FIITJEE - INTERNAL PHASE TEST

PHYSICS, CHEMISTRY & MATHEMATICS

CODE: 100870

Time Allotted: 3 Hours **Maximum Marks: 255**

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

INSTRUCTIONS

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

A. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains Three Parts.
3. **SECTION-I** is Physics, **SECTION -II** is Chemistry and **SECTION -III** is Mathematics.
4. Each **Section** is further divided into **Two Parts**: **Part-A & B** in the OMR.
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

B. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with ***Blue/Black Ball Point Pen*** for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Two Parts.

(i) **PART–A** (**01–07)** contains 7 Multiple Choice Questions which have **One or More Correct** answer.
For each question in the group **Q. 01 – 07** of **PART – A** you will be awarded
Full Marks: **+4** If only the bubble(s) corresponding to all the correct options(s) is (are) darkened.
Partial Marks: **+1** For darkening a bubble corresponding **to each correct option,** provided NO incorrect option is darkened.
Zero Marks: **0** If none of the bubbles is darkened.
***Negative Marks*: –1 In all other cases**.
For example, if **(A), (C) and (D)** are all the correct options for a question, darkening all these three will result in **+4 marks**; darkening only **(A) and (D)** will result in **+2 marks**; and darkening **(A) and (B)** will result in **–1** mark, as a wrong option is also darkened.

(ii) **Part-A (08-14) –** Contains seven (07) multiple choice questions which have **ONLY ONE CORRECT** answer Each question carries **+3 marks** for correct answer and **-1 marks** for wrong answer

(iii) **Part-A (15-18) -** This section contains Two paragraphs. Based on each table, there are Two multiple choice questions. Each question has **only one correct** answer and carries **+3 marks** for the correct answer. **There is no negative marking.**

(iv) **Part-A (19-20) –** This section contains Two (02) List-Match Sets, each List-Match set has One (01) Multiple Choice Questions. Each List-Match set has two lists: List-I and List-II. FOUR options are given in each Multiple Choice Question based On List-I and List-II and **ONLY ONE** of these four options satisfies the condition asked in the Multiple Choice Question. Each question carries **+3 Marks** for correct combination chosen and **-1 mark** for wrong options chosen.

(v) **Part-B (01-06)** contains six (06) Numerical based questions, the answer of which maybe positive or negative numbers or decimals to **Two decimal places** (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30) and each question carries **+3 marks** for correct answer. **There is no negative marking.**

Name of the Candidate :_____

Batch :_____ **Date of Examination :**_____

Enrolment Number :_____

BATCHES – Three Yr CRP427(R&W) & Four Year CRP327(R&W)_PT_3 + 4

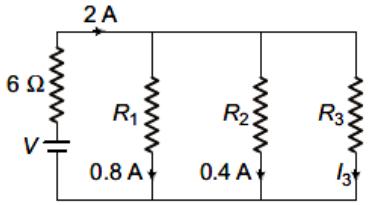
SECTION – I (PHYSICS)

PART – A

Multiple Correct Choice Type

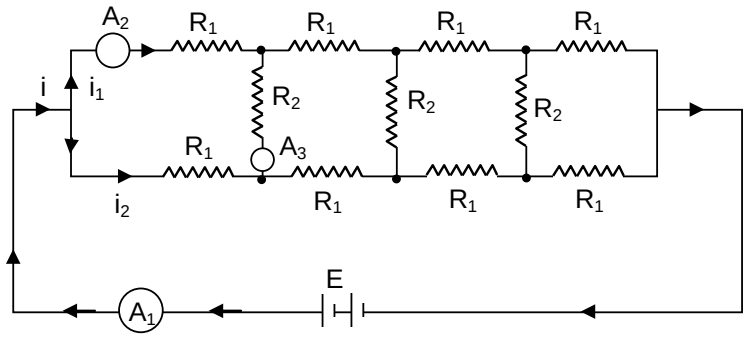
This section contains 7 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE or MORE THAN ONE are correct.

1. A source of emf having internal resistance of 6 Ω dissipates maximum power in a circuit consisting of three resistor R_1, R_2 and R_3 as shown. Then,



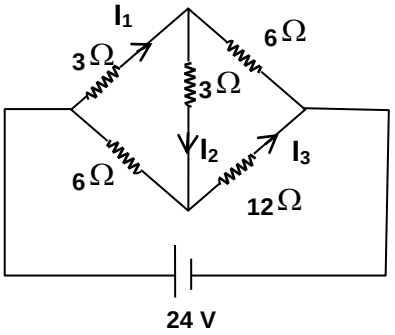
(A) $I_3 = 0.4$ A
(B) V = 24 V
(C) $R_1 = 15\ \Omega$
(D) Equivalent resistance of circuit is 6 Ω

2. In the given circuit, given $R_1 = 10\ \Omega$, $R_2 = 6\ \Omega$ and E = 10 V. Then which of the following statements are correct?



(A) Effective resistance of the circuit is 20Ω
(B) Reading of A_1 is ½ amp
(C) Reading of A_2 is ¼ amp
(D) Reading of A_3 is 1/8 amp

3. Which of the following are correct for given circuit diagram?



(A) $I_1 = \frac{24}{9} A$
(B) $I_2 =$ Zero
(C) $I_3 = \frac{4}{3} A$
(D) $I_3 = 2A$

Space For Rough Work

4. When no current is passed through a conductor:
   (A) the free electrons do not move
   (B) the average speed of a free electron over a large period of time is zero.
   (C) the average velocity of a free electron over a large period of time is zero.
   (D) the average of the velocities of all the free electrons at an instant is zero.

5. The magnitude of the magnetic field at the center of an equilateral triangular loop of side 1m which is carrying a current of 10 A is [Take $\mu_0 = 4\pi \times 10^{-7}$ NA^{-2}]
   (A) 18×10^{-6} T (B) 3×10^{-6} T
   (C) 18×10^{-2} G (D) 18×10^{-5} T

6. If we compare the magnetic field of a current carrying solenoid with that a pipe carrying current parallel to its axis, assuming both to be infinitely long:
   (A) the field inside the solenoid is zero (B) the field outside the solenoid is zero
   (C) the field inside the pipe is zero (D) the field outside the pipe is zero

7. A proton moving with a constant velocity passes through a region of space without any change in its velocity. If E and B represent the electric and magnetic fields respectively, this region of space may have
   (A) $B \neq 0, E = 0$ (B) $B = 0, E \neq 0$
   (C) $B = 0, E = 0$ (D) $B \neq 0, E \neq 0$

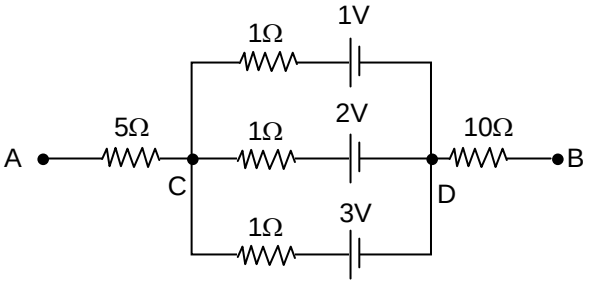
Single Correct Choice Type

This section contains 7 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE option is correct.

8. Two metal wires of identical dimensions are connected in series. If σ_1 and σ_2 are the conductivities of the metals respectively, the effective conductivity of the combination is
   (A) $\sigma_1 + \sigma_2$ (B) $\frac{\sigma_1 + \sigma_2}{2}$
   (C) $\sqrt{\sigma_1\sigma_2}$ (D) $\frac{2\sigma_1\sigma_2}{\sigma_1 + \sigma_2}$

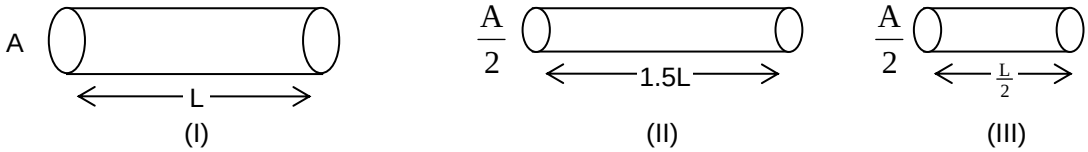
Space For Rough Work

9. In the circuit, the potential difference between A and B is



(A) 6 V (B) 3 V
(C) 2 V (D) 1 V

10. Figure shows three cylindrical copper conductors along with their face areas and lengths. If they are applied with same potential difference, rank them according to the current through them, greatest first



(I) (II) (III)

(A) $i_1 = i_2 = i_3$ (B)) $i_1 > i_2 > i_3$
(C) $i_1 < i_2 < i_3$ (D) $(i_1 = i_3) > i_2$

11. A metal wire of resistance 3 Ω is elongated to make a uniform wire of double its previous length. This new wire is now bent and the ends joined to make a circle. If two points on this circle make an angle 60° at the centre, the equivalent resistance between these two points will be

(A) 12/5 Ω (B) 5/3 Ω
(C) 5/2 Ω (D) 7/2 Ω

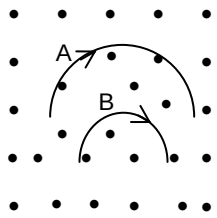
12. Two identical conducting wires AOB and COD are placed at right angles to each other .The wire AOB carries an electric current I_1, and COD carries a current I_2. The magnetic field on a point lying at a distance 'd' from O, in a direction perpendicular to the plane of the wires AOB and COD, will be given by

(A) $\frac{\mu_0}{2\pi}(I_1^2 + I_2^2)$ (B) $\frac{\mu_0}{2\pi}\left(\frac{I_1 + I_2}{d}\right)^2$

(C) $\frac{\mu_0}{2\pi d}(I_1 + I_2)$ (D) $\frac{\mu_0}{2\pi d}(I_1^2 + I_2^2)^{1/2}$

Space For Rough Work

13. Two particles A and B of masses m_A and m_B respectively and having the same charge are moving in a plane. A uniform magnetic field exists perpendicular to this plane. The speeds of the particles are v_A and v_B respectively and the trajectories are as shown in figure. Then



(A) $m_A v_A < m_B v_B$

(B) $m_A v_A > m_B v_B$

(C) $m_A < m_B$ and $v_A < v_B$

(D) $m_A = m_B$ and $v_A = v_B$

14. Two flat circular coils have a common centre, but their planes are at right angles to each other. The inner coil has 150 turns and radius of π cm. The outer coil has 400 turns and radius of 2π cm. The magnitude of the resultant magnetic induction at the common centres of the coils when a current of 200 mA is sent through each of them is

(A) $5\times10^{-3}\,Wb/m^2$ (B) $2\times10^{-3}\,Wb/m^2$

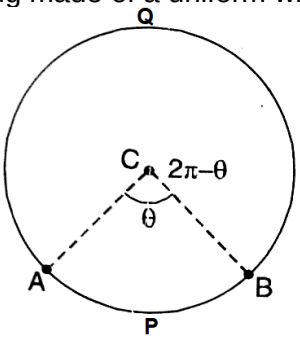
(C) $10^{-3}\,Wb/m^2$ (D) $7\times10^{-3}\,Wb/m^2$

Comprehension Type

This section contains 2 Paragraphs which has two multiple choice questions each. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE option is correct.

Paragraph - I (15-16)

A and B are two points on a circular ring made of a uniform wire of resistance R.



Based on the above facts, answer the following questions.

15. The resistance of the part of the ring subtending an angle θ at the centre of the ring is

(A) $\frac{R\theta}{2\pi}$ (B) $\frac{R(2\pi-\theta)}{2\pi}$ (C) $\frac{(2\pi-\theta)\theta}{4\pi^2}R$ (D) $\frac{R(\pi-\theta)}{2}$

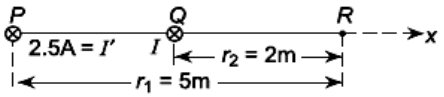
16. The effective resistance between A and B is

(A) $\frac{R\theta}{2\pi}$ (B) $\frac{R(2\pi-\theta)}{4\pi^2}$ (C) $\frac{(2\pi-\theta)\theta}{4\pi^2}R$ (D) $\frac{R(\pi-\theta)}{2}$

Space For Rough Work

Paragraph –II (17-18)

Two long parallel wires carrying currents 2.5 amperes and I ampere in the same direction into the plane of the paper. Positioned perpendicularly to the sheet, these wires extend from points P and Q, located 5 meters and 2 meters away, respectively, from a shared collinear point R as shown in figure.



An electron moving with a velocity of 4×10^5 m/s along the positive x-direction experiences a force of magnitude 3.2×10^{-20} N at the point R.

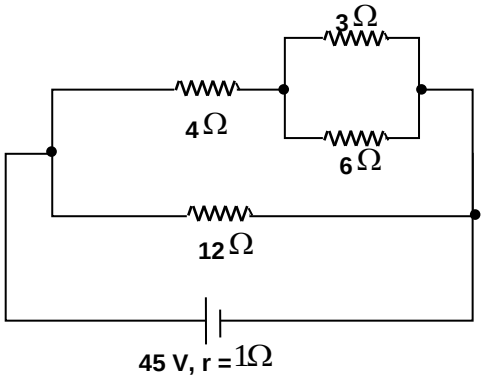
17. The magnitude of magnetic field at point R is
(A) 5×10^{-7} T (B) 5×10^{-6} T
(C) 2.5×10^{-7} T (D) 2.5×10^{-6} T

18. The current I in wire Q is
(A) 1 A (B) 2 A
(C) 3 A (D) 4 A

Match Type

This section contains Two (02) List-Match Sets, each List-Match set has One (01) Multiple Choice Questions. Each List-Match set has two lists: List-I and List-II. FOUR options are given in each Multiple Choice Question based On List-I and List-II and ONLY ONE of these four options satisfies the condition asked in the Multiple Choice Question.

19. Four resistor having resistance $12\Omega, 6\Omega, 3\Omega$ and 4Ω are connected to a battery of 45 V and internal resistance 1Ω as shown in figure.



Now match list-I to list-II

List-I		List-II	
(A)	Current flowing through 3Ω resistance (in A)	(P)	24
(B)	Potential across 12Ω resistance (in volt)	(Q)	4
(C)	Potential across 4Ω resistance (in volt)	(R)	36
(D)	Power developed in 4Ω resistance (in Watt)	(S)	144

The correct option is:
(A) A → Q ; B → P ; C → S ; D → R (B) A → R ; B → P ; C → S ; D → Q
(C) A → Q ; B → R ; C → P ; D → S (D) A → Q ; B → R ; C → S ; D → P

Space For Rough Work

20. Match the following.

List-I		List-II	
(A)	Electrical resistivity	(P)	$J\ s^{-1}$
(B)	Electric Power	(Q)	V As
(C)	Electric Energy	(R)	$J\ V^{-1}\ s^{-1}$
(D)	Electric Current	(S)	Ω m

The correct option is:

(A) A $\rightarrow$ S ; B $\rightarrow$ P ; C $\rightarrow$ R ; D $\rightarrow$ Q (B) A $\rightarrow$ S ; B $\rightarrow$ P ; C $\rightarrow$ Q ; D $\rightarrow$ R

(C) A $\rightarrow$ S ; B $\rightarrow$ R ; C $\rightarrow$ P ; D $\rightarrow$ Q (D) A $\rightarrow$ R ; B $\rightarrow$ S ; C $\rightarrow$ P ; D $\rightarrow$ Q

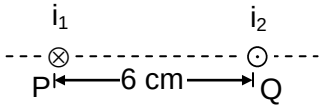
PART – B

Numerical Based

This section contains 6 questions. The answer of which maybe positive or negative numbers or decimals (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30) and each question carries +3 marks for correct answer.

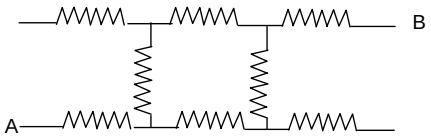
1. The electron in a hydrogen atom circles around the proton with a speed of 2.18×10^6 m/s in an orbit of radius 5.3×10^{-11} m. Find the magnetic field produced at the proton.
[$q = 1.6 \times 10^{-19}$ C, $\mu_0 = 4\pi \times 10^{-7}$ Tm/A]

2. Two parallel wires P and Q placed at a separation of 6 cm carry electric current i_1 = 5A and i_2 = 2A in opposite directions as shown in figure. Find the point on the line PQ where the resultant magnetic field is zero. (From point Q).

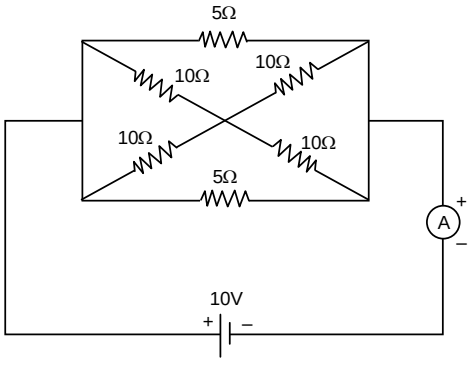


3. A coil of radius 200 mm is to produce a field of 0.4 G in its center with a current of 0.25 A. How many turns must there be in the coil?

4. In the network shown here, each resistance is of 1Ω The equivalent resistance between the points A and B is:



5. The current shown by the ammeter A in the circuit shown in figure in ampere is



6. A 60 W bulb carries a current of 0.5 A. If the total charge passing through it is n × 600 C in 1 hr. Find the value of 'n'.

Space For Rough Work

SECTION – II (CHEMISTRY)

PART – A

Multiple Correct Choice Type

This section contains 7 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE or MORE THAN ONE are correct.

1. Which one is correct for a homologous series?
   (A) All members have same chemical properties
   (B) All members have same physical properties
   (C) All member have a general formula
   (D) All members have same molecular mass

2. Which of following statement(s) is/are correct?
   (A) Graphite is lighter than diamond
   (B) Graphite is a good dry lubricant
   (C) Fullerene consists of 12 pentagonal faces and 20 hexagonal faces
   (D) Diamond is non conductor of heat and electricity

3. Which of the following compound has two π (pi) bonds?
   (A) 1, 3–Butadiene (B) Acetic acid
   (C) Propane (D) Ethyne

4. Which of the following statements are correct?
   (A) Soap are sodium or potassium salt of long chain carboxylic acid.
   (B) Hydrophilic end of soap align along dirt.
   (C) Hydrophobic end of soap align along dirt.
   (D) Inside water, soap molecules has unique orientation and form cluster of molecules which is called micelle

5. Which of the following characteristic(s) of the elements of group – 1 increase(s) on moving from top to bottom in the group?
   (A) Atomic size (B) Nuclear charge
   (C) Number of electrons (D) Metallic nature

6. Which of the following statements is/are correct?
   (A) F is the most electropositive and Cs is the most electronegative element.
   (B) The electronegativity of halogens decreases from F to I.
   (C) The electron affinity of Cl is higher than that of F though their electronegativity values are in the reverse order.
   (D) The electron affinity of noble gases is low.

Space For Rough Work

7. The set representing the correct order of ionic radius is / are

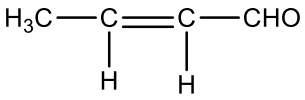
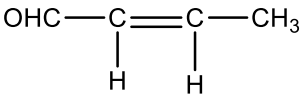
(A) $Li^+ > Be^{2+} > Na^+ < Mg^{2+}$ (B) $Na^+ > Li^+ > Mg^{2+} > Be^{2+}$

(C) $O^{2-} > F^- > O > F$ (D) $O^{2-} > O > F^- > F$

Single Correct Choice Type

This section contains 7 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE option is correct.

8. Which of the following is/are correct structure(s) of But-2-en-1-al?

(A)  (B) 

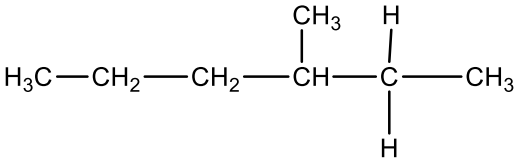
(C) Both (A) & (B) are correct (D) None of these

9. $A \xrightarrow[(\text{dehydration})]{\text{Conc.}\ H_2SO_4\ 170^\circ C} H_2C = CH_2 + H_2O$

In the above reaction the compound 'A' is

(A) Methanol (B) Ethanol

(C) Ethanoicacid (D) None of these

10. 

How many quaternary carbon atoms are present in the given structure?

(A) One (B) Two

(C) Three (D) Zero

11. Which of the following two elements have the maximum number of similar properties?

(A) Li and Cl (B) Be and K

(C) Mg and Li (D) Mg and Al

Space For Rough Work

12. A certain group in the periodic table contains the following elements

P
Q
R
S

Choose the correct statement regarding the elements
(A) P^+ and Q^+ are isoelectronic species
(B) R and S can lose or gain same number of electrons
(C) Q^+ has larger ionic radius than R^+
(D) P is less electronegative than Q

13. How many maximum number of electrons can be added into the outermost orbit of Group–16 elements?
(A) 4 (B) 2 (C) 6 (D) 3

14. Which of the following change takes place in the gaseous state with lowest amount of energy?
(A) $S \rightarrow S^+$ (B) $K \rightarrow K^+$ (C) $Ca \rightarrow Ca^{2+}$ (D) $Li \rightarrow Li^+$

Comprehension Type

This section contains 2 Paragraphs which has two multiple choice questions each. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE option is correct.

Paragraph - I (15-16)

Atoms of metals have only a few electrons in their valence shells while atoms of non-metals generally have more electrons in their valence shells. Metallic character is closely related to atomic radius and ionization enthalpy. Metallic character increases from top to bottom in a group and decreases from left to right in a period. Metallic character is inversely related to electronegativity.

15. Considering the elements B, C, N, F and Si, the correct order of their non-metallic character is :
(A) B > C > Si > N > F (B) Si > C > B > N > F
(C) F > N > C > B > Si (D) F > N > C > Si > B

16. Considering the elements B, Al, Mg and K, the correct order of their metallic character is :
(A) B > Al > Mg > K (B) Al > K > B > Mg
(C) Mg > Al > K > B (D) K > Mg > Al > B

Space For Rough Work

Paragraph –II (17-18)

Hybridization is the process of mixing of atomic orbitals to give mixed or hybrid orbitals. Hybrid orbitals have equal energy and their hypothetical shape.

17. In hexyne carbon (3) has
(A) sp^3 hybridisation (B) sp^2 hybridisation
(C) sp hybridization (D) none of these

18. In pent-1-ene-4–yne, carbon (5) has _____ p character.
(A) 33% (B) 25% (C) 75% (D) 50%

Match Type

This section contains Two (02) List-Match Sets, each List-Match set has One (01) Multiple Choice Questions. Each List-Match set has two lists: List-I and List-II. FOUR options are given in each Multiple Choice Question based On List-I and List-II and ONLY ONE of these four options satisfies the condition asked in the Multiple Choice Question.

19. Match the following

	Column – I		Column – II
A)	$C_2H_5OH + 2[O] \xrightarrow[\text{or (Acidified } K_2Cr_2O_7)]{\text{Alkaline } KMnO_4, \text{Heat}}$	p)	Addition reaction
B)	$CH_2=CH_2+H_2 \xrightarrow{Ni}$	q)	Substitution reaction
C)	$CH_4+Cl_2 \xrightarrow{\text{sunlight}}$	r)	Neutralization
D)	$CH_3COOH + NaOH \longrightarrow$	s)	Oxidation reaction

(A) A– p; B–s; C–q; D–r (B) A– s; B–q; C–p; D–r
(C) A– s; B–p; C–q; D–r (D) A– r; B–p; C–q; D–s

20. Match the following.

Column – I		Column – II	
(A)	Metallic character in a group	(P)	Decreases
(B)	Valency in a period	(Q)	First increases then decreases
(C)	Valence electron in a group	(R)	Remain same
(D)	Atomic size in a period	(S)	Increases

(A) A→S; B→Q; C→R; D→P (B) A→Q; B→S; C→R; D→P
(C) A→S; B→Q; C→P; D→R (D) A→S; B→R; C→Q; D→P

Space For Rough Work

PART – B

Numerical Based

This section contains 6 questions. The answer of which maybe positive or negative numbers or decimals (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30) and each question carries +3 marks for correct answer.

1. Number of 3° carbon atom in Neopentane.

2. The number of chain isomers for C_6H_{14} is

3. The number of compounds in the following compounds belong to same homologous series is
   CH_2O_2, C_3H_8O, $C_2H_4O_2$, C_2H_4, $C_3H_6O_2$, $C_5H_{10}O_2$, C_3H_8

4 Atomic number of the most electronegative element is _____.

5. Element 'P' belongs to group-13 and element 'Q' belongs to group-16. Both elements are present in the third period. If the formula of compound formed by them is represented as P_xQ_y, the sum (x + y) is

6. Number of valence shell electrons in Cl^- is:

Space For Rough Work

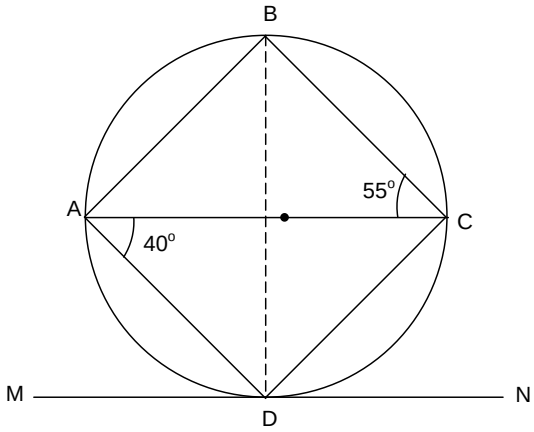
SECTION – III (MATHEMATICS)

PART – A

Multiple Correct Choice Type

This section contains 7 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE or MORE THAN ONE are correct.

1. ABCD is a cyclic quadrilateral. AC is the diameter of the circle. MN is the tangent to the circle at D. $\angle CAD = 40$, $\angle ACB = 55$, then which of the following is (are) correct?



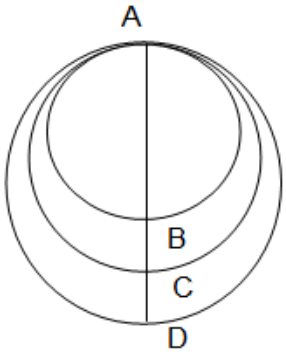
(A) $\angle ADM = 50^o$

(B) $\angle ADM = 45^o$

(C) $\angle BAD = 75^o$

(D) $\angle BAD = 80^o$

2. AB, AC and AD (in straight line) are diameters of three circles. The area of the middle circle is the average of the areas of the other two. If AB = 2, CD = 1 then



(A) $BC = \sqrt{6} - 1$

(B) $BC = \sqrt{6}$

(C) $AC = 1 + \sqrt{6}$

(D) $AC = 2 + \sqrt{3}$

3. Which of the following is/are true for the observations 2, 3, 3, 4, 4, 4, 5, 5, 6, 6, 6, 7, 7, 7, 9, 9, 9, 9, 10, 10

(A) Mean = 6.25 (B) Median = 6

(C) Mode = 4 (D) Mode – Median = 3

4. If $\log_2\left(5 \times 2^x + 1\right), \log_4\left(2^{1-x} + 1\right)$ and 1 are in A.P., then x is equal to

(A) $\dfrac{\log 5}{\log 2}$ (B) $\log_2\left(\dfrac{2}{5}\right)$

(C) $1 - \dfrac{\log 5}{\log 2}$ (D) $\dfrac{\log 2}{\log 5}$

Space For Rough Work

5. The number $\sqrt{18+\sqrt{308}}$ can be written in the form $\sqrt{a}+\sqrt{b}$ where a and b are whole numbers and $a>b$ then

(A) $a=7$ (B) $b=4$

(C) $a-b=4$ (D) $a=11$

6. The value(s) of 'a' in the equation: $\log_{10}\left(a^2-15a\right)=2$ is/are:

(A) $\frac{15+\sqrt{233}}{2}$ (B) 20

(C) $\frac{15-\sqrt{305}}{2}$ (D) –5

7. If α is one root of the equation $4x^2+2x-1=0,$ then other root is given by:

(A) $4\alpha^3-3\alpha$ (B) $4\alpha^3+3\alpha$

(C) $\alpha-\left(\frac{1}{2}\right)$ (D) $-\alpha-\left(\frac{1}{2}\right)$

Single Correct Choice Type

This section contains 7 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE option is correct.

8. A tangent of length 'L' is drawn from a point 'A' to a circle of radius 'r'. The length of tangent is $\frac{4}{3}$ of r, then the shortest distance from point A to circle is

(A) $\frac{r}{2}$ (B) r

(C) $\frac{L}{2}$ (D) $\frac{2L}{3}$

9. Three squares of a chess board are selected at random. The probability of getting two squares of one colour and other of a different colour is?

(A) $\frac{16}{21}$ (B) $\frac{8}{21}$

(C) $\frac{3}{32}$ (D) $\frac{3}{8}$

Space For Rough Work

10. A conical shaped container, whose radius of base is r cm and height is h cm, is full of water. A sphere of radius R is completely immersed in the container in such a way that the surface of sphere touches the base of the cone and its surfaces. The portion of water which comes out of the cone is?

(A) $\frac{R^2}{r^2h}$ (B) $\frac{r^2}{R^2h}$

(C) $\frac{4R^2}{r^2h}$ (D) None of these

11. The mean of 'n' numbers of a series is $\bar{X}$. If the sum of first (n – 1) terms is 'k', then the n^{th} number is?

(A) $\bar{X} - k$ (B) $n\bar{X} - k$

(C) $\bar{X} - nk$ (D) $n\left(\bar{X} - k\right)$

12. A point is chosen at random from within a circular region. What is the probability that the point is closer to the center of the region than it is to the boundary of the region?

(A) $\frac{1}{4}$ (B) $\frac{1}{3}$

(C) $\frac{1}{2}$ (D) $\frac{2}{3}$

13. One integer is chosen out of 1, 2, 3,……..,100. What is the probability that is neither divisible by 4 nor by 6.

(A) 0.59 (B) 0.67

(C) 0.41 (D) 0.33

14. If $a_1, a_2, a_3, ...$ is an A.P. such that $a_1 + a_5 + a_{10} + a_{15} + a_{20} + a_{24} = 225$ then $a_1 + a_2 + a_3 + ... + a_{23} + a_{24}$ is equal to:

(A) 999 (B) 900

(C) 1225 (D) none of these

Space For Rough Work

Comprehension Type

This section contains 2 Paragraphs which has two multiple choice questions each. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE option is correct.

Paragraph - I (15-16)

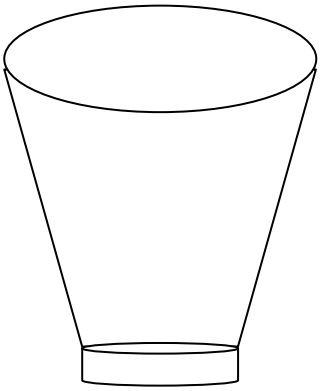
Let $f(x)$ be a polynomial of degree greater than one. If $f(x)$ is divided by $x-a$ then $f(a)$ is remainder.

15. Let $f(x)=x^{2013}+1$ then the remainder when $f(x)$ is divided by x^2-1 is
(A) $x-1$ (B) $x+1$
(C) 0 (D) 1

16. If $f(x)=x^3+px+q$ is divisible by x^2-x-2 then $p.q=$
(A) 2 (B) 4
(C) 6 (D) 8

Paragraph –II (17-18)

If a right circular cone is cut off by a plane parallel to its base, then the portion of cone between the cutting plane and the base of cone is called frustum of cone.



An open metal bucket is in the shape of a frustum of a cone, mounted on a hollow cylindrical base (stand) made of the same metallic sheet. The diameters of the two circular ends of the bucket are 45 cm and 25 cm, the total vertical height of the bucket is 40 cm and that of the cylindrical base is 6 cm. (Use $\pi=\frac{22}{7}$)

17. Find the area of the metallic sheet used to make the bucket.
(A) 4760.9 cm^2 (B) 4960.9 cm^2
(C) 4860.9 cm^2 (D) 4660.9 cm^2

18. Find the volume of water (approx) the bucket can hold, in litres.
(A) 30.62 Litre (B) 33.62 Litre
(C) 31.62 Litre (D) 34.62 Litre

Space For Rough Work

Match Type

This section contains Two (02) List-Match Sets, each List-Match set has One (01) Multiple Choice Questions. Each List-Match set has two lists: List-I and List-II. FOUR options are given in each Multiple Choice Question based On List-I and List-II and ONLY ONE of these four options satisfies the condition asked in the Multiple Choice Question.

19. Match the following

	Column-I		Column-II
(a)	$\frac{1}{7}\left(\log_{\sqrt{2}} 128\right)$	(p)	2
(b)	$\log_2 3 \times \log_3 2 \times \log_3 9$	(q)	0
(c)	$\log_{0.2} 625 - \log_{1/2} 16$	(r)	1
(d)	$\left(\frac{a^m}{a^n}\right)^{m+n}\left(\frac{a^n}{a^\ell}\right)^{n+\ell}\left(\frac{a^\ell}{a^m}\right)^{\ell+m} =$	(s)	4

(A) a–p; b– q; c–r; d–r
(B) a–p; b– r; c–r; d– p
(C) a–p; b– p; c–q; d– r
(D) a–p; b– s; c–q; d– r

20. Match the column I & column II.

	Column I		Column II
(a)	A card is drawn at random from a pack of 52 cards. The probability of this card being a red or queen is	(P)	$\frac{1}{26}$
(b)	A card is drawn from a well shuffled pack of 52 cards. The probability of getting a queen of club or king of heart is	(Q)	$\frac{4}{13}$
(c)	A card is drawn randomly from a well shuffled pack of 52 cards. What is the probability that it is either a face card or an eight?	(R)	$\frac{1}{17}$
(d)	From a well shuffled pack of 52 cards a person has drawn a Queen. If he draw one more card from remaining cards then what is the probability that it will also be a queen?	(S)	$\frac{7}{13}$

(A) a–Q; b–R; c–P; d–S
(B) a–S; b–P; c–Q; d–R
(C) a–R; b–Q; c–S; d–P
(D) a–P; b–S; c–R; d–Q

Space For Rough Work

PART – B

Numerical Based

This section contains 6 questions. The answer of which maybe positive or negative numbers or decimals (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30) and each question carries +3 marks for correct answer.

1. Find the circum – radius (in units) of the circum circle of the triangle whose vertices are (8, 6), (8, –2) and (2, –2).

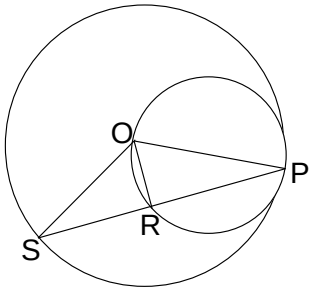
2. A rectangular sheet of paper 22 cm long and 12 cm broad can be curved to form the lateral surface of a right circular cylinder in two ways. Taking $\pi = \frac{22}{7}$, find the value of $\frac{\text{difference between the volumes of the two cylinders thus formed}}{35}$ (in cm^3).

3. A sphere is inscribed in a cube that has a surface area of 24 square meters. A second cube is then inscribed within the sphere. What is the surface area in square meters of the inner cube?

4. If the product of the roots of the equation $x^2 - 2\sqrt{2}Kx + 2e^{2\log_e K} - 1 = 0$ is 31, then the roots of the equation are real for K equal to:

5. The arithmetic mean of 10 observations is 12.45. Each of reading is increased by 5 then the resulting mean is increased by

6. In the adjoining figure the diameter of the larger circle is 10 cm and the smaller circle touches internally the lager circle at P and passes through O, the centre of the larger circle and OP is diameter of smaller circle. Chord SP cuts the smaller circle at R and OR is equal to 4 cm. What is the length of the chord SP (in cm) = ?



Space For Rough Work

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ANSWER KEYS

Physics

Part – A

1.	BCD	2.	ABC	3.	ABC	4.	CD
5.	AC	6.	BC	7.	ACD	8.	D
9.	C	10.	D	11.	B	12.	D
13.	B	14.	C	15.	A	16.	C
17.	A	18.	D	19.	C	20.	B

Part – B

1.	12.42	2.	4	3.	51	4.	3
5.	5	6.	3				

Chemistry

Part – A

1.	AC	2.	ABC	3.	AD	4.	ACD
5.	ABCD	6.	BCD	7.	C	8.	C
9.	B	10.	D	11.	C	12.	B
13.	B	14.	B	15.	C	16.	D
17.	A	18.	D	19.	C	20.	A

Part – B

1	0	2.	5	3.	4	4.	9
5.	5	6.	8				

Mathematics

Part – A

1.	AC	2.	AC	3.	ABD	4.	BC
5.	CD	6.	BD	7.	AD	8.	C
9.	A	10.	D	11.	B	12.	A
13.	B	14.	B	15.	B	16.	C
17.	C	18.	B	19.	C	20.	B

Part – B

1.	5	2.	6	3.	8	4.	4
5.	5	6.	6				

Answers & Solutions

SECTION – I (PHYSICS)

PART – A

1. BCD

Sol. Power is maximum when internal resistance is equal to external resistance,

$R_e = 6\Omega$

$V = (r + R_e)\, I$

$\Rightarrow V = 12 \times 2 = 24\ V$

Also $I_3 = 2 - 0.8 - 0.4 = 0.8$ A

Also, the potential difference across parallel combination

$V_P = \frac{V}{2} = 12\ V$

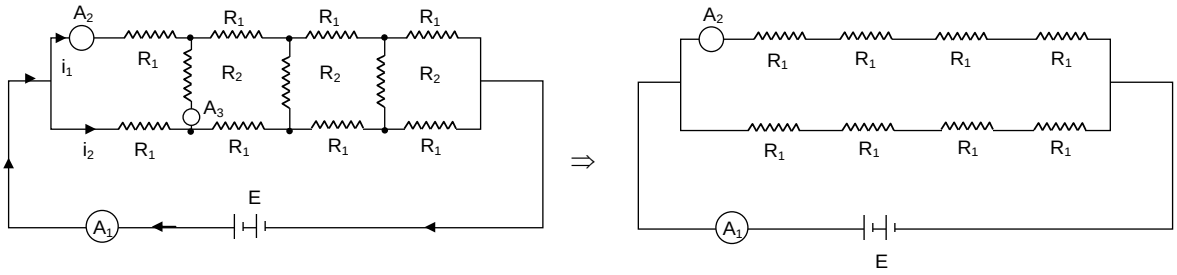
$\therefore R_1 = \frac{12}{0.8} = 15\Omega$

2. ABC

Sol. $R_{eq} = \frac{40 \times 40}{40 + 40} = \frac{40 \times 40}{80} = 20\Omega$,

$i = \frac{E}{R_{eq}} = \frac{10}{20} = \frac{1}{2}$ A and

$i_1 = i_2 = i/2 = \frac{1}{4}$ A



3. **ABC**

Sol. Balanced Wheat stone bridge

$I_2 = 0$; $R_{eq} = 6\ \Omega$; $I = 4$ A ; $I_3 = \frac{4}{3}$ A ; $I_1 = \frac{8}{3} = \frac{24}{9}$ A

4. **CD**

Sol. When no current is passed through a conductor the average velocity of a free electron over a large period of time is zero.

When no current is passed through a conductor the average of the velocities of all the free electrons at an instant is zero.

5. AC

Sol. $B = 3\left[\frac{\mu_0 I}{4\pi r}(\sin 60° + \sin 60°)\right]$

$r = \frac{1}{2\sqrt{3}}$

$$B = 3\left[\frac{\mu_0 \times 10}{4\pi \times \frac{1}{2\sqrt{3}}}\left[\frac{\sqrt{3}}{2} + \frac{\sqrt{3}}{2}\right]\right]$$

$B = 18 \times 10^{-6}$ T

6. BC

Sol. The magnetic field outside the solenoid as well as field is zero inside the pipe.

7. ACD

Sol. If B = 0, E = 0, then no force.
If B = 0, E ≠ 0 then electric force will act and cause an acceleration.
If B ≠ 0, E ≠ 0 then magnetic force and electric force might be balancing.
If B ≠ 0, E = 0 then speed will be same but velocity may not change if B acts along the velocity.

8. D

Sol.
$$R_1 = \frac{\ell}{\sigma_1 A}, R_2 = \frac{\ell}{\sigma_2 A},$$
$$R = R_1 + R_2$$
$$\Rightarrow \frac{2\ell}{\sigma A} = \frac{\ell}{\sigma_1 A} + \frac{\ell}{\sigma_2 A}$$
$$\Rightarrow \sigma = \frac{2\sigma_1\sigma_2}{\sigma_1 + \sigma_2}$$

9. C

Sol.
$$V_{AB} = V_{CD} = \frac{\frac{E_1}{r_1} + \frac{E_2}{r_2} + \frac{E_3}{r_3}}{\frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3}} = 2$$

10. **D**

Sol.
$$I = \frac{V}{R} \quad ; \quad R_1 = \rho\frac{L}{A} \; ; \; R_2 = \rho\frac{1.5L}{A/2} \; ; \; R_3 = \rho\frac{L/2}{A/2}$$
$$\Rightarrow \quad (i_1 = i_3) > i_2$$

11. B

Sol. $R \propto \ell^2$

$R_i = 3\Omega$; $R_f = 12\Omega$

$$R_1 = \frac{\pi}{3 \times 2\pi} \times R_f = 2\Omega$$

$$R_2 = \frac{5\pi}{3 \times 2\pi} \times R_f = 10\Omega$$

$R_{eq} = (R_1 \,||\, R_2) = \frac{5}{3}\Omega$

12. D

Sol. Magnetic field at P due to current in wire AOB,

$B_1 = \frac{\mu_0 I_1}{2\pi a}$

Magnetic field at P due to current in wire COD,

$B_2 = \frac{\mu_0 I_2}{2\pi a}$

As the two conductors are perpendicular to each other, so B_1 and B_2 will also be perpendicular to each other. Hence the resultant magnetic field at P is

$$B = \sqrt{B_1^2 + B_2^3} = \left[\left(\frac{\mu_0 I_1}{2\pi a}\right)^2 + \left(\frac{\mu_0 I_2}{2\pi a}\right)^2\right]^{1/2}$$

$$= \frac{\mu_0}{2\pi a}(I_1^2 + I_2^2)^{1/2}$$

13. B

Sol. $r = \frac{mv}{qB}$

As, $r_A > r_B$; $m_A V_A > m_B V_B$

14. C

Sol. $$B = \frac{\mu_0}{2}\left[\left(\frac{N_1 I_1}{r_1}\right)^2 + \left(\frac{N_2 I_2}{r_2}\right)^2\right]^{1/2}$$

$$= \frac{\mu_0}{2}\left[\left(\frac{150 \times 0.2}{\pi \times 10^{-2}}\right)^2 + \left(\frac{400 \times 0.2}{2\pi \times 10^{-2}}\right)^2\right]^{1/2}$$

$$= 10^{-3}\,\text{Wb/m}^2$$

15. A

Sol. Resistance per unit length $(R') = \frac{R}{2\pi r}$

Resistance of APB $R_1 = \frac{R}{2\pi r} \times r \times \theta = \frac{R\theta}{2\pi}$

16. C

Sol. Resistance of AQB $R_2 = \frac{R}{2\pi r} \times r \times (2\pi - \theta) = \frac{R(2\pi - \theta)}{2\pi}$

Both resistance are in parallel (R_1 || R_2)

So, $R_T = \frac{R(2\pi - \theta)\cdot\theta}{4\pi^2}$

17. A

Sol. B = $\frac{F}{qv\sin\theta} : \theta = 90°$

B = $\frac{3.2 \times 10^{-20}}{1.6 \times 10^{-19} \times 4 \times 10^5 \times 1} \Rightarrow 5 \times 10^{-7}\,T$

18. D

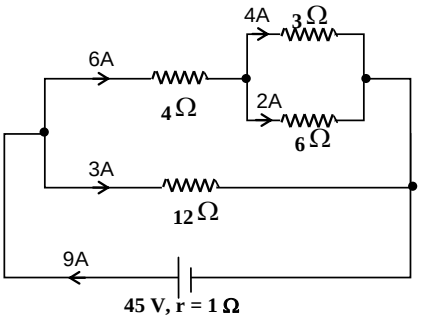
Sol. Total field (B) = $B_1 + B_2$

$$5\times10^{-7}=\frac{\mu_0 I_1}{2\pi r_1}+\frac{\mu_0 I_2}{2\pi r_2}$$

$5 \times 10^{-7} = 1 \times 10^{-7} + I \times 10^{-7} \Rightarrow I = 4$ Amp

19. **C**

Sol. Current through battery = $\frac{45}{5}=9\,A.$



20. **B**

Sol. $\rho = R\frac{A}{\ell} = \Omega\,m$

$$P=\frac{W}{t}=\frac{J}{s}$$

$E = VIt = VAs$

$$I=\frac{E}{Vt}=JV^{-1}s^{-1}$$

PART – B

1. 12.42

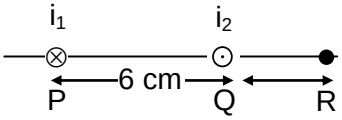
Range (12.40 – 12.45)

Sol. $i=\frac{q}{t}=\frac{q.v}{2\pi r}=1.048\times10^{-3}A$

$B = \frac{\mu_0}{2\pi r} i = 12.42$ T

2. 4

Sol.



$$B_1=\frac{\mu_0 i}{2\pi(6+x)}$$

$$B_2=\frac{\mu_0 i}{2\pi x}$$

$B_1 = B_2$

$\frac{i_1}{(6+x)}=\frac{i_2}{x}\Rightarrow 5x=2(6+x);\ x=4$ cm from Q.

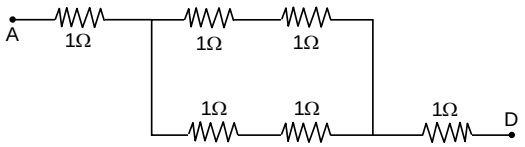
3. 51

Sol. $B = \left(\frac{\mu_0 i}{2r}\right)n \Rightarrow n = \frac{2rb}{\mu_0 i}$

$n = 51$

4. **3**

Sol. Equivalent ckt



$$R_{eff} = 1+\left(\frac{2\times 2}{2+2}\right)+1 = 3\ \Omega$$

5. **5**

Sol. $R_{eq} = 2\,\Omega$

$$I = \frac{V}{R} = 5\,A.$$

6. **3**

Sol. $q = It$

$= 0.5 \times (60 \times 60) = 1800\ C$

$= 3 \times 600$

SECTION – II (CHEMISTRY)

PART – A

1. AC

Sol. Homologous series have same functional group and general formula but differ in physical properties.

2. ABC

Sol. Graphite is lighter than diamond, graphite is a good dry lubricant and fullerene consists of 12 pentagonal faces and 20 hexagonal faces – are the correct statements.

3. AD

Sol. 1, 3-butadiene and ethyne have two π bonds.

4. ACD

Sol. Soap are sodium or potassium salt of long chain carboxylic acid, hydrophobic end of soap align along dirt and inside water soap molecules has unique orientation and form duster of molecules which is called micelle – are the correct statements

5. ABCD

Sol. Down the group, atomic size increases, metallic nature also increases.

6. BCD

Sol. The electronegativity of halogens decreases from F to I, the electron affinity of Cl is higher than that of F though their electronegativity values are in the reverse order and the electron affinity of noble gases is low – are the correct statements

7. C

Sol. The set representing the correct order of ionic radius is $O^{2-} > F^{-} > O > F$.

8. C

Sol. According to IUPAC nomenclature, C is correct.

9. B

Sol. The compound 'A' is Ethanol.

10. D

Sol. There are no quaternary carbon atom present in given structure.

11. C

Sol. They are diagonally related and therefore show similarity in properties.

12. B

Sol. R and S can lose or gain same number of electrons – is the correct statement.

13. B

Sol. 2 electrons can be added into the outermost orbit of Group–16 elements.

14. B

Sol. $K \rightarrow K^{+}$ takes place in the gaseous state with lowest amount of energy.

15. C

Sol. The correct order of their non-metallic character is F > N > C > B > Si.

16. D

Sol. The correct order of their metallic character is K > Mg > Al > B.

17. A

Sol. In hexyne carbon (3) has sp^3 hybridisation.

18. D

Sol. In pent-1-ene-4–yne, carbon (5) has 50% p character.

19. C

Sol. A– s; B–p; C–q; D–r

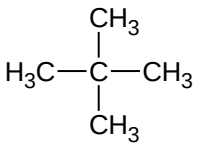
20. A

Sol. A→S; B→Q; C→R; D→P

PART – B

1 0

Sol.



2. 5

Sol. There are 5 chain isomers for C_6H_{14}.

3. 4

Sol. CH_2O_2, $C_2H_4O_2$, $C_3H_6O_2$, $C_5H_{10}O_2$

4. 9

Sol. Fluorine is most electronegative.

5. 5

Sol. P has valence 3 and Q has 2.

6. 8

Sol. Electronic configuration of Cl^- is 2, 8, 8

Space For Rough Work

SECTION – III (MATHEMATICS)

PART – A

1. AC

Sol. $\because$ AC is a diameter $\Rightarrow \angle ABC = 90^o$

$\because \angle CAD = \angle DBC$

(angle made by same arc DC)

$\Rightarrow \angle DBC = 40^o$

therefore $\angle ABD = 90^o - 40^o = 50^o$ and

$\angle ABD = \angle ADM = 50^o$ (angle in alternate segment)

Now, in ΔABC

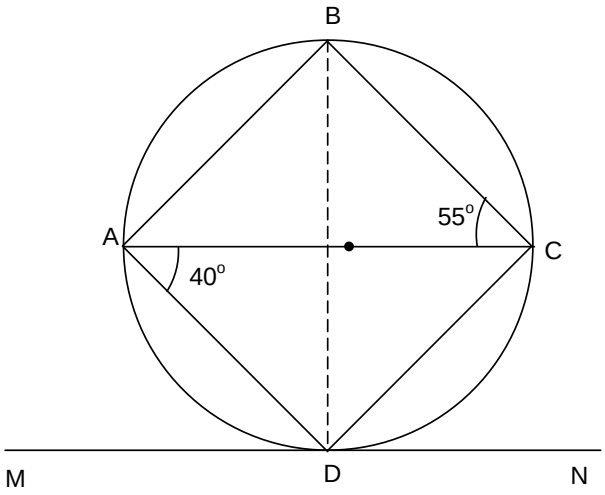
$\angle ABC + \angle BCA + \angle BAC = 180^o$

$\Rightarrow 90^o + 55^o + \angle BAC = 180^o$

$\Rightarrow \angle BAC = 35^o$

Now, $\angle BAD = \angle BAC + \angle CAD$

$= 35^o + 40^o = 75^o$



2. AC

Sol. Let's say radius of smaller circle = r_1

middle circle = r_2

and bigger circle = r_3

ATQ, $\pi r_2^{\,2} = \dfrac{\pi r_1^{\,2} + \pi r_3^{\,2}}{2} \Rightarrow 2r_2^2 = r_1^2 + r_3^2$

$\because AB = 2r_1 = 2 \Rightarrow r_1 = 1$ and

$CD = 2r_3 - 2r_2 = 1 \Rightarrow r_3 = r_2 + \dfrac{1}{2}$

$\because 2r_2^2 = 1 + r_3^2$

$\Rightarrow 2r_2^2 = 1 + \left(r_2 + \dfrac{1}{2}\right)^2$

$\Rightarrow 2r_2^2 = 1 + r_2^2 + \dfrac{1}{4} + r_2$

$\Rightarrow 4r_2^2 - 4r_2 - 5 = 0$

$\Rightarrow r_2 = \dfrac{4 \pm \sqrt{16 + 4 \times 4 \times 5}}{2 \times 4}$

$= \dfrac{4 \pm 4\sqrt{6}}{2 \times 4}$

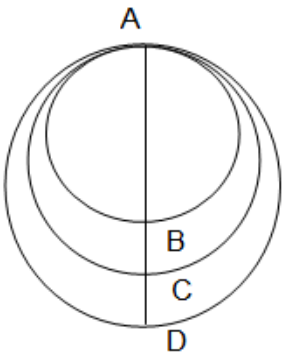
$= \dfrac{4 \pm 4\sqrt{6}}{2 \times 4} = \dfrac{1 \pm \sqrt{6}}{2}$

$\therefore r_2 = \dfrac{1 + \sqrt{6}}{2}$

$\therefore BC = 2r_2 - 2r_1 = 2\left(\dfrac{1 + \sqrt{6}}{2}\right) - 2 \times 1$

$= 1 + \sqrt{6} - 2 = \sqrt{6} - 1$ and $AC = 2r_2$

$= 2\left(\dfrac{1 + \sqrt{6}}{2}\right) = 1 + \sqrt{6}$



3. ABD

Sol. 2, 3, 3, 4, 4, 4, 5, 5, 6, 6, 6, 7, 7, 7, 9, 9, 9, 9, 10, 10.

$$\text{Mean} = \frac{\text{sum of observations}}{\text{number of observation}}$$

$$= \frac{125}{20} = 6.25$$

Mode = 9

$$\text{Median} = \frac{10^{\text{th}}\text{observation} + 11^{\text{th}}\text{observation}}{2} = \frac{6+6}{2} = 6$$

$\therefore$ Mode – Median = 9 – 6 = 3

4. BC

Sol. From the given condition, we must have

$$2\log_4\left(2^{1-x}+1\right) = \log_2\left(5\times 2^x + 1\right) + 1$$

$$\Rightarrow \frac{2\log\left(2^{1-x}+1\right)}{\log 4} = \frac{\log\left(5\times 2^x+1\right)}{\log 2} + 1$$

$$\Rightarrow \log\left(2^{1-x}+1\right) = \log\left[\left(5\times 2^x+1\right)2\right]$$

$$\Rightarrow 2^{1-x} + 1 = 5\times 2^x \times 2 + 2$$

Now, put $2^x = y$, so that

$$\frac{2}{y} + 1 = 10y + 2 \Rightarrow 10y^2 + y - 2 = 0$$

$\Rightarrow (5y-2)(2y+1) = 0$ which means $y = \frac{2}{5}$ or $y = -\frac{1}{2}$.

Since, $y = 2^x$ cannot be negative, we have $y = 2^x = \frac{2}{5}$

i.e., $x = \log_2\left(\frac{2}{5}\right)$.

But $2^x = \frac{2}{5}$ can also be expressed in the form

$$x = \frac{\log\left(\frac{2}{5}\right)}{\log 2} = 1 - \frac{\log 5}{\log 2}$$

5. CD

Sol. $\sqrt{18+\sqrt{308}}$

$$= \sqrt{7+11+2\sqrt{77}}$$

$$= \sqrt{\left(\sqrt{7}\right)^2 + \left(\sqrt{11}\right)^2 + 2\sqrt{7\times 11}}$$

$$= \sqrt{\left(\sqrt{7}+\sqrt{11}\right)^2} = \sqrt{7}+\sqrt{11}$$

$\therefore a = 11$ and $b = 7$

6. BD

Sol. Since $\log_{10}\left(a^2 - 15a\right) = 2$, then $a^2 - 15a = 10^2 = 100$.

The solution set for this quadratic equation is $\{20, -5\}$.

7. AD

Sol. If other root is β.

Then $\alpha+\beta=\frac{-2}{4}$

$\therefore \quad \beta=-\frac{1}{2}-\alpha$

and $4\alpha^2+2\alpha-1=0$

$\Rightarrow \quad 4\alpha^2=1-2\alpha$

$\therefore 4\alpha^3=\alpha\left(4\alpha^2\right)=\alpha(1-2\alpha)=\alpha-2\alpha^2$

$=\alpha-2\left[\frac{1-2\alpha}{4}\right]=\alpha-\frac{1}{2}+\alpha=2\alpha-\frac{1}{2}$

$\Rightarrow 4\alpha^3-3\alpha=-\alpha-\frac{1}{2}=\beta$

8. C

Sol. Here OB = r

L = AB = $\frac{4}{3}$r

$\therefore$ In ΔOAB by Pythagoras theorem

$(AB)^2+(OB)^2=(AO)^2$

$\Rightarrow\left(\frac{4}{3}r\right)^2+r^2=(AO)^2$

$\Rightarrow\frac{16}{9}r^2+r^2=(AO)^2$

$\Rightarrow\frac{25}{9}r^2=(AO)^2$

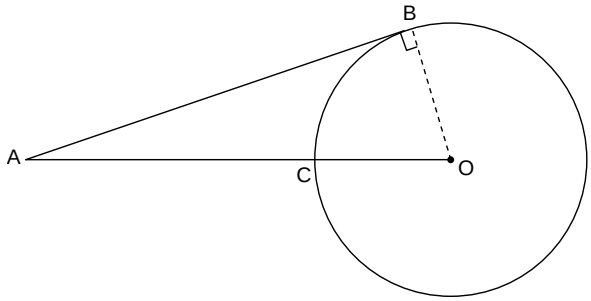
$\Rightarrow AO=\frac{5}{3}r$

$\therefore$ shortest distance = AC = AO – OC

$=\frac{5}{3}r-r=\frac{2}{3}r$

$\because L=\frac{4}{3}r\Rightarrow r=\frac{3L}{4}$

$\therefore AC=\frac{2}{3}\times\frac{3L}{4}=\frac{L}{2}$



9. A

Sol. $n(s)={}^{64}C_3=\frac{64\times63\times62}{1\times2\times3}$

Favourable cases $={}^{32}C_1\times{}^{32}C_2\times2$

$=32\times\frac{32\times31}{1\times2}\times2$

$\therefore$ Required probability $=\frac{\text{favourable cases}}{\text{total cases}}$

$=\frac{32\times32\times31\times1\times2\times3}{1\times2\times64\times63\times62}\times2=\frac{16}{21}$

10. D

Sol. Volume of sphere $=\frac{4}{3}\pi R^3$

Volume of cone $= \frac{1}{3}\pi r^2 h$

$\therefore$ Portion of water which come out from the cone $= \frac{\text{Volume of sphere}}{\text{Volume of cone}}$

$$= \frac{\frac{4}{3}\pi R^3}{\frac{1}{3}\pi r^2 h} = \frac{4R^3}{r^2 h}$$

11. B

Sol. $\bar{X} = \frac{x_1 + x_2 + ... + x_n}{n}$

$\Rightarrow n\bar{X} = (x_1 + x_2 + ... + x_{n-1}) + x_n$

$\Rightarrow x_n = n\bar{X} - k$

12. A

Sol. Let r denote the radius of the circle. A point P is closer to the center of the circle than it is to the boundary precisely when P belongs to the circle of radius $\frac{r}{2}$ with the same center. The probability that this occurs is $\frac{\pi\left(\frac{r}{2}\right)^2}{\pi r^2} = \frac{1}{4}$.

13. B

Sol. Total numbers which are divisible by 4 and 6 will be 33

So Required probability $= \frac{100 - 33}{100} = .67$

14. B

Sol. $a_1 + a_5 + a_{10} + a_{15} + a_{20} + a_{24} = 225$

$\Rightarrow a_1 + (a_1 + 4d) + (a_1 + 9d) + (a_1 + 14d) + (a_1 + 19d) + (a_1 + 23d) = 225$

$\Rightarrow 6a_1 + 69d = 225$ ……..(1)

Now, $a_1 + a_2 + a_3 + a_4 + ... + a_{23} + a_{24} = 24a_1 + 276d$

$= 4(6a_1 + 69d)$

$= 4 \times 225 = 900$

15. B

Sol. $f(x) = x^{2013} + 1 = (x - 1)(x + 1)\,q(x) + ax + b$

$f(1) = 2 = a + b$ --- (1)

$f(-1) = 0 = -a + b$ --- (2)

from (1) & (2) $a = 1, b = 1$

16. C

Sol. Zeros of $x^2 - x - 2$ are 2 and – 1. They will be zeros of $x^3 + px + q$ also.

$\therefore 8 + 2p + q = 0$ & $-1 - p + q = 0$

$\Rightarrow p = -3$, $q = -2$

17. C

18. B

Sol. (17 & 18)

The total height of the bucket is 40 cm, which includes the height of the base. So, the height of the frustum of the cone = (40 – 6) cm = 34 cm

Therefore, the slant height of the frustum, $l = \sqrt{h^2 + (r_1 - r_2)^2}$ where

$r_1 = \frac{45}{2}\text{cm} = 22.5 \text{ cm}, r_2 = \frac{25}{2}\text{cm} = 12.5$ and $h = 34$ cm

So, $l = \sqrt{34^2 + (22.5 - 12.5)^2}$

$= \sqrt{34^2 + 10^2} = 35.44$ cm

Area of metallic sheet used = Curved surface area of frustum of cone + Area of circular base + Curved surface area of cylinder.

$= \pi \times 35.44(22.5 + 12.5) + \pi(12.5)^2 + 2\pi(12.5)(6)$

$= 4860.9 \text{ cm}^2$

Now, the volume of the water that the bucket can hold

$= \frac{1}{3}\pi h\left((r_1)^2 + (r_2)^2 + r_1 r_2\right)$

$= \frac{1}{3}\left(\frac{22}{7} \times 34 \times 943.75\right) = 33615.48 = 33.62 \text{litres}$

19. C

Sol.

(a) $\frac{1}{7}\log_{\sqrt{2}}(128) = \frac{1}{7} \times \left[\log_{\sqrt{2}} 2^7\right] = \frac{1}{7} \times 7 \times 2\log_2 2$

= 2

(b) $\log_2 3 \times \log_3 2 \times \log_3 9$

$= \frac{\log 3}{\log 2} \times \frac{\log 2}{\log 3} \times \frac{\log 9}{\log 3}$

$= \frac{\log 9}{\log 3} = \frac{2\log 3}{\log 3} = 2$

(c) $\log_{0.2} 625 - \log_{1/2} 16$

$= \frac{\log 625}{\log 0.2} - \frac{\log 16}{\log(1/2)}$

$\Rightarrow \frac{\log 5^4}{\log(5^{-1})} - \frac{\log 2^4}{\log(2^{-1})} = \frac{4}{-1} - \frac{4}{(-1)} = -4 + 4 = 0$

(d) $\left(\frac{a^m}{a^n}\right)^{m+n}\left(\frac{a^n}{a^\ell}\right)^{n+\ell}\left(\frac{a^\ell}{a^m}\right)^{\ell+m}$

$= \left(a^{m-n}\right)^{m+n} \times \left(a^{n-\ell}\right)^{n+\ell} \times \left(a^{\ell-m}\right)^{\ell+m}$

$= a^{m^2-n^2} \times a^{n^2-\ell^2} \times a^{\ell^2-m^2}$

$= a^{m^2-n^2+n^2-\ell^2+\ell^2-m^2}$

$= a^0 = 1$

20. B

Sol. (a) P (Red or Queen) $= \frac{28}{52} = \frac{7}{13}$

(b) P (Queen of club or King of heart) $= \frac{2}{52} = \frac{1}{26}$

(c) P (Face card or eight) $= \frac{12+4}{52} = \frac{4}{13}$

(d) P (Queen) $= \frac{4-1}{52-1} = \frac{1}{17}$

PART – B

1. 5

Sol. A (8, 6) B (8, –2) C (2, –2)

AB = 8, BC = 6, AC = 10

$\Rightarrow \Delta ABC$ is right angled.

$\Rightarrow$ Circumcentre will be at midpoint of hypotenuse AC and circum radius will be half of hypotenuse

$\Rightarrow$ Circum radius = 5 units.

2. 6

Sol. Case (i) $h_1 = 22$ cm

$2\pi r_1 = 12\,\text{cm}$

$\therefore r_1 = \frac{6}{\pi}$

$\therefore$ Volume $= \pi r_1^2 h_1 = \pi \frac{36}{\pi^2} \times 22$

$= \frac{36 \times 22}{\frac{22}{7}} = 252$

Case (ii) $h_2 = 12$ cm

$2\pi r_2 = 22$ cm

$\therefore r_2 = \frac{11}{\pi} = \frac{7}{2}$

$\therefore$ Volume $= \pi r_2^2 h_2 = \frac{22}{7} \times \frac{49}{4} \times 12 = 462$

$\therefore$ Difference = 462 – 252 = 210 cm^3

$\therefore$ Required answer $= \frac{210}{35} = 6$

3. 8

Sol. Since the surface area of the original cube is 24 square meters, each face of the cube has a surface area of $\frac{24}{6} = 4$ square meters, and the side length of this cube is 2 meters. The sphere inscribed within the cube has diameter 2 meters, which is also the length of the diagonal of the cube inscribed in the sphere. Let l represent the side length of the inscribed cube. Applying the Pythagorean Theorem twice gives $l^2 + l^2 + l^2 = 2^2 = 4$.

Hence each face has surface area $l^2 = \frac{4}{3}$ square meters.

So the surface area of the inscribed cube is $6.\left(\frac{4}{3}\right) = 8$ square meters.

4. 4

Sol. K should be > 0

Products of roots

$2 \cdot e^{2\log_e K} = 32$

$\therefore e^{2\log_e K} = 16$

$\Rightarrow e^{\log_e K^2} = 16$

$K^2 = 16$

$K = \pm 4$

$\therefore$ K = 4

5. 5

Sol. $\bar{x} = \frac{x_1 + x_2 + ... + x_{10}}{10} = 12.45$

$\bar{x}_N = \frac{(x_1 + 5) + (x_2 + 5) + ... + (x_{10} + 5)}{10}$

$= \frac{x_1 + x_2 + ... + x_{10}}{10} + \frac{50}{10}$

$\bar{x}_N = \bar{x} + 5$

New mean increased by 5

6. 6

Sol. $OR \perp SP$

Then SR=RP

$OS^2 = OR^2 + SR^2$

$5^2 = 4^2 + SR^2$

$SR^2 = 9$

SR=3

SP=6cm