

## MATHEMATICS

**NOTE:-**

1. Attempt all questions.
2. Rough work must be enclosed with answer book.
3. There is no negative marking.
4. Answer each of Sections A, B, C at one place.
5. Use of calculators, slide rule, graph paper and logarithmic, trigonometric and statistical tables is not permitted.

**Note:-** All answers to questions in **Section-A**, **Section-B** and **Section-C** must be supported by mathematical arguments. In each of these sections order of the questions must be maintained.

## SECTION-A

**This section has Four Questions. Each question is provided with 4 alternative answers. Exactly one of them is the correct answer. Indicate the correct answer by A, B, C, D.** (4x3=12 MARKS)

1. If the roots of  $2016x^2 + bx + c = 0$  are  $5/63, -7/32$  then  $b + 6c$  is equal to  
A) 71 B) 491 C) -491 D) -37
2. P is a point between the parallel lines  $\overleftrightarrow{AB}, \overleftrightarrow{CD}$  such that A and C lie on the same side of the line perpendicular to the parallel lines and passing through P.  $\angle PAB = 40^\circ$  and  $\angle PCD = 60^\circ$  then  $\angle APC =$   
A)  $20^\circ$  B)  $60^\circ$  C)  $80^\circ$  D)  $100^\circ$
3. Let  $a = (\sqrt[3]{2} - 1)^{1/3}$ ,  $b = \sqrt[3]{\frac{1}{9}} - \sqrt[3]{\frac{2}{9}} + \sqrt[3]{\frac{4}{9}}$  then  
A)  $a > b$  B)  $a = -b$  C)  $a = b$  D)  $a^3 = b$
4. In a triangle ABC right angled at A, AD is the altitude through A. If  $AD = 2$  and  $CD = 3$  then  $AB =$   
A)  $\sqrt{52}/5$  B)  $\sqrt{13}/3$  C)  $4\sqrt{13}/3$  D)  $\sqrt{52}/3$

## SECTION-B

**This section has Four Questions. In each question a blank is left. Fill in the blank.** (4x3=12 MARKS)

5. The sum of a two digit number and the number represented with the aid of the same digits but in the reverse order is a perfect square. The number of such two digit numbers is \_\_\_\_\_
6. In the Cartesian plane let  $O(0, 0)$ ,  $P(\cos \theta, \sin \theta)$ ,  $Q(-\sin \theta, \cos \theta)$  be the vertices of a triangle. Two circles drawn with OP, OQ as diameters intersect at R then  $OR =$  \_\_\_\_\_
7.  $p, q$  are positive integers. The number of ordered pairs  $(p, q)$ , such that the LCM of  $p$  and  $q$  is 12 is \_\_\_\_\_
8. If  $r$  and  $s$  are positive real numbers such that  $\log(rs) = 10$  and  $\log(r/s) = 2$  then  $3\log(r) + 5\log(s) =$  \_\_\_\_\_

## SECTION-C

**State True or False in each of the following statements.** (4x3=12 MARKS)

9. If the solution set of the equation  $\sqrt{x+3-4\sqrt{x-1}} + \sqrt{x+8-6\sqrt{x-1}} = 1$  is  $[a, b]$  then  $b - a = 5$
10. A class of 32 is counted off once beginning with number 1. Each student who counted an even number stood up. Then the students who were still seated counted off by once again. Each student who counted an even number also stood up. After the second counting was over, the number of students remained seated was 8.
11. If  $a, b$  are integers such that  $a^2 + b^2 = 29$  then the maximum value of  $|a - b| = 3$
12. Given a point P inside a circle, different from its centre, there is more than one chord through P having P as mid point.

## SECTION-D

(4x6=24 MARKS)

13. If  $f: \mathbf{R} \rightarrow \mathbf{R}$  is a function defined by  $f(x) = 2|x| + 3$  for every  $x$  in  $\mathbf{R}$  then draw the graph of  $f(f(x))$ .
14. E is a point on the side AC of a triangle ABC. D and F are points on the sides BC and AB respectively such that the line segments DE, FE are parallel to the sides AB and BC respectively. If  $\Delta_1, \Delta_2, \Delta_3$  are the areas of the quadrilateral BDEF, triangle AEF triangle CDE respectively then evaluate  $\frac{\Delta_1^2}{\Delta_2 \Delta_3}$ .
15. Find the number of integral solutions of  $5x^2 - 7y^2 = 9$ .
16. In a plane AB is a fixed line segment of length 8. P is a varying point in the same plane such that  $\overline{AB}$  subtends a right angle at P and the length of the perpendicular from P on to  $\overline{AB}$  is 3. Find the number of such points P.

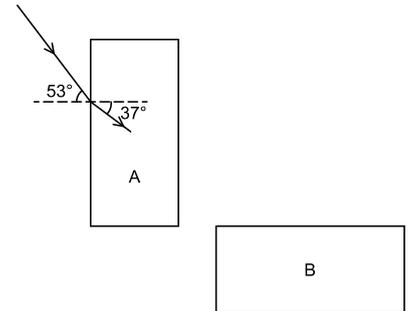
**PHYSICS (10 × 6 = 60 Marks)**

*Attempt all questions*

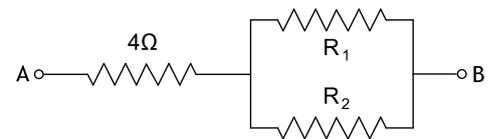
17. A car travels from A to B covering half the distance at  $v_1$  and the remaining half of the distance at  $v_2$ . This car then returns from B to A at  $v_3$ . If the time taken for the return journey from B to A is half of the time taken to go from A to B, find the relation between  $v_1$ ,  $v_2$  and  $v_3$ .

18. Equal volumes of two liquids A and B whose densities are in the ratio 1:2 are mixed to form a homogenous mixture. When a solid body C is dropped in to this mixture, it floats with half of its volume submerged. If the ratio of the volumes liquids A and B is changed to 2:1, find the fraction of the submerged volume of C.

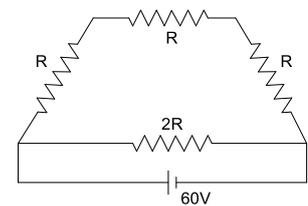
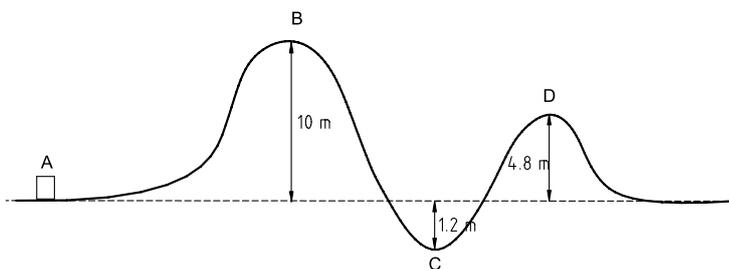
19. A ray of light is incident on the left face of a transparent slab A and is refracted in to it. Find the refractive index of the slab A. The ray emerging from the right face of the slab A is incident on top face of slab B and emerges through the bottom face of B. Find the angle between emergent ray from bottom face of B and the incident ray on the left face of A. ( $\sin 53^\circ = 4/5$  and  $\sin 37^\circ = 3/5$ )



20. Resistances  $R_1$  and  $R_2$  are in the ratio 1:2. Equivalent resistance between A and B is  $8 \Omega$ . Find  $R_1$  and  $R_2$ . If  $R_1$  is now doubled and a potential difference of 20 V is applied between A and B find the current flowing from A to B



21. A linear object AB of length 5 cm is placed along the principal axis of a convex mirror of radius of curvature 20 cm. If A and B are 5 and 10 cm from the pole of the mirror, find the length of the image.
22. On fission of  $U^{235}$  nucleus 200 MeV of energy is released. Assume 50% efficiency and find the number of  $U^{235}$  nuclei undergoing fission in 1 hour in a nuclear power plant of 200 MW. Also find the mass converted in to energy in this time. ( $1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$ , velocity of light  $c = 3 \times 10^8 \text{ m/s}$ )
23. A block of mass 4 kg is moving along a smooth curved path (below, left) in a vertical plane. Its kinetic energy at A is 600 J. Find least and largest velocities of the block as it moves along the path. (Assume  $g = 10 \text{ m/s}^2$ . Figure is not to scale)



24. In the circuit shown (above, right) current through  $2R$  is 3 A. Find the current through  $R$  if a 24 V cell replaces the 60 V cell.
25. A vertical wire carries current upward. A positively charged particle located east of the wire has a velocity directed a) upward b) westward. In each of the cases find the direction of the force on the wire.
26. One end of a cylindrical conducting rod is maintained at  $T_1$  and the other end at  $T_2$ . The amount of heat transferred from hotter end to colder end in 2 minutes is 200 J. If the radius and the length of the rod were doubled and same temperature difference were to be maintained between the ends, find the amount of heat transferred through this rod in 5 minutes. Given that heat transferred by a conducting rod is given by  $Q = \frac{KA(T_1 - T_2)t}{L}$

$$Q = \frac{KA(T_1 - T_2)t}{L}$$

where  $Q$  is the amount of heat transferred in time  $t$  by a conductor of length  $L$  and cross section  $A$  when its ends are maintained at  $T_1$  and  $T_2$ .  $K$  is the coefficient of thermal conductivity which is a property of the material of the conductor. (Ignore heat losses from the curved surfaces of the conductor)

# CHEMISTRY

Attempt all questions. Each question carries 3 marks.

**SECTION-A : Each question is provided with 4-alternative answers. One or more than one of them are correct answers. Indicate the correct answer by A,B,C,D.**

27. Ground state electronic configuration of chromium is against to  
A) Hund's rule                      B) Pauli's rule                      C) Aufbau's rule                      D) All
28. Which of the following pairs of ions have the same electronic configuration  
A)  $\text{Cr}^{+1}, \text{Fe}^{+3}$                       B)  $\text{Fe}^{+3}, \text{Mn}^{+2}$                       C)  $\text{Fe}^{+3}, \text{Cr}^{+3}$                       D)  $\text{Sc}^{+3}, \text{Cr}^{+3}$
29. The correct set of quantum numbers for the valence electron of sodium ( $Z=11$ ) is  
A) 4, 1, 0,  $\frac{1}{2}$                       B) 3, 0, 0,  $\frac{1}{2}$                       C) 5, 0, 0,  $\frac{1}{2}$                       D) none
30. The first I.P values of three elements are 1314, 1680, 2080  $\text{kJm}^{-1}$ . The correct sequence of elements is  
A) F, O and Ne                      B) F, Ne and O                      C) F, Ne and O                      D) O, F and Ne
31. Which pair of species has same percentage of carbon  
A)  $\text{CH}_3\text{COOH}$  and  $\text{C}_6\text{H}_{12}\text{O}_6$                       B)  $\text{CH}_3\text{COOH}$  and  $\text{C}_2\text{H}_5\text{OH}$   
C)  $\text{HCOOCH}_3$  and  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$                       D)  $\text{C}_6\text{H}_{12}\text{O}_6$  and  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$
32. For the reaction, the equilibrium constant values are given  $\text{A} \rightleftharpoons \text{B}$ ,  $K_1=2$ ;  $\text{B} \rightleftharpoons \text{C}$ ,  $K_2=4$ ;  
 $\text{C} \rightleftharpoons \text{D}$ ,  $K_3=3$ . The equilibrium constant for the reaction  $\text{A} \rightleftharpoons \text{D}$  is  
A) 48                      B) 24                      C) 6                      D) 12
33. The addition of HCl will not suppress the ionization of  
A) acetic acid                      B) sulphuric acid                      C) hydrogen sulphide                      D) benzoic acid
34. When a mixture of 10 moles of  $\text{SO}_2$  and 16 moles of  $\text{O}_2$  were passed over a catalyst, 8 moles of  $\text{SO}_3$  were formed at equilibrium. The number of moles of  $\text{SO}_2$  and  $\text{O}_2$  remaining unreacted were:  
A) 2, 12                      B) 12, 2                      C) 3, 10                      D) 10, 3
35. Which of the following compound(s) liberate gas on reaction with water?  
A)  $\text{Mg}_3\text{N}_2$                       B)  $\text{CaC}_2$                       C)  $\text{CaH}_2$                       D)  $\text{Ca}_3\text{P}_2$
36. For which of the following cases does the reaction go to nearly completion  
A)  $K=1$                       B)  $K=10^{-10}$                       C)  $K=10^{10}$                       D) none of these

**SECTION-B: In each question a blank or blanks are left. Fill in the blank(s) with relevant answer(s).**

37. Arrange in the increasing order of first I.Ps for Li, Be, B, C, N, O \_\_\_\_\_
38. To demonstrate volcanic eruption in science exhibitions ammonium dichromate is used ( $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$ ). Show balanced decomposition reaction of  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$  \_\_\_\_\_
39. Give the hybridization and no.of lone pairs over the central atom  

Molecule	Hybridization	No.of lone pairs
i) $\text{XeF}_4$	_____	_____
ii) $\text{ICl}_3$	_____	_____
iii) $\text{NH}_3$	_____	_____
40. The main oxides of Li, Na and K are formed when they are burnt in excess of air  
i) Li : \_\_\_\_\_                      ii) Na: \_\_\_\_\_                      iii) K: \_\_\_\_\_
41.  $\text{H}_3\text{C}-\text{CH}_2-\text{Br} + \text{H}_3\text{C}-\underset{\text{CH}_3}{\text{CH}}-\text{CH}_2-\text{Br} \xrightarrow[\text{dry ether}]{\text{Na}}$  Products  
In the above wurtz reaction, maximum no.of carbon atoms in one of the products is \_\_\_\_\_
42. 0.1 M HCl is diluted from 1 lit to 10 lit. The  $\text{p}^{\text{OH}}$  of the resulting solution is \_\_\_\_\_
43. In a reaction  $\text{A}+\text{B} \rightarrow \text{C}+\text{D}$ , 5  $\text{mol.L}^{-1}$  of 'A' is allowed to react with 3  $\text{mol L}^{-1}$  of 'B'. After 10 min the concentration of A was found to be 4  $\text{mol L}^{-1}$ . Rate of reaction with respect to 'A' is \_\_\_\_\_
44. No.of  $\text{Na}^+$  ions present in 100 ml of 1M solution of NaCl is \_\_\_\_\_
45. Arrange the following in increasing oxidation number of iodine:  $\text{I}_2$ , HI,  $\text{HIO}_4$  and ICl
46. At  $100^\circ\text{C}$   $\text{p}^{\text{Kw}}$  of water is 13 and its pH is 6.5. But  $\text{H}_2\text{O}$  is neutral because \_\_\_\_\_