (B, D) | 55. | (B, C, D) | 56. | (A,B,C,D) |
| 57. | (C, D) | 58. | (B, C) | | | | |

59. (A - P); (B - T) ; (C - Q) ; (D - S)
60. (A - Q); B -R); (C - P) ; (D - T)

# SAMPLE PAPER FOR JEE ADVANCED 2018 (PAPER-II)

**Duration: 3 Hours.** **Maximum Marks: 240**

**[Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.]**

## INSTRUCTIONS FOR JEE ADV. (P-II)

**QUESTION PAPER FORMAT AND MARKING SCHEME :**

1. The question paper has three parts A to C (Physics, Chemistry and Mathematics). Each part consists of three sections.
2. Carefully read the instructures given at the beginning of each section.
3. **Section-1** contains **8 questions. The answer to each question is a single digit integer ranging from 0 to 9 (both inclusive)**.
   **Marking scheme :** +4 for correct answer and 0 in all other cases.
4. **Section-2** contains **8 multiple choice questions with one or more thane one correct option.**
   **Marking scheme :** +4 for correct answer, 0 if not attempted and –2 in all other cases.
5. **Section-3** contains **2 "paragraph" type questions. Each paragraph descries an experiment, a situation or a problem. Two multiple choice questions will be alsed based on this paragraph. One or more than one option can be correct.**
   **Marking scheme :** +4 for correct answer, 0 if not attempted and –2 in all other cases.

## PART-A : PHYSICS

### SECTION 1 (Maximum Marks : 32)

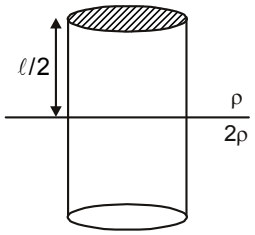
- This section contains **EIGHT** questions
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS
- Marking scheme :

  +4 If the bubble corresponding to the answer is darkened

  0 If none of the bubbles is darkened

**1.** A plate of mass m and area A is placed on a smooth horizontal surface. A light beam of intensity $I$ and frequency $\nu$ is incident on the plate at an angle $\theta$ with the normal on the plate. 40% of the light is absorbed. The acceleration of the plate is $\frac{2IA\sin\theta\cos\theta}{nmc}$. Value of n is — .

**2.** A solid cylinder of length $\ell$ floats in equilibrium at the interface of two liquids of densities $\rho$ and $2\rho$. Half length of the cylinder is in one liquid and the other half is in the other liquid. If the cylinder is depresed downward by $\ell/\sqrt{6}$ and released, its maximum velocity is $\sqrt{\ell g}/n$ .




Neglect viscosity of the liquids. Value of n is — .

**3.** Charge is distributed in space such that charge density is given by

$\rho = \rho_0[(x-a)^2 + (y-a)^2 + z^2]$ c/m$^3$

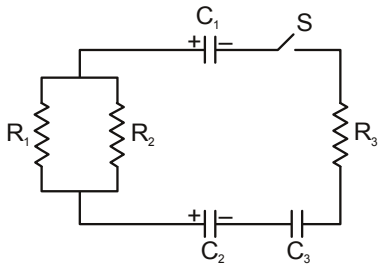
The net electric flux passing through the surface $(x-a)^2 + (y-a)^2 + z^2 = 4a^2$ is $\frac{32\alpha\pi\rho_0 a^5}{\beta\varepsilon_0}$

Value of $\sqrt{\alpha+\beta}$ is — .

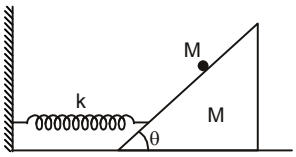
**4.** Consider a water sphere of radius R in a gravity free region. Density of water is $\rho$ at all points in the sphere. Due to the self gravitational effects of the water sphere, the pressure developed at its centre is $\frac{4G\pi R^2\rho^2}{n}$ .

Value of n is — .

**5.** Consider the arrangement shown in the figure. The capacitors $C_1$ and $C_2$ are initially charged with the polarity shown in the figure, with potential difference 2 V and V respectively. $C_3$ is initially neutral. $C_1 = 2C_2 = 2C_3$ and $R_1 = R_2 = 2R_3$. If the switch S is closed, the heat generated in $R_2$ after closing the switch, is $CV^2/5n$. Value of n is — .

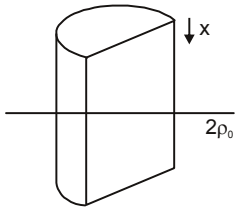


**6.** A particle of mass M is placed on the inclined rough surface of a wedge of inclination $\theta$. Mass of the wedge is M and it is placed on a smooth horizontal surface. The wedge is connected to a spring of spring constant k. The other end of the spring is fixed to a rigid support. The coefficient of friction between the particle and the inclined surface of wedge is $\mu = 4\tan\theta$. The wedge is pulled aside and released so that it oscillates horizontally. The maximum amplitude with which the wedge can oscillate, without the slipping of the particle on the wedge, is $\frac{\alpha Mg\sin 2\theta}{k(1+\beta\sin^2\theta)}$. The value of $\alpha+\beta$ is — .




**7.** A particle moves with a constant speed of 1 m/s over the curve $y = kx^2$ in the xy-plane. Here $k = 1\ m^{-1}$. The x-coordinate of the particle changes from $-\infty$ to $+\infty$. Maximum angular velocity of the particle about the point (1 m, 2 m) is $\frac{2}{\sqrt{\alpha-\beta\sqrt{3}}}$ rad/s. Value of $\alpha-\beta$ is — .

**8.** A solid semi-cylinder of length $\ell$ and cross section radius R floats on the surface of a liquid of density $2\rho_0$. The density of the cylinder varies as $\rho = \frac{\rho_0}{\ell}(x+\ell)$, where x is distance from top end of the cylinder. There is no atmosphere above the surface of the liquid. The net force applied by the liquid on the cylindrical surface of the cylinder is $\frac{\alpha R\rho_0 g\ell^2}{\beta}$. Value of $\alpha-\beta$ is—




**SECTION 2 (Maximum Marks : 32)**

- This section contains **EIGHT** questions
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
- Marking scheme :
  +4 If only the bubble(s) corresponding to all the correct option(s) is (are) darkened
  0 If none of the bubbles is darkened
  –2 In all other cases

**9.** A conducting rod of length $4\ell$ moves with constant velocity $v\hat{i}$ in the xy plane. The rod remains parallel to the y-axis. A magnetic field $\vec{B} = B_0(x-y)\hat{k}$ exist in the region. A and E are the ends of the rod. B, C and D are three points on the rod such that AB = BC = CD = DE = $\ell$.

Point C moves on the x-axis.

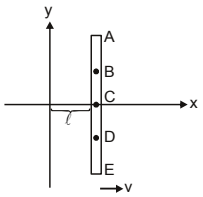
$V_A$, $V_B$, $V_C$, $V_D$ and $V_E$ are the potentials at A, B, C, D and E respectively. At the moment C becomes $(\ell, 0)$

(A) $V_E - V_A = 4vB_0\ell^2$

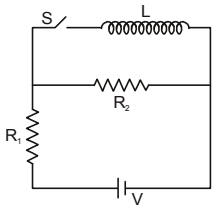
(B) $V_C - V_E = -4vB_0\ell^2$

(C) Potential is minimum at B

(D) $V_A - V_C = -4vB_0\ell^2$




**10.** Consider circuit shown in the figure. The inductor has inductance L and zero resistance. $R_1 = R_2 = R$. The circuit is in its steady state. Now the switch S is closed at t = 0.




(A) The total heat generated in $R_2$, after closing the switch, is $V^2L/2R^2$.

(B) Current in the inductor at time t is $\frac{V}{R}\left[1-e^{-Rt/2L}\right]$

(C) Current in $R_2$, at time t, is $\frac{V}{R}\left[e^{-Rt/2L}\right]$

(D) Potential difference across $R_1$, at time t, is $V\left[1-\frac{1}{2}e^{-Rt/2L}\right]$

**11.** Some charge is distributed above the xz-plane such that charge density is given by $\sigma = \frac{\sigma_0}{(y+a)^2}\ C/m^3$, for $y \geq 0$. There is no charge in the region y < 0.

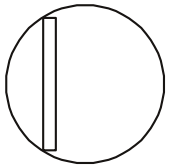
(A) Electric field intensity at (a, a, 2a) is 0

(B) Electric field intensity at (a, 0, –a) is $\frac{\sigma_0}{2\varepsilon_0 a}$

(C) Electric field intensity at (a, 2a, 3a) is $\frac{\sigma_0}{6\varepsilon_0 a}$

(D) Electric field intensity at (0, 0, 0) is $\frac{\sigma_0}{\varepsilon_0 a}$

**12.** A thin rod of length $\sqrt{2}R$ is placed inside a smooth spherical shell of radius R. The rod is vertical and its ends are in contact with the inner surface of the shell. The rod is released from this position.



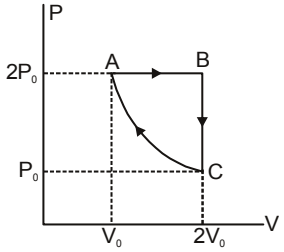
(A) Maximum speed of the mid-point of the rod will be $\sqrt{\frac{3gR}{2\sqrt{2}}}$

(B) Angular velocity of the rod, when it becomes horizontal, is $\sqrt{3g/2R}$

(C) At any moment, all points of rod will have same speed.

(D) The maximum velocity of the ends of the rod will be $\sqrt{\frac{3gR}{\sqrt{2}}}$

**13.** A cyclic process is carried out on a monoatomic ideal gas. The cycle used is shown in the figure. The step CA is isothermal.



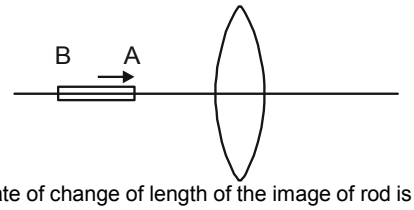

(A) Efficiencyof the cycle is $\frac{2}{5}(1-\ell n2)$

(B) Heat is supplied to the gas in the step $B \to C$.

(C) Heat is extracted from the gas in the step $C \to A$.

(D) Temperature of the gas is maximum at B.

**14.** A thin rod of length 10 cm moves along the principal axis of a convex lens of focal length 10 cm. The rod remains along the principal axis of the lens. End A of the rod is nearer to the lens. Velocity of the rod is 1 mm/s. At the moment the end A of the rod is at distance 20 cm from the lens,




(A) rate of change of length of the image of rod is 3/4 mm/s.

(B) relative velocity of image of end A with respect to A is 2 mm/s.

(C) acceleration of the image of A is 0.02 mm/s$^2$.

(D) velocity of the image of end B is 0.5 mm/s.

**15.** The electron in a hydrogen atom makes a transition from $n_1$ to $n_2$, where $n_1$ and $n_2$ are principal quantum numbers of the two states. Assume Bohr model to be valid. The kinetic energy of the electron in the final state is four times the kinetic energy in the initial state. Possible values of $n_1$ and $n_2$ are :

(A) $n_1 = 2, n_2 = 4$ (B) $n_1 = 6, n_2 = 3$

(C) $n_1 = 1, n_2 = 2$ (D) $n_1 = 4, n_2 = 2$

**16.** A current $I = I_0 + 2I_0(\sin\omega t + \cos\omega t)$ flows in a wire.

(A) Average value of the current from t = 0 to $t = \frac{3\pi}{4\omega}$ is $2I_0$

(B) Average value of the current from t = 0 to $t = \frac{3\pi}{4\omega}$ is $I_0\left(1+\frac{16\sqrt{2}}{3\pi}\right)$

(C) Root mean square value of the current is $\sqrt{5}I_0$

(D) Root mean square value of the current is $3I_0$

**SECTION – 3 (Maximum Marks : 16)**

- This section contains **TWO** paragraphs
- Based on each paragraph, there will be **TWO** questions
- Each question has **FOUR** option (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
- Marking Scheme :

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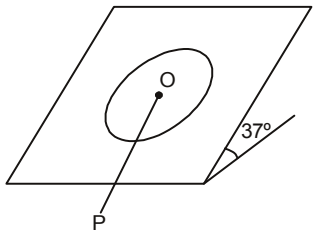
  0 If none of the bubblees is darkened

  –2 In all other cases

**Paragraph for questions 17 and 18**

A rider drives a bike in a circle of radius 20 m on an inclined rough plane with coefficient of friction μ = 1 and inclination 37°.

The rider moves with constant speed v. O is the centre of the circle and OP is the line of greatest slope.




Mass of 'rider + bike' is 100 kg.

**17.** The maximum value of v for which the bike will not slip is :

(A) $\sqrt{20}$ m/s (B) $\sqrt{30}$ m/s (C) $\sqrt{40}$ m/s (D) $\sqrt{50}$ m/s

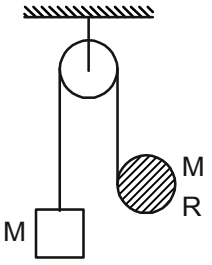
**18.** If the rider drives the bike at the maximum constant speed for which the bike does not slip, the friction acting on the bike at the moment the line joining the bike to O makes angle 60º with OP, is :

(A) $100\sqrt{52}$ N (B) $100\sqrt{62}$ N

(C) $100\sqrt{53}$ N (D) $100\sqrt{63}$ N

**Paragraph for questions 19 and 20**

A light thread is wound over a circular disc of mass M and radius R. The thread passes over a smooth massless pulley and its other end is tied to a block of mass M. Both the disc and the block are released at the same time to move under gravity.




**19.** Acceleration of the block is

(A) g (B) g/2 (C) g/3 (D) g/4

**20.** By the time the disc has rotated by $2\pi$, the speed of the highest point on the disc, is :

(A) $2\sqrt{\pi Rg}$ (B) $\sqrt{3\pi Rg}$ (C) $\sqrt{5\pi Rg}$ (D) $\sqrt{\pi Rg}$

## PART-B : CHEMISTRY

### SECTION 1 (Maximum Marks : 32)

- This section contains **EIGHT** questions
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS
- Marking scheme :

  +4 If the bubble corresponding to the answer is darkened

  0 If none of the bubbles is darkened

**21.** Among the following number of cation(s) that gives precipitate with NaCl, $Ag^+$ (aq.), $Cu^{2+}$ (aq.), $Fe^{2+}$ (aq.), $Mg^{2+}$ (aq.), $K^+$ (aq), $Ca^{2+}$ (aq), $Hg_2^{2+}$(aq) , $Pb^{2+}$ (aq.) and $Al^{3+}$ (aq.).

**22.** From the following given species, find out total number of species having partially filled HOMO (highest occupied molecular orbital) of Pi character.

$N_2^-$, $N_2^+$, $O_2$, $C_2^{2-}$, $B_2$, $H_2^+$, CO, NO and $O_2^+$

**23.** How many d-orbitals are involved for each I atom in the formation of $I_2Cl_6$ molecules?

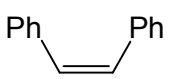
**24.** A saturated solution is made by dissolving $BaSO_4$(s) ($K_{sp}$= 4 × $10^{-10}$) into $10^{-5}$ M $Al_2(SO_4)_3$(aq) (strong electrolyte) solution. Calculate the osmotic pressure of this solution at 342.85 K in millibar $\left(R = \frac{1}{12}\frac{\text{bar}-\text{L}}{\text{mol}-\text{K}}\right)$.

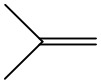
**25.** How many milli mol of caclium acetate must be added to 200 mL of 0.04 M HCl solution so that resultant solution has pH of 4.14. Given Pka ($CH_3COOH$) = 4.74 (Assume volume does not change after addition of solid calcium acetate) [log 2 = 0.30]

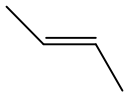
**26.** Xg of $Fe_2(SO_4)_3$ was dissolved in water to prepare 375 mL of its aqueous solution. Upon analysis it was found that each mL of the above soution contains $1.2 \times 10^{-4}$ $N_A$ $SO_4^{2-}$ ions.

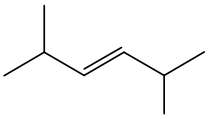
The value of X is : ($N_A$ = Avogadro's Number) [ Mol. wt. of $Fe_2(SO_4)_3$ = 400]

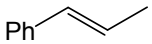
**27.** How many of the following hydrocarbons will give the same product with HBr and HBr/$R_2O_2$?

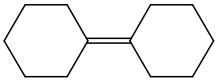
(a) 

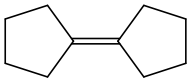

(b) 

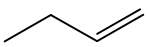
(c) 

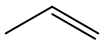
(d) 

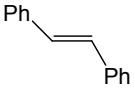
(e) 

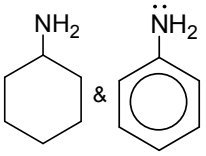

(f) 

(g) 

(h) 

(i) 

(j) 


**28.** Find the number of test by which 

can be distinguished :

(a) Isocycnide test (b) Lucas test

(c) Victor Mayer Tese (d) Hinsberg's test

(e) Mustard oil test (f) Azo-dye test

**SECTION 2 (Maximum Marks : 32)**

- This section contains **EIGHT** questions
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
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0 If none of the bubbles is darkened

–2 In all other cases

**29.** Which is/are the possible F – I – F angle than exist in $IF_7$ molecule?

(A) 90° (B) 180° (C) 72° (D) 60°

**30.** $PH_3$ is obtained, when

(A) Red P is heated with NaOH

(B) Withe P is heated with NaOH

(C) $Ca_3P_2$ is reacted with $H_2O$

(D) Phosphorus trioxide is boiled with water.

**31.** $2Co(CO)_4 \longrightarrow Co_2(CO)_8$

In this case

(A) EAN increases (B) EAN decreases

(C) Stability increases (D) Stability decreases

**32.** $PCl_5 + Cu \longrightarrow X + Y$

$Y + H_2O \longrightarrow$ Acidic solution

Which of the following is correct?

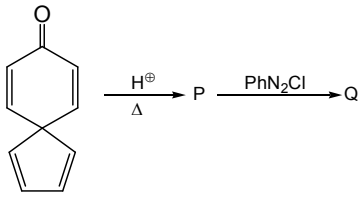
(A) One of the hydrolysed product of Y undergoes tautomerism.

(B) On passing $NH_3$ gas into solution of X it give colourless solution.

(C) X gives chocolate brown colour with $K_4[Fe(CN)_6]$

(D) X produces precipitates with $NH_4SCN$.

**33.** The correct statement(s) regarding the following reaction is/are




(A) P on reaction with Zn dust gives naphthalene.

(B) Q is a orange red dye.

(C) P is $\beta$ -napthol.

(D) Q on reaction with EtOH can give P.

**34.** Formaldehyde is obtained as one of the product during reaction of $HIO_4$ and

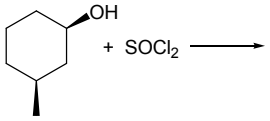
(A) Methyl $\alpha$- D-Glucopyranoside

(B) Methyl $\alpha$- D-Glucofuranoside

(C) 2,3-Butanediol

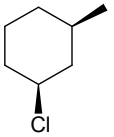
(D) 1-Hydroxy-2-butanone

**35.**

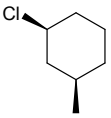



The products obtained in the above reaction is/are

(A)




(B)




(C) $SO_2$ (g) (D) HCl(g)

**36.** Consider a setup of two urea solutions of concentrations 0.1 M and 0.25 M at 300 K seperated by a semi permeable membrane. External pressures $P_1$ and $P_2$ respectively are applied on the two solutions. For what value of $P_1$ and $P_2$ osmosis doesn't occur :

(A) $P_1$ = 2.463 atm $P_2$ = 6.1575 atm

(B) $P_1$ = 0 $P_2$ = 3.6945 atm

(C) $P_1$ = 6.1575 atm $P_2$ = 2.463 atm

(D) $P_1$ = 4.926 atm $P_2$ = 8.6205 atm

**SECTION – 3 (Maximum Marks : 16)**

- This section contains **TWO** paragraphs
- Based on each paragraph, there will be **TWO** questions
- Each question has **FOUR** option (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
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**Paragraph for Question No. 37 & 38**

ZnS occurs in nature as two crystalline structure (1) Zincblende (2) Wurtzite

The two types have these features in common

(A) a 1 : 1 stoichiometry of $\overset{+2}{Zn}$ and $\overset{2-}{S}$.

(B) A Co-ordination of 4 for each ion (4:4)

(C) Tetrahedral co-ordination.

Zinc blende is based on a F.C.C. lattice of anions whereas wurtzite is derived from an hcp array of anions. In both structures the cations occupy tetrahedral voids present. Zinc-blende is its own antitype you can switch the anions and cations positions in the unitcell and it doesnot matter! In fact replacement of both Zn and S with carbon gives the diamond struecture.

**37.** An ionic solid $\overset{+}{A}\overset{-}{B}$ crystallises in zincblende type of lattice. If r ($A^+$) = 100 Å, r ($B^-$)=300 Å then distance between two nearest $B^-$ ions are

(A) $\frac{800}{\sqrt{3}}$Å (B) $\frac{800\sqrt{2}}{\sqrt{3}}$Å (C) $800\sqrt{6}$Å (D) $\frac{800\sqrt{3}Å}{\sqrt{2}}$

**38.** The packing fraction of solid AB is :

(A) $\frac{11\sqrt{3}}{32}$ (B) $\frac{11\sqrt{2}}{32}$ (C) $\frac{11}{32\sqrt{3}}$ (D) $\frac{11}{32\sqrt{2}}$

**Paragraph for Question No. 39 & 40**

Bohr's model for hydrogen atom is based on the following postulates :

(i) The electron in the hydrogen atom can move around the nucleus in a circular path of fixed radius and energy. These paths are called orbits, stationary states or allowed energy states. These orbits are arranged concentrically around the nucleus.

(ii) The energy of an electron in the orbit does not change with time. However, the electron will move from a lower stationary state to a higher stationary state when required amount of energy is absorbed by the electron or energy is emitted when electron moves from higher stationary state to lower stationary state. The energy change does not take place in a continuous manner.

(iii) The frequency of radiation observed or emitted when transition occurs between two statioanry states that differ in energy by $\triangle E$ is given by :

$$v = \frac{\Delta E}{h} = \frac{E_2 - E_1}{h}$$

where $E_1$ and $E_2$ are the energies of the lower and higher allowed energy states respectively. This expression is commonly known as Bohr's frequency rule.

(iv) The angular momentum of an electron in a given stationary state can be expressed as

$$mvr = n\left(\frac{h}{2\Pi}\right) \quad n = 1,2,3,.....$$

Thus an electron can move only in those orbits for which its angular momentum is integral multiple of $\frac{h}{2\Pi}$ that is why only certain fixed orbits are allowed.

**39.** The ratio of frequency of revolution of electron in the 2nd excited state of $Li^{+2}$ and 2nd state of Helium is :

(A) $\frac{2}{3}$ (B) $\frac{9}{4}$ (C) $\frac{4}{9}$ (D) $\frac{3}{2}$

**40.** Photons of energy 15 eV is used to strike a sample of $Li^{+2}$ ion in second excited state. The emitted electron is accelerated through de Broglie wavelength of this electron is :

(A) 4.4 Å (B) 5.0 Å (C) 5.4 Å (D) 6.0 Å

## PART-C : MATHEMATICS

### SECTION 1 (Maximum Marks : 32)

- This section contains **EIGHT** questions
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS
- Marking scheme :

  +4 If the bubble corresponding to the answer is darkened

  0 If none of the bubbles is darkened

**41.** If $\int \frac{1-\cot^{104}x}{\tan x + \cot^{105}x}dx = \frac{1}{K}\log|\cos^K x + \sin^K x| + C$, then the sum digits in K is

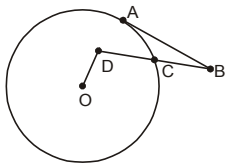
**42.** Q if $m_1$, $m_2$ be the roots of the equation $x^2 + \left(\sqrt{3}+2\right)x + \left(\sqrt{3}-1\right) = 0$ and the area of the triangle formed by the lines $y = m_1x$, $y = m_2x$ and $y = 2$ is $\left(\sqrt{33}+K\right)$ then value of $\sqrt{K^2+5}$ is

**43.** The number of ways in which 10 persons take seats in a row of 24 fixed seats so that no two persons take consecutive seats is $\frac{15!}{K!}$, then the value of K is

**44.** The largest power of $x^2 + xy + y^2$ by which the polynomial $(x + y)^7 - x^7 - y^7$ is divisible, is

**45.** The coefficient of $\lambda^n \cdot \mu^n$ in the expansion of $[(1+\lambda)\cdot(1+\mu)\,(\lambda+\mu)]^n$ is $\sum_{r=0}^{n}\left({}^nC_r\right)^K$ then the value of K is

**46.** In the adjoining figure, AB is tangent at A to the circle with centre O; point D is interior to the circle and DB intersects the circle at C if BC = DC = 3; OD = 2 and AB = 6, and the radius of the circle is $\sqrt{K}$ then sum of digits of K is




**47.** If $x^2 + y^2 + z^2 = 1$ for x,y, $z \in R$, then the maximum value of $x^3 + y^3 + z^3 - 3xyz$ is

**48.** $E_1$, $E_2$ and $E_3$ are excentres of $\triangle ABC$. From incentre of $\triangle ABC$ perpendiculars are drawn to the sides meet the sides at D, E and F. If $\frac{ar(\triangle E_1E_2E_3)}{ar(\triangle DEF)} = 36$, 'R' is circumradius and 'r' is inradius then the value of $\frac{R}{r}$ is

**SECTION 2 (Maximum Marks : 32)**

- This section contains **EIGHT** questions
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
- Marking scheme :
  +4 If only the bubble(s) corresponding to all the correct option(s) is (are) darkened
  0 If none of the bubbles is darkened
  –2 In all other cases

**49.** If $z = tz_1 + (1 - t)z_2$, where $z_1$, $z_2$ are the points A and B respectively on arrgand plane, where $t \in R$, then for point P(z)

(A) Locus of P(z) is an ellipse $\forall\ t \in (0,1)$

(B) If t > 1, P(z) does not lie on the line segment AB

(C) If t < 0, P(z) does not lie on the line segment AB

(D) If 0 < t < 1, P(z) lie between A and B

**50.** If $f(x) = \begin{cases} -x+1 & x \le 0 \\ -(x-1)^2, & x \ge 1 \end{cases}$, then the solution of the equation $f(x) - f^{-1}(x) = 0$ is

(A) x = – 1 (B) x = 0 (C) x = 1 (D) x = 2

**51.** From a point P, the chord of contact to the ellipse $E_1 : \frac{x^2}{a} + \frac{y^2}{b}$ = (a + b) touches the ellipse $E_2 : \frac{x^2}{a^2} + \frac{y^2}{b^2}$ = 1 then the locus of the points P is

(A) director circle of $E_1$ (B) Director circle of $E_2$

(C) $x^2 + y^2 = (a + b)^2$ (D) $x^2 + y^2 = a^2 + b^2$

**52.** Let $\vec{a}, \vec{b}, \vec{c}$ are three vectors such that

$\vec{a} \cdot \vec{a} = \vec{b} \cdot \vec{b} = \vec{c} \cdot \vec{c} = 3$ and $|\vec{a} - \vec{b}|^2 + |\vec{b} - \vec{c}|^2 + |\vec{c} - \vec{a}|^2 = 27$, then

(A) $\vec{a}, \vec{b}, \vec{c}$ are necessarily coplanar

(B) $\vec{a}, \vec{b}, \vec{c}$ represent sides of a triangle in magnitude and direction

(C) The value of $\vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}$ here , is the least possible value

(D) $\vec{a}, \vec{b}, \vec{c}$ represent orthogonal triad of vectors

**53.** A rectangular hyperbola passes through (1,1), (–1,3) and (5, 5) then the normal to the rectangular hyperbola of slope $\frac{1}{3}$ is

(A) x–3y + 2 = 0 (B) x–3y + 18 = 0

(C) x – 3y + 10 = 0 (D) x – 3y + 15 = 0

**54.** If a,b,c are positive real numbers satisfying a + 2b + 3c = 12 then

(A) max $(a^5 b^4 c^3)$ = 4096

(B) max $(a^5 b^4 c^3)$ = 50000

(C) For maximum value of $a^5 b^4 c^3$ , a = 5

(D) minimum value of $\frac{25}{a} + \frac{8}{b} + \frac{3}{c}$ is 12

**55.** $f(x) = \begin{cases} 3 - |x|, & |x| \le 3 \\ 0, & \text{elsewhere} \end{cases}$. g(x) = f(x +3) + f(x – 3) and h (x) = g(x + 6) + g (x –6) then

(A) number of points of non-differentiability of h (x) on R is 9

(B) $\int_{-\infty}^{\infty} h(x)dx = 36$ .

(C) If k (x) = max {h(x), 2} then $\int_{-10}^{10} k(x)dx = 44$

(D) If k (x) = min {h(x), 2} then $\int_{-\infty}^{\infty} k(x)dx = 32$

**56.** If m,n,k ∈ N , and [x] is greatest integer value of x then area of the region, in square units, defined by $\left[\left|\frac{x}{m}\right|\right] + \left[\left|\frac{x}{n}\right|\right] \le k$ is

(A) 24, if m = n = 1, k = 2 (B) 96, if m = n = k = 2

(C) 52, if m = n = k = 2 (D) 100, if m = n = 2, k = 3

**SECTION – 3 (Maximum Marks : 16)**

- This section contains **TWO** paragraphs
- Based on each paragraph, there will be **TWO** questions
- Each question has **FOUR** option (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
- Marking Scheme :
  +4 If only the bubble(s) corresponding to all the correct option(s) is(are) darkended
  0 If none of the bubblees is darkened
  –2 In all other cases

**Paragraph for questions 57 and 58**

Let a function f(x) satisfies the condition $f^2(x) - f^2(y) = 4(x - y)$ such that f(0) = 2 and f(x) $\ge$ 0

**57.** Area bounded between y = f(|x|) and y = 7 – |x| is

(A) $\frac{23}{6}$ sq. unit (B) $\frac{11}{6}$ sq. unit

(C) $\frac{86}{6}$ sq. unit (D) 7 sq. unit

**58.** The number of points where g(x) = max {f(|x|), 6,7 –|x|} is non differentiable on interval [–10,10] is

(A) 5 (B) 6 (C) 7 (D) 8

**Paragraph for questions 59 and 60**

Let S be the set of points $\{(x,y) : 0 \le x \le 3, 0 \le y \le 4$, where $x,y \in I\}$. Two distinct points are randomly chosen from S. It is given that mid point of the line segment joining $A(x_1, y_1)$ and $B(x_2, y_2)$ is $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$

**59.** The probability that the mid point of the line segment of the two points chosen belongs to S is

(A) $\frac{21}{95}$ (B) $\frac{42}{95}$

(C) $\frac{36}{95}$ (D) none of these

**60.** If the two points chosen are $A(x_1, y_1)$ and $B(x_2, y_2)$ then the probability that $x_1 = x_2$ and $y_1 \neq y_2$ and mid point of **A** and B is an integral point, is

(A) $\frac{10}{95}$ (B) $\frac{12}{95}$

(C) $\frac{16}{95}$ (D) none of these

## ANSWER KEY

## [PAPER - II]

### PART-A : PHYSICS

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

### PART-B : CHEMISTRY

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 21. | (3) | 22. | (5) | 23. | (2) | 24. | (2) |
| 25. | (5) | 26. | (6) | 27. | (4) | 28. | (1) |
| 29. | (A, B, C) | 30. | (B, C, D) | 31. | (A, C) | 32. | (A, C, D) |
| 33. | (A, B, C) | 34. | (B, D) | 35. | (C, D) | 36. | (A,B,D) |
| 37. | (B) | 38. | (A) | 39. | (A) | 40. | (B) |

### PART-C : MATHEMATICS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 41. | (7) | 42. | (4) | 43. | (5) | 44. | (2) |
| 45. | (3) | 46. | (4) | 47. | (1) | 48. | (3) |
| 49. | (B, C, D) | 50. | (A,B,C,D) | 51. | (A, C) | 52. | (A,B,C) |
| 53. | (A,B) | 54. | (B,C,D) | 55. | (A,B,C,D) | 56. | (A, B) |
| 57. | (C) | 58. | (A) | 59. | (A) | 60. | (D) |