| SUBJECTS	XI STD	DT -85	JEE QP
PHYSICS	**THERMODYNAMICS (S1)**		
CHEMISTRY	**GENERAL ORGANIC CHEMISTRY SOME BASIC PRINCIPLES AND TECHNIQUES (S7)**		
MATHS	**COMPLEX NUMBERS (S2)**		
TOTAL MARKS – 120		***DURATION – 40 mins***	
EACH QUESTION CARRIES 4 MARKS. (-1 MARK) FOR WRONG ANSWER.			

PHYSICS

1. In a thermodynamic process, 200 joules of heat is given to a gas and 100 joules of work is also done on it. The change in internal energy of the gas is
   a) 100 J   b) 300 J   c) 419 J   d) 24 J

2. In a given process for an ideal gas, $dW = 0$ and $dQ < 0.$ Then for the gas,
   a) The temperature will decrease   b) The volume will increase
   c) The pressure will remain constant   d) The temperature will increase

3. The specific heat of hydrogen gas at constant pressure is $C_P = 3.4 \times 10^3 \text{cal kg}^{-1} \,^{\circ}\text{C}^{-1}$ and at constant volume is $C_V = 2.4 \times 10^3 \text{ cal kg}^{-1} \,^{\circ}\text{C}^{-1}$. If one kilogram hydrogen gas is heated from 10°C to 20°C at constant pressure, the external work done on the gas to maintain it at constant pressure is
   a) 10^5 cal   b) 10^4 cal   c) 10^3 cal   d) 5×10^3 cal

4. A system is provided with 200 cal of heat and the work done by the system on the surrounding is 40 J. Then its internal energy
   a) Increases by 600 J   b) Decreases by 800 J
   c) Increases by 800 J   d) Decreases by 50 J

5. A perfect gas goes from state *A* to another state *B* by absorbing 8×10^5 J of heat and doing 6.5×10^5 J of external work. It is now transferred between the same two states in another process in which it absorbs 10^5 J of heat. Then in the second process,
   a) Work done on the gas is 0.5×10^5 J   b) Work done by gas is 0.5×10^5 J
   c) Work done on the gas is 10^5 J   d) Work done by the gas is 10^5 J

6. In an isothermal expansion,
   a) Internal energy of the gas increases
   b) Internal energy of the gas decreases
   c) Internal energy remains unchanged
   d) Average kinetic energy of gas molecules decreases

7. A cylinder fitted with a piston contains 0.2 moles of air at temperature 27°C. The piston is pushed so slowly that the air within the cylinder remains in thermal equilibrium with the surroundings. Find the approximate work done by the system if the final volume is twice the initial volume.
   a) 543 J   b) 345 J   c) 453 J   d) 600 J

8. A monoatomic gas $(\gamma = 5/3)$ is suddenly compressed to $\dfrac{1}{8}$ of its original volume adiabatically. Then the pressure of the gas will change to *x* times its initial pressure. Find *x*.
   a) $\dfrac{24}{5}$ b) 8   c) $\dfrac{40}{3}$ d) 32

9. An ideal gas at $27°C$ is compressed adiabatically to $\dfrac{8}{27}$ of its original volume. If $\gamma = \dfrac{5}{3}$, then the rise in temperature is

a) 450 K   b) 375 K   c) 225 K   d) 405 K

10. A container having 1 mole of a gas at a temperature $27°C$ has a movable piston which maintains at constant pressure in container of 1 atm. The gas is compressed until temperature becomes $127°C$. The work done is nearly (C_p for gas is $7.03\,\text{cal mol}^{-1}\text{K}^{-1}$)

a) 703 J   b) 814 J   c) 121 J   d) 2035 J

CHEMISTRY
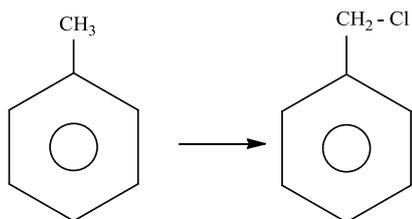
11.

The above reaction proceeds through

a) Nucleophilic substitution   b) Electrophilic substitution

c) Free radical substitution   d) More than one of the above processes

12. In electrophilic substitution reaction nitrobenzene is

a) Meta-directing   b) Ortho-directing

c) Para-directing   d) Not reactive and does not undergo any substitution

13. Geometry of reaction intermediate in SN^1 reaction is

a) Tetrahedral   b) Planar

c) Triangular bipyramidal   d) None of these

14. In which type of reaction do two molecules combine to form a single product?

a) Polymerization   b) Substitution

c) Elimination   d) Addition

15. Which is an electrophile.

a) BCl_3 b) CH_3OH c) NH_3 d) $AlCl_4^-$

16. The following compound will undergo electrophilic substitution more readily than benzene

a) Nitrobenzene   b) Benzoic acid

c) Benzaldehyde   d) Phenol

17. $CH_3 - Br + NH_3 \rightarrow CH_3 - NH_2 + HBr$

The above reaction is classified as

a) Substitution   b) Addition

c) Elimination   d) Rearrangement

18. Consider the following carbocations

A)   B)

C)   D) $CH_3 - \overset{\oplus}{C}H_2$
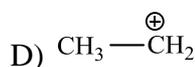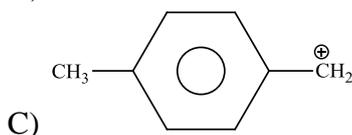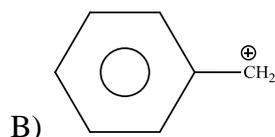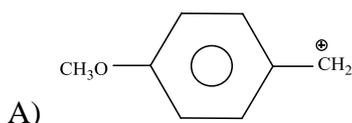
The relative stabilities of these carbocations are such that

a) $D < B < C < A$ b) $B < D < C < A$

c) $D < B < A < C$ d) $B < D < A < C$

19. The substitution reaction among the following is:

a)

b)

C=O+NaHSO$_3$ $\longrightarrow$ C (with OH, SO$_3$Na)

c)

$CH_3 - C - OH +$ (with CH$_3$ top, CH$_3$ bottom) $\xrightarrow[\text{Lucas reagent}]{\text{Dry HCl / Anhy.ZnCl}_2}$ $CH_3 - C - Cl$ (with CH$_3$ top, CH$_3$ bottom)

d)

$(CH_3)_2\ C = CH_2 + BrCl \longrightarrow (CH_3)_2\ C - CH_2$ (with Br top, Cl bottom)

20. The most common type of reaction in aromatic compounds is
   a) Elimination reaction   b) Addition reaction
   c) Electrophilic substitution reaction   d) Rearrangement reaction

MATHS

21. Let $z = \dfrac{\cos\theta + i\sin\theta}{\cos\theta - i\sin\theta}, \dfrac{\pi}{4} < \theta < \dfrac{\pi}{2}$. then, arg (z) =

   a) 2θ b) $2\theta - \pi$ c) $\pi + 2\theta$ d) None of these

22. If z = a + ib satisfies arg(z - 1) = arg(z + 3i), then (a - 1) : b =

   a) 2:1   b) 1:3   c) -1:3   d) None of these

23. The value of $\displaystyle\sum_{n=1}^{10}\left(\sin\frac{2n\pi}{11} - i\cos\frac{2n\pi}{11} \right)$, is

   a) -1   b) 0   c) -i   d) i

24. If $x^2+x+1 = 0$, then the value of $\left(x+\dfrac{1}{x} \right)^2 + \left(x^2 + \dfrac{1}{x^2} \right)^2 + ... + \left(x^{27} + \dfrac{1}{x^{27}} \right)^2$, is

   a) 27   b) 72   c) 45   d) 54

25. The number of solutions of the equation $z^2 + \bar{z} = 0$ is
   a) 1   b) 2   c) 3   d) 4

26. If z_1 and z_2 are two of the 8th roots of unity such that $\arg\left(\dfrac{z_1}{z_2} \right)$ is least positive, then $\dfrac{z_1}{z_2}$ is

   a) 1 + i   b) 1 - i   c) $\dfrac{1+i}{\sqrt{2}}$ d) $\dfrac{1-i}{\sqrt{2}}$

27. Let $z_k = \cos\left(\dfrac{2k\pi}{10} \right) + i\sin\left(\dfrac{2k\pi}{10} \right); k = 1,2,...,9$. Then, $\dfrac{1}{10}\left\{ |1 - z_1||1 - z_2|.....|1 - z_9| \right\}$ equals

   a) 0   b) 1   c) 2   d) 3

28. If figure a point 'z' is equidistant from three distinct points z_1, z_2 and z_3 in the argand plane. If z, z_1 and z_2 are collinear, then $\arg\left(\dfrac{z_3 - z_1}{z_3 - z_2}\right)$ will be (z_1, z_2, z_3 are in anticlockwise sense)
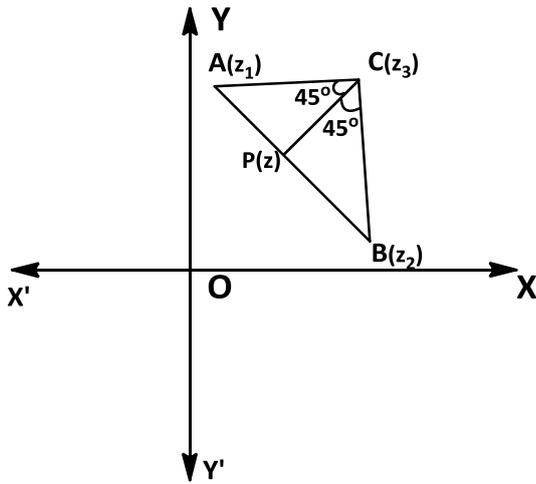
a) $\dfrac{\pi}{2}$ b) $-\dfrac{\pi}{2}$ c) $\dfrac{\pi}{6}$ d) $\dfrac{2\pi}{3}$

29. Let $|z_i| = i$, $i = 1,2,3,4$ and $|16z_1z_2z_3 + 9z_1z_2z_4 + 4z_1z_3z_4 + z_2z_3z_4| = 48$, then the value of $\left|\dfrac{1}{\overline{z_1}} + \dfrac{4}{\overline{z_2}} + \dfrac{9}{\overline{z_3}} + \dfrac{16}{\overline{z_4}}\right|$ is equal to

a) 1   b) 2   c) 4   d) 8

30. If $x^2 + x + 1 = 0$, then the value of $\left(x + \dfrac{1}{x}\right)^2 - \left(x^2 + \dfrac{1}{x^2}\right)^2 + \left(x^3 + \dfrac{1}{x^3}\right)^2 - .... - \left(x^{30} + \dfrac{1}{x^{30}}\right)^2$, is

a) 30   b) -1   c) 1   d) 0