BITSAT Solved Paper 2025
Session-II
Memory Based

INSTRUCTIONS

- *This question paper contains total 130 questions divided into four parts:*

  Part I : Physics Q. No. 1 to 30

  Part II : Chemistry Q. No. 31 to 60

  Part III : (A) English Proficiency Q. No. 61 to 70

  (B) Logical Reasoning Q. No. 71 to 90

  Part IV : Mathematics Q. No. 91 to 130
- *All questions are multiple choice questions with four options, only one of them is correct.*
- *Each correct answer awarded 3 marks and –1 for each incorrect answer.*
- *Duration of paper-3 Hours*

PART - I : PHYSICS

1. The amplitude of magnetic field in an electromagnetic wave propagating along y-axis is 6.0×10^{-7} T. The maximum value of electric field in the electromagnetic wave is:

(a) $5 \times 10^{14}\ Vm^{-1}$ (b) $180\ Vm^{-1}$

(c) $2 \times 10^{15}\ Vm^{-1}$ (d) $6.0 \times 10^{-7}\ Vm^{-1}$

2. The ratio of powers of two motors is $\frac{3\sqrt{x}}{\sqrt{x}+1}$, that are capable of raising 300 kg water in 5 minutes and 50 kg water in 2 minutes respectively from a well of 100 m deep. The value of x will be

(a) 2 (b) 4 (c) 2.4 (d) 16

3. The electric intensity due to a dipole of length 10 cm and having a charge of 500 μC, at a point on the axis at a distance 20 cm from one of the charges in air, is

(a) 6.25×10^7 N/C (b) 9.28×10^7 N/C

(c) 13.1×10^{11} N/C (d) 20.5×10^7 N/C

4. If the rms speed of oxygen molecules at 0°C is 160 m/s, find the rms speed of hydrogen molecules at 0°C.

(a) 640 m/s (b) 40 m/s

(c) 80 m/s (d) 332 m/s

5. Focal length of a convex lens of refractive index 1.5 is 2 cm. Focal length of the lens when immersed in a liquid of refractive index of 1.25 will be

(a) 10 cm (b) 2.5 cm

(c) 5 cm (d) 7.5 cm

6. If E and G respectively denote energy and gravitational constant, then $\frac{E}{G}$ has the dimensions of

(a) $[M^2][L^{-2}][T^{-1}]$ (b) $[M^2][L^{-1}][T^0]$

(c) $[M][L^{-1}][T^{-1}]$ (d) $[M][L^0][T^0]$

7. Light of frequency 1.5 times the threshold frequency is incident on a photosensitive material. What will be the photoelectric current if the frequency is halved and intensity is doubled?

(a) four times (b) one-fourth

(c) zero (d) doubled

8. The centre of mass of a system of particles does not depend upon

(a) masses of the particles

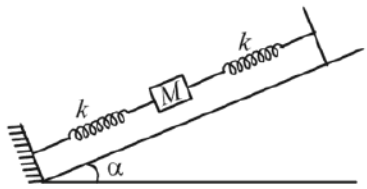
(b) forces acting on the particles

(c) position of the particles

(d) relative distances between the particles

9. In the given figure, a body of mass M is held between two massless springs, on a smooth inclined plane. The free ends of the springs are attached to firm supports. If each spring has

spring constant k, the frequency of oscillation of given body is :



(a) $\frac{1}{2\pi}\sqrt{\frac{k}{2M}}$ (b) $\frac{1}{2\pi}\sqrt{\frac{2k}{Mg\sin\alpha}}$

(c) $\frac{1}{2\pi}\sqrt{\frac{2k}{M}}$ (d) $\frac{1}{2\pi}\sqrt{\frac{k}{Mg\sin\alpha}}$

10. A parallel plate capacitor has a uniform electric field E in the space between the plates. If the distance between the plates is d and area of each plate is A, the energy stored in the capacitor is :

(a) $\frac{1}{2}\varepsilon_0 E^2$ (b) E^2Ad/ε_0

(c) $\frac{1}{2}\varepsilon_0 E^2 Ad$ (d) $\varepsilon_0 EAd$

11. The height y and the distance x along the horizontal plane of a projectile on a certain planet [with no surrounding atmosphere] are given by $y = [5t - 8t^2]$ metre and $x = 12t$ metre where t is the time in second. The velocity with which the projectile is projected, is:

(a) 5 m/s
(b) 12 m/s
(c) 13 m/s
(d) not obtainable from the data

12. A square loop of side 1 m and resistance 1 Ω is placed in a magnetic field of 0.5 T. If the plane of loop is perpendicular to the direction of magnetic field, the magnetic flux through the loop is:

(a) 0.5 weber (b) 1 weber
(c) Zero weber (d) 2 weber

13. A car moves at a speed of 20 ms^{-1} on a banked track and describes an arc of a circle of radius $40\sqrt{3}$ m. The angle of banking is ($g = 10\ ms^{-2}$)

(a) 25° (b) 60° (c) 45° (d) 30°

14. A closed organ pipe has a fundamental frequency of 1.5 kHz. The number of overtones that can be distinctly heard by a person with this organ pipe will be: (Assume that the highest frequency a person can hear is 20,000 Hz)

(a) 6 (b) 4 (c) 7 (d) 5

15. From Ampere's circuital law for a long straight wire of circular cross-section carrying a steady current, the variation of magnetic field in the inside and outside region of the wire is:

(a) a linearly increasing function of distance upto the boundary of the wire and then linearly decreasing for the outside region.
(b) a linearly increasing function of distance r upto the boundary of the wire and then decreasing one with 1/r dependence for the outside region.
(c) a linearly decreasing function of distance upto the boundary of the wire and then a linearly increasing one for the outside region.
(d) uniform and remains constant for both the regions.

16. A wire of resistance 160 Ω is melted and drawn in wire of one-fourth of its length. The new resistance of the wire will be

(a) 10 Ω (b) 640 Ω (c) 40 Ω (d) 16 Ω

17. A block of mass M is pulled along a horizontal frictionless surface by a rope of mass m. If a force P is applied at the free end of the rope, the force exerted by the rope on the block is

(a) $\frac{Pm}{M+m}$ (b) $\frac{Pm}{M-m}$

(c) P (d) $\frac{PM}{M+m}$

18. A 12 V, 60 W lamp is connected to the secondary of a step-down transformer, whose primary is connected to ac mains of 220 V. Assuming the transformer to be ideal, what is the current in the primary winding?

(a) 0.27A (b) 2.7A (c) 3.7A (d) 0.37A

19. If $\vec{F}$ is the force acting on a particle having position vector $\vec{r}$ and $\vec{\tau}$ be the torque of this force about the origin, then:

(a) $\vec{r}\cdot\vec{\tau} > 0$ and $\vec{F}\cdot\vec{\tau} < 0$

(b) $\vec{r}\cdot\vec{\tau} = 0$ and $\vec{F}\cdot\vec{\tau} = 0$

(c) $\vec{r}\cdot\vec{\tau} = 0$ and $\vec{F}\cdot\vec{\tau} \neq 0$

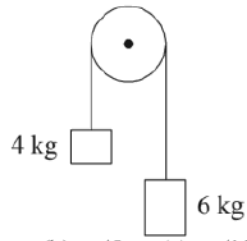
(d) $\vec{r}\cdot\vec{\tau} \neq 0$ and $\vec{F}\cdot\vec{\tau} = 0$

20. If the nucleus $^{27}_{13}Al$ has nuclear radius of about 3.6 fm, then $^{125}_{32}Te$ would have its radius approximately as

(a) 9.6 fm (b) 12.0 fm

(c) 4.8 fm (d) 6.0 fm

21. Two bodies of mass 4 kg and 6 kg are tied to the ends of a massless string. The string passes over a pulley which is frictionless (see figure). The acceleration of the system in terms of acceleration due to gravity (g) is:



(a) g/2 (b) g/5 (c) g/10 (d) g

22. In a Young's double slit experiment, a student observes 8 fringes in a certain segment of screen when a monochromatic light of 600 nm wavelength is used. If the wavelength of light is changed to 400 nm, then the number of fringes he would observe in the same region of the screen is:

(a) 8 (b) 9 (c) 12 (d) 6

23. In a reverse biased diode when the applied voltage changes by 1 V, the current is found to change by 0.5 μA. The reverse bias resistance of the diode is

(a) $2 \times 10^5\,\Omega$ (b) $2 \times 10^6\,\Omega$

(c) $200\,\Omega$ (d) $2\,\Omega$

24. A student measures the terminal potential difference (V) of a cell (of emf E and internal resistance r) as a function of the current (I) flowing through it. The slope and intercept, of the graph between V and I, then, respectively, equal:

(a) – r and E (b) r and – E

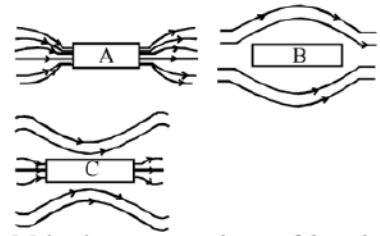
(c) – E and r (d) E and – r

25. Proton (P) and electron (e) will have same de-Broglie wavelength when the ratio of their momentum is (assume, $m_p = 1849 m_e$)

(a) 1 : 43 (b) 43 : 1

(c) 1 : 1849 (d) 1 : 1

26. Three identical bars A, B and C are made of different magnetic materials. When kept in a uniform magnetic field, the field lines around them look as follows:



Make the correspondence of these bars with their material being diamagnetic (D), ferromagnetic (F) and paramagnetic (P):

(a) $A \leftrightarrow D, B \leftrightarrow P, C \leftrightarrow F$

(b) $A \leftrightarrow F, B \leftrightarrow D, C \leftrightarrow P$

(c) $A \leftrightarrow P, B \leftrightarrow F, C \leftrightarrow D$

(d) $A \leftrightarrow F, B \leftrightarrow P, C \leftrightarrow D$

27. Two solid metal balls of radii r and $2r$ are falling with their terminal speeds in a viscous liquid. What is the ratio of drag force acting on these two balls?

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

28. A metre scale is balanced on a knife edge at its centre. When two coins, each of mass 10 g are put one on the top of the other at the 10.0 cm mark the scale is found to be balanced at 40.0 cm mark. The mass of the metre scale is found to be $x \times 10^{-2}$ kg. The value of x is

(a) 6 (b) 12 (c) 18 (d) 24

29. The approximate height from the surface of earth at which the weight of the body becomes $\frac{1}{3}$ of its weight on the surface of earth is :

[Radius of earth R = 6400 km and $\sqrt{3} = 1.732$]

(a) 3840 km (b) 4685 km

(c) 2133 km (d) 4267 km

30. The length of a rubber cord is l_1 meter when tension is 4 N and l_2 meter when tension is 6 N respectively. The length when tension is 9 N is

(a) $(6l_2 - 1.5l_1)$ m (b) $(3l_2 - 2l_1)$ m

(c) $(2.5l_1 - 3.5l_2)$ m (d) $(2.5l_2 - 1.5l_1)$ m

PART - II : CHEMISTRY

31. The equilibrium constant for the reaction

$SO_3(g) \rightleftharpoons SO_2(g) + \frac{1}{2}O_2(g)$ is $K_c = 4.9 \times 10^{-2}$.

The value of K_c for the reaction given below is

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ is

(a) 4.9 (b) 41.6 (c) 49 (d) 416

32. The complex that shows Facial – Meridional isomerism is

(a) $[Co(NH_3)_3Cl_3]$(b) $[Co(NH_3)_4Cl_2]^+$

(c) $[Co(en)_3]^{3+}$ (d) $[Co(en)_2Cl_2]^+$

33. Identify the factor from the following that **does not** affect electrolytic conductance of a solution.

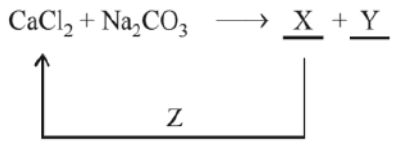
(a) The nature of solvent used.

(b) Concentration of the electrolyte.

(c) The nature of the electrode used.

(d) The nature of the electrolyte added.

34. In the given reaction cycle



X, Y and Z respectively are

(a)

X	Y	Z
CaO	$NaCl + CO_2$	KCl

(b)

X	Y	Z
$CaCO_3$	NaCl	KCl

(c)

X	Y	Z
$CaCO_3$	NaCl	HCl

(d)

X	Y	Z
CaO	$NaCl + CO_2$	NaCl

35. Allyl phenyl ether can be prepared by heating:

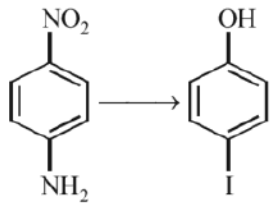
(a) $C_6H_5Br + CH_2 = CH - CH_2 - ONa$

(b) $CH_2 = CH - CH_2 - Br + C_6H_5ONa$

(c) $C_6H_5 - CH = CH - Br + CH_3 - ONa$

(d) $CH_2 = CH - Br + C_6H_5 - CH_2 - ONa$

36. The correct sequential order of the reagents for the given reaction is :



(a) HNO_2, Fe/H^+, HNO_2, KI, H_2O/H^+

(b) HNO_2, KI, Fe/H^+, HNO_2, H_2O/warm

(c) HNO_2, KI, HNO_2, Fe/H^+, H_2O/H^+

(d) HNO_2, Fe/H^+, KI, HNO_2, H_2O/warm

37. A sugar 'X' dehydrates very slowly under acidic condition to give furfural which on further reaction with resorcinol gives the coloured product after sometime. Sugar 'X' is

(a) Aldopentose (b) Aldotetrose

(c) Oxalic acid (d) Ketotetrose

38. A similarity between optical and geometrical isomerism is that

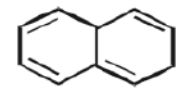
(a) each forms equal number of isomers for a given compound

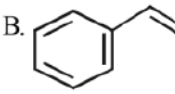
(b) if in a compound one is present then so is the other

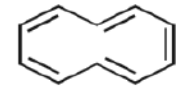
(c) both are included in stereoisomerism

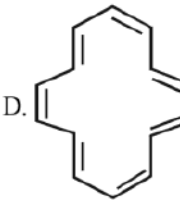
(d) they have no similarity

39. Which of the following are aromatic?

A. 

B. 

C. 

D. 

(a) B and D only (b) A and C only

(c) A and B only (d) C and D only

40. $t_{1/4}$ can be taken as the time taken for the concentration of a reactant to drop to 3/4 of its initial value. If the rate constant for a first order reaction is k, the $t_{1/4}$ can be written as

(a) $0.75/k$ (b) $0.69/k$

(c) $0.29/k$ (d) $0.10/k$

41. A sample of red ink (a colloidal suspension) is prepared by mixing eosin dye, egg white, HCHO and water. The component which ensures stabilitiy of the ink sample is :

(a) Egg white (b) Water

(c) HCHO (d) Eosin dye

42. At 300 K, the density of a certain gaseous molecule at 2 bar is double to that of dinitrogen (N_2) at 4 bar. The molar mass of gaseous molecule is :

(a) $28\ g\ mol^{-1}$ (b) $56\ g\ mol^{-1}$

(c) $112\ g\ mol^{-1}$ (d) $224\ g\ mol^{-1}$

43. $S(g)+\frac{3}{2}O_2(g) \rightarrow SO_3(g)+2x\,kcal$

$SO_2(g)+\frac{1}{2}O_2(g) \rightarrow SO_3(g)+y\,kcal$

The heat of formation of $SO_2(g)$ is given by :

(a) $\frac{2x}{y}kcal$ (b) $y-2x\ kcal$

(c) $2x+y\ kcal$ (d) $x+y\ kcal$

44. Which of the following electronegativity order is incorrect?

(a) $Al < Mg < B < N$

(b) $Al < Si < C < N$

(c) $Mg < Be < B < N$

(d) $S < Cl < O < F$

45. What will be the decreasing order of basic strength of the following conjugate bases ?

$^{-}OH, R\bar{O}, CH_3C\bar{O}O, C\bar{l}$

(a) $C\bar{l} > OH > R\bar{O} > CH_3CO\bar{O}$

(b) $R\bar{O} > {}^{-}OH > CH_3CO\bar{O} > C\bar{l}$

(c) $^{-}OH > R\bar{O} > CH_3CO\bar{O} > C\bar{l}$

(d) $C\bar{l} > R\bar{O} > {}^{-}OH > CH_3C\bar{O}O$

46. $2-\text{Hexene} \xrightarrow[(ii)\,H_2O]{(i)\,O_3} \text{Products}$

The two products formed in above reaction are -

(a) Butanoic acid and acetic acid

(b) Butanal and acetic acid

(c) Butanal and acetaldehyde

(d) Butanoic acid and acetaldehyde

47. Preparation of potassium permanganate from MnO_2 involves two step process in which the 1st step is a reaction with KOH and KNO_3 to produce

(a) $K_4[Mn(OH)_6]$ (b) K_3MnO_4

(c) $KMnO_4$ (d) K_2MnO_4

48. Arrange the carbanions,

$(CH_3)_3\bar{C}, \bar{C}Cl_3, (CH_3)_2\bar{C}H, C_6H_5\bar{C}H_2$

in order of their decreasing stability.

(a) $(CH_3)_2\bar{C}H > \bar{C}Cl_3 > C_6H_5\bar{C}H_2 > (CH_3)_3\bar{C}$

(b) $\bar{C}Cl_3 > C_6H_5\bar{C}H_2 > (CH_3)_2\bar{C}H > (CH_3)_3\bar{C}$

(c) $(CH_3)_3\bar{C} > (CH_3)_2\bar{C}H > C_6H_5\bar{C}H_2 > \bar{C}Cl_3$

(d) $C_6H_5\bar{C}H_2 > \bar{C}Cl_3 > (CH_3)_3\bar{C} > (CH_3)_2\bar{C}H$

49. What pressure (bar) of H_2 would be required to make emf of hydrogen electrode zero in pure water at 25°C ?

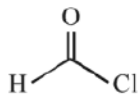
(a) 10^{-14} (b) 10^{-7} (c) 1(d) 0.5

50. Element not showing variable oxidation state is :

(a) Bromine (b) Iodine

(c) Chlorine (d) Fluorine

51. Salicylaldehyde is synthesized from phenol, when reacted with

(a)  , NaOH

(b) CO_2, NaOH

(c) CCl_4, NaOH

(d) $HCCl_3$, NaOH

52. Reaction of *trans* 2-phenyl-1-bromocyclopentane on reaction with alcoholic KOH produces

(a) 1-phenylcyclopentene

(b) 3-phenylcyclopentene

(c) 4-phenylcyclopentene

(d) 2-phenylcyclopentene

53. An element has a face-centred cubic (fcc) structure with a cell edge of *a*. The distance between the centres of two nearest tetrahedral voids in the lattice is :

(a) $\sqrt{2a}$ (b) a (c) $\frac{a}{2}$ (d) $\frac{3}{2}a$

54. The correct set of four quantum numbers for the valence electrons of rubidium atom ($Z = 37$) is:

(a) $5, 0, 0, +\frac{1}{2}$ (b) $5, 1, 0, +\frac{1}{2}$

(c) $5, 1, 1, +\frac{1}{2}$ (d) $5, 0, 1, +\frac{1}{2}$

55. Consider the ions/molecule O_2^+, O_2, O_2^-, O_2^{2-}

For increasing bond order the correct option is :

(a) $O_2^{2-} < O_2^- < O_2 < O_2^+$

(b) $O_2^- < O_2^{2-} < O_2 < O_2^+$

(c) $O_2^- < O_2^{2-} < O_2^+ < O_2$

(d) $O_2^- < O_2^+ < O_2^{2-} < O_2$

56. Which one of the following is used as antihistamine?

(a) Omeprazole

(b) Chloranphenicol

(c) Diphenhydramine

(d) Norethindrone

57. 2,4-DNP test can be used to identify

(a) Aldehydes (b) Amines

(c) Ethers (d) Halogens

58. Thermal power plants can lead to :

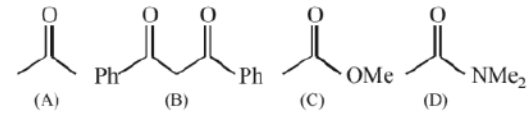
(a) Acid rain

(b) Blue baby syndrome

(c) Ozone layer depletion

(d) Eutrophication

59. The increasing order of the acidity of the α-hydrogen of the following compounds is :



(a) (D) < (C) < (A) < (B)

(b) (B) < (C) < (A) < (D)

(c) (A) < (C) < (D) < (B)

(d) (C) < (A) < (B) < (D)

60. Which of the following mixing of 1M base and 1M acid leads to the largest increase in temperature?

(a) 30 mL HCl and 30 mL NaOH

(b) 30 mL CH_3COOH and 30 mL NaOH

(c) 50 mL HCl and 20 mL NaOH

(d) 45 mL CH_3COOH and 25 mL NaOH

PART - III (A): ENGLISH PROFICIENCY

DIRECTION (Q. 61): *In the following question, four alternatives are given for the Idiom/Phrase underlined in the sentence. Choose the alternative which best expresses the meaning of the Idiom/ Phrase.*

61. After losing the final match, the team had to **face the music** from their disappointed coach.

(a) Enjoy the praise
(b) Accept the punishment or criticism
(c) Dance to the tunes
(d) Start a new performance

DIRECTIONS (Qs. 62-63): *In the question given below, the 1st and the last sentences /parts of the passage/sentence are numbered 1 and 6. The rest of the passage/ sentence is split into four parts and named P, Q, R and S. These four parts are not given in their proper order. Read the passage/ sentence and find out which of the four combinations is correct. Then find the correct answer.*

62. **1.** Creativity is not a talent reserved for a chosen few, but a skill that can be nurtured with practice and patience.

P. This often means allowing oneself to explore new ideas without the fear of judgment or failure.

Q. Like any skill, it flourishes in environments that encourage curiosity, risk-taking, and persistence.

R. Over time, these habits strengthen cognitive flexibility and deepen original thinking.

S. Engaging regularly in creative pursuits, even in small ways, builds confidence and resilience.

6. Therefore, cultivating creativity is as much about mindset as it is about method.

(a) QPSR (b) PQSR
(c) QSRP (d) PSQR

63. **1.** Human memory is not a perfect recorder of events.

P. Instead, memories are reconstructed, often influenced by our current beliefs and emotions.

Q. Studies show that people frequently misremember details of events they've experienced.

R. This explains why eyewitness testimonies can sometimes be unreliable.

S. Even vivid memories may change subtly each time we recall them.

6. Thus, memory is more malleable and subjective than we usually assume.

(a) PSQR (b) SPQR
(c) SQPR (d) PQSR

64. Choose the word opposite in meaning to the word given in capital.

WRANGLE

(a) Argue (b) Fight
(c) Agree (d) Dispute

65. Choose the word which is nearest in meaning to the given word.

Gaudy

(a) Modest (b) Elegant
(c) Dull (d) Flashy

DIRECTIONS (Qs. 66-67): *Choose the most effective word from the given options to fill in the blank and to make the sentence meaningfully complete.*

66. In an age dominated by social media, the line between authentic emotion and performative _____ has grown increasingly thin.

(a) isolation (b) sympathy
(c) outrage (d) detachment

67. The CEO's decision to resign was seen as a _____ move, aimed at protecting the company's reputation during the scandal.

(a) Cowardly (b) Tactical
(c) Abrupt (d) Emotional

DIRECTIONS (Qs. 68-69): *In the questions given below, find out the part of sentence which contains an error.*

68. Hardly had the meeting begun

(a) when the delegates
(b) starts raising objections
(c) to the proposed resolution.
(d) No error

69. Scarcely had she stepped

(a) out of the room when
(b) she remembered she left
(c) her phone on the table.
(d) No error

DIRECTION (Q. 70): *In a question below, a part of the sentence is underlined. Below are given alternatives to the underlined part at (a), (b),(c) which may improve the sentence. Choose the correct alternative. In case no improvement is needed, mark your answer as option (d).*

70. She ***has been knowing*** the secret for several months.
(a) knows
(b) knew
(c) has known
(d) No improvement

PART - III (B) : LOGICAL REASONING

DIRECTIONS (Qs 71-90) : *On the following questions, select the related word/letters/numbers fro the attractive*

71. $\sqrt{AFI} = M : \sqrt{ADD} = L :: \sqrt{ABA} = ?$
(a) I (b) N (c) O (d) K

72. AKP : 1121256 :: LNO : ?
(a) 196125144
(b) 144196225
(c) 144225196
(d) 41521196

73. Find the odd one out:
Ostrich, Crow, Pigeon, Sparrow.
(a) Ostrich (b) Pigeon
(c) Crow (d) Sparrow

74. If it is possible to form a word with the first, fourth, seventh and eleventh letters in the word 'SUPERFLUOUS, write the first letters of that word.
(a) O (b) E (c) S (d) L

75. Select the missing number from the given responses.

(a) 20 (b) 5
(c) 4 (d) 21

76. If PALE is coded as 5293, EARTH is coded as 32681, how is PEARL coded in that code?
(a) 53269
(b) 53629
(c) 53829
(d) 53289

77. Which one set of letters when sequentially placed at the gaps in the given letter series would complete it?
fgg _____ gff _____ f _____ gfg _____ fgf
(a) fggf
(b) ccfc
(c) fgfg
(d) ffgg

DIRECTIONS (Qs. 78-79): *In each questions below are given two statements followed by two conclusions numbered I and II. You have take the two given statements to be true even if they seem to be at variance with commonly known facts. Read the conclusions logically follows from the given statements disregarding commonly known facts. Give answer.*

(a) If only conclusion I follows.
(b) If only conclusion II follows.
(c) If either conclusion I or conclusion II follows.
(d) If neither conclusion I nor conclusion follows.
(e) If both conclusion I and Ii conclusion follow.

78. **Statement:**
All mangoes are grapes.
Some grapes are black.
Conclusion
(I) Some mangoes being black is a possibility
(II) There is a possibility that some mangoes are not black

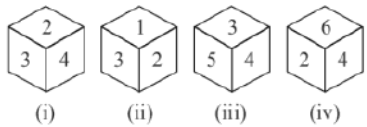
79. **Statement:**
Some dreams are nights
Some nights are days
Conclusion:
(I) All days are either nights or dreams
(II) Some days are nights

80. Find the missing number from the given responses,

7	3	10
3	4	7
2	7	?
42	84	140

(a) 2 (b) 17
(c) 9 (d) 34

81. 1, 2, 3, 4, 5 and 6 have written on surface of dice. Four forms of dice shown below. In this dice which digit will be on the surface opposite to the digit 3?



(a) 4 (b) 5
(c) 6 (d) 1

DIRECTION (Q. 82): *Which answer figure complete the form in question figure ?*

82. Question Figure:

X

Answer Figures:

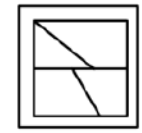
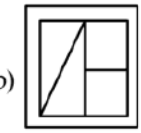
(a)  (b) 

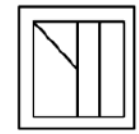
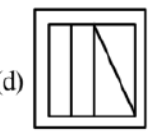
(c)  (d) 

DIRECTION (Q. 83): *Question figure and four answer figures marked (a), (b), (c) and (d) are given. Select the answer figure which can be formed from the cut-out pieces given in the question figure.*

83. Question Figure:

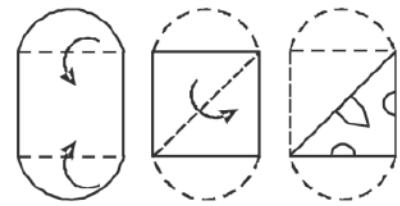
Answer Figures:

(a)  (b) 

(c)  (d) 

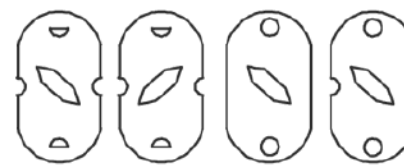
DIRECTION (Q. 84): *Question consist set of 3 figures A, B, and C showing a sequence of folding of a piece of paper. Figure C shows manner in which paper has been cut. You have to choose a figure which would most closely resembled the unfolded form of C.*

84. Question Figure:



(A) **(B)** **(C)**

Answer-Figures:



(a) (b) (c) (d)

DIRECTION: *In questions 85, four figures (a), (b), (c), (d) have been given in each question. Of these four figures three figures are similar in some way and one figure is different. Select the figure which is different.*

85. (a) 

(b) 

(c) 

(d) 

DIRECTION: *In questions 86, there is a problem figure and four answer figures marked (a), (b), (c), (d) are given. Select the answer figure which is exactly the mirror image of the problem figure.*

86. Question Figure:

Answer Figures:

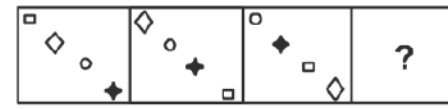
(a) 
(b) 
(c) 
(d) 

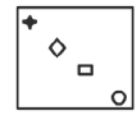
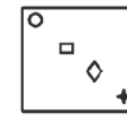
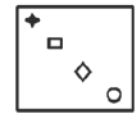
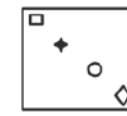
87. Select the correct option that indicates the arrangement of the following words in a logical and meaningful order.

1. Drive vehicle
2. Unlock vehicle
3. Start vehicle
4. Reach destination
5. Parking of vehicle

(a) 2, 3, 4, 1, 5 (b) 2, 3, 1, 4, 5
(c) 1, 5, 4, 3, 2 (d) 2, 4, 1, 3, 5

88. Select the figure that will replace the question mark (?) in the following figure series.



(a) 
(b) 
(c) 
(d) 

89. Deepika tells Shraddha "Your mother's father's son is the husband of my sister." How is Deepika related to Shraddha?

(a) Sister-in-law
(b) Cousin.
(c) Aunt
(d) Data inadequate
(e) None of these

90. Choose the correct alternative from the given ones that will complete the series.

Double, Triple, Quadruple, ?

(a) Quintuple (b) Nonuple
(c) Sextuple (d) Octuple

PART - IV : MATHEMATICS

91. Given the sets

$A = \{1, 3, 5\}, B = \{2, 4, 6\}$ and $C = \{0, 2, 4, 6, 8\}$. Which of the following may be considered as universal set for all the three sets A, B and C?

(a) $\{0, 1, 2, 3, 4, 5, 6\}$
(b) ϕ
(c) $\{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$
(d) $\{1, 2, 3, 4, 5, 6, 7, 8\}$

92. Which of the following relation is a function ?

(a) $\{(a,b)(b,e)(c,e)(b,x)\}$

(b) $\{(a,d)(a,m)(b,e)(a,b)\}$

(c) $\{(a,d)(b,e)(c,d)(e,x)\}$

(d) $\{(a,d)(b,m)(b,y)(d,x)\}$

93. If $\sin A = \frac{3}{5}$ and A is in first quadrant, then the values of sin 2A, cos 2A and tan 2A are

(a) $\frac{24}{25}, \frac{7}{25}, \frac{24}{7}$

(b) $\frac{1}{25}, \frac{7}{25}, \frac{1}{7}$

(c) $\frac{24}{25}, \frac{1}{25}, \frac{24}{7}$

(d) $\frac{1}{25}, \frac{24}{25}, \frac{1}{24}$

94. If $2\tan^2\theta = \sec^2\theta$, then general value of θ are

(a) $n\pi \pm \frac{\pi}{4}, n \in I$

(b) $n\pi \pm \frac{\pi}{6}, n \in I$

(c) $2n\pi + \frac{\pi}{4}, n \in I$

(d) $2n\pi \pm \frac{\pi}{6}, n \in I$

95. If $\left(\frac{1-i}{1+i}\right)^{100} = a + ib$ then

(a) $a = 2, b = -1$ (b) $a = 1, b = 0$

(c) $a = 0, b = 1$ (d) $a = -1, b = 2$

96. Let α, β be the roots of the equation

$x^2 - \sqrt{2}x + \sqrt{6} = 0$ and $\frac{1}{\alpha^2} + 1, \frac{1}{\beta^2} + 1$ be the roots of the equation $x^2 + ax + b = 0$. Then the roots of the equation $x^2 - (a + b - 2)x + (a + b + 2) = 0$ are:

(a) non-real complex numbers

(b) real and both negative

(c) real and both positive

(d) real and exactly one of them is positive

97. The set of values of k for which the equation $4x^2 - 2x + k = 0$ has two roots lying in the interval $(-1, 1)$ is

(a) $\left(-2, \frac{1}{4}\right]$ (b) $(-6, \infty)$

(c) $\left(-\infty, \frac{1}{4}\right]$ (d) $(-2, \infty)$

98. The set of all x satisfying the inequality $\frac{4x-1}{3x+1} \geq 1$

(a) $\left(-\infty, -\frac{1}{3}\right) \cup \left[\frac{1}{4}, \infty\right)$

(b) $\left(-\infty, -\frac{2}{3}\right) \cup \left[\frac{5}{4}, \infty\right)$

(c) $\left(-\infty, -\frac{1}{3}\right) \cup [2, \infty)$

(d) $\left(-\infty, -\frac{2}{3}\right] \cup [4, \infty)$

99. The number of three digit numbers having only two consecutive digits identical is

(a) 153 (b) 162 (c) 168 (d) 163

100. The number of 3 digit numbers having at least one of their digit as 5 are

(a) 250 (b) 251 (c) 252 (d) 253

101. The smallest natural number n, such that the coefficient of x in the expansion of $\left(x^2 + \frac{1}{x^3}\right)^n$ is ${}^nC_{23}$, is :

(a) 38 (b) 58 (c) 23 (d) 35

102. If a, b, c are in G.P., then

(a) a^2, b^2, c^2 are in G.P.

(b) $a^2(b+c), c^2(a+b), b^2(a+c)$ are in G.P.

(c) $\frac{a}{b+c}, \frac{b}{c+a}, \frac{c}{a+b}$ are in G.P.

(d) None of the above

103. If $A = 1 + r^a + r^{2a} + r^{3a} + ...\infty$

and $B = 1 + r^b + r^{2b} + r^{3b} + ...\infty$, then $\frac{a}{b}$ is equal to

(a) $\log_B(A)$ (b) $\log_{1-B}(1-A)$

(c) $\log_{\frac{B-1}{B}}\left(\frac{A-1}{A}\right)$ (d) None of these

104. If the point $P(x, y)$ is equidistant from the points $A(a + b, b - a)$ and $B(a - b, a + b)$, then

(a) $ax = by$

(b) $bx = ay$ and P can be (a, b)

(c) $x^2 - y^2 = 2(ax + by)$

(d) None of the above

105. Equation of the straight line making equal intercepts on the axes and passing through the point (2, 4) is :

(a) $4x - y - 4 = 0$ (b) $2x + y - 8 = 0$

(c) $x + y - 6 = 0$ (d) $x + 2y - 10 = 0$

106. If the slope of one of the lines given by $a^2x^2 + 2hxy + b^2y^2 = 0$ be three times of the other then h is equal to

(a) $2\sqrt{3}ab$ (b) $-2\sqrt{3}ab$

(c) $\frac{2}{\sqrt{3}}ab$ (d) None of these

107. A circle touches both the y-axis and the line $x + y = 0$. Then the locus of its center is

(a) $y = \sqrt{2}x$ (b) $x = \sqrt{2}y$

(c) $y^2 - x^2 = 2xy$ (d) $x^2 - y^2 = 2xy$

108. The circle described on focal radii of a parabola as diameter touches

(a) the axis

(b) the tangent at the vertex

(c) the directrix

(d) none of these

109. If the perpendicular distance of the point (6, 5, 8) from the Y-axis is 5λ unit, then λ is equal to

(a) 5 (b) 3 (c) 4 (d) 2

110. If value of $\lim_{x\to\frac{\pi}{4}} \frac{4\sqrt{2} - (\cos x + \sin x)^5}{1 - \sin 2x}$ is $a\sqrt{2}$, then the value of 'a' is

(a) 2 (b) 3 (c) 4 (d) 5

111. If the letters of the word ATTEMPT are written down at random, the chance that all T's are consecutive, is

(a) $\frac{1}{42}$ (b) $\frac{6}{7}$

(c) $\frac{1}{7}$ (d) None of these

112. The mean and SD of 63 children on an arithmetic test are respectively 27, 6 and 7.1. To them are added a new group of 26 who had less training and whose mean is 19.2 and SD 6.2. The values of the combined group differ from the original as to (i) the mean and (ii) the SD is

(a) 25.1, 7.8 (b) 2.3, 0.8

(c) 1.5, 0.9 (d) None of these

113. Let $f : R \to R$, $g : R \to R$ be two functions such that $f(x) = 2x - 3$, $g(x) = x^3 + 5$. The function $(fog)^{-1}(x)$ is equal to

(a) $\left(\frac{x+7}{2}\right)^{1/3}$ (b) $\left(x - \frac{7}{2}\right)^{1/3}$

(c) $\left(\frac{x-2}{7}\right)^{1/3}$ (d) $\left(\frac{x-7}{2}\right)^{1/3}$

114. If $\tan^{-1}(x+1) + \cot^{-1}(x-1)$

$= \sin^{-1}\frac{4}{5} + \cos^{-1}\frac{3}{5}$, then x has the value :

(a) $4\sqrt{\frac{3}{7}}$ (b) $4\sqrt{\frac{7}{3}}$

(c) $14\sqrt{3}$ (d) $6\sqrt{7}$

115. If $A = \begin{bmatrix} 1 & 0 & 3 \\ 2 & 1 & 1 \\ 0 & 0 & 2 \end{bmatrix}$, then the value of $|\text{adj}(\text{adj } A)|$ is

(a) 14 (b) 16 (c) 15 (d) 12

116. The number of $\theta \in (0, 4\pi)$ for which the system of linear equations $3(\sin 3\theta)x - y + z = 2$, $3(\cos 2\theta)x + 4y + 3z = 3$

$6x + 7y + 7z = 9$ has no solution, is:

(a) 6 (b) 7 (c) 8 (d) 9

117. If $x = b\cos^{-1}\sqrt{\frac{y}{b}} + \sqrt{by - y^2}$, then $\frac{dy}{dx} =$

(a) $-\sqrt{\frac{b}{y} - 1}$ (b) $\sqrt{1 - \frac{b}{y}}$

(c) $\sqrt{by - y^2}$ (d) 0

118. Let $f(x) = \begin{cases} \frac{x-4}{|x-4|} + a, & x < 4 \\ a + b, & x = 4. \\ \frac{x-4}{|x-4|} + b, & x > 4 \end{cases}$

Then $f(x)$ is continuous at $x = 4$ when

(a) $a = 0, b = 0$

(b) $a = 1, b = 1$

(c) $a = -1, b = 1$

(d) $a = 1, b = -1$

119. The height of the cylinder of maximum volume that can be inscribed in a sphere of radius a is

(a) $\frac{a}{\sqrt{3}}$ (b) $\frac{2a}{\sqrt{3}}$ (c) $\frac{3}{2}a$ (d) None

120. $\int \frac{2x^4 + x - 1}{2(x-1)(x^2+1)} dx$ is equal to

(a) $\frac{x^2}{2} + x + \frac{1}{2}\log(x-1) - \frac{1}{4}\log(x^2+1)$

(b) $\frac{x^2}{2} + x + \frac{1}{2}\log(x-1) + \frac{1}{4}\log(x^2+1)$

(c) $\frac{x^2}{2} - x + \frac{1}{2}\log(x-1)$

$+ \frac{1}{4}\log(x^2+1) + \frac{1}{2}\tan^{-1}x + C$

(d) None of these

121. The integral $\int_0^{\frac{\pi}{2}} \frac{1}{3 + 2\sin x + \cos x} dx$ is equal to:

(a) $\tan^{-1}(2)$

(b) $\tan^{-1}(2) - \frac{\pi}{4}$

(c) $\frac{1}{2}\tan^{-1}(2) - \frac{\pi}{8}$

(d) $\frac{1}{2}$

122. The area bounded by curves $(x-1)^2 + y^2 = 1$ and $x^2 + y^2 = 1$ is

(a) $\left(\frac{2\pi}{3} - \frac{\sqrt{3}}{2}\right)$ (b) $\frac{2\pi}{3}$

(c) $\frac{\sqrt{3}}{2}$ (d) $\frac{2\pi}{3} + \frac{\sqrt{3}}{2}$

123. The solution of the differential equation

$\frac{dy}{dx} + \frac{y}{x\log x} = \frac{1}{x}$ is

(a) $y = \frac{1}{2}\log x + c(\log x)^{-1}$

(b) $y = \log x + c(\log x)^{-1}$

(c) $y = \frac{1}{2}\log x + \frac{c}{(\log x)^2}$

(d) $y = \frac{1}{3}\log x - c(\log x)^{-1}$

124. The solution of $xdx + ydy = x^2ydy - xy^2dx$ is

(a) $x^2 - 1 = c(1 + y^2)$ (b) $x^2 + 1 = c(1 - y^2)$

(c) $x^3 - 1 = c(1 + y^3)$ (d) $x^3 + 1 = c(1 - y^3)$

125. For three vectors $\vec{u}, \vec{v}, \vec{w}$ which of the following expressions is not equal to any of the remaining three ?

(a) $\vec{u}.(\vec{v}\times\vec{w})$ (b) $(\vec{v}\times\vec{w}).\vec{u}$

(c) $\vec{v}.(\vec{u}\times\vec{w})$ (d) $(\vec{u}\times\vec{v}).\vec{u}$

126. If $\vec{a}=\hat{i}+2\hat{j}+3\hat{k}$, $\vec{b}=2\hat{i}+3\hat{j}+\hat{k}$, $\vec{c}=3\hat{i}+\hat{j}+2\hat{k}$ and $\alpha\vec{a}+\beta\vec{b}+\gamma\vec{c}=-3(\hat{i}-\hat{k})$, then the ordered triplet (α, β, γ) is

(a) $(2,-1,-1)$ (b) $(-2,1,1)$

(c) $(-2,-1,1)$ (d) $(2,1,-1)$

127. A line makes the same angle θ, with each of the x and z axis. If the angle β, which it makes with y-axis, is such that $\sin^2\beta=3\sin^2\theta$, then $\cos^2\theta$ equals

(a) $\frac{2}{5}$ (b) $\frac{1}{5}$ (c) $\frac{3}{5}$ (d) $\frac{2}{3}$

128. The plane $x+3y+13=0$ passes through the line of intersection of the planes $2x-8y+4z=p$ and $3x-5y+4z+10=0$. If the plane is perpendicular to the plane $3x-y-2z-4=0$, then the value of p is equal to

(a) 2 (b) 5

(c) 9 (d) 3

129. Let A and b be two events such that $P(B|A)=\frac{2}{5}$, $P(A|B)=\frac{1}{7}$ and $P(A\cap B)=\frac{1}{9}$. Consider

$$(S1): P(A'\cup B)=\frac{5}{6}$$

$$(S2): P(A'\cap B')=\frac{1}{18}$$

(a) Both (S1) and (S2) are true

(b) Both (S1) and (S2) are false

(c) Only (S1) is true

(d) Only (S2) is true

130. If A and B are two independent events and P(C) = 0, then A, B, C are :

(a) independent

(b) dependent

(c) not pairwise independent

(d) none of the above

SOLUTIONS

PART - I : PHYSICS

1. **(b)** Given,

Amplitude of magnetic field in an electromagnetic wave, $B = 6 \times 10^{-7} T$

Relation between magnetic field (B) and electric field (E) of an electromagnetic wave is given by

$$\frac{E}{B} = c \Rightarrow E = Bc = 6 \times 10^{-7} \times 3 \times 10^{8}$$

$(\because c = 3 \times 10^{8}\ m/s)$

$\Rightarrow E = 180\ Vm^{-1}$

2. **(d)** Power, $P = \frac{W}{t} = \frac{mgh}{t}$

$$\therefore \frac{P_1}{P_2} = \frac{\frac{m_1 gh}{t_1}}{\frac{m_2 gh}{t_2}} = \frac{m_1}{t_1}\frac{t_2}{m_2}$$

$$\therefore \frac{P_1}{P_2} = \frac{300 \times 2}{5 \times 50} = \frac{12}{5} = \frac{3\sqrt{x}}{\sqrt{x}+1}$$

So, $12\sqrt{x} + 12 = 15\sqrt{x} \Rightarrow 3\sqrt{x} = 12$

$\therefore x = 16$

3. **(a)** **Given :** Length of the dipole $(2l) = 10cm = 0.1m$ or $l = 0.05\ m$

Charge on the dipole $(q) = 500\ \mu C = 500 \times 10^{-6}\ C$ and distance of the point on the axis from the mid-point of the dipole $(r) = 20 + 5 = 25\ cm = 0.25\ m$.

We know that the electric field intensity due to dipole on the given point (E)

$$= \frac{1}{4\pi\varepsilon_0} \times \frac{2(q.2l)r}{(r^2 - l^2)^2}$$

$$= 9 \times 10^{9} \times \frac{2(500 \times 10^{-6} \times 0.1) \times 0.25}{[(0.25)^2 - (0.05)^2]^2}$$

$$= 6.25 \times 10^{7}\ N/C$$

4. **(a)** Root mean square speed is given by

$$v_{rms} = \sqrt{\frac{3kT}{M}} \Rightarrow v_{rms} \propto \frac{1}{M}$$

$$\therefore \frac{(v_{rms})_{O_2}}{(v_{rms})_{H_2}} = \sqrt{\frac{M_{H_2}}{M_{O_2}}}$$

$$\Rightarrow \frac{(v_{rms})_{O_2}}{(v_{rms})_{H_2}} = \sqrt{\frac{2}{32}} = \frac{1}{4}$$

$$\Rightarrow (v_{rms})_{H_2} = 4 \times (v_{rms})_{O_2}$$

$\left(\because (v_{rms})_{O_2} = 160\, m/s\right)$

$= 4 \times 160 = 640\ m/s$

5. **(c)** $$\frac{f_a}{f_l} = \frac{\left(\frac{\mu_g}{\mu_l} - 1\right)}{(\mu_g - 1)} = \frac{\left(\frac{1.5}{1.25} - 1\right)}{1.5 - 1} = \frac{\frac{1}{5}}{\frac{1}{2}} = \frac{2}{5}$$

$$f_l = \frac{5}{2} f_a = \frac{5}{2} \times 2 = 5\ cm$$

6. **(b)** Dimensional formula of energy

$$E = \frac{1}{2} mv^2$$

$[E] = [M^1 L^2 T^{-2}]$ ...(I)

Dimensional formula of gravitational constant

$$G = \frac{Fr^2}{m_1 m_2}$$

$[G] = [M^{-1} L^3 T^{-2}]$ ...(II)

From eq. (I) & (II)

$$\therefore \frac{E}{G} = \frac{\left[M^1\ L^2\ T^{-2}\right]}{\left[M^{-1}\ L^3\ T^{-2}\right]} = \left[M^2\ L^{-1}\ T^0\right]$$

7. **(c)** For photoelectric emission, incident light frequency should be greater than threshold frequency.

Frequency of incident light is 1.5 times the threshold frequency v_0.

$$v = \frac{3}{2} v_0$$

If frequency is halved,

$$\therefore v' = \frac{v}{2} = \frac{3}{4} v_0 \qquad \because v' < v_0$$

$\therefore$ No photoelectric emission will take place.

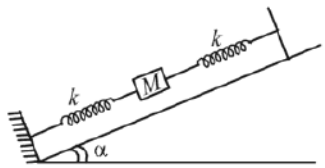
8. **(b) Centre of mass of system depends upon position and masses of particle. Also, it depends upon relative distance between particles.**

9. **(c)** The two springs are in parallel, so the effective spring constant is

$$k_{eq} = k_1 + k_2 = k + k = 2k$$

The period of oscillation,

$$T = 2\pi \sqrt{\frac{m}{k_{eq}}} = 2\pi \sqrt{\frac{m}{2k}}$$



Frequency of oscillation,

$$f = \frac{1}{T} = \frac{1}{2\pi} \sqrt{\frac{2k}{m}}$$

10. **(c)** The energy stored by a capacitor

$$U = \frac{1}{2} CV^2$$

...(i)

V is the p.d. between two plates of the capacitor potential difference $V = E.d.$

The capacitance of the parallel plate capacitor

$$C = \frac{A\varepsilon_0}{d}$$

Substituting the value of C in equation (i)

$$U = \frac{1}{2} \frac{A\varepsilon_0}{d} (Ed)^2 = \frac{1}{2} A\varepsilon_0 E^2 d$$

11. **(c)** $v_x = \frac{dx}{dt} = \frac{d(12t)}{dt} = 12$

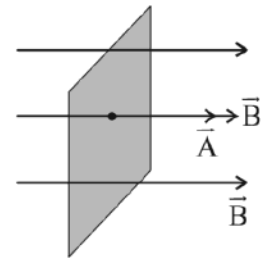
and $v_y = \frac{dy}{dt} = \frac{d(5t - 8t^2)}{dt} = 5 - 16\,t.$

$$\therefore v_{t=0} = \sqrt{v_x^2 + v_y^2} = \sqrt{12^2 + 5^2} = 13 \text{ m/s}$$

12. **(a) Clearly angle between $\vec{B}$ and $\vec{A}$ is O°**

so, $f(\text{flux}) = \vec{B}.\vec{A} = BA \cos 0°$

$= BA = 0.5 \times 1^2 = 0.5$ weber



13. **(d)** $\tan\theta = \frac{v^2}{rg}$

14. **(c)** For closed organ pipe, resonate frequency is odd multiple of fundamental frequency.

$\therefore (2n + 1) f_0 \leq 20{,}000$

(f_0 is fundamental frequency = 1.5 kHz)

$\therefore n = 6$

$\therefore$ Total number of overtone that can be heared = 7

15. **(b)** For long straight wire

$$B = \frac{\mu_0 i r}{2\pi R^2} \Rightarrow B \propto r, r < R$$

$$B = \frac{\mu_0 I}{2\pi r} \Rightarrow B \propto \frac{1}{r}$$

16. **(a)** Let

Initial length = l_1

Final length = l_2

Initial area $= A_1$
Final area $= A_2$
$\therefore$ Volume remains same

$$\therefore A_1 l_1 = A_2 l_2 \Rightarrow A_1 l_1 = A_2 \frac{l_1}{4}$$

$$\Rightarrow 4A_1 = A_2$$

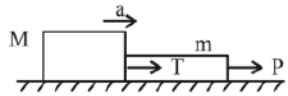
Initial resistance, $R_1 = \frac{\rho l_1}{A_1} = 160\Omega$ (given)

Final resistance, $R_2 = \frac{\rho l_2}{A_2}$

$$\therefore \frac{R_2}{R_1} = \frac{l_2 A_1}{A_2 l_1} = \frac{l_1}{4}\frac{A_1}{4A_1 l_1}$$

$$\Rightarrow R_2 = \frac{1}{16}R_1 = \frac{1}{16}\times 160 = 10\Omega$$

17. **(d)** Taking the rope and the block as a system we get $P = (m + M)\, a$

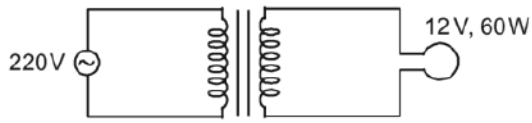


$$\therefore \quad a = \frac{P}{m + M}$$

Taking the block as a system,

we get $T = Ma$ $\qquad\qquad$ $\therefore \quad T = \frac{MP}{m + M}$

18. **(a)**



As transfer to be ideal and for ideal transformer

$P_{input} = P_{output}$

$\therefore (VI)_{in} = 60 \Rightarrow 220 \times I = 60$

$\therefore I = 0.27\,A$

19. **(b)** $\vec{\tau} = \vec{r} \times \vec{F} \Rightarrow \vec{r}\,.\,\vec{\tau} = 0 \quad \vec{F}\,.\,\vec{\tau} = 0$

Since, $\vec{\tau}$ is perpendicular to the plane of $\vec{r}$ and $\vec{F}$, hence the dot product of $\vec{\tau}$ with $\vec{r}$ and $\vec{F}$ is zero.

20. **(d)** It has been known that a nucleus of mass number A has radius

$R = R_0 A^{1/3}$,

where $R_0 = 1.2 \times 10^{-15}$m and A = mass number

In case of $^{27}_{13}Al$, let nuclear radius be R_1

and for $^{125}_{32}Te$, nuclear radius be R_2

For $^{27}_{13}Al$, $R_1 = R_0(27)^{1/3} = 3R_0$

For $^{125}_{32}Te$, $R_2 = R_0(125)^{1/3} = 5R_0$

$$\frac{R_2}{R_1} = \frac{5R_0}{3R_0} \Rightarrow R_2 = \frac{5}{3}R_1 = \frac{5}{3}\times 3.6 = 6\,\text{fm}$$

21. **(b)** Given : Mass $m_1 = 4$ kg and $m_2 = 6$ kg.
Acceleration of the system,

$$a = \frac{(m_2 - m_1)g}{(m_1 + m_2)} \text{ where } m_2 > m_1$$

$$\therefore a = \frac{(6-4)g}{6+4} = \frac{g}{5}$$

22. **(c)**

$$\text{No. of fringes(n)} = \frac{\text{length of segment (x)}}{\text{fringe width } (\beta)}$$

$$\Rightarrow n = \frac{x}{\beta} \Rightarrow x = n\beta = \text{cons.}$$

$$\Rightarrow n_1\beta_1 = n_2\beta_2 \Rightarrow n_1\frac{\lambda_1 D}{d} = n_2\frac{\lambda_2 D}{d}$$

$$\Rightarrow n_1\lambda_1 = n_2\lambda_2 \Rightarrow 8 \times 600 = 400 \times n_2$$

$$\Rightarrow n_2 = 12$$

23. **(b)** Reverse resistance

$$= \frac{\Delta V}{\Delta I} = \frac{1}{0.5\times 10^{-6}} = 2\times 10^6\Omega$$

24. **(a)** The terminal potential difference of a cell is given by $V + Ir = E$

$V = V_A - V_B$

or $\quad V = E - Ir$

$$\Rightarrow \quad \frac{dV}{dI} = -r, \quad \text{Also for, } i = 0 \text{ then } V = E$$

$\therefore$ slope $= -r$, intercept $= E$

25. **(d)** De Broglie wavelength is $\lambda = \frac{h}{mv}$

$$\lambda_p = \lambda_e \Rightarrow \frac{h}{m_p v_p} = \frac{h}{m_e v_e}$$

$$m_e v_e = m_p v_p \Rightarrow p_e = p_v \qquad \therefore \quad \frac{p_p}{p_e} = \frac{1}{1}$$

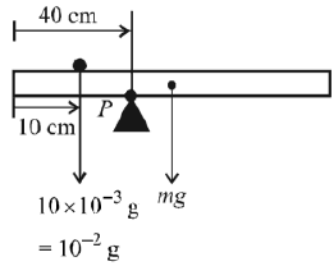
26. **(b)** Diamagnetic materials does not allow magnetic field lines to passes through them. Bar *B* represents diamagnetic materials.

27. **(c)** $F_v = mg - F_b$

$$= \rho Vg - \rho_l Vg = Vg(\rho - \rho_l)$$

$$\text{So, } \frac{F_{v_1}}{F_{v_2}} = \frac{V_1}{V_2} = \left(\frac{r}{2r}\right)^3 = \frac{1}{8}$$

28. **(a)**



Let mass of scale be '*m*'. Then,

About '*P*' $\hat{\tau}_{net} = 0$

$\Rightarrow 2\times10^{-2}\,g\times30 - mg\times10 = 0$

$\Rightarrow 6\times10^{-1} - 10\,m = 0 \Rightarrow 0.6 = 10\,m$

$$\Rightarrow m = \frac{0.6}{10} \Rightarrow m = 0.06\,\text{kg}$$

29. **(b)** $W_h = \frac{W_{surface}}{3} \Rightarrow Mg' = \frac{Mg}{3}$

$$\Rightarrow \frac{g}{\left(1+\frac{h}{R}\right)^2} = \frac{g}{3} \Rightarrow \left(1+\frac{h}{R}\right) = \sqrt{3}$$

$$\Rightarrow \frac{h}{R} = \sqrt{3} - 1 \Rightarrow h = (\sqrt{3}-1)R$$

$\Rightarrow h = 0.732\times6400 \simeq 4685\,\text{km}$

30. **(d)** Let L is the original length of the rubber cord and K is the force constant of rubber cord.

Final length = initial length + elongation

$$L' = L + \frac{F}{K}$$

For tension 4N

$$\ell_1 = L + \frac{4}{K} \qquad \text{.....(i)}$$

For tension 6N

$$\ell_2 = L + \frac{6}{K} \qquad \text{.....(ii)}$$

Solving (i) and (ii) we get

$$L = 3\ell_1 - 2\ell_2 \text{ and } K = \frac{2}{\ell_2 - \ell_1}$$

when tension is 9 N, then

$$\text{length} = L + \frac{9}{K} = 2.5\ell_2 - 1.5\ell_1$$

PART - II : CHEMISTRY

31. **(d)** $SO_3(g) \rightleftharpoons SO_2(g) + \frac{1}{2}O_2(g)$

On reversing the reaction and multiplying by 2 we get desired reaction. Thus,

$$K'_c = \left(\frac{1}{K_c}\right)^2 = \left(\frac{1}{4.9\times10^{-2}}\right)^2, \; K'_c = 416.49$$

32. **(a)** Ma_3b_3 type complexes show Facial - Meridional isomerism

(a) $[Co(NH_3)_3Cl_3] \Rightarrow Ma_3b_3$

(b) $[Co(NH_3)_4Cl_2]^+ \Rightarrow Ma_4b_2$

(c) $[Co(en)_3]^{3+} \Rightarrow M(AA)_3$

(d) $[Co(en_2)Cl_2]^+ \Rightarrow M(AA)_2b_2$

a, *b* = NH_3, Cl^- (Monodentate ligands)

AA = en (Bidentate ligand)

33. **(c)** Conductivity of electrolytic cell is affected by concentration of electrolyte, nature of electrolyte and nature of solvent.

34. **(c)** $CaCl_2 + Na_2CO_3 \rightarrow \underset{X}{CaCO_3} + \underset{Y}{NaCl}$

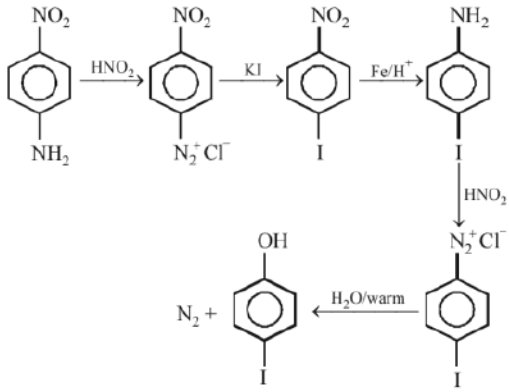
$\xrightarrow[Z]{HCl}$

35. **(b)** $C_6H_5ONa + Br - CH_2 - CH = CH_2 \longrightarrow C_6H_5 - O - CH_2 - CH = CH_2 + NaBr$

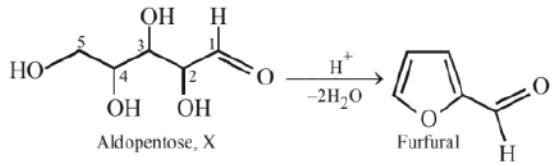
Allyl phenyl ether

In other three options – Br is attached to sp^2 – C atom.

36. **(b)**



37. **(a)**

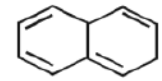


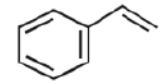
Since furfural is a five membered cyclic compound having an aldedydic group, so the parent sugar (X) should be an aldopentose.

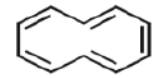
Reaction of aldose/ketose with resorcinol gives coloured compound (**Seliwanoff test**). Ketoses respond this test immediately while aldoses after sometime.

38. **(c)** Both differ in the arrangement of group in space, therefore grouped under sterio-isomerism.

39. **(a)** For a compound to be aromatic it should be planar and follow Huckel's rule of $(4n+2)\pi$ electrons.

A.  → Non aromatic

B.  → Aromatic

C.  → Non aromatic

D.  → Aromatic

40. **(c)** $t_{1/4} = \frac{2.303}{k}\log\frac{1}{3/4} = \frac{2.303}{k}\log\frac{4}{3}$

$= \frac{2.303}{k}(2\times 0.301 - 0.4771) = \frac{0.29}{k}$

41. **(a)** If the surface tension and vapour pressure are low and the substance solidifies on the surface then stability will be enhanced. Egg white possess all these properties.

42. **(c)** $\text{Density}(\rho) = \frac{PM}{RT}$ $(1\text{ bar} = 0.987\text{ atm})$

$$\rho_{N_2} = \frac{4\times 0.987\text{ atm}\times 28\text{ g/mol}}{R\times 300\text{ K}}$$

Let the molar mass of gas be x

$$\rho_{gas} = \frac{2\times 0.987\text{ atm}\times x}{R\times 300\text{ K}}$$

Given $\rho_{gas} = \rho_{N_2}\times 2$

$$\frac{2\times 0.987\ \text{atm}\times x}{R\times 300\ \text{K}}=\frac{4\times 0.987\ \text{atm}\times 28\ \text{g/mol}}{R\times 300}\times 2$$

$\therefore \quad x = 112\ \text{g/mol}.$

43. **(b)** $S(g)+\frac{3}{2}O_2(g)\rightarrow SO_3(g) \quad \Delta H_1=-2x$

$$SO_2(g)+\frac{1}{2}O_2(g)\rightarrow SO_3(g) \quad \Delta H_2=-y$$

$\Delta H_f(SO_2)=(\Delta H_1)-\Delta H_2=(-2x)-(-y)=y-2x$ and is shorter than a single bond but longer than a double bond as bond order is 1.5

44. **(a)**

	Li	Be	B	C	N	O	F
(E.N.) =	1	1.5	2	2.5	3	3.5	4.0

On pauling scale

	Na	Mg	Al	Si	P	S	Cl
(E.N.) =	0.9	1.2	1.5	1.8	2.1	2.5	3.0

Correct order Mg < Al < B < N

45. **(b)** Strong acid have weak conjugate base.

Acidic strength :

H–Cl > CH_3COOH > H_2O > R–OH

Conjugate base strength :

$Cl^- < CH_3COO^- < \bar{O}H < RO^-$

46. **(a)** 

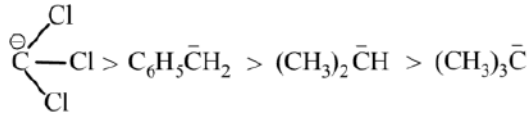
$CH_3COOH + CH_3CH_2CH_2COOH$

Acetic acid Butanoic acid

It is oxidative ozonolysis.

47. **(d)** $MnO_2 \xrightarrow[KNO_3,\Delta]{KOH} K_2MnO_4$

48. **(b)**



$> C_6H_5\bar{C}H_2 > (CH_3)_2\bar{C}H > (CH_3)_3\bar{C}$

–ve charge highly dispersed due to – I effect

–M effect delocalises –ve charge

+I effect of CH_3 group intensifies the –ve charge

49. **(a)** $2H^+(aq)+2e^-\rightarrow H_2(g)$

$$E=E^\circ-\frac{0.059}{n}\log\frac{P_{H_2}}{\left[H^+\right]^2}$$

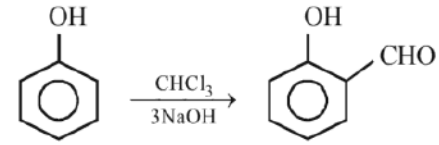
For pure water, $[H^+]=10^{-7}$M

$$0=0-\frac{0.059}{2}\log\frac{P_{H_2}}{\left(10^{-7}\right)^2}$$

$$\log\frac{P_{H_2}}{\left(10^{-7}\right)^2}=0\Rightarrow\frac{P_{H_2}}{10^{-14}}=1$$

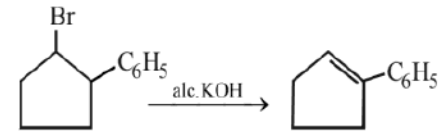
$P_{H_2}=10^{-14}$bar

50. **(d)** Fluorine does not show variable oxidation state as it is the most electronegative element and shows only –1 state.

51. **(d)** 

(Reimer-Tiemann reaction)

52. **(a)** The reaction is dehydrohalogenation



1-Phenyl cyclopentene

53. **(c)** In fcc, tetrahedral voids are located on the body diagonal at a distance of $\frac{\sqrt{3}a}{4}$ from the corner. Together they form a smaller cube of edge length $\frac{a}{2}$. Therefore, distance between centres of two nearest tetrahedral voids in the lattice is also $\frac{a}{2}$.

54. **(a)** The electronic configuration of Rubidium (Rb = 37) is

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 5s^1$

The last electron enters in 5s orbital.

Hence, $n = 5, l = 0, m = 0, s = \pm\frac{1}{2}$

55. **(a)**

ion / molecule	Number of e^- in BMO	Number of e^- in ABMO	Bond order
O_2^+	10	5	2.5
O_2	10	6	2
O_2^-	10	7	1.5
O_2^{2-}	10	8	1

Bond order: $O_2^{2-} < O_2^- < O_2 < O_2^+$

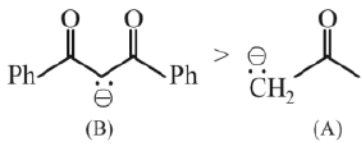
56. **(c)** Diphenhydramine is used as antihistamine.

57. **(a)** 2, 4-Dinitrophenylhydrazine reacts with aldehydes and ketones to form 2, 4-dinitrophenylhydrazone derivatives. It is a condensation reaction with elimination of water.

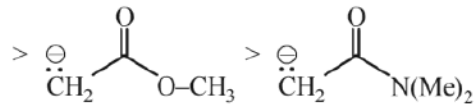
58. **(a)** Burning of fossil fuels (which contain sulphur and nitrogenous matter) such as coal and oil in power stations and furnaces produce sulphur dioxide and nitrogen oxides which causes acid rain.

59. **(a)** Acidity $\propto$ Stability of conjugate base

Stability order of conjugate bases



(B) (A)



(C) (D)

Thus increasing order of acidity is D < C < A < B.

60. **(a)** Higher the number of milli moles of acid or base reacted higher will be temperature rise.

Option (a) n_{acid} or n_{base} reacted = 30 m mol

Option (b) n_{acid} or n_{base} reacted = 30 m mol

but less energy will be released by neutralisation reaction of weak acid hence option (b) can not be correct.

Option (c) $\Rightarrow$ 20 m mol

Option (d) $\Rightarrow$ 25 m mol

PART - III (A): ENGLISH PROFICIENCY

61. **(b)** The idiom **"face the music"** means to accept the consequences of one's actions, especially criticism or punishment. In the sentence, the team must endure the coach's disapproval after a poor performance.

62. **(a)** The paragraph starts with **Q**, which introduces the idea that creativity grows in encouraging environments. **P** follows by highlighting the need to overcome fear. **S** shows how small actions build creative confidence, and **R** concludes by explaining the long-term benefits. Together, they build a logical, developmental flow from environment to habit to result.

63. **(b)** **S** introduces the idea that even vivid memories shift over time. **P** explains why — memories are reconstructed. **Q** then supports this with scientific findings. **R** concludes with the real-world impact of this phenomenon. The sequence builds logically from subtle memory change to explanation, then evidence, then consequence.

64. **(c)** **"Wrangle"** means to **argue or quarrel noisily**. The opposite of that is **"agree,"** which means to share the same opinion or come to a mutual understanding. The other options are synonyms of "wrangle."

65. **(d)** Gaudy means **excessively bright, showy, or tastelessly flashy**. The word **"flashy"** best captures that sense. The other options either imply subtlety (**modest**, **elegant**) or lack of color/brightness (**dull**).

66. **(c)** The contrast is between **real feelings** and **"performative" acts**, especially common online. **"Performative outrage"** (acting angry just to make a point or show off) is a well-known phrase, fitting best here. The other choices don't match the collocation or context as closely.

67. **(b)** The sentence suggests the resignation had a **strategic** purpose ("protecting the company's reputation"). **"Tactical"** fits this nuance, while the others either imply negative traits or unrelated emotional context.

68. **(b)** This sentence uses an **inversion** ("Hardly had…"), so the rest must follow correct tense. The verb **"starts"** (present tense) is incorrect; it should be **"started"** (past tense) to maintain consistency.

69. **(b)** Tense consistency is the issue. It should be **"she had left"** to reflect the **past perfect** action that occurred **before** the remembering. So, the correct phrase is: **"she remembered she had left."**

70. **(b)** The verb **"know"** is a **stative verb**, and such verbs are **not used in continuous tenses**. Therefore, "has known" (present perfect) is the correct form.

PART - III (B) : LOGICAL REASONING

71. **(d)** $\sqrt{AFI} = \sqrt{169} = 13 = M$

$\sqrt{ADD} = \sqrt{144} = 12 = L$

Similarly,

$\sqrt{ABA} = \sqrt{121} = 11 = K$

72. **(b)** As,

A K P : 1121256

↓ ↓ ↓

1^2 11^2 16^2

Similarly,

L N O : **144196225**

↓ ↓ ↓

12^2 14^2 15^2

73. **(a)**

74. **(d)** S U P E R F L U O U S

1st 4th 7th 11th

So, possible word with S, E, L, S is L E S S

75. **(b)** $225 = (15)^2 \triangleright (8+7)^2$

$49 = (7)^2 \triangleright (3+4)^2$

$121 = (11)^2 \triangleright (6+5)^2$

So missing number is 5.

76. **(a)** P A L E and E A R T H

↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓

5 2 9 3 3 2 6 8 1

So,

P E A R L

↓ ↓ ↓ ↓ ↓

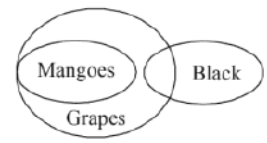
5 3 2 6 9

77. **(a)** The sequence is:

f g g f / g f f / f g f / g f f g / f

So, option (a) is correct.

78. **(e)**



Conclusion:-

(I) Some mangoes being black is a possibility ✓

(II) There is a possibility that some mangoes are not black ✓

79. **(b)**

Conclusions:-

(I) All days are either nights or dreams ×

(II) Some days are nights ✓

80. (a) The pattern is as follows :

$(7 \times 3 \times 2) = 42$

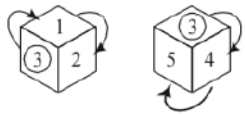
$(3 \times 4 \times 7) = 84$

$(10 \times 7 \times x) = 140$

$\Rightarrow \quad \therefore \quad x = \dfrac{140}{70} = 2$

$\therefore$ The missing number is $= 2$.

81. (c) From figure (ii) and (iii)



1 will be opposite of 4

2 will be opposite of 5

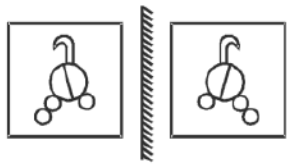
3 will be opposite of 6 missing number

82. (c)

83. (c) **84. (d)**

85. (a) Options (b) and (c), (d) have line of symmetry.

86. (c)



87. (b) Meaning order

= unlock vehicle, start vehicle, drive vehicle, Reach distination, Parking of vehicle

88. (c) In the every next fig. each symbol is shifted to its next top position along the same diagonal and symbol at top position comes to bottom position in every next fig.

89. (c) Shraddha's mother's father's son ⊳ Shraddha's maternal uncle. Shraddha's maternal uncle is husband of Deepika's sister. Deepika is 'aunt' of Shraddha.

90. (a) The next term is quintuple because quintuple means five times.

PART - IV : MATHEMATICS

91. (c) $A \cup B \cup C = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

92. (c) Since in (c) each element is associated with unique element. While in (a) element *b* is associated with two elements, in (b) element *a* is associated with three elements and in (d) element *b* is associated with two elements so relation given in option (c) is function.

93. (a) We have, $\sin A = \dfrac{3}{5}$

$\Rightarrow \quad \cos A = \sqrt{1 - \sin^2 A}$

$= \sqrt{1 - \dfrac{9}{25}} = \sqrt{\dfrac{16}{25}} = \dfrac{4}{5}$

and $\tan A = \dfrac{\sin A}{\cos A} = \dfrac{\frac{3}{5}}{\frac{4}{5}} = \dfrac{3}{4}$

Now, $\sin 2A = 2 \sin A \cdot \cos A$

$= 2 \times \dfrac{3}{5} \times \dfrac{4}{5} = \dfrac{24}{25}$

$\cos 2A = 1 - 2 \sin^2 A = 1 - 2 \times \dfrac{9}{25}$

$= 1 - \dfrac{18}{25} = \dfrac{7}{25}$ and $\tan 2A = \dfrac{24}{7}$.

94. (a) $2 \tan^2\theta = \sec^2\theta = 1 + \tan^2\theta$

$\Rightarrow \tan^2\theta = 1 = (1)^2$

$= \tan^2 \dfrac{\pi}{4}$

$\theta = n\pi \pm \dfrac{\pi}{4}, n \in I$

95. **(b)** $\frac{1-i}{1+i}=\frac{(1-i)(1-i)}{(1+i)(1-i)}=\frac{(1-i)^2}{1-i^2}=\frac{1+i^2-2i}{2}=-i$

$\therefore\ (-i)^{100}=(i)^{100}=(i^4)^{25}=1$

$\Rightarrow 1=a+ib\ \Rightarrow a=1, b=0$

96. **(b)** For $x^2+ax+b=0$

Sum of roots $=a=\frac{-1}{\alpha^2}-\frac{1}{\beta^2}-2$

Product of roots $=b=\frac{1}{\alpha^2}+\frac{1}{\beta^2}+1+\frac{1}{\alpha^2\beta^2}$

$a+b=\frac{1}{(\alpha\beta)^2}-1=\frac{1}{6}-1=-\frac{5}{6}\ [\because \alpha\beta=\sqrt{6}\,]$

$x^2-\left(-\frac{5}{6}-2\right)x+\left(2-\frac{5}{6}\right)=0$

$\Rightarrow 6x^2+17x+7=0$

$x=-\frac{7}{3}, x=-\frac{1}{2}$ are the roots

Both roots are real and negative.

97. **(a)** $D=4-16k\geq 0\Rightarrow k\leq\frac{1}{4}$

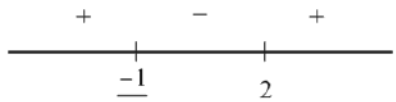
$f(-1)=6+k>0\Rightarrow k>-6$

$f(1)=2+k>0\Rightarrow k>-2$

$\therefore\quad k\in\left(-2,\frac{1}{4}\right]$

98. **(c)** $\frac{4x-1}{3x+1}\geq 1\ \Rightarrow\ \frac{4x-1}{3x+1}-1\geq 0\ \Rightarrow\ \frac{x-2}{3x+1}\geq 0$

By using wavy-curve method



$\therefore\quad x\leq\frac{-1}{3},\ x\geq 2$ but $x\neq\frac{-1}{3}$

$\therefore\quad x<\frac{-1}{3},\ x\geq 2,$

$\therefore\quad \left(-\infty,-\frac{1}{3}\right)\cup[2,\infty)$

99. **(b)** Total number
= (First two digit identical) +
(Last two digit identical)
$=9\times 1\times 9+9\times 9\times 1=81+81=162$

100. **(c)** Total number of 3-digit numbers having at least one of their digits as 5 = Total number of 3-digit numbers – (Total number of 3-digit numbers in which 5 does not appear at all)
$= 9\times 10\times 10-8\times 9\times 9$
$= 900-648=252$

101. **(a)** $\left(x^2+\frac{1}{x^2}\right)^n$

General term $T_{r+1}={}^nC_r\left(x^2\right)^{n-r}\left(\frac{1}{x^3}\right)^r$

$={}^nC_r\cdot x^{2n-5r}$

To find coefficient of x, $2n-5r=1$

Given ${}^nC_r={}^nC_{23}\Rightarrow r=23$ or $n-r=23$

$\therefore\ n=58$ or $n=38$

Minimum value is $n=38$

102. **(a)** $\because a, b, c$ are in G.P.

$\therefore\frac{b}{a}=\frac{c}{b}=r\Rightarrow\frac{b^2}{a^2}=\frac{c^2}{b^2}=r^2$

$\Rightarrow a^2, b^2, c^2$ are in G.P.

103. **(c)** $A=\frac{1}{1-r^a}\Rightarrow 1-r^a=\frac{1}{A}$

$\Rightarrow r^a=1-\frac{1}{A}=\frac{A-1}{A}$

$B=\frac{1}{1-r^b}\Rightarrow 1-r^b=\frac{1}{B}\Rightarrow r^b=1-\frac{1}{B}=\frac{B-1}{B}$

$\therefore\ a\log r=\log\left(\frac{A-1}{A}\right)$ and

$b\log r=\log\left(\frac{B-1}{B}\right)$

$$\therefore \frac{a}{b}=\frac{\log\left(\frac{A-1}{A}\right)}{\log\left(\frac{B-1}{B}\right)}=\log_{\frac{B-1}{B}}\left(\frac{A-1}{A}\right)$$

104. (b) We have, $PA = PB \Rightarrow (PA)^2 = (PB)^2$

$$\Rightarrow [x-(a+b)]^2+[y-(b-a)]^2$$

$$=[x-(a-b)]^2+[y-(a+b)]^2$$

$$\Rightarrow [(x-a)-b]^2+[(y-b)+a]^2$$

$$\Rightarrow [(x-a)+b]^2+[(y-b)-a]^2$$

$$\Rightarrow [(x-a)+b]^2-[(x-a)-b]^2$$

$$=[(y-b)+a]^2-[(y-b)-a]^2$$

$$\Rightarrow 4b(x-a)=4a(y-b)\Rightarrow bx=ay \qquad ...(i)$$

Also, $P(a, b)$ satisfies the conditon (i), so that P can be (a, b).

105. (c) Let intercept on x-axis and y-axis be a and b respectively so that the equation of line is

$$\frac{x}{a}+\frac{y}{b}=1$$

But $a = b$ so; $x + y = a$

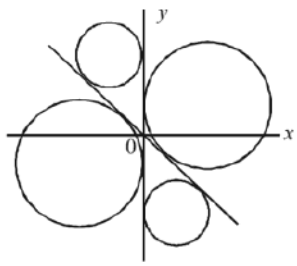
Also it passes through $(2, 4)$ (given)

Thus $2 + 4 = a \Rightarrow a = 6$

Now, the reqd. equation of the straight line $x + y = 6$ or, $x + y - 6 = 0$.

106. (c) $h=\frac{2ab}{\sqrt{3}}$

107. (d)



Let (h, k) is centre of circle

$$\left|\frac{h-k}{\sqrt{2}}\right|=|h|,\ k^2-h^2+2hk=0$$

Then, equation of locus is $y^2 - x^2 + 2xy = 0$

108. (b) The tangent at the ventex.

109. (d) Foot of perpendicular from $(6, 5, 8)$ on Y-axis is $(0, 5, 9)$.

Req. distance $=\sqrt{(6-0)^2+(5-5)^2+(8-0)^2}$

$$=10 \text{ unit} \Rightarrow 5\lambda = 10 \Rightarrow \lambda=\frac{10}{5}=2$$

110. (d) We have

$$\lim_{x\to\frac{\pi}{4}}\frac{4\sqrt{2}-(\cos x+\sin x)^5}{1-\sin 2x}$$

$$=\lim_{x\to\frac{\pi}{4}}\frac{2^{\frac{5}{2}}-[(\cos x+\sin x)^2]^{\frac{5}{2}}}{2-(1+\sin 2x)}$$

$$=\lim_{x\to\frac{\pi}{4}}\frac{(1+\sin 2x)^{\frac{5}{2}}-2^{\frac{5}{2}}}{(1+\sin 2x)-2}$$

$$=\lim_{t\to 2}\frac{t^{\frac{5}{2}}-2^{\frac{5}{2}}}{t-2}, \text{ where } t=1+\sin 2x$$

$$=\frac{5}{2}\times(2)^{\frac{5}{2}-1}=5\sqrt{2}$$

111. (c) $n(S)=\frac{7!}{3!},\ n(E)=5!$

So, $P(E)=\frac{5!}{7!/3!}=\frac{1}{7}$

112. (a) Mean and SD σ of the combined group are

$$m=\frac{63\times 27.6+26\times 19.2}{63+26}=25.1$$

Thus, AM is decreased by $27.6 - 25.1 = 2.5$.

$$\sigma^2=\frac{63\times(7.1)^2+26\times(6.2)^2}{89}$$

$$+\frac{63(25.1-27.6)^2+26(25.1-19.2)^2}{89}\Rightarrow\sigma=7.8$$

(approx.)

113. (d) We have, $f(x)=2x-3$, $g(x)=x^3+5$

$(fog)x=f(x^3+5)=2(x^3+5)-3=2x^3+7$

Let $y=(fog)x=2x^3+7$

$$\Rightarrow x=\left(\frac{y-7}{2}\right)^{1/3}$$

$$\Rightarrow (fog)^{-1}x=\left(\frac{x-7}{2}\right)^{1/3}$$

114. (a) Given $\tan^{-1}(x+1)+\cot^{-1}(x-1)$

$$=\sin^{-1}\left(\frac{4}{5}\right)+\cos^{-1}\left(\frac{3}{5}\right)$$

$$\Rightarrow \tan^{-1}(x+1)+\tan^{-1}\left(\frac{1}{x-1}\right)$$

$$=\tan^{-1}\frac{4}{3}+\tan^{-1}\frac{4}{3}=2\tan^{-1}\frac{4}{3}$$

$$\Rightarrow \tan^{-1}\left[\frac{x+1+\frac{1}{x-1}}{1-(x+1)\left(\frac{1}{x-1}\right)}\right]=\tan^{-1}\left[\frac{2\times\frac{4}{3}}{1-\frac{16}{9}}\right]$$

$$\left[\text{using } 2\tan^{-1}x=\tan^{-1}\left(\frac{2x}{1-x^2}\right)\right]$$

$$\Rightarrow \tan^{-1}\left(-\frac{x^2}{2}\right)=\tan^{-1}\left(-\frac{24}{7}\right)$$

$$\Rightarrow \frac{x^2}{2}=\frac{24}{7}\Rightarrow x^2=\frac{48}{7}\Rightarrow x=4\sqrt{\frac{3}{7}}$$

115. (b) $$|A|=\begin{vmatrix}1&0&3\\2&1&1\\0&0&2\end{vmatrix}=2$$

$$\therefore |\text{adj (adj A)}|=|A|^{(n-1)^2}=|A|^{2^2}$$

$[\because \text{Here } n=3]$

$$=2^4=16$$

116. (b) The system of equation has no solution.

$$D=\begin{vmatrix}3\sin 3\theta&-1&1\\3\cos 2\theta&4&3\\6&7&7\end{vmatrix}=0$$

$21\sin 3\theta+42\cos 2\theta-42=0$

$\sin 3\theta+2\cos 2\theta-2=0$

$4\sin^3\theta+4\sin^2\theta-3\sin\theta=0$

$\sin\theta[4\sin^2\theta+4\sin\theta-3]=0$

Number of solutions are 7 in $(0, 4\pi)$

117. (b) $$x=b\cos^{-1}\sqrt{\frac{y}{b}}+\sqrt{by-y^2}$$

$$\Rightarrow \frac{dx}{dy}=-b\frac{1}{\sqrt{1-\frac{y}{b}}}\cdot\frac{1}{2\sqrt{\frac{y}{b}}}\cdot\frac{1}{b}+\frac{b-2y}{2\sqrt{by-y^2}}$$

$$=\frac{-b}{2\sqrt{by-y^2}}+\frac{b}{2\sqrt{by-y^2}}-\frac{2y}{2\sqrt{by-y^2}}$$

$$\Rightarrow \frac{dy}{dx}=-\frac{\sqrt{by-y^2}}{y}=-\sqrt{\frac{b}{y}-1}$$

118. (d) $$\lim_{x\to 4^-}f(x)=\lim_{h\to 0}f(4-h)$$

$$=\lim_{h\to 0}\frac{4-h-4}{|4-h-4|}+a=\lim_{h\to 0}-\frac{h}{h}+a=a-1.$$

$$=\lim_{x\to 4^+}f(x)=\lim_{h\to 0}f(4+h)$$

$$=\lim_{h\to 0}\frac{4+h-4}{|4+h-4|}+b=b+1$$

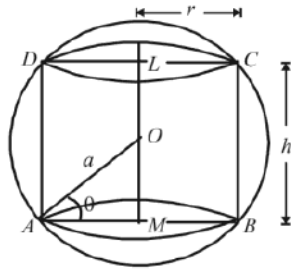
and $f(4)=a+b$

Since $f(x)$ is continuous at $x=4$

Therefore $\lim_{x\to 4^-}f(x)=f(4)=\lim_{x\to 4^+}f(x)$

$\Rightarrow a-1=a+b=b+1 \quad\Rightarrow\quad b=-1$ and $a=1$.

119. (b)



If a is the radius of sphere and h the height of cylinder, then from adjacent figure,

$r^2 + (h^2/4) = a^2$ or $h^2 = 4(a^2 - r^2)$

Now,

$$V = \pi r^2 h = \pi\left(a^2 - \frac{1}{4}h^2\right)h = \pi\left(a^2 h - \frac{1}{4}h^3\right)$$

$$\Rightarrow \frac{dV}{dh} = \pi\left(a^2 - \frac{3}{4}h^2\right) = 0 \text{ (for maximum or minimum).}$$

This gives $h = (2/\sqrt{3})a$ for which

$d^2V/dh^2 = -6h/4 < 0.$

Hence, V is maximum when $h = 2a/\sqrt{3}$.

120. (a) $$\int\left(x + 1 + \frac{1}{2(x-1)} - \frac{2x}{4(x^2+1)}\right)dx$$

$$= \frac{x^2}{2} + x + \frac{1}{2}\log(x+1) - \frac{1}{4}\log(x^2+1) + c$$

121. (b) Now we are given that the integral

$$I = \int_0^{\frac{\pi}{2}} \frac{dx}{3 + 2\sin x + \cos x} = \int_0^{\frac{\pi}{2}} \frac{\sec^2\frac{x}{2}.dx}{2\tan^2\frac{x}{2} + 4\tan\frac{x}{2} + 4}$$

Put $\tan\frac{x}{2} = t \Rightarrow \frac{1}{2}\sec^2\left(\frac{x}{2}\right)dx = dt$

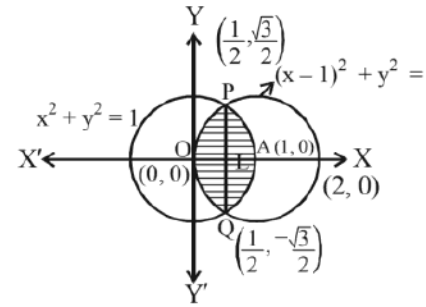
Now $$I = \int_0^1 \frac{dt}{(t+1)^2 + 1} = \tan^{-1}(x+1)\Big|_0^1$$

$$= \tan^{-1}2 - \frac{\pi}{4}$$

122. (a) Given circles are $x^2 + y^2 = 1$ ...(i)

and $(x-1)^2 + y^2 = 1$ ...(ii)

Centre of (i) is O (0, 0) and radius = 1



Both these circle are symmetrical about x-axis

solving (i) and (ii), we get, $-2x + 1 = 0 \Rightarrow x = \frac{1}{2}$

then $y^2 = 1 - \left(\frac{1}{2}\right)^2 = \frac{3}{4} \Rightarrow y = \frac{\sqrt{3}}{2}$

$\therefore$ The points of intersection are

$$P\left(\frac{1}{2}, \frac{\sqrt{3}}{2}\right) \text{ and } Q\left(\frac{1}{2}, -\frac{\sqrt{3}}{2}\right)$$

It is clear from the figure that the shaded portion in region whose area is required.

$\therefore$ Required area = area OQAPO

= 2 × area of the region OLAP

= 2 × (area of the region OLPO + area of LAPL)

$$= 2\left[\int_0^{1/2}\sqrt{1-(x-1)^2}\,dx + \int_{1/2}^1 \sqrt{1-x^2}\,dx\right]$$

$$= 2\left[\frac{(x-1)\sqrt{1-(x-1)^2}}{2} + \frac{1}{2}\sin^{-1}(x-1)\right]_0^{1/2}$$

$$+2\left[\frac{x\sqrt{1-x^2}}{2}+\frac{1}{2}\sin^{-1}x\right]_{1/2}^{1}$$

$$=-\frac{1}{2}\cdot\frac{\sqrt{3}}{2}+\sin^{-1}\left(\frac{-1}{2}\right)-\sin^{-1}(-1)+0$$

$$+\sin^{-1}(1)-\left(\frac{1}{2}\cdot\frac{\sqrt{3}}{2}+\sin^{-1}\left(\frac{1}{2}\right)\right)$$

$$=\left(\frac{2\pi}{3}-\frac{\sqrt{3}}{2}\right)\text{ sq. units.}$$

123. (a) $I\cdot F=e^{\int\frac{1}{x\log}=\log x}$

$$y\cdot\log x=\int\frac{\log x}{x}dx$$

$$\Rightarrow y=\frac{1}{2}\log x+c(\log x)^{-1}$$

124. (a) $\int\frac{x}{x^2-1}dx=\int\frac{y}{1+y^2}dy$

$$\Rightarrow x^2-1=C(1+y^2)$$

125. (d) Three vectors are $\vec{u},\vec{v},\vec{w}$ Since, the dot product is commutative and the position of dot and cross can be interchanged in scalar triple product

$\therefore\ \vec{u}.(\vec{v}\times\vec{w})=(\vec{v}\times\vec{w}).\vec{u}$ and

$(\vec{u}\times\vec{v}.\vec{w})=\vec{u}.(\vec{v}\times\vec{w})$

$\Rightarrow\ \vec{v}.(\vec{u}\times\vec{w})=(\vec{u}\times\vec{w}).\vec{v}$

and option (d) gives : $\vec{u}.(\vec{w}\times\vec{v})=-\vec{u}.(\vec{v}\times\vec{w})$

126. (a) Equating the components in

$\alpha(\hat{i}+2\hat{j}+3\hat{k})+\beta(2\hat{i}+3\hat{j}+\hat{k})+\gamma(3\hat{i}+\hat{j}+2\hat{k})$

$=-3(\hat{i}-\hat{k})$, we have

$\alpha+2\beta+3\gamma=-3$ ....(i)

$2\alpha+3\beta+\gamma=0$ ....(ii)

$3\alpha+\beta+2\gamma=3$ ....(iii)

Solving the equations (i), (ii), & (iii), we get

$\alpha=2,\ \beta=-1,\ \gamma=-1.$

127. (c) The direction cosines of the line are cosθ, cosβ, cosθ

$\therefore\cos^2\theta+\cos^2\beta+\cos^2\theta=1$

$\Rightarrow 2\cos^2\theta=\sin^2\beta=3\sin^2\theta$

$\Rightarrow 2\cos^2\theta=3-3\cos^2\theta\ \ \therefore\cos^2\theta=\frac{3}{5}$

128. (d) The required plane is

$(2+3\lambda)x+(-8-5\lambda)y+(4+4\lambda)z+P-10\lambda=0$

Compare the coefficients with the plan

We get, $4+4\lambda=0\Rightarrow\ \lambda=-1$

$x+3y+0z+13=0$

Then we get $p=3$.

129. (a) Given that $P(A\mid B)=\frac{1}{7}\Rightarrow\frac{P(A\cap B)}{P(B)}=\frac{1}{7}$

$$\Rightarrow P(B)=\frac{7}{9}$$

$$P(B\mid A)=\frac{2}{5}\Rightarrow\frac{P(A\cap B)}{P(A)}=\frac{2}{5}\ \Rightarrow P(A)=\frac{5}{18}$$

We know that $P(A'\cup B)=1-P(A\cup B)+P(B)$

$$=1-P(A)+P(A\cap B)=\frac{5}{6}$$

$$P(A'\cap B')=1-P(A\cup B)$$

$$=1-P(A)-P(B)+P(A\cap B)=\frac{1}{18}$$

$\Rightarrow$ Both (S1) and (S2) are true.

130. (a) Since, A and B are independent events.

$\therefore P(A\cap B)=P(A)P(B)$

Further since, $A\cap C$, $B\cap C$, $A\cap B\cap C$ are subsets of C, we have, $P(A\cap C)\le P(C)=0$

$P(B\cap C)\le P(C)=0$

and $P(A\cap B\cap C)\le P(C)=0$

$\Rightarrow P(A\cap C)=0=P(A)P(C)$

$P(B\cap C)=0=P(B)P(C)$

$P(A\cap B\cap C)=0=P(A)P(B)P(C)$.

Clearly A, B, C are pairwise independent as well as mutually independent. Thus, A,B,C are independent events.