

Test ID					
Student ID					

**Time: 45 Minutes**

**Maximum Marks: 96**

**Important Instructions**

1. The test is of **45 minutes** duration.
2. The Test consists of **18** questions. The maximum marks are **72**.
3. There are three parts in the question paper. The distribution of marks subject wise in each part is as under for each correct response.

**Part A – Physics (32 marks)** – Questions No. 1 to 3 and 6 consist of **FOUR (4)** marks each and Questions No. 4 and 5 consist of **EIGHT (8)** marks each for each correct response.

**Part B – Math (32 marks)** – Questions No. 7 to 9 and 12 consist of **FOUR (4)** marks each and Questions No. 10 and 11 consist of **EIGHT (8)** marks each for each correct response.

**Part C – Chemistry (32 marks)** – Questions No. 13 to 15 and 18 consist of **FOUR (4)** marks each and Questions No. 16 and 17 consist of **EIGHT (8)** marks each for each correct response.

4. Candidates will be awarded marks as stated above in Instruction No. 3 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.

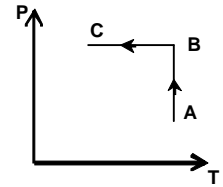
**Part 1 (Physics)**

1. A particle of mass  $m$  is acted upon by a force  $F = F_0 \cos\left(\frac{\pi}{2}t\right)$ . The distance travelled by the particle when it stops first (initial velocity of the particle is zero) is

- (A)  $\frac{2F_0}{m\pi}$                       (B)  $\frac{4F_0}{\pi^2 m}$                       (C)  $\frac{8F_0}{m\pi^2}$                       (D) zero

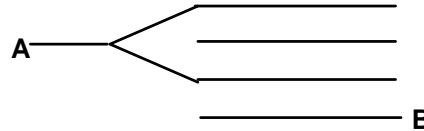
2. Ideal gas is taken through the process shown in the figure

- (A) In process AB, work done by system is positive.  
 (B) In process AB, heat is rejected.  
 (C) In process AB, internal energy increases .  
 (D) In process AB internal energy decreases and in process BC, internal energy increases.



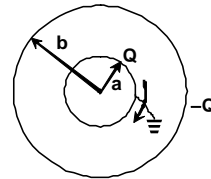
3. Four conducting plates are arranged parallel to each other. If separation between them is  $D$  and area of each plate is  $A$ , the capacitance between points A and B is

- (A)  $\frac{\epsilon_0 A}{D}$                       (B)  $\frac{\epsilon_0 A}{3D}$   
 (C)  $\frac{3\epsilon_0 A}{D}$                       (D)  $\frac{\epsilon_0 A}{2D}$

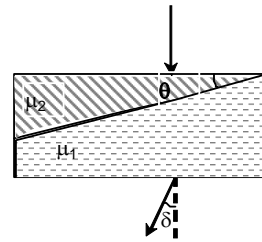


4. Two conducting and concentric spherical shells of radius  $a$  and  $b$  are shown in the figure. The initial charges on the shells are  $Q$  and  $-Q$ . If the inner shell is earthed, then

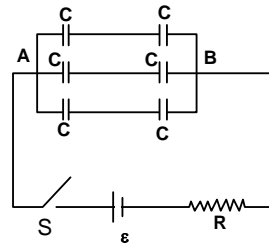
- (A) charge  $Q$  will flow from shell to the ground.  
 (B) no charge will flow from shell to the ground.  
 (C) charge  $(1 - a/b)Q$  will flow to the ground.  
 (D) charge  $(1 - b/a)Q$  will flow from the ground to the shell.



5. A ray of light falls perpendicularly at the surface of composite glass slab, made of two materials of refractive index  $\mu_1$  and  $\mu_2$  respectively, as shown in the figure. The angle  $\theta$  is very small. The deviation of the ray is



- (A) zero (B)  $(\mu_1 + \mu_2)\theta$   
 (C)  $(\mu_2 - \mu_1)\theta$  (D)  $(1 - \mu_1)\theta$
6. Find the total loss of energy in the circuit due to heating in the resistance after the switch has been closed for a long time. Initially all the capacitors are uncharged



- (A)  $\frac{3}{4}C\epsilon^2$  (B)  $\frac{6}{5}C\epsilon^2$   
 (C)  $\frac{5}{4}C\epsilon^2$  (D)  $\frac{5}{2}C\epsilon^2$

**Part 2 (Mathematics)**

7. If  $z^5 = (z-1)^5$ , then the roots are represented in the argand plane by the points that are  
 (A) collinear (B) concyclic (C) vertices on a parallelogram (D) none of these
8. If  $\theta, \phi \in R$ , then the determinat  $\Delta = \begin{vmatrix} \cos \theta & -\sin \theta & 1 \\ \sin \theta & \cos \theta & 1 \\ \cos(\theta + \phi) & -\sin(\theta + \phi) & 0 \end{vmatrix}$  lies in  
 (A)  $[-\sqrt{2}, \sqrt{2}]$  (B)  $[-1, 1]$  (C)  $[-\sqrt{2}, 1]$  (D)  $[-1, \sqrt{2}]$
9. Let  $f(x) = (x-4)(x-5)(x-6)(x-7)$  then  
 (A)  $f'(x) = 0$  has four real roots (B) three roots of  $f'(x) = 0$  lie in  $(4,5) \cup (5,6) \cup (6,7)$   
 (C) the equation  $f'(x) = 0$  has only two roots (D) three roots of  $f'(x) = 0$  lie in  $(3,4) \cup (4,5) \cup (5,6)$
10. Equation of a circle having radius equal to twice the radius of the circle  $x^2 + y^2 + (2p+3)x + (3-2p)y + p-3 = 0$  and touching it at the origin is  
 (A)  $x^2 + y^2 + 9x - 3y = 0$  (B)  $x^2 + y^2 - 9x + 3y = 0$  (C)  $x^2 + y^2 + 18x + 6y = 0$  (D)  $x^2 + y^2 + 18x - 6y = 0$

**From Question 11 and 12.**

**This section contains two questions. Each question consists of two statements, an Assertion (A) and Reason(R).**

**Select your option to each question according to the following code :**

- (A) Both A and R are true, and R is a correct explanation of A  
 (B) Both A and R are true, but R is not a correct explanation of A  
 (C) A is true and R is false  
 (D) A is false and R is true.

11. Assertion (A) : Derivative of  $\sin^{-1}\left(\frac{2x}{1+x^2}\right)$  with respect to  $\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$  is 1 for  $0 < x < 1$ .

Reason (R) :  $\sin^{-1}\left(\frac{2x}{1+x^2}\right) = \cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$  for  $-1 \leq x \leq 1$

- (A) A (B) B (C) C (D) D

12. Assertion (A) : The points (2, 1) and (-3, 5) lie on opposite side of the line  $3x - 2y + 1 = 0$ .

Reason (R) : The algebraic perpendicular distance from the given point to the line have opposite sign.

- (A) A (B) B (C) C (D) D

**Part 3 (Chemistry)**

13. If the uncertainties of position and velocity of a particle of mass  $m$  are equal, the uncertainty of position would be :

- (A)  $\sqrt{\hbar}$                       (B)  $\sqrt{\frac{\hbar}{2m}}$                       (C)  $\sqrt{2\hbar m}$                       (D)  $m\sqrt{\frac{\hbar}{2}}$

14. Which of the following is correct w.r.t. the covalent character ?

- (A)  $\text{NaCl} < \text{NaBr} < \text{NaI} < \text{NaF}$                       (B)  $\text{NaF} < \text{NaCl} < \text{NaBr} < \text{NaI}$   
 (C)  $\text{NaI} < \text{NaBr} < \text{NaCl} < \text{NaF}$                       (D)  $\text{NaF} < \text{NaBr} < \text{NaI} < \text{NaCl}$

15. For the reaction,  $2\text{NH}_3 \rightleftharpoons \text{N}_2 + 3\text{H}_2$  equilibrium constants at  $25^\circ\text{C}$  and  $400^\circ\text{C}$  respectively are 3.5 and 35. This means that the forward reaction is :

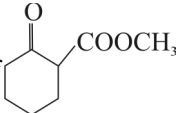
- (A) exothermic                      (B) endothermic                      (C) exergic                      (D) unpredictable

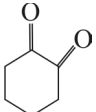
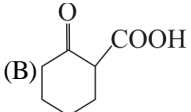
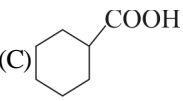
16. Gold numbers of starch, gelatin and albumin are respectively 25, 0.01 and 0.15. Which of the following is the correct decreasing order of protective power ?

- (A) Starch > gelatin > albumin                      (B) Starch > albumin > gelatin  
 (C) Gelatin > albumin > starch                      (D) Data is insufficient to decide

17. Specific rotation of an optically active pure compound 'X' is  $+30^\circ$ . A mixture with its enantiomer 'Y' gave specific rotation  $+10^\circ$ . The X:Y ratio in the mixture is:

- (A) 2:1                      (B) 1:2                      (C) 1:3                      (D) 3:1

18. Distillation of a mixture of  and dilute  $\text{H}_2\text{SO}_4$  will give:

- (A)                       (B)                       (C)                       (D) 