Vidyamandir Classes
Gurukul for IITJEE Preparation

3HRT - 2/Aim-iiT-2016

22/12/2013	**CODE : AECG**	**M.M. : 240**
11.00 A.M. - 02.00 P.M.		**TIME : 3 hrs**

Read the following Instructions very carefully before you proceed.

The question paper contains **20 pages** and a total of 60 Objective type Questions. It has Three Parts : Part I : Chemistry, Part II : Physics and Part III : Mathematics. Each Part contains 20 questions. Each question has 4 choices (A), (B), (C) and (D), out of which **Only One choice is Correct.**

For each question in **Section - I**, you will be given **3 marks** if you have darkened only the bubble corresponding to the correct answer and zero marks if no bubble is darkened. In all other cases, **minus one (–1) marks (NEGATIVE MARKING)** will be given.

For each question in **Section - II**, you will be given **5 marks** if you have darkened only the bubble corresponding to the correct answer and zero marks if no bubble is darkened. In all other cases, **minus one (–2) marks (NEGATIVE MARKING)** will be given.

For answering a question, an **ANSWER SHEET (OMR SHEET)** is provided separately. Please fill your **Name, Roll Number, Seat ID** and the **PAPER CODE** properly in the space provided in the **ANSWER SHEET.**

IT IS YOUR OWN RESPONSIBILITY TO FILL THE OMR SHEET CORRECTLY.

A blank space has been provided on each page for rough work. You will not be provided with any supplement or rough sheet. However some blank pages for rough work are given at the end of this paper.

The use of log tables, calculator, mobile or any other electronic device is strictly prohibited.

There are no errors in the paper. Please do not disturb the invigilator or any other student for any corrections/suggestions in the paper. **Violating the examination room discipline will immediately leads to the cancellation of your paper and no excuses will be entertained.**

PART - I	CHEMISTRY

SECTION - I

This section contains 10 Single Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

Use the following Data where ever necessary :

Planck's Constant $h = 6.6 \times 10^{-34}$ J-s Avogadro's Number $N = 6.023 \times 10^{23}$

1. The physical quantity which is dependent on temperature is :
   (A) Molality (B) Mole Fraction (C) Molarity (D) Number of moles

2. Which of the following statements is correct :
   (A) Reduction involves loss of electrons (B) Oxidation involves gain of electrons.
   (C) Reduction involves gain of electrons (D) Washing soda is $NaHCO_3$

3. Which of the following devices is based on the principle of photoelectric effect?
   (A) Photovoltaic cell (B) Compound microscope
   (C) Electron microscope (D) Endoscope

4. Which of the following is a Redox reaction :
   (A) $Na_2SO_4 + BaCl_2 \longrightarrow 2NaCl + BaSO_4$
   (B) $Na_2CO_3 + 2HCl \longrightarrow 2NaCl + H_2O + CO_2$
   (C) $2Na_2S_2O_3 + I_2 \longrightarrow Na_2S_4O_6 + 2NaI$
   (D) $AgNO_3 + HCl \longrightarrow AgCl + HNO_3$

5. In the reaction $CuO + H_2 \longrightarrow Cu + H_2O$, the oxidising agent is :
   (A) CuO (B) H_2 (C) Cu (D) H_2O

6. The correct order of decreasing electronegativity for the elements N, O, F, S and Cl is:

(A) F > N > O > Cl > S (B) F > O > N > Cl > S

(C) Cl > F > O > N > S (D) Cl > F > N > O > S

7. Which one of these elements has the highest value of first ionization energy?

(A) C (B) N (C) O (D) Ne

8. Bohr's model is applicable to:

(A) Only H atom (B) Two electron atoms only

(C) Both one and two electron atoms (D) None of these

9. Which of the following is not an example of a metalloid?

(A) Si (B) Sn (C) Sb (D) Te

10. The atomic number of an element Y is 17. Its valency is:

(A) −1 (B) −7 (C) +1 (D) +3

SECTION - II

This section contains 10 Single Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

11. The label on a popular brand of bottled water claims to contain 35 mg of sodium chloride. The mass of $AgNO_3$ required to react with this amount of NaCl will be? (Molecular weight of $NaCl = 58.5 g\,mol^{-1}$, molecular weight of $AgNO_3 = 170\ g\ mol^{-1}$)

(A) 0.35 g **(B)** 0.25 g **(C)** 0.10 g **(D)** 0.53 g

12. A mixture of H_2 and He is kept in a closed vessel at 3 atm pressure and 27° C temperature. If the volume of the vessel is 0.0821 litres and the mole fraction of H_2 is $\frac{1}{4}$, then the number of moles of He are :

$(R = 0.0821\ L\ atm\ mol^{-1} K^{-1})$

(A) 0.0025 **(B)** 0.0075 **(C)** 0.025 **(D)** 0.075

13. The energy released (in ergs) when 2.5 gm atom of Hydrogen atoms undergo transition giving spectral line of lowest energy in visible region of its atomic spectra is:

(A) 4.56×10^{12} ergs **(B)** 3.65×10^{12} ergs **(C)** 4.56×10^{5} ergs **(D)** 3.65×10^{5} ergs

14. A sample (X) of concentrated H_2SO_4 has a density of 1.8 g/ml and contains 49% acid by weight. The molarity of a solution which is prepared by dissolving 100 ml of X in sufficient water to make 500 ml of solution will be:

(A) 9 M **(B)** 1.8 M **(C)** 18 M **(D)** 0.9 M

15. An organic compound X on reaction with six moles of oxygen forms six moles each of carbon di-oxide and water. X can be :

(A) Sucrose **(B)** Glucose **(C)** Oxalic Acid **(D)** Acetic Acid

16. The kinetic energy of an electron, when it is accelerated with a potential of 20 Mega Volts will be:
(Electronic charge $= 1.6 \times 10^{-19}$ C)

(A) 3.2×10^{-12} J **(B)** 10^{-12} J **(C)** 3.2×10^{-18} J **(D)** 1.6×10^{-19} J

17. An electron in a hydrogen like species, makes a transition from nth Bohr orbit to next outer Bohr $(\equiv n+1)$ orbit. The approximate relation between the dependence of the frequency (υ) of the photon absorbed as a function of 'n'. Assume n to be very large ($n >> 1$)

(A) $\upsilon \propto n^{-3}$ **(B)** $\upsilon \propto n^{-2}$ **(C)** $\upsilon \propto n^{2}$ **(D)** $\upsilon \propto n^{3}$

18. A radiation with $\lambda = 200$ nm falls on a metal surface. If the work function of the metal is 4.8×10^{-19} Joules, the potential required to stop the photoelectrons at the metal surface is?

(A) 6.2 V **(B)** 3.0 V **(C)** 3.2 V **(D)** None of these

19. The maximum number of lines that can be emitted when an electron in H atom in n = 6 state de-excites to the first excited state:

(A) 15 **(B)** 10 **(C)** 6 **(D)** zero

20. The wavelength of β line of Balmer series of Hydrogen atom is: ($R = 109677$ cm^{-1})

(A) 656.2 Å **(B)** 4862.8 Å **(C)** 6562.8 Å **(D)** 486.2 Å

PART - II	PHYSICS

SECTION - I

This section contains 10 Single Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

Use the following Data where ever necessary : $g = 10 m/s^2$

21. Maximum and minimum magnitudes of the resultant of two vectors of magnitudes P and Q are in the ratio 3 : 1, then :

(A) $P = 2Q$ **(B)** $P = Q$ **(C)** $PQ = 1$ **(D)** None of these

22. Two resistance R and $2R$ are connected in parallel in an electric circuit. The thermal energy developed in R and $2R$ are in the ratio

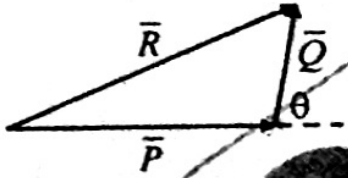
(A) 1 : 2 **(B)** 2 : 1 **(C)** 1 : 4 **(D)** 4 : 1

23. A positively charged particle projected towards East is deflected towards North by a magnetic field. The field may be:

(A) Towards west **(B)** Towards south **(C)** Upwards **(D)** Downward

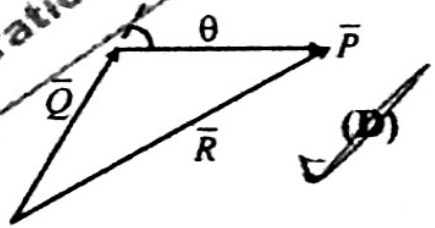
24. Which of the following representation is incorrect for vector equation $\bar{R} = \bar{P} + \bar{Q}$?

(A)

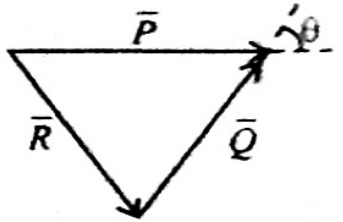


(B)

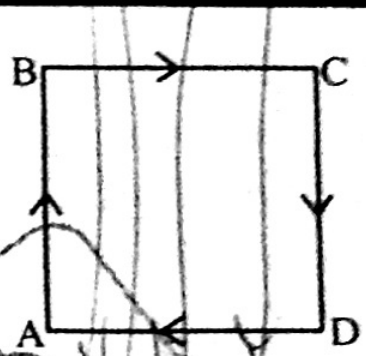
(C)



(D)



25. A rectangular current carrying loop is lying an a table, in a magnetic field from North to South. Selected the correct choice (regarding magnetic force):



(A) Force an BC and AD is maximum

(B) Force on AB and CD acts in same direction inwards

(C) Force on AB is the plane of paper while force on CD is upwards the plane of paper

(D) Force on AB is upwards the plane of paper while force on CD is inwards the plane of paper

26. Fleming's left and right hand rule are used in :

(A) DC motor and AC generator **(B)** DC generator and AC motor

(C) DC motor and DC generator **(D)** Both rules are same, any one can be used

27. A vector changes when we

(A) Rotate the coordinate axis **(B)** Slide the vector without changing its orientation

(C) Rotate the vector **(D)** All of the above

28. The magnetic field inside the solenoid:

(A) Decreases from North pole to south pole

(B) Increases from North pole to south pole

(C) There is no magnetic field inside the solenoid

(D) Uniform magnetic field

29. The magnitude of a given vector with ends point (4, −4, 0) and (−2, 2, 0) must be:

(A) 6 (B) $5\sqrt{2}$ (C) 4 (D) $2\sqrt{10}$

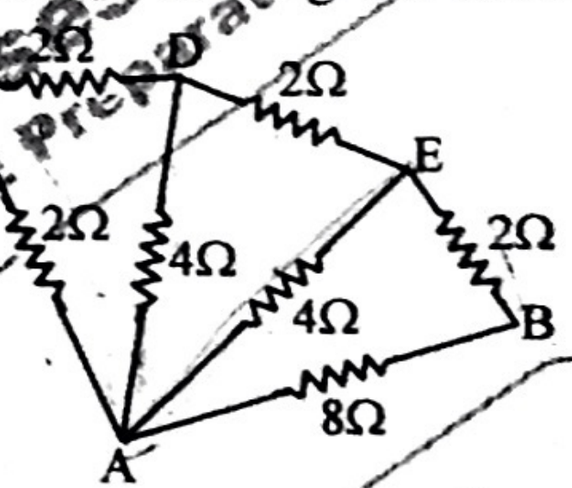
30. What is the equivalent resistance between A and B in the given circuit?

(A) 4 Ω

(B) 2 Ω

(C) $\frac{8}{3}\Omega$

(D) $\frac{3}{8}\Omega$



SECTION - II

This section contains 10 Single Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

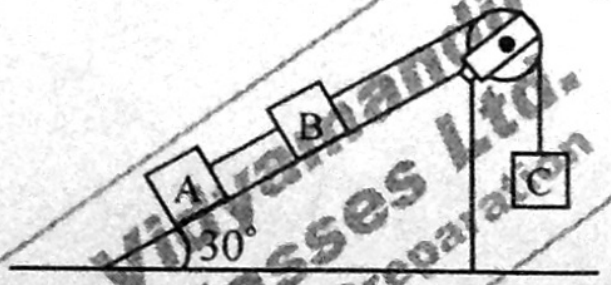
31. In the diagram shown, the blocks A and B are connected together by a string and placed on a smooth inclined plane. B is connected to C (which is suspended vertically) by another string which passes over a smooth pulley fixed to the plane. The system is at rest. If $W_A = 20\ N$, $W_B = 30\ N$, Then the value of W_C is :

(A) 10 N

(B) 15 N

(C) 20 N

(D) 25 N



32. The resultant of $\bar{P}$ and $\bar{Q}$ is perpendicular to $\bar{P}$. Then the angle between $\bar{P}$ and $\bar{Q}$ is:

(A) $\cos^{-1}(P/Q)$ **(B)** $\cos^{-1}(-P/Q)$ **(C)** $\sin^{-1}(P/Q)$ **(D)** $\sin^{-1}(-P/Q)$

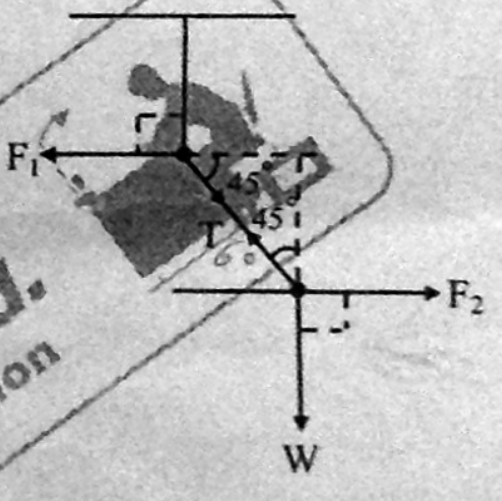
33. In the figure, the tension in the diagonal string is 60 N.
Then the magnitude of horizontal force F_1 is :

(A) 27 N

(B) 42.4

(C) 30 N

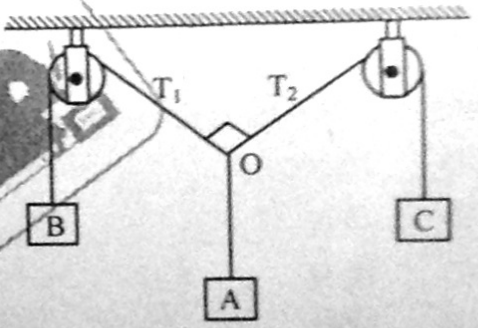
(D) None of these



34. The resistance of a 10 m long wire is 10Ω. Its length is increased by 25% by stretching the wire uniformly. The new resistance of the wire is :

(A) $12.5\ \Omega$ (B) $14.5\ \Omega$ (C) $15.6\ \Omega$ (D) $16.6\ \Omega$

35. Weights of B and C are 10 N and $10\sqrt{3}$ N respectively. Then the weight of A if the system in equilibrium.



(A) $10(\sqrt{3}+1)/\sqrt{2}\ N$

(B) $20\ N$

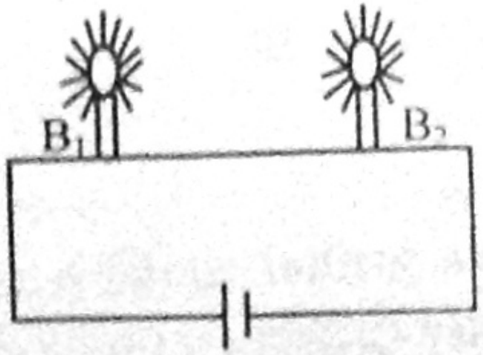
(C) $10(\sqrt{3}+1)\text{N}$

(D) $10\ N$

36. In the Question No. 35 the angle which T_2 makes with horizontal is:

(A) 45° (B) 30° (C) 60° (D) 37°

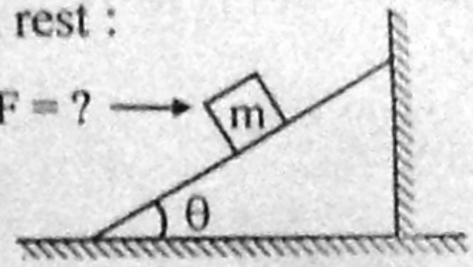
37. Bulb $B_1(100W - 250V)$ and bulb $B_2(100W - 200V)$ are connected across 250 V. The potential drop across B_2 is:



(A) 200 V (B) 250 V

(C) 98 V (D) 48 V

38. A block of mass m is placed on an incline against the wall as shown in figure and a force F applied in horizontal direction acts on the block m. The value of F for which the block remain at rest :



(A) $F = mg \cos\theta$ (B) $F = mg \tan\theta$

(C) $F = mg \sin\theta$ (D) $F = mg$

39. Six forces of magnitude 1, 2, 3, 4, 5 and 6 act along the sides of a regular hexagon, taken in order. Resultant has magnitude

(A) 2 (B) 3 (C) 4 (D) 6

40. A material B has twice the specific resistance of A. A circular wire made of B has twice the diameter of a wire made of A. Then for the two wires to have the same resistance, the ratio l_B/l_A of their respective lengths must be:

(A) 1 (B) 1/2 (C) 1/4 (D) 2

PART - III	MATHEMATICS

SECTION - I

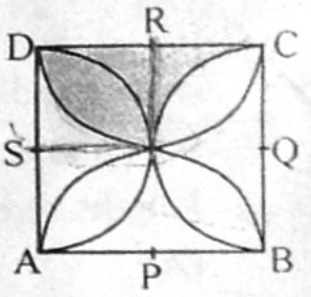
This section contains 10 Single Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

41. If the roots of the equation $ax^2 - bx + c = 0$ are α, β then the roots of the equation $b^2cx^2 - ab^2x + a^3$ are :

(A) $\frac{1}{\alpha^3 + \alpha\beta}, \frac{1}{\beta^3 + \alpha\beta}$ **(B)** $\frac{1}{\alpha^2 + \alpha\beta}, \frac{1}{\beta^2 + \alpha\beta}$

(C) $\frac{1}{\alpha^4 + \alpha\beta}, \frac{1}{\beta^4 + \alpha\beta}$ **(D)** None of these

42. In the adjacent figure, $ABCD$ is a square with side length = 8 cm and P, Q, R, S are mid points of its sides. Semi-circles have been drawn with P, Q, R, S as centres and sides of square as diameter. The area of the shaded region is:



(A) 4 cm^2 **(B)** 8 cm^2

(C) 16 cm^2 **(D)** 32 cm^2

43. The values of m for which the expression $2x^2 + mxy + 3y^2 - 5y - 2$ can be resolved into two linear factors are :

(A) ± 5 **(B)** ± 6 **(C)** ± 7 **(D)** None of these

44. If $a_1, a_2, a_3, \ldots\ldots, a_{2n}$ are in A.P. then the value of $a_1^2 - a_2^2 + a_3^2 - a_4^2 + \ldots\ldots + a_{2n-1}^2 - a_{2n}^2$ is equal to :

(A) $\frac{n}{2n-1}\left(a_1^2 - a_{2n}^2\right)$ **(B)** $\frac{2n}{n-1}\left(a_{2n}^2 - a_1^2\right)$ **(C)** $\frac{n}{n+1}\left(a_1^2 + a_{2n}^2\right)$ **(D)** None of these

45. Hari wishes to determine the distance between two objects A and B, but there is an obstacle between these two objects which prevents him from making a direct measurement. He devises an ingenious way to overcome this difficulty. First he fixes a pole at a convenient point O so that from O, both A and B are visible. Then he fixes another pole at the point D on the line AO (produced) such that $AO = DO$. In a similar way he fixes a third pole at the point C on the line BO (produced) such that $BO = CO$. Then he measures CD which is equal to 170 cm. Then the distance (in cm) between the objects A and B is :

(A) 85 **(B)** 265 **(C)** 170 **(D)** None of these

46. Two identical right circular cones each of height 2 cm are placed as shown in diagram (each is vertical, apex downward). At the start, the upper cone is full of water and lower cone is empty.

Then water drips down through a hole in the apex of upper cone into the lower cone. The height of water in the lower cone at the moment when height of water in upper cone is 1 cm is:

(A) 1 cm **(B)** $\sqrt{\frac{1}{2}}$ cm **(C)** $\sqrt[3]{\frac{1}{4}}$ cm **(D)** $\sqrt[3]{7}$ cm

47. A ball of diameter 13 cm is floating so that top of the ball is 4 cm above the smooth surface of the pond. The circumference (in cm) of the circle formed by the contact of water surface with the ball is :

(A) 3π **(B)** 6π **(C)** 9π **(D)** 12π

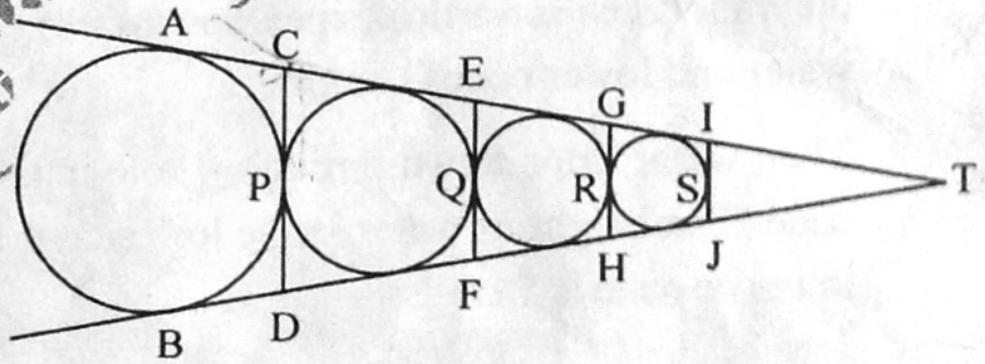
48. If α, β, γ are such that $\alpha + \beta + \gamma = 2$, $\alpha^2 + \beta^2 + \gamma^2 = 6$, $\alpha^3 + \beta^3 + \gamma^3 = 8$, then $\alpha^4 + \beta^4 + \gamma^4$ is:

(A) 18 **(B)** 10 **(C)** 15 **(D)** 36

49. A jogging park has two identical circular tracks touching each other and a rectangular track enclosing the two circles. The edges of the rectangles are tangential to the circles. Two friends, A and B, start jogging simultaneously from the point where one of the circular tracks touches the smaller side of the rectangular track, A jogs along the rectangular track while B jogs along the two circular tracks in a figure of eight. Approximately, how much faster than A does B have to run, so that they take the same time to return to their starting point? (*Take* $\pi = 3.1416$)

(A) 3.88 % **(B)** 4.22 % **(C)** 4.44 % **(D)** 4.72 %

50. In the adjoining figure, AT and BT are the two tangents at A and B respectively. CD is also a tangent at P. There are some more circles touching each other and the tangents AT and BT also. Which one of the following is true ?



(A) $PC + CT = PD + DT$

(B) $RG + GT = RH + HT$

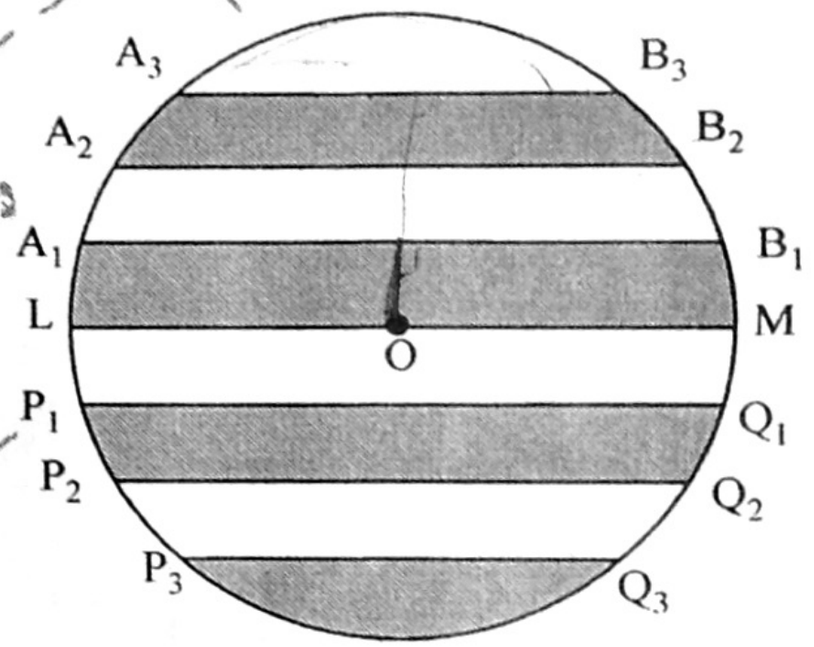
(C) $PC + QE = CE$

(D) All of the above

SECTION - II

This section contains 10 Single Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

51. In the adjacent figure, chords A_iB_i are parallel to P_iQ_i $(i = 1, 2, 3)$ and at a distance of i unit from centre of a circle $C(O, 4\ cm)$. The area of shaded region is :



(A) $4\pi\ cm^2$

(B) $8\pi\ cm^2$

(C) $32\pi\ cm^2$

(D) None of these

52. Let $x_1, x_2, x_3, \ldots\ldots, x_k$ be the all possible divisors of positive integer 'n' (including 1 and n).

If $x_1 + x_2 + x_3 + \ldots\ldots + x_k = 75$, then $\left(\frac{1}{x_1} + \frac{1}{x_2} + \ldots\ldots + \frac{1}{x_k}\right)$ is equal to :

(A) $\frac{75}{n^2}$ **(B)** $\frac{75}{n}$ **(C)** $\frac{75}{k}$ **(D)** $\frac{75}{k^2}$

53. In a ΔABC, AD, BE and CF are the altitudes from the vertices A, B, C respectively.
Which of the following holds good?

(A) $\Delta AEF \sim \Delta ABC$ **(B)** $\Delta AEF \sim \Delta DBF$ **(C)** Both (A) and (B) **(D)** None of these

54. Let r, s and t be the zeroes of the cubic expression $8x^3 + 1001x + 2008$.
The value of $(r+s)^3 + (s+t)^3 + (t+r)^3$ is :

[**Hint :** $ax^3 + bx^2 + cx + d = a(x-\alpha)(x-\beta)(x-\gamma)$ where α, β, γ are corresponding zeroes.]

(A) 251 **(B)** 751 **(C)** 735 **(D)** 753

55. Two circles with radii a and b respectively touch each other externally. Let c be the radius of a circle that touches these two circles as well as a common tangents to the two circles. Then which of the following is true ?

(A) $\frac{1}{\sqrt{c}} = \frac{1}{\sqrt{a}} + \frac{1}{\sqrt{b}}$ **(B)** $\frac{1}{\sqrt{c}} = \frac{1}{\sqrt{a}} - \frac{1}{\sqrt{b}}$ **(C)** $\frac{1}{\sqrt{c}} = \frac{1}{\sqrt{a}} - \frac{2}{\sqrt{b}}$ **(D)** None of these

56. If central angles corresponding to the sides of a cyclic quadrilateral are in A.P. with $20°$ as their common difference, then the area of cyclic quadrilateral is : (r = radius of the circumscribing circle to quadrilateral, Take $\sin 60° = 0.865$, $\sin 80° = 0.985$)

(A) $0.95\, r^2$ **(B)** $1.85\, r^2$ **(C)** $1.35\, r^2$ **(D)** None of these

57. The sum of first 24 terms of the A.P. $a_1, a_2, a_3, \ldots\ldots$ if it is known that $a_1 + a_5 + a_{10} + a_{15} + a_{20} + a_{24} = 225$ is:

(A) 1800 **(B)** 1350 **(C)** 900 **(D)** None of these

58. The number of integral ordered pair of a and b for which graph of a linear equation $\frac{x}{a} + \frac{y}{b} = 1$ passes through point (4, 3) is :

(A) 4 **(B)** 5 **(C)** 6 **(D)** 8

59. If a, b, c, d are distinct numbers in $A.P.$, then :

(A) $(a+1)(b+1) < (c+1)(d+1)$ **(B)** $(a+1)(d+1) < (b+1)(c+1)$

(C) $a + c < b + d$ **(D)** None of these

60. If a, b, c, d are four consecutive terms of an increasing A.P. then the roots of the equation $(x-a)(x-c) + 2(x-b)(x-d) = 0$ are :

(A) Non real **(B)** Real and equal **(C)** Integers **(D)** Real and distinct