

# FIITJEE - JEE (Mains)

PHYSICS, CHEMISTRY & MATHEMATICS

Time Allotted: 3 Hours

Maximum Marks: 360

- Do not open this Test Booklet until you are asked to do so.
- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

## **Important Instructions:**

1. Immediately fill in the particulars on this page of the Test Booklet with *Blue / Black Ball Point Pen*. *Use of pencil is strictly prohibited.*
2. The Answer Sheet is kept inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars carefully.
3. The test is of **3 hours** duration.
4. The Test Booklet consists of **90** questions. The maximum marks are **360**.
5. There are **three** parts in the question paper A, B, C consisting of **Physics, Chemistry and Mathematics** having 30 questions in each part of equal weightage. Each question is allotted **4 (four)** marks for correct response.
6. *Candidates will be awarded marks as stated above in instruction No.5 for correct response of each question.  $\frac{1}{4}$  (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.*
7. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 6 above.
8. Use **Blue / Black Ball Point Pen only** for writing particulars / marking responses on **Side-1** and **Side-2** of the Answer Sheet. **Use of pencil is strictly prohibited.**
9. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. except the Admit Card inside the examination hall / room.
10. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room / Hall. **However, the candidates are allowed to take away this Test Booklet with them.**
11. **Do not fold or make any stray marks on the Answer Sheet.**

Name of the Candidate (in Capital Letters) : \_\_\_\_\_

Enrolment Number : \_\_\_\_\_

Batch : \_\_\_\_\_ Date of Examination : \_\_\_\_\_

**SECTION - 1**  
**PHYSICS**

1. A wide vessel with small hole in the bottom is filled with water and kerosene. Neglecting viscosity, the velocity of water flow  $v$ , if the thickness of water layer is  $h_1$  and that of kerosene layer is  $h_2$  is (density of water  $\rho_1$  gm/cc and that of kerosene is  $\rho_2$  gm/cc).

(A)  $v = \sqrt{2g(h_1 + h_2)}$

(B)  $v = \sqrt{2g(h_1\rho_1 + h_2\rho_2)}$

(C)  $v = \sqrt{2g \left[ h_1 + h_2 \left( \frac{\rho_2}{\rho_1} \right) \right]}$

(D)  $v = \sqrt{2g \left[ h_1 \left( \frac{\rho_1}{\rho_2} \right) + h_2 \right]}$

2. A small ball of lead is falling under gravity in a viscous liquid. The velocity of the ball  
(A) goes on increasing  
(B) goes on decreasing  
(C) remains uniform all along  
(D) increases to a certain value and subsequently the ball continues to fall with this velocity.

3. The linear density of rod is given by  $\lambda = Bx^2$  where  $B$  is a constant. The rod is placed along x-axis with one end at origin. Then the co-ordinates of centre of mass are (Thickness of rod negligible)

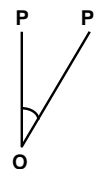
(A)  $\left( \frac{3L}{4}, 0 \right)$

(B)  $\left( 0, \frac{3L}{4} \right)$

(C)  $\left( \frac{4L}{3}, 0 \right)$

(D)  $\left( \frac{0, 4L}{3} \right)$

4. A uniform rod of mass  $m$  and length  $L$  can freely rotate in a vertical. The angular velocity of the rod, when it falls from position  $P$  to  $P'$  through an angle  $\alpha$ , is (point  $O$  is fixed)



(A)  $\sqrt{\frac{6g}{5L}} \sin \alpha$

(B)  $\sqrt{\frac{6g}{L}} \sin \frac{\alpha}{2}$

(C)  $\sqrt{\frac{6g}{L}} \cos \frac{\alpha}{2}$

(D)  $\sqrt{\frac{6g}{L}} \sin \alpha$

5. A cubical block of mass  $M$  and edge  $a$  slides down a rough inclined plane of inclination  $\theta$  with a uniform velocity. The torque of the normal force on the block about its centre has a magnitude :

(A) zero

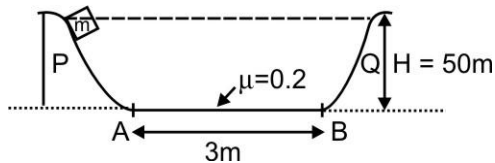
(B)  $Mga$

(C)  $Mg \frac{a}{2} \sin \theta$

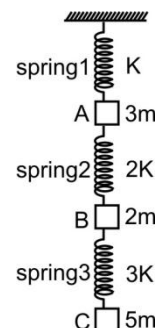
(D)  $Mga \cos \theta$

**Space For Rough Work**

6. Incline planes P & Q are smooth but plane surface from A to B is rough. Find number of times block of mass 2 kg will climb on Q. If released from P at a height 50 m  
 (a) 45 (b) 41  
 (c) 42 (d) 40



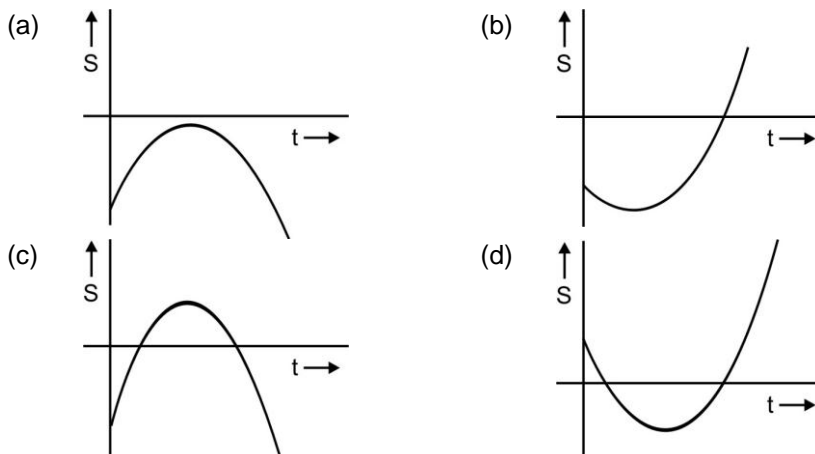
7. The system of springs and masses are in equilibrium. If the spring 2 is cut then the initial acceleration of block B will be.  
 (a)  $\frac{7}{2}g$  downward (b)  $2g$  downward  
 (c)  $2g$  upward (d)  $\frac{7}{2}g$  upward



8. A piece of stone is thrown from the top of a tower with a horizontal speed of  $10\sqrt{3}$  m/s. It is found that at a point P along the path, the velocity vector of the stone makes an angle of  $30^\circ$  with the horizontal. The point P is reached in time t which is given by ( $g = 10\text{m/s}^2$ )  
 (a) 1 sec (b)  $\sqrt{3}$  sec (c) 2 sec (d)  $2\sqrt{3}$  sec

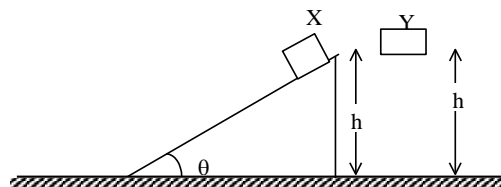
9. Given  $\vec{A} = 4\hat{i} + 2\hat{j}$  and  $\vec{B} = 3\hat{i} + 4\hat{j}$ . Find magnitude of component of  $\vec{A}$  along  $\vec{B}$ .  
 (a) 4 (b)  $\sqrt{20}$  (c) 2 (d) 3

10. Position (S) versus time (t) graph of a particle moving in straight line with  $u = -8$  m/s,  $a = 4$  m/s<sup>2</sup> and  $S = -1$  m at  $t = 0$  is



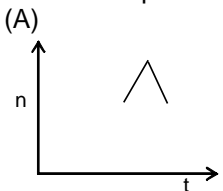
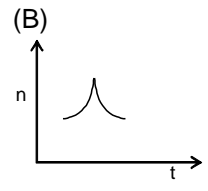
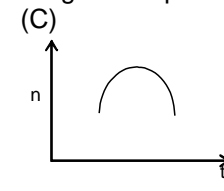
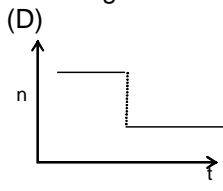
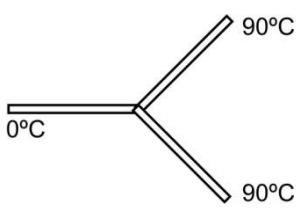
Space For Rough Work

11. A block X slides down upon a friction less inclined plane when released from the top of the inclined plane while another block falls freely from the same point then  
 (A) block X will strike the ground first  
 (B) block Y will strike the ground first  
 (C) both block will strike the ground simultaneously.  
 (D) none.



12. A simple pendulum has a bob of mass  $m$  and swings with an angular amplitude  $\phi$ . The tension in the thread is  $T$ . At a certain time, the string makes an angle  $\theta$  with the vertical ( $\theta \leq \phi$ ). Then which one of the following is not correct?  
 (a)  $T = mg\cos\theta$ , for all values of  $\theta$  (b)  $T = mg\cos\theta$ , only for  $\theta = \phi$   
 (c)  $T = mg$ , for  $\theta = \cos^{-1}\left[\frac{1}{3}(2\cos\phi + 1)\right]$  (d)  $T$  will be larger for smaller values of  $\theta$
13. The dimensional formula for latent heat is  
 (a)  $M^0L^2T^{-2}$  (b)  $MLT^{-2}$  (c)  $ML^2T^{-2}$  (d)  $ML^2T^{-1}$
14. Two wires of the same material and length are stretched by the same force. Their masses are in the ratio 3 : 2, their elongations are in the ratio :  
 (a) 1 : 2 (b) 2 : 3 (c) 2 : 1 (d) 3 : 2
15. A liquid of density  $\rho$  and surface tension  $T$  rises to a height  $h$  in a capillary tube of radius  $r$ . The increase in the potential energy of the liquid in the capillary due to the rise of the liquid, is : (assume contact angle is zero and ignore surface energy)  
 (a)  $\frac{\pi T^2}{\rho g}$  (b)  $\frac{2\pi T^2}{\rho g}$  (c)  $\frac{\pi^2 T^2}{\rho g}$  (d)  $\frac{4\pi^2 T^2}{\rho g}$
16. A wave equation which gives the displacement along the  $y$  direction is given by  $y = 10^{-4} \sin(60t + 2x)$ , where  $x$  and  $y$  are in meters and  $t$  is time in seconds. This represents a wave  
 (A) travelling with a velocity of  $60 \text{ ms}^{-1}$  in the negative  $x$  direction.  
 (B) of wavelength  $2\pi \text{ m}$   
 (C) of frequency  $60/\pi \text{ Hz}$   
 (D) of amplitude  $10^{-4} \text{ m}$  travelling along the negative  $x$  direction
17. Two waves of intensities  $I$  and  $4I$  produce interference. Then the intensity at constructive and destructive interference respectively is  
 (A)  $3I, 5I$  (B)  $5I, 3I$   
 (C)  $I, 9I$  (D)  $9I, I$

**Space For Rough Work**

18. An open pipe is suddenly closed at one end as a result of which the frequency of the first overtone of the closed pipe is found to be higher by 100 Hz than the fundamental frequency of the open pipe is  
 (A) 200 Hz (B) 300 Hz (C) 240 Hz (D) 480 Hz
19. P and Q are two small loud speakers which emit sound waves of the same amplitude but with a phase difference of  $\pi$ . A small receiver R moves along the perpendicular bisector of PQ in the direction away from P and Q. The intensity of the sound recorded in the receiver is :  
 (A) continuously decreasing tending to zero at a very large distance  
 (B) alternates between a constant maximum and zero minimum  
 (C) alternates between diminishing maximum and increasing minimum  
 (D) remains constant equal to zero.
20. A railway engine whistle at a constant frequency moves with a constant speed. It goes past a stationary observer standing beside the railway track. The frequency  $n$  of the sound heard by the observer is plotted against time  $t$ . Which of the following best represents the resulting curve?  
 (A)  (B)  (C)  (D) 
21. Find the pressure at which temperature attains its maximum value if the relation between pressure and volume for an ideal is  $P = P_0 + (1 - \alpha)V^2; \alpha > 1$   
 (a)  $\frac{2P_0}{3}$  (b)  $\frac{P_0}{3}$  (c)  $P_0$  (d)  $\frac{4P_0}{3}$
22. Three rods made of the same material and having the same cross-section have been joined as shown in the figure. Each rod is of the same length. The left and right ends are kept at  $0^\circ\text{C}$  and  $90^\circ\text{C}$  respectively. The temperature of junction of the three rods will be :  
 (a)  $45^\circ\text{C}$  (b)  $60^\circ\text{C}$   
 (c)  $30^\circ\text{C}$  (d)  $20^\circ\text{C}$
- 
23. Two bodies of masses  $m_1$  and  $m_2$  are initially at rest placed infinite distance apart. They are then allowed to move towards each other under mutual gravitational attraction. Their relative velocity when they are  $r$  distance apart is :  
 (a)  $\sqrt{\frac{2G(m_1 + m_2)}{r}}$  (b)  $\sqrt{\frac{2Gm_1m_2}{(m_1 + m_2)r}}$  (c)  $\sqrt{\frac{G(m_1 + m_2)}{r}}$  (d)  $\sqrt{\frac{Gm_1m_2}{(m_1 + m_2)r}}$

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**Space For Rough Work**

24. A spherical black body of radius 12 cm radiates 450W at 500 K. If the radius is halved and temperature in K is doubled, the radiated power in watts will be  
 (A) 225 (B) 450 (C) 900 (D) 1800

25. Two rods of lengths  $l_1$  and  $l_2$  are made of material whose coefficients of linear expansions are  $\alpha_1$  and  $\alpha_2$ . If the difference between two lengths is independent of temperature

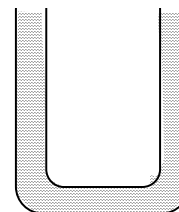
(A)  $\frac{l_1}{l_2} = \frac{\alpha_1}{\alpha_2}$  (B)  $\frac{l_1}{l_2} = \frac{\alpha_2}{\alpha_1}$  (C)  $l_1^2 \alpha_1 = l_2^2 \alpha_2$  (D)  $\frac{\alpha_1^2}{l_1} = \frac{\alpha_2^2}{l_2}$

26. In order to calculate the speed of sound in nitrogen gas at 300 K, you are given that the gas is diatomic. You will also need to know only the

- (A) density of the gas at 300 K, and the mass of one mole of the nitrogen  
 (B) pressure of the gas at 300 K  
 (C) molecular weight of nitrogen and the universal gas constant  
 (D) characteristic gas constant for nitrogen

27. The tube open at both ends as shown in the figure is completely filled with a liquid. The liquid level does not change in the tube with rise in the temperature. Let  $\gamma$  = coefficient of volume expansion of the liquid and  $\alpha$  = coefficient of linear expansion of the material of the tube. Which of the following is correct relation between  $\gamma$  &  $\alpha$ .

- (A)  $\gamma = \alpha$  (B)  $\gamma = 2\alpha$   
 (C)  $\gamma = 3\alpha$  (D)  $\gamma = 0$



28. Two identical plates of metal are welded end to end as shown in figure (A), 20 cal of heat flows through it in 4 minutes. If the plates are welded as shown in figure (B) the same amount of heat will flow through the plates in:

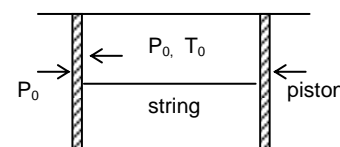


A

B

- (A) 1 minute (B) 2 minute (C) 4 minute (D) 16 minute

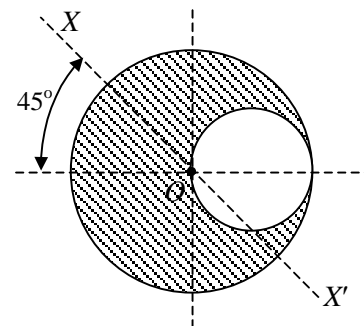
29. A cylindrical tube of cross-section area  $A$  fitted with two frictionless pistons. The pistons are connected to each other by a metallic wire. The temperature of gas is  $T_0$  and its pressure is  $P_0$  which is equal to atmospheric pressure. Calculate tension in the wire.



- (A)  $P_0 A$  (B)  $2P_0 A$  (C) zero (D)  $\frac{P_0 A}{2}$

30. A disc of radius  $R/2$  is cut from a uniform disc of radius  $R$  as shown in the figure. The mass of the disc (with cavity) is  $M$ . The moment of inertia of this disc about an axis  $XX'$  which passes through the center  $O$  of the disc and is in the plane of the disc will be

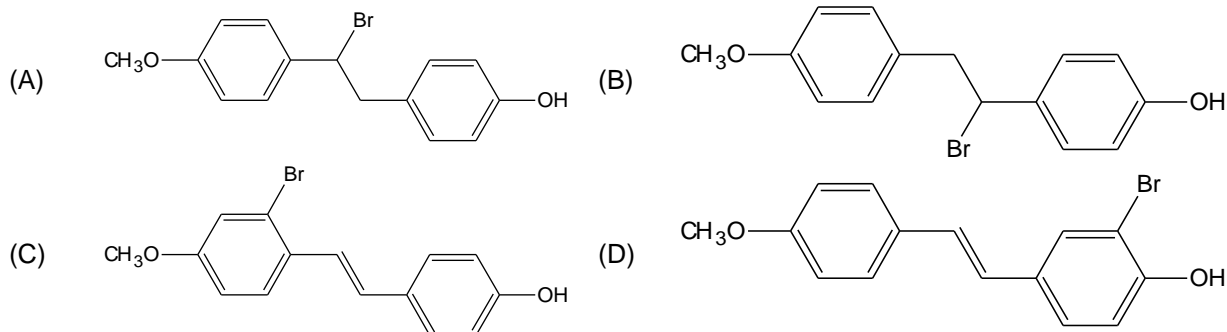
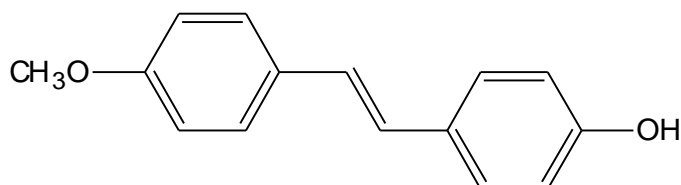
(a)  $\frac{7MR^2}{12}$  (b)  $\frac{13MR^2}{24}$   
 (c)  $\frac{13MR^2}{48}$  (d)  $\frac{11MR^2}{36}$



**SECTION – 2**  
**CHEMISTRY**

- A balloon filled with  $N_2O$  is pricked with a sharper point and quickly plunged into a tank of  $CO_2$  under the same temperature and pressure. The balloon will  
 (A) be enlarged (B) be shrink  
 (C) remain unchanged in size (D) collapse completely
- If the total energy of an electron in a hydrogen like atom in excited state is  $-3.4$  eV, then the de Broglie wavelength of the electron is  
 (A)  $6.6 \times 10^{-10}$  m (B)  $3 \times 10^{-10}$  m (C)  $5 \times 10^9$  m (D)  $9.3 \times 10^{-12}$  m
- The correct order of the increasing s-character of the orbital of B which overlaps with the orbital of F to form B – F bonds in  $BF_2^+$ ,  $BF_3$  and  $BF_4^-$  is  
 (A)  $BF_2^+ < BF_3 < BF_4^-$  (B)  $BF_3 < BF_2^+ < BF_4^-$   
 (C)  $BF_2^+ < BF_4^- < BF_3$  (D)  $BF_4^- < BF_3 < BF_2^+$

- The major product of the reaction between HBr and the following compound is:

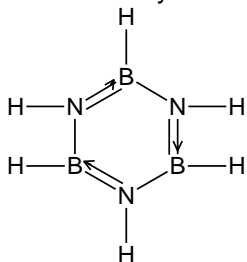


- Solubility product constant ( $K_{sp}$ ) of salts of types MX,  $MX_2$  and  $M_3X$  at temperature 'T' are  $4.0 \times 10^{-8}$ ,  $3.2 \times 10^{-14}$  and  $2.7 \times 10^{-15}$ , respectively. Solubilities (mole  $dm^{-3}$ ) of the salts at temperature 'T' are in the order  
 (A)  $MX > MX_2 > M_3X$  (B)  $M_3X > MX_2 > MX$   
 (C)  $MX_2 > M_3X > MX$  (D)  $MX > M_3X > MX_2$

**Space For Rough Work**

6. 0.1 M  $\text{CH}_3\text{COOH}$  is titrated against 0.1 M  $\text{NaOH}$  solution. Find the difference in pH between  $\left(\frac{1}{n}\right)$ th and  $\left(1 - \frac{1}{n}\right)$ th stages of neutralization.  
 (A)  $\log(n - 1)$  (B)  $\log(2n - 1)$  (C)  $2\log(n - 1)$  (D)  $\log(2n - 2)$

7. Predict the hybridization of boron and nitrogen atoms in the following molecule:



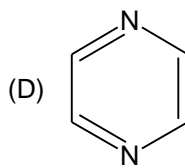
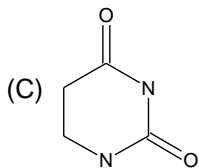
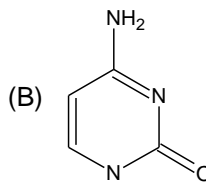
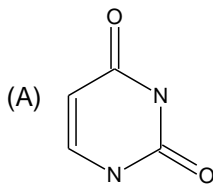
- (A)  $sp^2, sp^2$  (B)  $sp^2, sp^3$  (C)  $sp, sp^2$  (D)  $sp, sp$
8. The first emission line of Balmer series in H spectrum has the wave number equal to  
 (A)  $\frac{9R_H}{400} \text{ cm}^{-1}$  (B)  $\frac{7R_H}{144} \text{ cm}^{-1}$  (C)  $\frac{3R_H}{4} \text{ cm}^{-1}$  (D)  $\frac{5R_H}{36} \text{ cm}^{-1}$

9. The approach of the following equilibrium was observed kinetically from both directions  
 $\text{PtCl}_4^{2-} + \text{H}_2\text{O} \rightleftharpoons \text{Pt}(\text{H}_2\text{O})\text{Cl}_3^- + \text{Cl}^-$

$$-\frac{d}{dt}[\text{PtCl}_4^{2-}] = (500 \times 10^{-3})\text{s}^{-1}[\text{PtCl}_4^{2-}] - 25(\text{Lmol}^{-1}\text{s}^{-1})[\text{Pt}(\text{H}_2\text{O})\text{Cl}_3^-][\text{Cl}^-]$$

What is the value of equilibrium constant when fourth  $[\text{Cl}^-]$  is complexed?

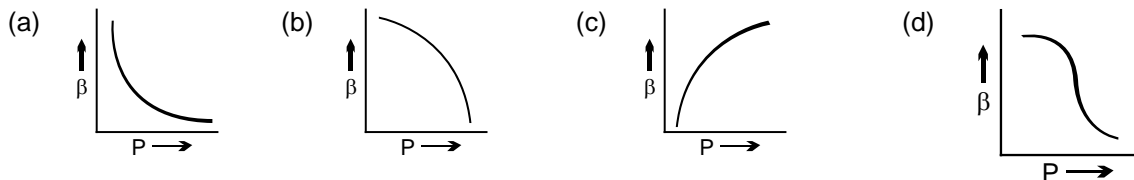
- (A)  $2 \times 10^{-2}$  (B)  $5 \times 10^{-3}$  (C) 50 (D) Data insufficient
10. Which is not aromatic?



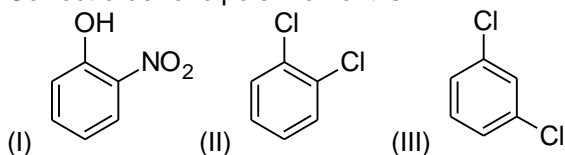
**Space For Rough Work**



11. The solubility of calomel( $\text{Hg}_2\text{Cl}_2(\text{s})$ ) in water at  $25^\circ\text{C}$  is  $x$  moles/litre. Its solubility product is  
 (A)  $4x^3$  (B)  $12x^3$  (C)  $108x^3$  (D)  $x^2$
12. Which of the following graphs correctly represents the variation of  $\beta \left[ = -\frac{1}{v} \left( \frac{dv}{dp} \right)_T \right]$  with pressure for an ideal gas at constant temperature

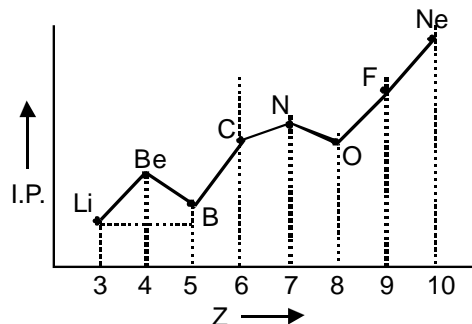


13. If the value of Avogadro number ( $N_A$ ) be taken as  $1.2 \times 10^{23} \text{ mol}^{-1}$ , then the molar mass of  $\text{O}_2$  will become  
 (a)  $5 \times 32 \text{ g mol}^{-1}$  (b)  $32 \text{ g mol}^{-1}$  (c)  $32 \times 1.2 \times 10^{23} \text{ g mol}^{-1}$  (d)  $32 \times 1.2 \text{ g mol}^{-1}$
14. Correct order of dipole moment is :

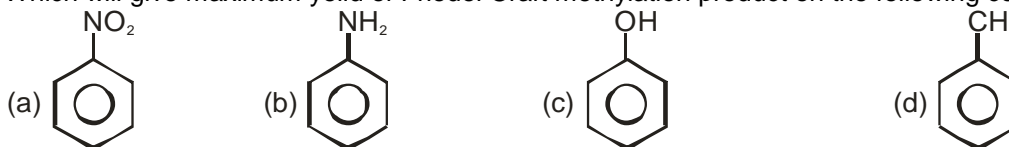


- (a)  $I = II = III$  (b)  $I < II < III$  (c)  $I > II > III$  (d)  $II < III < I$

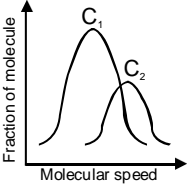
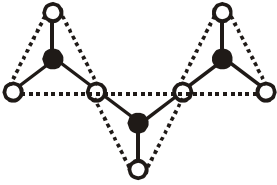
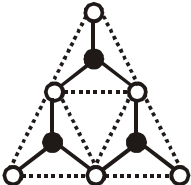
15. Following graph shows the variation of Ionisation potential with atomic number in second period ( $\text{Li} \rightarrow \text{Ne}$ ). The value of ionization potential of Na ( $Z = 11$ ) will be :  
 (a) Above Ne (b) below Ne but above O  
 (c) Below Li (d) between N and O




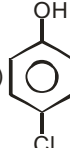
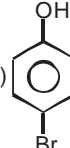
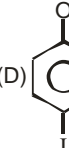
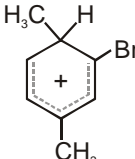
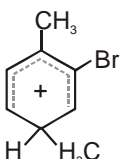
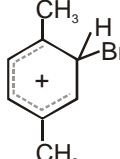
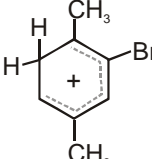
16. Which will give maximum yield of Friedel Craft methylation product on the following compound



**Space For Rough Work**

17. Carbon atoms in  $C_2(CN)_4$  are :  
 (a)  $sp$ -hybridized (b)  $sp^2$ -hybridized  
 (c)  $sp$  and  $sp^2$  hybridized (d)  $sp^3$ ,  $sp$  and  $sp^2$  hybridized
18. Ammonium sulphate, a common fertilizer used by gardeners is produced commercially by passing gaseous ammonia into an aqueous solution, that is 65%  $H_2SO_4$  by mass and has density of 1.55 gm/ml. The volume of sulphuric acid required to convert 1.00 kg  $NH_3$  to  $(NH_4)_2SO_4$  is  
 (a) 6.8 L (b) 2.9 L (c) 6.3 L (d) 3.5 L
19. The distribution of molecular speeds for  $CO_2$  at different temperature is given below, which of the following statement is **incorrect** ?  
 (a) It represent Maxwell's distribution curve.  
 (b) Temperature of  $C_2$  graph is more than that of  $C_1$   
 (c) The average velocity of molecules in  $C_2$  graph is more than  $C_1$   
 (d) Velocity  $\propto \frac{1}{\sqrt{M}}$ , therefore molecular mass of molecules in  $C_1 > C_2$
- 
20. Neelotpal is comparing Vander Waals equation with Virial equation for one mol of real gas.  
 Vander Waals equation  $\left(p + \frac{a}{V^2}\right)(V - b) = RT$  Virial equation  $Z = 1 + \frac{x}{V} + \frac{y}{V^2} + \dots$   
 In terms of Vander Waals constants, second coefficient of Virial equation is  
 (a)  $\frac{8a}{27Rb}$  (b)  $b - \frac{a}{RT}$  (c)  $\frac{a}{27b^2}$  (d)  $3b$
21. Stability of trivalent and monovalent cation of group III A (boron family) will be order :  
 (a)  $Ga^{3+} < In^{3+} < Tl^{3+}$  (b)  $Ga^{3+} > In^{3+} > Tl^{3+}$  (c)  $Ga^+ > In^+ > Tl^+$  (d) None of these
22. Denver is trying to find heat of the following reaction  $H_2O \longrightarrow ^-OH + H^+ \quad \Delta H = ?$ . Its value will be :  
 (a) -13.7 kJ/mol (b) 57.5 kcal / mol (c) 13.7 kcal / mol (d) Can not be find
23.  $Si_3O_9^{6-}$  (having three tetrahedral) is represented as :  
 (a)  (b)   
 (c) Both (A) and (B) (d) None of these

**Space For Rough Work**

24.  $\Delta H - \Delta U$  for the formation of CO from its element at 298 K is :  
 (a)  $-1238.78 \text{ J mol}^{-1}$  (b)  $1238.78 \text{ J mol}^{-1}$  (c)  $-2477.57 \text{ J mol}^{-1}$  (d)  $2477.57 \text{ J mol}^{-1}$
25. Consider the following carbocation  
 (A)  $\text{CH}_3 - \text{CHCl} - \text{CH}_2 - \overset{+}{\text{C}}\text{H}_2$  (B)  $\text{CH}_2\text{Cl} - \text{CH}_2 - \text{CH}_2 - \overset{+}{\text{C}}\text{H}_2$   
 (C)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \overset{+}{\text{C}}\text{HCl}$  (D)  $\text{CH}_3 - \text{CH}_2 - \text{CHCl} - \overset{+}{\text{C}}\text{H}_2$   
 Arrange these carbocation in increasing order of stability :  
 (a)  $\text{C} < \text{D} < \text{A} < \text{B}$  (b)  $\text{B} < \text{C} < \text{A} < \text{D}$  (c)  $\text{D} < \text{A} < \text{B} < \text{C}$  (d)  $\text{A} < \text{B} < \text{C} < \text{D}$
26. Arrange the following compound in their increasing acidity order :  
 (A)  (B)  (C)  (D)   
 (a)  $\text{D} < \text{C} < \text{B} < \text{A}$  (b)  $\text{C} < \text{B} < \text{A} < \text{D}$  (c)  $\text{B} < \text{A} < \text{D} < \text{C}$  (d)  $\text{A} < \text{D} < \text{C} < \text{B}$
27. Identify the statement that is **incorrect** as far as structure of diborane is concerned  
 (a) There are two bridging hydrogen atoms in diborane  
 (b) Each boron atom forms four bonds in diborane  
 (c) All the hydrogen atoms are not in the same plane in diborane  
 (d) all B-H bonds in diborane are similar
28. Which of the following structures most closely represents an intermediate in the electrophilic bromination of para-xylene ?  
 (a)  (b)  (c)  (d) 
29. Basic lead carbonate is :  
 (a)  $\text{Pb}(\text{OH})_2 \cdot 2\text{PbCO}_3$  (b)  $\text{Pb}(\text{OH})_2 \cdot \text{Pb}(\text{CH}_3\text{COO})_2$   
 (c)  $\text{PbCO}_3$  (d)  $\text{PbCO}_3 \cdot \text{Pb}(\text{OH})_2$
30. Graphite conducts electricity because of :  
 (a) weak van der Waal's forces between layers  
 (b) covalent bonding between carbon atoms of layers  
 (c) delocalized electrons in each layer  
 (d)  $\text{sp}^2$  - hybridization of carbon atoms in each layer

**Space For Rough Work**

**SECTION – 3**  
**MATHS**

1. Maximum distance of any point on the curve  $2013x^2 - 4008xy + 2013y^2 = 1$  from origin is  
(a) 2013 (b) 9 (c) 3 (d)  $1/3$
2. The relation R on the set  $A = \{1, 2, 3, 4, 5, 6\}$  defined by  $R = \{(x, y) \mid x, y \in A \text{ and } y = 2x + 1\}$  is  
(a) Reflexive (b) Symmetric (c) Transitive (d) Equivalence
3. If a chord of the circle  $x^2 + y^2 - 4x - 2y - c = 0$  is trisected at the points  $\left(\frac{1}{3}, \frac{1}{3}\right)$  and  $\left(\frac{8}{3}, \frac{8}{3}\right)$ , then 'c' equals to  
(a) 10 (b) 20 (c) 40 (d) None of these
4. The expression  $\tan 55^\circ \cdot \tan 65^\circ \cdot \tan 75^\circ$  simplifies to  $\cot x^\circ$  where  $x \in (0, 90)$ , then x equals to :  
(a) 8 (b) 10 (c) 5 (d) 9
5. The value of the expression  $\log_{\sqrt{2}} \log_{1/4} \left( \cos \frac{\pi}{17} \cdot \cos \frac{2\pi}{17} \cdot \cos \frac{4\pi}{17} \cdot \cos \frac{8\pi}{17} \right)^4$  is  
(a) 17 (b) 13 (c) 8 (d) 6
6. If  $\lim_{x \rightarrow 0} \frac{\tan 3x}{\sin 7x} = |k - 1|$ , then k equals to  
(A)  $\frac{10}{7}, \frac{4}{7}$  (B)  $\frac{3}{7}, \frac{4}{7}$  (C)  $\frac{4}{7}, \frac{8}{7}$  (D)  $\frac{3}{7}$
7. The coefficient of  $t^{50}$  in  $(1+t^2)^{25}(1+t^{25})(1+t^{40})(1+t^{45})(1+t^{47})$  is  
(A)  $1 + {}^{25}C_5$  (B)  $1 + {}^{25}C_5 + {}^{25}C_7$  (C)  $1 + {}^{25}C_7$  (D) none of these
8. The expression  $P(x) = \left(\sqrt{x^5 - 1} + x\right)^7 - \left(\sqrt{x^5 - 1} - x\right)^7$  is polynomial of degree  
(A) 16 (B) 18 (C) 20 (D) 27
9. A 1.5 m tall boy is standing at some distance from a 30 m tall building. The angle of elevation from his eyes to the top of the building increases from  $30^\circ$  to  $60^\circ$  as he walks towards the building, then the distance he walked towards the building is  
(A) 19 m (B)  $19\sqrt{3}$  m (C) 17 m (D)  $17\sqrt{3}$  m

**Space For Rough Work**

10.  $-\frac{\pi}{2} < x < \frac{\pi}{2}$  and the sum to infinite number of terms of the series  $\cos x + \frac{2}{3} \cos x \sin^2 x + \frac{4}{9} \cos x \sin^4 x + \dots$  is finite, then  $x$  lies in the set
- (A)  $-\frac{\pi}{2} < x < \frac{\pi}{2}$       (B)  $-\frac{\pi}{6} < x < \frac{\pi}{6}$       (C)  $\frac{\pi}{6} < x < \frac{\pi}{2}$       (D)  $0 < x < \frac{\pi}{2}$
11. In a  $\triangle ABC$ ,  $a, b, A$  are given and  $c_1, c_2$  are two values of the third side  $c$ . The sum of the areas of two triangles with sides  $a, b, c_1$  and  $a, b, c_2$  is
- (A)  $\frac{1}{2}b^2 \sin 2A$       (B)  $\frac{1}{2}a^2 \sin 2A$       (C)  $b^2 \sin 2A$       (D) none of these.
12. If  $P$  is any general point on  $x + y = 2$  and  $A$  and  $B$  are respectively at  $(3, 5)$  and  $(6, 11)$ , then maximum possible value of  $|PA - PB|$  is
- (a)  $2\sqrt{5}$       (b)  $3\sqrt{5}$       (c)  $5\sqrt{2}$       (d) None of these
13. The value of  $\sum_{k=1}^{2013} \left( \sin \frac{2\pi k}{2014} - i \cos \frac{2\pi k}{2014} \right) =$
- (a) 1      (b) -1      (c)  $i$       (d)  $-i$
14. If  $x^2 + x + 1 = 0$ , then  $\sum_{n=1}^{2013} \left( x^n + \frac{1}{x^n} \right)^2 =$
- (a) 0      (b) 2013      (c) 4026      (d) None of these
15. If normals drawn to  $y^2 = 4x$  at  $(1, 2)$ ,  $(9, -6)$  and  $(\alpha, \beta)$  are concurrent then  $\alpha\beta =$
- (a) 0      (b) 4      (c) 8      (d) 16
16. For the hyperbola  $xy + 4 = 4x + 2y$  which of the following is not true ?
- (a)  $x = 2$  is an asymptote  
 (b)  $y = 4$  is an asymptote  
 (c)  $xy + 16 = 4x + 2y$  is the equation of the conjugate hyperbola  
 (d)  $xy + 12 = 4x + 2y$  is the equation of the conjugate hyperbola
17. If  $z \in \mathbb{C}$  the eccentricity of  $|z - (1 + 2i)| + |z - (-1 + 2i)| = 4$  is
- (a)  $\frac{1}{2}$       (b) 1      (c) 2      (d) None of these
18. The length of latusrectum of the parabola  $25[(x - 1)^2 + (y - 4)^2] = (3x + 4y - 4)^2$  is
- (a)  $3/5$       (b) 3      (c) 6      (d) 15

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**Space For Rough Work**

19. The equation of the line passing through the centre and bisecting the chord  $2013x + y - 1 = 0$  of the ellipse  $\frac{x^2}{1} + \frac{y^2}{2013} = 1$  is  
 (a)  $x = y$  (b)  $x = 2013y$  (c)  $2013x = y$  (d)  $x + 2013y = 0$
20. The locus of the feet of perpendiculars from the foci on any tangent of the ellipse  $\frac{x^2}{9} + \frac{y^2}{4} = 1$  is  
 (a)  $x^2 + y^2 = 4$  (b)  $x^2 + y^2 = 9$  (c)  $x^2 + y^2 = 13$  (d) None of these
21. If PSQ is the focal chord of the parabola  $y^2 = 8x$  such that SP = 6. Then the length of SQ is  
 (a) 6 (b) 4 (c) 3 (d) none of these
22. The equation of the circle passing through the point of intersection of the curves  $(2x+3y+19)(9x+6y-17) = 0$  and  $xy = 0$  is  
 (a)  $x^2 + y^2 + 137x + 63y - 303 = 0$  (b)  $4x^2 + 4y^2 + 137x + 63y - 323 = 0$   
 (c)  $18x^2 + 18y^2 + 137x + 63y - 323 = 0$  (d) None of these
23. The length of the common chord of the ellipse  $\frac{(x-1)^2}{9} + \frac{(y-2)^2}{4} = 1$  and the circle  $(x-1)^2 + (y-2)^2 = 1$ .  
 (a) 2 (b)  $\sqrt{3}$  (c) 4 (d) None of these
24. Eccentricity of the hyperbola whose asymptotes are given by  $3x + 2y - 5 = 0$  and  $2x - 3y - 5 = 0$  is  
 (a)  $\sqrt{2}$  (b)  $\frac{3}{2}$  (c) 2 (d) None of these
25. If all the real solutions of the equation  $4^x - (a-3)2^x + (a-4) = 0$  are non positive, then  
 (a)  $4 < a \leq 5$  (b)  $0 < a < 4$  (c)  $a > 4$  (d)  $a < 3$
26. If the centroid of a triangle lies at the origin and the coordinate of its two vertices are  $(-8, 7)$  and  $(9, 4)$  the area of the triangle is  
 (a)  $\frac{95}{6}$  (b)  $\frac{285}{2}$  (c)  $\frac{190}{3}$  (d) 285
27. The number of ordered triplets  $(a, b, c)$ ,  $a, b, c \in \mathbb{N}$ , such that  $a + b + c \leq 20$  is  
 (A) less than 100 (B) less than 1000 (C) equal to 1000 (D) more than 1000
28. In a hockey tournament, a total of 153 matches were played. If each team played one match with every other team, the total number of teams that participated in the tournament were  
 (A) 20 (B) 18 (C) 16 (D) 14
29. If  $x = 9$  is the chord of contact of the hyperbola  $x^2 - y^2 = 9$ , then the equation of the corresponding pair of tangent is  
 (A)  $9x^2 - 8y^2 + 18x - 9 = 0$  (B)  $9x^2 - 8y^2 - 18x + 9 = 0$   
 (C)  $9x^2 - 8y^2 - 18x - 9 = 0$  (D)  $9x^2 - 8y^2 + 18x + 9 = 0$
30. If tangent at a point on the hyperbola  $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$  cuts the axis at A and B and rectangle OAPB is completed, then locus of point P is given by (when O is the centre of the hyperbola)  
 (A)  $\frac{a^2}{x^2} - \frac{b^2}{y^2} = 1$  (B)  $\frac{a^2}{y^2} + \frac{b^2}{x^2} = 1$  (C)  $\frac{a^2}{y^2} - \frac{b^2}{x^2} = 1$  (D)  $\frac{x^2}{a\sqrt{1-b^2}} + \frac{y^2}{b\sqrt{1-a^2}} = 1$

**ANSWERS**

Que. No.	PHYSICS		CHEMISTRY		MATHS	
	C.Code	Answer	C.Code	Answer	C.Code	Answer
1	P111010	C	C111208	C	M111404	D
2	P111012	D	C110106	A		C
3	P110602	A	C110305	D	M110804	B
4	P110717	B	C111804	B	M111412	C
5	P110802	C	C110501	D	M111416	D
6	P110502	C	C110502	C	M110603	A
7	P110413	A	C110507	A	M110410	A
8	P110310	A	C110104	D	M110414	A
9	P110205	A	C110402	C	M111311	B
10	P110301	B	C111801	C	M110503	A
11	P110321	B	C110501	A	M111502	A
12	P110505	A	C111201	A	M110701	B
13	P110108	A	C110202	B	M110307/8	C
14	P111101	B	C110304	C	M110307	C
15	P111029	B	C110703	C	M110915	D
16	P111302	D	C111102	D	M111123/4	C
17	P111306	D	C110305	C	M111001	A
18	P111309	A	C111101	B	M110902	C
19	P111304	D	C111206	D	M111010	A
20	P111313	D	C111204	B	M111007	B
21	P111205	A	C111501	B	M110910	C
22	P111221	B	C111909	C	M110803	C
23	P110901	A	C111608	B	M111024	D
24	P111222	D	C111903	B	M111128	A
25	P111203	B	C111303	C	M110109	A
26	P111303	C	C111302	D	M110708	B
27	P111204	B	C111506	D	M111218	D
28	P111221	A	C111804	C	M111210	B
29	P111209	C	C111610	A	M111110	B
30	P110707	C	C111602	C	M111106	A