

IIT APTITUDE TEST – 2018

PHYSICS, CHEMISTRY & MATHEMATICS

ANSWER KEY VERSION CODE – A														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B	C	C	B	C	A	D	D	B	A	B	D	A	B	C
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
A	C	B	C	C	A	B	A	B	D	A	A	D	A	B
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
C	A	B	D	D	D	D	B	C	A	B	A	C	A	C
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
A	D	D	D	A	A	C	C	C	A	A	D	A	D	D
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
D	B	C	D	A	B	C	C	B	B	C	B	A	A	C
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
C	D	C	B	A	C	B	B	C	B	C	C	C	A	B
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
C	A	A	B	A	A	C	A	C	B	B	D	D	A	C
106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
A	C	C	B	B	D	D	A	D	A	D	A	A	A	E
ANSWER KEY VERSION CODE – B														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
D	B	A	B	C	D	D	A	B	D	A	A	B	A	C
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
D	C	C	B	B	D	C	C	A	C	B	B	C	A	B
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
B	A	B	C	A	D	A	D	A	D	C	B	D	A	C
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
C	A	D	C	A	A	A	D	C	B	C	D	D	B	A
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
C	D	D	A	C	A	A	B	C	D	C	A	A	D	B
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
A	C	B	B	C	D	D	A	D	A	D	A	A	A	E
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
C	A	A	B	A	A	C	A	C	B	C	B	B	C	B
106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
C	C	C	A	B	B	D	D	A	C	A	C	C	B	B



IIT APTITUDE TEST – 2018

WARNING : Any attempt to commit malpractice in the examination will lead to the 'Disqualification' of the candidate

PHYSICS, CHEMISTRY & MATHEMATICS

Version Code	A	
Time : 2 ½ Hours	Number of Questions: 120	Maximum marks : 480
Name of Candidate		
Reg. Number		
Signature of Candidate		

INSTRUCTIONS TO CANDIDATES

1. Write your Name and Reg. number and put your signature in the space provided above
2. Use blue or black ink ball point pen for bubbling.
3. Use of calculators and logarithm tables are prohibited.

IMMEDIATELY AFTER OPENING THE QUESTION BOOKLET, CANDIDATE SHOULD VERIFY WHETHER THE QUESTION BOOKLET ISSUED CONTAINS ALL THE 120 QUESTIONS IN SERIAL ORDER. IF NOT, REQUEST FOR REPLACEMENT

DO NOT OPEN THE BOOKLET UNTIL THE INVIGILATOR ASKS YOU TO DO SO

1. In a hypothetical new system of measurement, the gravitational force between two particles, each of mass 1 kg, separated by 1 km is taken as a unit of force. Let us call this new unit of force "notwen". How many Newton will be there in one 'notwen'? Given : $G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$.

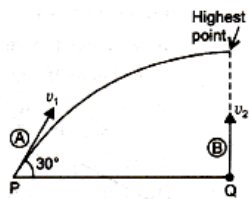
- a) 6.67×10^{-11} b) 6.67×10^{-17}
 c) $\frac{1}{6.67 \times 10^{-11}}$ d) $\frac{1}{6.67 \times 10^{-17}}$

2. A stone is dropped under gravity from rest from a height h ($g = 9.8 \text{ m s}^{-2}$) and it travels a distance $\frac{9h}{25}$ in the last second. The height h is ?

- a) 145 m b) 130 m c) 122.5 m d) 100 m

3. A projectile A is thrown at an angle of 30° to the horizontal from point P. At the same time, another projectile B is thrown with velocity v_2 upwards from the point Q vertically below the highest point. For B

to collide with A, $\frac{v_2}{v_1}$ should be



- a) 1 b) 2 c) 1/2 d) 4

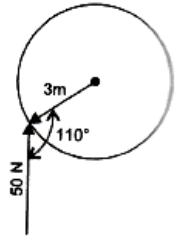
4. A block starts to move on a rough horizontal surface having coefficient of friction $\mu = 0.5$. The block stops after travelling a distance of 9.8m. The initial velocity of the block was

- a) 4.9 m s^{-1} b) 9.8 m s^{-1}
 c) 19.6 m s^{-1} d) 39.2 m s^{-1}

5. A fast moving neutron suffers one-dimensional elastic collision with a nucleus ${}^7\text{N}_{14}$. What approximate percentage of energy is lost by the neutron in the collision?

- a) 5% b) 10% c) 25% d) 0%

6. A boy pushes a merry-go-round of radius 3 m with a force 50N as shown in the figure. If $\cos 20^\circ = 0.9$, then the torque applied by the boy is



- a) 135 N m b) 140 N m c) 40 N m d) 0 N m

7. If the value of acceleration due to gravity on the surface of Earth is 10 m s^{-2} , then a girl can jump safely from a height of 2 m. If she has to jump on a planet where acceleration due to gravity is 0.2 m s^{-2} , then the safe height will be

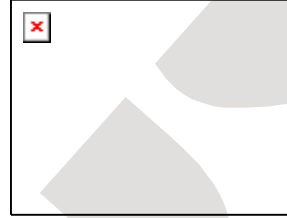
- a) 0.2 m b) 10 m c) 2 m d) 100 m

8. A massive stone pillar 20 m high and of uniform cross – section rests on a rigid base and supports a vertical load of $5.0 \times 10^5 \text{ N}$ at its upper end. If the compressive stress in the pillar is not to exceed

compressive stress in the minimum cross – sectional $1.6 \times 10^6 \text{ N m}^{-2}$, what is the minimum cross sectional area of the pillar? Density of the stone = $2.5 \times 10^3 \text{ kg m}^{-3}$ (Take $g = 10 \text{ N kg}^{-1}$)

- a) 0.15 m^2 b) 0.25 m^2 c) 0.35 m^2 d) 0.45 m^2

9. A cubical block of wood 10 cm on a side floats at the interface between oil and water, as in figure with its lower face 2 cm below the interface. The density of the oil is 0.6 g cm^{-3} . The mass of the block is



- a) 340 g b) 680 g c) 80 g d) 10 g

10. A steel tape measures the length of a copper rod as 50.0 cm when both are at 20°C . The calibration temperature of the tape is also 20°C . The coefficients of linear expansion of steel and copper are $1.2 \times 10^{-5} \text{ }^\circ\text{C}^{-1}$ and $1.7 \times 10^{-5} \text{ }^\circ\text{C}^{-1}$ respectively. At 40°C , the steel tape would measure the length of the rod approximately as

- a) 50.01 cm b) 50.02 cm
 c) 50.03 cm d) 50.04 cm

11. A container of volume 1 m^3 is divided into two equal compartments by a partition. One of these compartments contains an ideal gas at 300 K. The other compartment is vacuum. The whole system is thermally isolated from its surroundings. The partition is removed and the gas expands to occupy the whole volume of the container. Its temperature now would be

- a) 300K b) 239 K c) 200K d) 100K

12. Two perfect gases at absolute temperature T_1 and T_2 are mixed. There is no loss of energy. The masses of the molecule are m_1 and m_2 . The number of molecules in the two gases are n_1 and n_2 . The temperature T of the mixture is:

- a) $n_1 T_1 + n_2 T_2$ b) $\frac{n_1 T_1}{n_1 + n_2}$
 c) $\frac{n_2 T_2}{n_1 + n_2}$ d) $\frac{n_1 T_1 + n_2 T_2}{n_1 + n_2}$

13. The displacement of a particle executing simple harmonic motion is given by: $y = 10 \sin \left(6t + \frac{\pi}{3} \right)$.

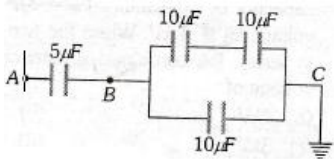
Here y is in metre and t is in second. The initial displacement and velocity of the particle are respectively

- a) $5\sqrt{3} \text{ m}$ and 30 m s^{-1} b) $20\sqrt{3} \text{ m}$ and 30 m s^{-1}
 c) $15\sqrt{3} \text{ m}$ and 30 m s^{-1} d) 15 m and $5\sqrt{3} \text{ m s}^{-1}$

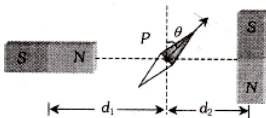
14. Elevation of a cloud is 60° above the horizon. A thunder is heard 8 second after the observation of the lightning. The speed of sound is 330 m s^{-1} . The vertical height of the cloud from the ground is

- a) $8 \times 330 \text{ m}$ b) $8 \times 330 \times \sin 60^\circ \text{ m}$
 c) $8 \times 330 \times \cos 60^\circ \text{ m}$ d) $8 \times 330 \times \tan 60^\circ \text{ m}$

15. An electric dipole of length 1 cm is placed with the axis making an angle of 30° to an electric field of strength 10^4NC^{-1} . If it experiences a torque of $10\sqrt{2} \text{Nm}$, the potential energy of the dipole is
 a) 0.245 J b) 2.45J c) 24.5J d) 245.0J
16. The plates of parallel plate capacitor are changed upto 100V. A 2mm thick plate is inserted between the plates. Then to maintain the same potential difference, the distance between the plates is increased by 1.6 mm. The dielectric constant of the plate is
 a) 5 b) 1.25 c) 4 d) 2.5
17. In the given circuit if point C is connected to the earth and a potential of + 2000 V is given to the point A, the potential at B is

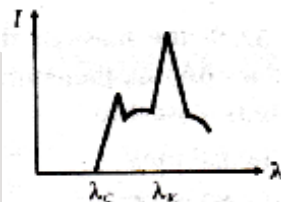


- a) 1500V b) 1000V c) 500V d) 400V
18. A galvanometer of resistance 50Ω is connected to a battery of 3V along with a resistance of 2950Ω in series. A full scale deflection of 30 divisions is obtained in the galvanometer. In order to reduce this deflection to 20 divisions, the resistance in series should be
 a) 6050Ω b) 4450Ω c) 5050Ω d) 5500Ω
19. A conductor in the form of a right angle ABC with $AB = 3 \text{ cm}$ and $BC = 4 \text{ cm}$ carries a current of 10 A. There is a uniform magnetic field of 5 T perpendicular to the plane of the conductor. The force on the conductor will be
 a) 1.5 N b) 2.0 N c) 2.5N d) 3.5 N
20. Two magnets A and B are identical and these are arranged as shown in the figure. Their length is negligible in comparison to the separation between them. A magnetic needle is placed between the magnets at point P which gets deflected through an angle θ under the influence of magnets. The ratio of distance d_1 and d_2 will be



- a) $(2 \tan \theta)^{1/3}$ b) $(2 \tan \theta)^{-1/3}$
 c) $(2 \cot \theta)^{1/3}$ d) $(2 \cot \theta)^{-1/3}$
21. The magnetic flux linked with coil, in weber is given by the equation, $\phi = 5t^2 + 3t + 16$. The induced emf in the coil in the fourth second is
 a) 10V b) 30V c) 45V d) 90V
22. An alternating voltage $E = 200\sqrt{2} \sin(10t)$ is connected to a 1 microfarad capacitor through an ammeter. The reading of the ammeter shall be
 a) 10 mA b) 20 mA c) 40mA d) 80 mA
23. What is the nature of electromagnetic waves?
 a) Transverse Nature
 b) Longitudinal Nature
 c) Transverse as well as longitudinal nature
 d) None of the above

24. A 52 year old near – sighted person wears eye-glass with a power of -5.5 dioptres for distance viewing. His doctor prescribes a correction of +1.5 dioptres in the near vision section of his bi-focals. This is measured relative to the main part of the lens. The focal length of the near-vision section of the lens is
 a) 19.1 cm b) 15.4 cm c) 17.4 cm d) 21.4 cm
25. In a Young's double slit experiment, the slits are separated by 0.28 mm and the screen is placed 1.4 m away. The distance between the central bright fringe and the fourth bright fringe is measured to be 1.2cm. The wavelength of light used in the experiment is.
 a) 6480\AA b) 5993\AA c) 6660\AA d) 6000\AA
26. The work function for the surface of aluminium is 4.2 eV. The potential difference which is required to stop the emission of maximum energy electrons emitted by light of 2000\AA wavelength is.
 a) 1.9875V b) 2.7895V
 c) 3.5935V d) 1.0125V
27. The intensity of X-rays from a Coolidge tube is plotted against wavelength λ as shown in the figure. The minimum wavelength found is λ_C and the wavelength of the K_α line is λ_K . As the accelerating voltage is increased



- a) $\lambda_K - \lambda_C$ increases b) $\lambda_K - \lambda_C$ decreases
 c) λ_K increases d) λ_K decreases
28. A radioactive sample contains 2.2 mg of pure ${}_{6}^{11}\text{C}$ which has half life period of 1224 second. Calculate the activity when 5 μg of the sample will be left.
 a) 0.35×10^{14} disintegrations/second
 b) 3.72×10^{14} disintegrations/second
 c) 2.95×10^{14} disintegrations/second
 d) 1.55×10^{14} disintegrations/second
29. A potential barrier of 0.50 V exists across a P.N. junction. If the depletion region is $5.0 \times 10^{-7} \text{ m}$ wide, the intensity of the electric field in this region is
 a) $10 \times 10^6 \text{ V/m}$
 b) $1.0 \times 10^5 \text{ V/m}$
 c) $2.0 \times 10^5 \text{ V/m}$
 d) $2.0 \times 10^6 \text{ V/m}$
30. A transmitting antenna at the top of a tower has a height of 45m and the height of the receiving antenna is 80m. The maximum distance between them, for satisfactory communication in LOS mode is (radius of earth = 6400 km)
 a) 65 km b) 56 km c) 73 km d) 49 km
31. Shunt required in an ammeter of resistance R to decrease its deflection from 30 A to 10 A is
 a) R/4 b) R/3 c) R/2 d) R

32. The resistance of each arm of the Wheatstone's bridge is 10Ω . A resistance of 10Ω is connected in series with galvanometer then the equivalent resistance across the battery will be

- a) 10Ω b) 15Ω c) 20Ω d) 40Ω

33. A transmitter radiates 9 kW power with only carrier and 10.125 W with modulated carrier. The depth of modulation is

- a) 25% b) 50% c) 12.5% d) 30%

34. Two blocks of masses 5 kg and 2 kg are placed on a frictionless surface and connected by a spring. An external kick gives a velocity of 14 m/s to the heavier block in the direction of lighter one. Calculate the velocity gained by the centre of mass.

- a) 14 m/s b) 7 m/s c) 8 m/s d) 10 m/s

35. An engine takes in compressed steam at 127°C and rejects it at 47°C . Efficiency of the engine is

- a) 60% b) 35% c) 25% d) 20%

36. Two circuits have mutual inductance of 0.09 H. Average e. m. f induced in the secondary by a change of current from 0 to 20 A in 0.006 s in primary will be

- a) 120 V b) 200 V c) 180 V d) 300 V

37. A heater of 220 V heats a volume of water in 5 min. A heater of 110 V heats the same volume of water in

- a) 5 min b) 8 min c) 10 min d) 20 min

38. Two bulbs of 500 W and 300 W are manufactured to operate on a 220 V line. If their resistances are R_1 and R_2 respectively, then value of R_1/R_2 is

- a) 5/3 b) 3/5 c) 25/9 d) 9/25

39. Frequency of photon having energy 66 eV is

- a) 8×10^{-15} Hz b) 12×10^{-15} Hz
c) 16×10^{-15} Hz d) 20×10^{-15} Hz

40. If a bar magnet is dropped vertically into a long metallic tube then its final acceleration a will be

- a) $a = 0$ b) $a = g$ c) $a > g$ d) $a < g$

41. Given the following statements regarding d-orbitals

- 1) It has 4 lobes and 2 angular nodes
2) It has 4 lobes and one angular node
3) The orbital angular momentum of electron in this

orbital is $\sqrt{6} \frac{h}{2\pi}$

4) It is non-degenerate

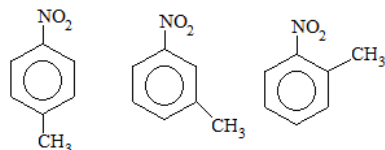
The correct statement(s) is/are

- a) only 1 b) 1 and 3 c) 2 and 3 d) 1 and 4

42. The number of atoms in 100g of fcc crystal with density (d) = 10 g cm^{-3} and edge length 200 pm is equal to

- a) 3×10^{25} b) 5×10^{24} c) 1×10^{25} d) 2×10^{25}

43. Correct order of dipole moment is:

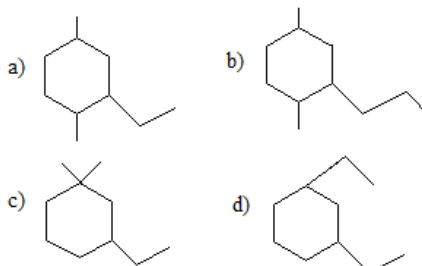


- a) I = II = III b) I < II < III
c) I > II > III d) II < III < I

44. Which one of the following set of ions represent the collection of isoelectronic species?

- a) K^+ , Ca^{2+} , Sc^{3+} , Cl^- b) Na^+ , Ca^{2+} , Sc^{3+} , F^-
c) K^+ , Cl^- , Mg^{2+} , Sc^{3+} d) Na^+ , Mg^{2+} , Al^{3+} , Cl^-

45. Which of the following represent 3-Ethyl-1,1-dimethylcyclohexane



46. Which of the following statements is correct?

- a) Alkyl halides are more reactive than aryl halides towards nucleophilic substitution reactions
b) The presence of an electron withdrawing substituent at ortho and / or para position decreases the reactivity of nucleophilic substitution of chlorine in the substituted chlorobenzene.
c) Alkyl halides are less reactive than aryl halide towards nucleophilic substitution reaction.
d) All of these.

47. Which of the following statement is correct

- a) All the alkali metal carbonate are stable to heat.
b) Liquid sodium metal is used as a coolant in nuclear reaction.
c) Washing soda generally exist as a decahydrate
d) Both (b) and (d)

48. The reaction, $\text{A} + 2\text{B} \rightleftharpoons 2\text{C} + \text{D}$ was studied using an initial concentration of B which was 1.5 times that of A. But the equilibrium concentrations of A and C were found to be equal. Then the K_c for the equilibrium is:

- a) 4 b) 8 c) 6 d) 0.323

49. Atoms of elements B form hcp lattice and those of element A occupy two third of tetrahedral voids. The formula of compound is:

- a) AB_2 b) AB_3
c) AB d) A_4B_3

50. The rate constant (K) for the reaction, $\text{A} + \text{B} \rightarrow \text{Product}$ was found to be $2.5 \times 10^{-5} \text{ litre mol}^{-1} \text{ sec}^{-1}$ after 15 sec and $2.60 \times 10^{-5} \text{ litre mol}^{-1} \text{ sec}^{-1}$ after 50 sec. The order of reaction is:

- a) 2 b) 3 c) zero d) 1

51. $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{Cl} \xrightarrow{\text{KOH(alc)}} \text{A}$

$\xrightarrow{\text{HBr}}$ C, the compound 'C' is

Peroxide
a) $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{Br}$

b) $\text{CH}_3-\text{CH}_2-\overset{\text{Br}}{\underset{|}{\text{C}}}-\text{CH}_3$

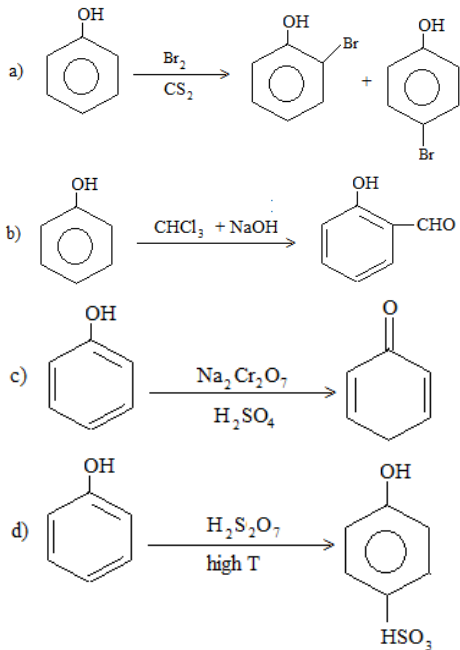
c) $\text{CH}_3-\text{CH}_2-\text{CH}=\text{CHBr}$

d) $\text{CH}_3-\text{CH}_3-\overset{\text{Br}}{\underset{|}{\text{C}}}=\text{CH}_2$

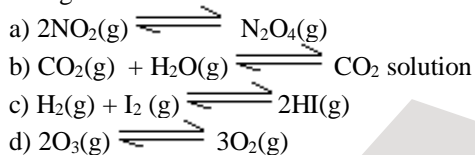
52. The enthalpy and entropy change for a reaction is $-2.5 \times 10^3 \text{ cal}$ and 7.4 cal deg^{-1} respectively. At 298 K the reaction is

- a) reversible
b) irreversible
c) spontaneous
d) non-spontaneous

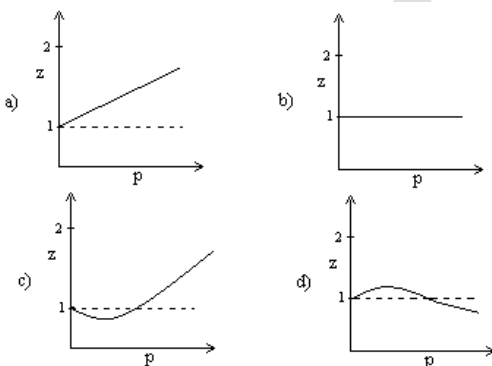
53. Which among the following is wrong.



54. Which of the following is not effected by pressure change



55. Which of the following represents a plot of compressibility factor (Z) vs P at room temperature for helium?



56. Dry air was passed successively through a solution of 5 gm of a solute in 80 gm of water and then through pure water. The weight of ions in solution was 2.50 gm and that of pure solvent 0.04 gm. What is the molecular weight of the solute

- a) 70.31 b) 7.143 c) 714.3 d) 80

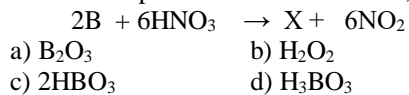
57. Which of the following is not correct for D_2O ?

- a) boiling point is higher than that of H_2O
- b) viscosity is higher than H_2O
- c) melting point is higher than H_2O
- d) dielectric constant is more than H_2O

58. The uncertainty in momentum of an electron is $1 \times 10^{-5} \text{ kg} \cdot \text{m/s}$. The uncertainty in its position will be ($h = 6.62 \times 10^{-34} \text{ kg} \cdot \text{m}^2/\text{s}$)

- a) $5.27 \times 10^{-30} \text{ m}$ b) $1.05 \times 10^{-26} \text{ m}$
- c) $1.05 \times 10^{-28} \text{ m}$ d) $5.25 \times 10^{-28} \text{ m}$

59. What is the product X in the reaction,



60. If $E^\circ_{\text{Au}^+/\text{Au}}$ is 1.69 V and $E^\circ_{\text{Au}^{3+}/\text{Au}}$ is 1.40 V, then $E^\circ_{\text{Au}^+/\text{Au}^{3+}}$ will be

- a) 0.19 V b) 2.945 V
 c) 1.255 V d) None of these

61. Choose the isoelectronic structures from the following

- I. CH_3 II. H_3O^+ III. NH_3 IV. CH_3^-
- a) I and II b) III and IV
 c) I and III d) II, III, IV

62. Which of the following solutions will have pH = 10 at 298 K?

- a) $1 \times 10^{-10} \text{ M HCl}$ solution
 b) $1 \times 10^{-4} \text{ M NaOH}$ solution
 c) $1 \times 10^{-10} \text{ M NaOH}$ solution
 d) Both (a) and (b)

63. Both oxidation and reduction takes place in:

- a) $\text{NaBr} + \text{HCl} \rightarrow \text{NaCl} + \text{HBr}$
 b) $\text{HBr} + \text{AgNO}_3 \rightarrow \text{AgBr} + \text{HNO}_3$
 c) $\text{H}_2 + \text{Br}_2 \rightarrow 2\text{HBr}$
 d) $\text{CaO} + \text{H}_2\text{SO}_4 \rightarrow \text{CaSO}_4 + \text{H}_2\text{O}$

64. Which of the following pairs will give ether?

- a) $\text{C}_2\text{H}_5\text{ONa}$ and $\text{C}_2\text{H}_5\text{I}$
- b) $\text{CH}_3-\text{CH}_2-\text{OH} \xrightarrow[140^\circ\text{C}]{\text{H}^\oplus}$
- c) $\text{CH}_3-\text{CH}_2-\text{I} \xrightarrow{\text{Dry Ag}_2\text{O}}$
- d) All of these

65. On hydrolysis of starch, we finally get

- a) glucose
 b) fructose
 c) Both (a) and (b)
 d) sucrose

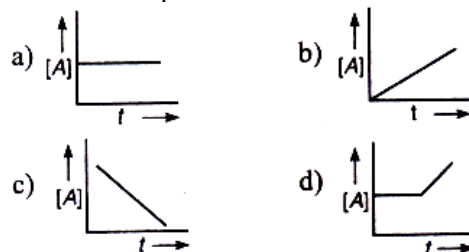
66. Which of the following is thermosetting polymer?

- a) Nylon - 6 b) Bakelite
 c) Nylon - 66 d) SBR

67. Lyophillic sols are more stable than lyophobic sols because

- a) the colloidal particles have positive charge
 b) the colloidal particles have no charge
 c) the colloidal particles are solvated
 d) there are strong electrostatic repulsions between the negatively charged colloidal particles

68. Which curve represents zero order reaction?



69. Which of the following compounds is formed when benzamide is warmed with bromine and alkali?

- a) Benzenediazonium chloride
 b) Aniline
 c) Benzene
 d) Bromobenzene

94. The coordinates of the foot of perpendiculars from the point (2, 3) on the line $y = 3x + 4$ is given by

- a) $\left(\frac{37}{10}, \frac{1}{10}\right)$ b) $\left(\frac{-1}{10}, \frac{37}{10}\right)$
 c) $\left(\frac{10}{37}, -10\right)$ d) none of these

95. The value of $(z + 3)(\bar{z} + 3)$ is equivalent to

- a) $|z + 3|^2$ b) $|z - 3|$
 c) $z^2 + 3$ d) none of these

96. The distance between the foci of a hyperbola is 16 and its eccentricity is $\sqrt{2}$. Its equation is

- a) $x^2 - y^2 = 32$ b) $\frac{x^2}{4} - \frac{y^2}{9} = 1$
 c) $2x - 3y^2 = 7$ d) none of these

97. $|z_1 + z_2| = |z_1| + |z_2|$ is possible if

- a) $z_2 = \bar{z}_1$ b) $z_2 = \frac{1}{z_1}$
 c) $\arg(z_1) = \arg(z_2)$ d) none of these

98. The values of x for which

$$[1 \ 2 \ 1] \begin{bmatrix} 1 & 2 & 0 \\ 2 & 0 & 1 \\ 1 & 0 & 2 \end{bmatrix} \begin{bmatrix} 0 \\ 2 \\ x \end{bmatrix} = 0 \text{ is}$$

- a) -1 b) 1 c) 0 d) none

99. If $A^2 = A$ for $A = \begin{bmatrix} -1 & b \\ -b & 2 \end{bmatrix}$, then the value of b is

- a) ± 2 b) 2 c) $\pm\sqrt{2}$ d) none

100. The value of k , such that the function

$$f(x) = \begin{cases} kx^2, & \text{if } x \leq 2 \\ 3, & \text{if } x > 2 \end{cases}, \text{ continuous at } x = 2 \text{ is}$$

- a) $k = 2$ b) $k = 3/4$
 c) $k = 1$ d) none of these

101. If $y = \sin^{-1} x$, then $(1 - x^2) \frac{d^2y}{dx^2} - x \frac{dy}{dx} =$

- a) 1 b) 0 c) $2y$ d) none

102. If $y = x^3 + \tan x$, then $\frac{d^2y}{dx^2} =$

- a) $3x^2 + \sec^2 x$ b) $3x^2 - \sec^2 x$
 c) $2\sec^2 x + \tan x$ d) none of these

103. The maximum area of the rectangle that can be inscribed in a circle of radius r is

- a) πr^2 b) r^2 c) $\frac{\pi r^2}{4}$ d) none

104. The principal value of $\cot^{-1}\left(\frac{-1}{\sqrt{3}}\right)$ is

- a) $\frac{2\pi}{3}$ b) $\frac{\pi}{2}$ c) $\frac{\pi}{3}$ d) none

105. $\tan^{-1} \frac{1}{2} + \tan^{-1} \frac{2}{11} =$

- a) $\pi/4$ b) 1
 c) $\tan^{-1} 3/4$ d) none

106. Let R be the relation on the set R of all real numbers defined by aRb iff $|a - b| \leq 1$. The R is

- a) reflexive and symmetric
 b) symmetric only
 c) transitive only
 d) none of these

107. The identity element for the binary operation $*$ defined by $a * b = \frac{ab}{2} \forall a, b \in Q_0$ (the set of all non-zero rational numbers) is

- a) 1 b) 0 c) 2 d) none

108. The radius of spherical balloon is changing at the rate of $\frac{1}{4\pi}$ m/sec. The value of radius of the balloon when its volume changes at the same rate as its surface area

- a) $4m$ b) $\frac{1}{2}m$

- c) $2m$ d) none

109. Equation of the line passing through (1, 1, 1) and parallel to the plane $2x + 3y + z + 5 = 0$ is

a) $\frac{x-1}{1} = \frac{y-1}{2} = \frac{z-1}{1}$ b) $\frac{x-1}{-1} = \frac{y-1}{1} = \frac{z-1}{-1}$

c) $\frac{x-1}{3} = \frac{y-1}{2} = \frac{z-1}{1}$ d) $\frac{x-1}{2} = \frac{y-1}{3} = \frac{z-1}{1}$

- e) none of these

110. The value of k so that $\frac{x-1}{-3} = \frac{y-2}{2k} = \frac{z-3}{2}$ and

$$\frac{x-1}{3k} = \frac{y-1}{1} = \frac{z-6}{-5}$$

may be perpendicular is

- a) $-7/10$ b) $-10/7$ c) -10
 d) $10/7$ e) none of these

111. $\int \frac{(x+1)(x+\log x)^2}{x} dx$ is equal to

a) $\frac{3}{(x-\log x)^3} + c$ b) $\frac{3}{(x+\log x)^3} + c$

c) $\frac{(x-\log x)^3}{3} + c$ d) $\frac{(x+\log x)^3}{3} + c$

- e) none of these

112. $\int \sin^{-1}(3x - 4x^3) dx =$

a) $x \sin^{-1} x + \sqrt{1-x^2} + c$

b) $x \sin^{-1} x - \sqrt{1-x^2} + c$

c) $2 [x \sin^{-1} x + \sqrt{1-x^2}] + c$

d) $3 [x \sin^{-1} x + \sqrt{1-x^2}] + c$

- e) none of these

113. $\int \sin^{-1} \left[\frac{2x}{1+x^2} \right] dx$ is equal to

- a) $2x \tan^{-1} x - \log(1+x^2) + c$
 b) $2x \tan^{-1} x + c$
 c) $2 \tan^{-1} x + c$
 d) $2x \tan^{-1} x + \log(1+x^2) + c$
 e) none of these

114. If the vectors $\hat{i} + 3\hat{j} - 2\hat{k}$, $2\hat{i} - \hat{j} + 4\hat{k}$ and $3\hat{i} + 2\hat{j} + x\hat{k}$ are coplanar, then the value of $x =$

- a) 1 b) 3 c) -2 d) 2 e) none

115. Let $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{b} = \hat{i} + 2\hat{j} - \hat{k}$ and $\vec{c} = \hat{i} + \hat{j} - 2\hat{k}$ be three vectors. A vector in the plane of \vec{b} and \vec{c} whose projection on \vec{a} is of

magnitude $\sqrt{\frac{2}{3}}$ is

- a) $2\hat{i} + 3\hat{j} - 3\hat{k}$
 b) $2\hat{i} + 3\hat{j} + 3\hat{k}$
 c) $2\hat{i} - \hat{j} + 5\hat{k}$
 d) $2\hat{i} + \hat{j} + 5\hat{k}$
 e) none of these

116. If the vectors $\hat{i} + 2\hat{j} - 3\hat{k}$, $3\hat{i} + \lambda\hat{j} + \hat{k}$ and $\hat{i} + 2\hat{j} + 2\hat{k}$ are coplanar, then the value of λ is

- a) 5 b) -5 c) -6 d) 6 e) none

117. If $I_n = \int_0^{\pi/4} \tan^n \theta d\theta$, then $I_8 + I_6$ is equal to

- a) 1/7 b) 1/4 c) 1/5 d) 1/6 e) 1/2

118. If $\int_{-1/2}^{1/2} \cos x \log \left(\frac{1+x}{1-x} \right) dx = k \cdot \log 2$, then k equals

- a) 0 b) -1 c) -2 d) 1/2 e) -1/2

119. $\int_{\pi/6}^{\pi/3} \frac{dx}{1 + \sqrt{\tan x}}$ is equal to

- a) $\frac{\pi}{12}$ b) $\frac{\pi}{2}$ c) $\frac{\pi}{6}$
 d) $\frac{\pi}{4}$ e) $\frac{2\pi}{3}$

120. $\int_{-\pi}^{\pi} \frac{\sin^4 x}{\sin^4 x + \cos^4 x} dx$ is equal to

- a) $\pi/4$ b) $\pi/2$ c) $3\pi/2$
 d) 2π e) π

Space for rough work

מבט על



IIT APTITUDE TEST – 2018

WARNING : Any attempt to commit malpractice in the examination will lead to the ‘Disqualification’ of the candidate

PHYSICS, CHEMISTRY & MATHEMATICS

Version Code	B	
Time : 2 ½ Hours	Number of Questions: 120	Maximum marks : 480
Name of Candidate		
Reg. Number		
Signature of Candidate		

INSTRUCTIONS TO CANDIDATES

1. Write your Name and Reg. number and put your signature in the space provided above
2. Use blue or black ink ball point pen for bubbling.
3. Use of calculators and logarithm tables are prohibited.

IMMEDIATELY AFTER OPENING THE QUESTION BOOKLET, CANDIDATE SHOULD VERIFY WHETHER THE QUESTION BOOKLET ISSUED CONTAINS ALL THE 120 QUESTIONS IN SERIAL ORDER. IF NOT, REQUEST FOR REPLACEMENT

DO NOT OPEN THE BOOKLET UNTIL THE INVIGILATOR ASKS YOU TO DO SO

- A heater of 220 V heats a volume of water in 5 min. A heater of 110 V heats the same volume of water in
 - 5 min
 - 8 min
 - 10 min
 - 20 min
- Two bulbs of 500 W and 300 W are manufactured to operate on a 220 V line. If their resistances are R_1 and R_2 respectively, then value of R_1/R_2 is
 - 5/3
 - 3/5
 - 25/9
 - 9/25
- If a bar magnet is dropped vertically into a long metallic tube then its final acceleration a will be
 - $a = 0$
 - $a = g$
 - $a > g$
 - $a < g$
- A block starts to move on a rough horizontal surface having coefficient of friction $\mu = 0.5$. The block stops after travelling a distance of 9.8m. The initial velocity of the block was
 - 4.9 m s^{-1}
 - 9.8 m s^{-1}
 - 19.6 m s^{-1}
 - 39.2 m s^{-1}
- A fast moving neutron suffers one-dimensional elastic collision with a nucleus ${}^7\text{N}_{14}$. What approximate percentage of energy is lost by the neutron in the collision?
 - 5%
 - 10%
 - 25%
 - 0%
- If the value of acceleration due to gravity on the surface of Earth is 10 m s^{-2} , then a girl can jump safely from a height of 2 m. If she has to jump on a planet where acceleration due to gravity is 0.2 m s^{-2} , then the safe height will be
 - 0.2 m
 - 10 m
 - 2 m
 - 100 m
- A massive stone pillar 20 m high and of uniform cross – section rests on a rigid base and supports a vertical load of $5.0 \times 10^5 \text{ N}$ at its upper end. If the compressive stress in the pillar is not to exceed compressive stress in the minimum cross – sectional $1.6 \times 10^6 \text{ N m}^{-2}$, what is the minimum cross sectional area of the pillar? Density of the stone = $2.5 \times 10^3 \text{ kg m}^{-3}$ (Take $g = 10 \text{ N kg}^{-1}$)
 - 0.15 m^2
 - 0.25 m^2
 - 0.35 m^2
 - 0.45 m^2
- A steel tape measures the length of a copper rod as 50.0 cm when both are at 20°C . The calibration temperature of the tape is also 20°C . The coefficients of linear expansion of steel and copper are $1.2 \times 10^{-5}\text{C}^{-1}$ and $1.7 \times 10^{-5}\text{C}^{-1}$ respectively. At 40°C , the steel tape would measure the length of the rod approximately as
 - 50.01 cm
 - 50.02 cm
 - 50.03 cm
 - 50.04 cm
- A container of volume 1 m^3 is divided into two equal compartments by a partition. One of these compartments contains an ideal gas at 300 K. The other compartment is vacuum. The whole system is thermally isolated from its surroundings. The partition is removed and the gas expands to occupy the whole volume of the container. Its temperature now would be
 - 300K
 - 239 K
 - 200K
 - 100K
- Two perfect gases at absolute temperature T_1 and T_2 are mixed. There is no loss of energy. The masses of the molecule are m_1 and m_2 . The number of molecules in the two gases are n_1 and n_2 . The temperature T of the mixture is:
 - $n_1T_1 + n_2T_2$
 - $\frac{n_1T_1}{n_1 + n_2}$

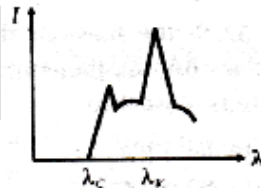
- $\frac{n_2T_2}{n_1 + n_2}$
- $\frac{n_1T_1 + n_2T_2}{n_1 + n_2}$

- The displacement of a particle executing simple harmonic motion is given by: $y = 10 \sin \left(6t + \frac{\pi}{3} \right)$.

Here y is in metre and t is in second. The initial displacement and velocity of the particle are respectively

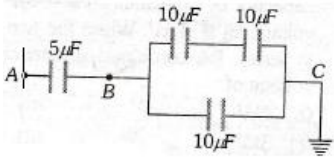
- $5\sqrt{3} \text{ m}$ and 30 m s^{-1}
- $20\sqrt{3} \text{ m}$ and 30 m s^{-1}
- $15\sqrt{3} \text{ m}$ and 30 m s^{-1}
- 15 m and $5\sqrt{3} \text{ m s}^{-1}$

- The intensity of X-rays from a Coolidge tube is plotted against wavelength λ as shown in the figure. The minimum wavelength found is λ_C and the wavelength of the K_α line is λ_K . As the accelerating voltage is increased

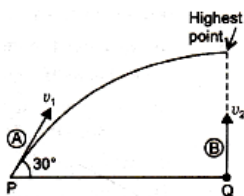


- $\lambda_K - \lambda_C$ increases
 - $\lambda_K - \lambda_C$ decreases
 - λ_K increases
 - λ_K decreases
- Elevation of a cloud is 60° above the horizon. A thunder is heard 8 second after the observation of the lightning. The speed of sound is 330 m s^{-1} . The vertical height of the cloud from the ground is
 - $8 \times 330 \text{ m}$
 - $8 \times 330 \times \sin 60^\circ \text{ m}$
 - $8 \times 330 \times \cos 60^\circ \text{ m}$
 - $8 \times 330 \times \tan 60^\circ \text{ m}$
 - The plates of parallel plate capacitor are changed upto 100V. A 2mm thick plate is inserted between the plates. Then to maintain the same potential difference, the distance between the plates is increased by 1.6 mm. The dielectric constant of the plate is
 - 5
 - 1.25
 - 4
 - 2.5
 - A conductor in the form of a right angle ABC with $AB = 3 \text{ cm}$ and $BC = 4 \text{ cm}$ carries a current of 10 A. There is a uniform magnetic field of 5 T perpendicular to the plane is the conductor. The force on the conductor will be
 - 1.5 N
 - 2.0 N
 - 2.5 N
 - 3.5 N
 - In a Young's double slit experiment, the slits are separated by 0.28 mm and the screen is placed 1.4 m away. The distance between the central bright fringe and the fourth bright fringe is measured to be 1.2cm. The wavelength of light used in the experiment is.
 - 6480 \AA
 - 5993 \AA
 - 6660 \AA
 - 6000 \AA
 - Frequency of photon having energy 66 eV is
 - $8 \times 10^{-15} \text{ Hz}$
 - $12 \times 10^{-15} \text{ Hz}$
 - $16 \times 10^{-15} \text{ Hz}$
 - $20 \times 10^{-15} \text{ Hz}$

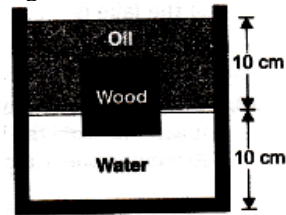
18. In the given circuit if point C is connected to the earth and a potential of + 2000 V is given to the point A, the potential at B is



- a) 1500V b) 1000V c) 500V d) 400V
19. In a hypothetical new system of measurement, the gravitational force between two particles, each of mass 1 kg, separated by 1 km is taken as a unit of force. Let us call this new unit of force “notwen”. How many Newton will be there in one ‘notwen’? Given : $G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$.
- a) 6.67×10^{-11} b) 6.67×10^{-17}
 c) $\frac{1}{6.67 \times 10^{-11}}$ d) $\frac{1}{6.67 \times 10^{-17}}$
20. A transmitter radiates 9 kW power with only carrier and 10.125 W with modulated carrier. The depth of modulation is
- a) 25% b) 50% c) 12.5 % d) 30%
21. Two blocks of masses 5 kg and 2 kg are placed on a frictionless surface and connected by a spring. An external kick gives a velocity of 14 m/s to the heavier block in the direction of lighter one. Calculate the velocity gained by the centre of mass.
- a) 14 m/s b) 7 m/s c) 8 m/s d) 10 m/s
22. A stone is dropped under gravity from rest from a height h ($g = 9.8 \text{ m s}^{-2}$) and it travels a distance $\frac{9h}{25}$ in the last second. The height h is ?
- a) 145 m b) 130 m c) 122.5 m d) 100 m
23. An electric dipole of length 1 cm is placed with the axis making an angle of 30° to an electric field of strength 10^4 NC^{-1} . If it experience a torque of $10\sqrt{2} \text{ Nm}$, the potential energy of the dipole is
- a) 0.245 J b) 2.45J c) 24.5J d) 245.0J
24. A potential barrier of 0.50 V exists across a P.N. junction. If the depletion region is $5.0 \times 10^{-7} \text{ m}$ wide, the intensity of the electric field in this region is
- a) $10 \times 10^6 \text{ V/m}$ b) $1.0 \times 10^5 \text{ V/m}$
 c) $2.0 \times 10^5 \text{ V/m}$ d) $2.0 \times 10^6 \text{ V/m}$
25. A projectile A is thrown at an angle of 30° to the horizontal from point P. At the same time, another projectile B is thrown with velocity v_2 upwards from the point Q vertically below the highest point. For B to collide with A, $\frac{v_2}{v_1}$ should be

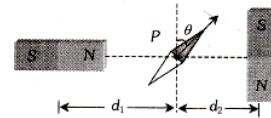


- a) 1 b) 2 c) 1/2 d) 4
26. A cubical block of wood 10 cm on a side floats at the interface between oil and water, as in figure with its



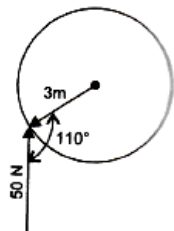
lower face 2 cm below the interface. The density of the oil is 0.6 g cm^{-3} . The mass of the block is

- a) 340 g b) 680 g c) 80 g d) 10 g
27. A galvanometer of resistance 50Ω is connected to a battery of 3V along with a resistance of 2950Ω in series. A full scale deflection of 30 divisions is obtained in the galvanometer. In order to reduce this deflection to 20 divisions, the resistance in series should be
- a) 6050Ω b) 4450Ω
 c) 5050Ω d) 5500Ω
28. Two magnets A and B are identical and these are arranged as shown in the figure. Their length is negligible in comparison to the separation between them. A magnetic needle is placed between the magnets at point P which gets deflected through an angle θ under the influence of magnets. The ratio of distance d_1 and d_2 will be

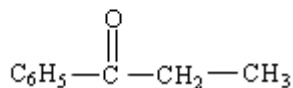
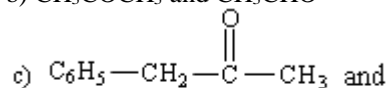


- a) $(2 \tan \theta)^{1/3}$ b) $(2 \tan \theta)^{-1/3}$
 c) $(2 \cot \theta)^{1/3}$ d) $(2 \cot \theta)^{-1/3}$
29. The magnetic flux linked with coil, in weber is given by the equation, $\Phi = 5t^2 + 3t + 16$. The induced emf in the coil in the fourth second is
- a) 10V b) 30V c) 45V d) 90V
30. An alternating voltage $E = 200\sqrt{2} \sin(10t)$ is connected to a 1 microfarad capacitor through an ac ammeter. The reading of the ammeter shall be
- a) 10 mA b) 20 mA c) 40mA d) 80 mA
31. A 52 year old near – sighted person wears eye-glass with a power of -5.5 dioptres for distance viewing. His doctor prescribes a correction of +1.5 dioptres in the near vision section of his bi-focals. This is measured relative to the main part of the lens. The focal length of the near-vision section of the lens is
- a) 19.1 cm b) 15.4 cm c) 17.4 cm d) 21.4 cm
32. What is the nature of electromagnetic waves?
- a) Transverse Nature b) Longitudinal Nature
 c) Transverse as well as longitudinal nature
 d) None of the above
33. A transmitting antenna at the top of a tower has a height of 45m and the height of the receiving antenna is 80m. The maximum distance between them, for satisfactory communication in LOS mode is (radius of earth = 6400 km)
- a) 65 km b) 56 km
 c) 73 km d) 49 km
34. Shunt required in an ammeter of resistance R to decrease its deflection from 30 A to 10 A is
- a) R/4 b) R/3 c) R/2 d) R

35. The resistance of each arm of the Wheatstone's bridge is 10Ω . A resistance of 10Ω is connected in series with galvanometer then the equivalent resistance across the battery will be
 a) 10Ω b) 15Ω c) 20Ω d) 40Ω
36. An engine takes in compressed steam at 127°C and rejects it at 47°C . Efficiency of the engine is
 a) 60% b) 35% c) 25% d) 20%
37. A boy pushes a merry-go-round of radius 3 m with a force 50 N as shown in the figure. If $\cos 20^\circ = 0.9$, then the torque applied by the boy is



- a) 135 N m b) 140 N m c) 40 N m d) 0 N m
38. Two circuits have mutual inductance of 0.09 H. Average e. m. f induced in the secondary by a change of current from 0 to 20 A in 0.006 s in primary will be
 a) 120 V b) 200 V c) 180 V d) 300 V
39. The work function for the surface of aluminium is 4.2 eV. The potential difference which is required to stop the emission of maximum energy electrons emitted by light of 2000 \AA wavelength is.
 a) 1.9875V b) 2.7895V
 c) 3.5935V d) 1.0125V
40. A radioactive sample contains 2.2 mg of pure $^{11}_6\text{C}$ which has half life period of 1224 second. Calculate the activity when 5 μg of the sample will be left.
 a) 0.35×10^{14} disintegrations/second
 b) 3.72×10^{14} disintegrations/second
 c) 2.95×10^{14} disintegrations/second
 d) 1.55×10^{14} disintegrations/second
41. Lyophillic sols are more stable than lyophobic sols because
 a) the colloidal particles have positive charge
 b) the colloidal particles have no charge
 c) the colloidal particles are solvated
 d) there are strong electrostatic repulsions between the negatively charged colloidal particles
42. Schiff's reagent is used for the differentiation between:
 a) HCHO and CH_3CHO
 b) CH_3COCH_3 and CH_3CHO



- d) HCHO and $\text{C}_6\text{H}_5\text{CHO}$
43. Choose the isoelectronic structures from the following
 I. CH_3 II. H_3O^+ III. NH_3 IV. CH_3^-
 a) I and II b) III and IV

- c) I and III d) II, III, IV
44. The crystalline form of sulphur stable at room temperature is
 a) Rhombic sulphur b) Monoclinic sulphur
 c) Plastic sulphur d) Prismatic sulphur
45. Both oxidation and reduction takes place in:
 a) $\text{NaBr} + \text{HCl} \rightarrow \text{NaCl} + \text{HBr}$
 b) $\text{HBr} + \text{AgNO}_3 \rightarrow \text{AgBr} + \text{HNO}_3$
 c) $\text{H}_2 + \text{Br}_2 \rightarrow 2\text{HBr}$
 d) $\text{CaO} + \text{H}_2\text{SO}_4 \rightarrow \text{CaSO}_4 + \text{H}_2\text{O}$
46. In zone refining method, the molten zone
 a) contains impurities
 b) contains purified metal only
 c) contains more impurity than the original metal
 d) moves to either side
47. Hypophosphorus acid, H_3PO_2 is
 a) a monobasic acid
 b) a dibasic acid
 c) a tribasic acid
 d) not an acidic at all
48. Which of the following is not correct for D_2O ?
 a) boiling point is higher than that of H_2O
 b) viscosity is higher than H_2O
 c) melting point is higher than H_2O
 d) dielectric constant is more than H_2O
49. Which of the following is not effected by pressure change
 a) $2\text{NO}_2(\text{g}) \rightleftharpoons \text{N}_2\text{O}_4(\text{g})$
 b) $\text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightleftharpoons \text{CO}_2 \text{ solution}$
 c) $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$
 d) $2\text{O}_3(\text{g}) \rightleftharpoons 3\text{O}_2(\text{g})$
50. Which of the following statements is correct?
 a) Alkyl halides are more reactive than aryl halides towards nucleophilic substitution reactions
 b) The presence of an electron withdrawing substituent at ortho and / or para position decreases the reactivity of nucleophilic substitution of chlorine in the substituted chlorobenzene.
 c) Alkyl halides are less reactive than aryl halide towards nucleophilic substitute reaction.
 d) All of these .
51. $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{Cl} \xrightarrow{\text{KOH(alc)}} \text{A}$
 $\xrightarrow{\text{HBr}}$ C, the compound 'C' is
 Peroxide
 a) $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{Br}$
 b) $\text{CH}_3-\text{CH}_2-\overset{\text{Br}}{\underset{|}{\text{C}}}-\text{CH}_3$
 c) $\text{CH}_3-\text{CH}_2-\overset{\text{Br}}{\underset{|}{\text{C}}}=\text{CHBr}$
 d) $\text{CH}_3-\text{CH}_3-\overset{\text{Br}}{\underset{|}{\text{C}}}=\text{CH}_2$
52. The number of atoms in 100g of fcc crystal with density (d) = 10 g cm^{-3} and edge length 200 pm is equal to
 a) 3×10^{25} b) 5×10^{24}
 c) 1×10^{25} d) 2×10^{25}
53. Atoms of elements B form hcp lattice and those of element A occupy two third of tetrahedral voids. The formula of compound is:
 a) AB_2 b) AB_3 c) AB d) A_4B_3

54. Monochlorination of 2-bromopropane will yield
 a) 2-bromo-2-chloropropane
 b) 2-bromo-1-chloropropane
 c) 1-bromo-2-chloropropane
 d) 1,2-dichloropropane

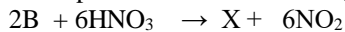
55. Which one of the following can show optical isomerism?

- a) $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ b) $\text{K}_3[\text{Cr}(\text{C}_2\text{O}_4)_3]$
 c) $\text{K}_3[\text{Fe}(\text{CN})_6]$ d) $[\text{Cr}(\text{NH}_3)_6]\text{Cl}_3$

56. Most stable ion is

- a) $[\text{Fe}(\text{OH})_6]^{4-}$ b) $[\text{Fe}(\text{OH})_6]^{3-}$
 c) $[\text{Fe}(\text{CN})_6]^{4-}$ d) $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$

57. What is the product X in the reaction,



- a) B_2O_3 b) H_2O_2
 c) 2HBO_3 d) H_3BO_3

58. Which of the following statement is correct

- a) All the alkali metal carbonate are stable to heat.
 b) Liquid sodium metal is used as a coolant in nuclear reaction.
 c) Washing soda generally exist as a decahydrate
 d) Both (b) and (d)

59. Given the following statements regarding d-orbitals

- 1) It has 4 lobes and 2 angular nodes
 2) It has 4 lobes and one angular node
 3) The orbital angular momentum of electron in this

orbital is $\sqrt{6} \frac{h}{2\pi}$

- 4) It is non-degenerate

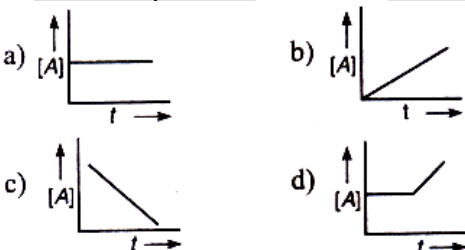
The correct statement(s) is/are

- a) only 1 b) 1 and 3 c) 2 and 3 d) 1 and 4

60. Which one of the following set of ions represent the collection of isoelectronic species?

- a) $\text{K}^+, \text{Ca}^{2+}, \text{Sc}^{3+}, \text{Cl}^-$ b) $\text{Na}^+, \text{Ca}^{2+}, \text{Sc}^{3+}, \text{F}^-$
 c) $\text{K}^+, \text{Cl}^-, \text{Mg}^{2+}, \text{Sc}^{3+}$ d) $\text{Na}^+, \text{Mg}^{2+}, \text{Al}^{3+}, \text{Cl}^-$

61. Which curve represents zero order reaction?

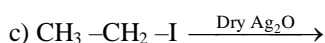
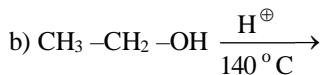


62. Which of the following gaseous ions contains maximum number of unpaired electrons?

- a) Fe^{2+} b) Co^{3+} c) Co^{2+} d) Fe^{3+}

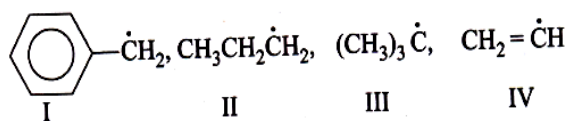
63. Which of the following pairs will give ether?

- a) $\text{C}_2\text{H}_5\text{ONa}$ and $\text{C}_2\text{H}_5\text{I}$



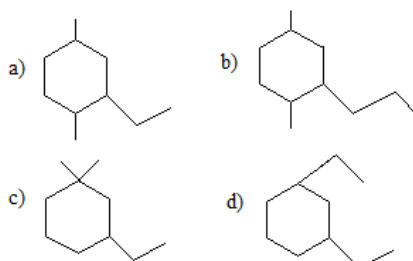
- d) All of these

64. Stability order of the following is,



- a) $\text{IV} < \text{II} < \text{III} < \text{I}$ b) $\text{IV} < \text{II} < \text{I} < \text{III}$
 c) $\text{I} < \text{II} < \text{III} < \text{IV}$ d) $\text{IV} < \text{I} < \text{III} < \text{II}$

65. Which of the following represent 3-Ethyl-1,1-dimethylcyclohexane



66. The rate constant (K) for the reaction, $\text{A} + \text{B} \rightarrow \text{Product}$ was found to be $2.5 \times 10^{-5} \text{ litre mol}^{-1} \text{ sec}^{-1}$ after 15 sec and $2.60 \times 10^{-5} \text{ litre mol}^{-1} \text{ sec}^{-1}$ after 50 sec. The order of reaction is:

- a) 2 b) 3 c) zero d) 1

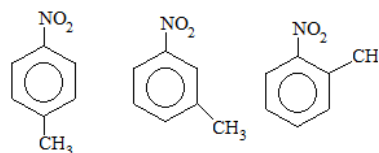
67. Dry air was passed successively through a solution of 5 gm of a solute in 80 gm of water and then through pure water. The weight of ions in solution was 2.50 gm and that of pure solvent 0.04 gm. What is the molecular weight of the solute

- a) 70.31 b) 7.143 c) 714.3 d) 80

68. Both $[\text{Ni}(\text{CO})_4]$ and $[\text{Ni}(\text{CN})_4]^{2-}$ are diamagnetic. The hybridizations of nickel in these complexes respectively are,

- a) sp^3, sp^3 b) $\text{sp}^3, \text{dsp}^2$
 c) $\text{dsp}^2, \text{sp}^3$ d) $\text{dsp}^2, \text{dsp}^2$

69. Correct order of dipole moment is:



- a) $\text{I} = \text{II} = \text{III}$ b) $\text{I} < \text{II} < \text{III}$
 c) $\text{I} > \text{II} > \text{III}$ d) $\text{II} < \text{III} < \text{I}$

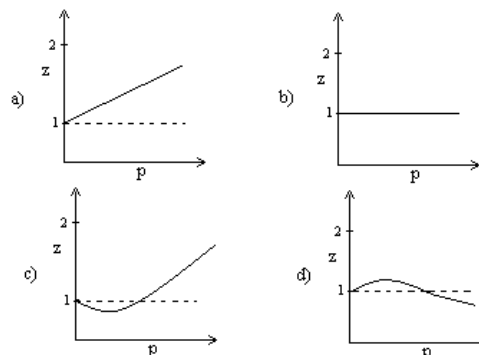
70. The reaction, $\text{A} + 2\text{B} \rightleftharpoons 2\text{C} + \text{D}$ was studied using an initial concentration of B which was 1.5 times that of A. But the equilibrium concentrations of A and C were found to be equal. Then the K_c for the equilibrium is:

- a) 4 b) 8 c) 6 d) 0.323

71. The enthalpy and entropy change for a reaction is $-2.5 \times 10^3 \text{ cal}$ and 7.4 cal deg^{-1} respectively. At 298 K the reaction is

- a) reversible b) irreversible
 c) spontaneous d) non-spontaneous

72. Which of the following represents a plot of compressibility factor (Z) vs P at room temperature for helium?



73. The uncertainty in momentum of an electron is $1 \times 10^{-5} \text{ kg} \cdot \text{m/s}$. The uncertainty in its position will be ($h = 6.62 \times 10^{-34} \text{ kg} \cdot \text{m}^2/\text{s}$)

- a) $5.27 \times 10^{-30} \text{ m}$ b) $1.05 \times 10^{-26} \text{ m}$
 c) $1.05 \times 10^{-28} \text{ m}$ d) $5.25 \times 10^{-28} \text{ m}$

74. If $E^\circ_{\text{Au}^+/\text{Au}}$ is 1.69 V and $E^\circ_{\text{Au}^{3+}/\text{Au}}$ is 1.40 V, then $E^\circ_{\text{Au}^+/\text{Au}^{3+}}$ will be

- a) 0.19 V b) 2.945 V
 c) 1.255 V d) None of these

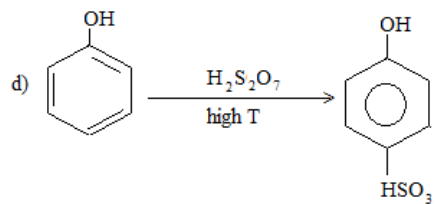
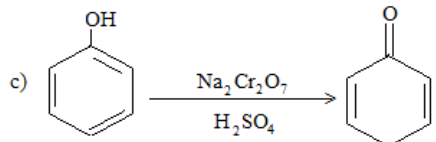
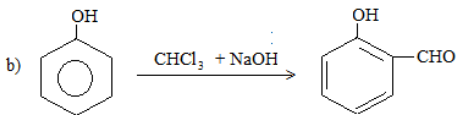
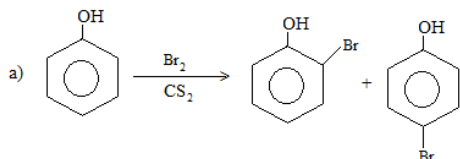
75. Which of the following solutions will have pH = 10 at 298 K?

- a) $1 \times 10^{-10} \text{ M HCl}$ solution
 b) $1 \times 10^{-4} \text{ M NaOH}$ solution
 c) $1 \times 10^{-10} \text{ M NaOH}$ solution
 d) Both (a) and (b)

76. On hydrolysis of starch, we finally get

- a) glucose b) fructose
 c) Both (a) and (b) d) sucrose

77. Which among the following is wrong.



78. Which of the following is thermosetting polymer?

- a) Nylon - 6 b) Bakelite
 c) Nylon - 66 d) SBR

79. Which of the following compounds is formed when benzamide is warmed with bromine and alkali?

- a) Benzenediazonium chloride
 b) Aniline c) Benzene d) Bromobenzene

80. Which among the following cannot show optical activity

- a) 2-butanol b) Penta-2,3 diene
 c) 2-butanone d) 6, 6'-dinitrobiphenic acid

81. $\int \frac{(x+1)(x+\log x)^2}{x} dx$ is equal to

- a) $\frac{3}{(x-\log x)^3} + c$ b) $\frac{3}{(x+\log x)^3} + c$
 c) $\frac{(x-\log x)^3}{3} + c$ d) $\frac{(x+\log x)^3}{3} + c$
 e) none of these

82. $\int \sin^{-1}(3x-4x^3) dx =$

- a) $x \sin^{-1} x + \sqrt{1-x^2} + c$
 b) $x \sin^{-1} x - \sqrt{1-x^2} + c$
 c) $2 [x \sin^{-1} x + \sqrt{1-x^2}] + c$
 d) $3 [x \sin^{-1} x + \sqrt{1-x^2}] + c$
 e) none of these

83. $\int \sin^{-1} \left[\frac{2x}{1+x^2} \right] dx$ is equal to

- a) $2x \tan^{-1} x - \log(1+x^2) + c$
 b) $2x \tan^{-1} x + c$
 c) $2 \tan^{-1} x + c$
 d) $2x \tan^{-1} x + \log(1+x^2) + c$
 e) none of these

84. If the vectors $\hat{i} + 3\hat{j} - 2\hat{k}$, $2\hat{i} - \hat{j} + 4\hat{k}$ and $3\hat{i} + 2\hat{j} + x\hat{k}$ are coplanar, then the value of x =

- a) 1 b) 3 c) -2 d) 2 e) none

85. Let $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{b} = \hat{i} + 2\hat{j} - \hat{k}$ and $\vec{c} = \hat{i} + \hat{j} - 2\hat{k}$ be three vectors. A vector in the plane of \vec{b} and \vec{c} whose projection on \vec{a} is of

magnitude $\sqrt{\frac{2}{3}}$ is

- a) $2\hat{i} + 3\hat{j} - 3\hat{k}$ b) $2\hat{i} + 3\hat{j} + 3\hat{k}$
 c) $2\hat{i} - \hat{j} + 5\hat{k}$ d) $2\hat{i} + \hat{j} + 5\hat{k}$
 e) none of these

86. If the vectors $\hat{i} + 2\hat{j} - 3\hat{k}$, $3\hat{i} + \lambda\hat{j} + \hat{k}$ and $\hat{i} + 2\hat{j} + 2\hat{k}$ are coplanar, then the value of λ is

- a) 5 b) -5 c) -6 d) 6 e) none

87. If $I_n = \int_0^{\pi/4} \tan^n \theta d\theta$, then $I_8 + I_6$ is equal to

- a) 1/7 b) 1/4 c) 1/5 d) 1/6 e) 1/2

88. If $\int_{-1/2}^{1/2} \cos x \log \left(\frac{1+x}{1-x} \right) dx = k \cdot \log 2$, then k equals

- a) 0 b) -1 c) -2 d) 1/2 e) -1/2

89. $\int_{\pi/6}^{\pi/3} \frac{dx}{1+\sqrt{\tan x}}$ is equal to

- a) $\frac{\pi}{12}$ b) $\frac{\pi}{2}$ c) $\frac{\pi}{6}$ d) $\frac{\pi}{4}$ e) $\frac{2\pi}{3}$

90. $\int_{-\pi}^{\pi} \frac{\sin^4 x}{\sin^4 x + \cos^4 x} dx$ is equal to

- a) $\pi/4$ b) $\pi/2$ c) $3\pi/2$ d) 2π e) π

91. Everybody in a room shakes hands with everybody else. The total number of handshakes is 78. The total number of persons in the room is

- a) 11 b) 12 c) 13 d) none

92. If the focus of a parabola is $(0, -3)$ and its directrix is $y = 3$, then its equation is
 a) $x^2 = -12y$ b) $x^2 = 12y$
 c) $y^2 = -12x$ d) none of these
93. A line cutting off intercept -3 from the y - axis and the tangent at angle to the x - axis is $3/5$, its equation is
 a) $5y - 3x + 15 = 0$ b) $3y - 5x + 15 = 0$
 c) $5y - 3x - 15 = 0$ d) none of these
94. The coordinates of the foot of perpendiculars from the point $(2, 3)$ on the line $y = 3x + 4$ is given by
 a) $\left(\frac{37}{10}, \frac{1}{10}\right)$ b) $\left(\frac{-1}{10}, \frac{37}{10}\right)$
 c) $\left(\frac{10}{37}, -10\right)$ d) none of these
95. The value of $(z + 3)(\bar{z} + 3)$ is equivalent to
 a) $|z + 3|^2$ b) $|z - 3|^2$
 c) $z^2 + 3$ d) none of these
96. The distance between the foci of a hyperbola is 16 and its eccentricity is $\sqrt{2}$. Its equation is
 a) $x^2 - y^2 = 32$ b) $\frac{x^2}{4} - \frac{y^2}{9} = 1$
 c) $2x - 3y^2 = 7$ d) none of these
97. $|z_1 + z_2| = |z_1| + |z_2|$ is possible if
 a) $z_2 = \bar{z}_1$ b) $z_2 = \frac{1}{z_1}$
 c) $\arg(z_1) = \arg(z_2)$ d) none of these
98. The values of x for which $\begin{bmatrix} 1 & 2 & 0 \\ 1 & 2 & 1 \end{bmatrix} \begin{bmatrix} 0 \\ 2 \\ x \end{bmatrix} = 0$ is
 a) -1 b) 1 c) 0 d) none
99. If $A^2 = A$ for $A = \begin{bmatrix} -1 & b \\ -b & 2 \end{bmatrix}$, then the value of b is
 a) ± 2 b) 2 c) $\pm\sqrt{2}$ d) none
100. The value of k , such that the function $f(x) = \begin{cases} kx^2, & \text{if } x \leq 2 \\ 3, & \text{if } x > 2 \end{cases}$, continuous $x = 2$ is
 a) $k = 2$ b) $k = 3/4$
 c) $k = 1$ d) none of these
101. If $\sin \theta + \operatorname{cosec} \theta = 2$, then $\sin^2 \theta + \operatorname{cosec}^2 \theta$ is equal to
 a) 1 b) 4 c) 2 d) none
102. If $\tan \theta = 1/2$ and $\tan \phi = 1/3$, then the value of $\theta + \phi$ is
 a) $\pi/6$ b) $\pi/4$ c) 0 d) none
103. Equation of the circle with centre on the y - axis and passing through the origin and the point $(2, 3)$ is
 a) $x^2 + y^2 + 13y = 0$ b) $3x^2 + 3y^2 - 13y = 0$
 c) $6x^2 + 6y^2 - 13x = 0$ d) none of these
104. The equation of a circle with origin as centre and passing through the vertices of an equilateral triangle whose median is of length $3a$ is
 a) $x^2 + y^2 = 9a^2$ b) $x^2 + y^2 = 16a^2$
 c) $x^2 + y^2 = 4a^2$ d) none of these
105. Which of the following functions from Z to itself are bijection?
 a) $f(x) = x^3$ b) $f(x) = x + 2$
 c) $f(x) = 2x + 1$ d) none of these
106. The term independent of x , $x \neq 0$, in the expansion of $\left(\frac{3x^2}{2} - \frac{1}{3x}\right)^{15}$ is
 a) ${}^{15}C_{10}$ b) ${}^{15}C_{10} \left(\frac{1}{6}\right)$
 c) ${}^{15}C_{10} \left(\frac{1}{6}\right)^5$ d) none of these
107. If the middle term of $\left(\frac{1}{x} + x \sin x\right)^{10}$ is equal to $7 \frac{7}{8}$, then the value of x is
 a) $2n\pi + \frac{\pi}{6}$ b) $n\pi + \frac{\pi}{6}$
 c) $n\pi + (-1)^n \frac{\pi}{6}$ d) none of these
108. If the coefficients of $(2r + 4)^{\text{th}}$ and $(r - 2)^{\text{th}}$ terms in the expansion of $(1 + x)^{18}$ are equal, then the value of r is
 a) 2 b) 4 c) 6 d) none
109. If the vertex of the parabola is the point $(-3, 0)$ and the directrix is the line $x + 5 = 0$, then its equation is
 a) $y^2 = 8(x + 3)$ b) $x^2 = 8(y + 3)$
 c) $y^2 = -8(x + 3)$ d) none of these
110. The number of possible outcomes when a coin is tossed 6 times is
 a) 36 b) 64 c) 12 d) none
111. If $y = \sin^{-1} x$, then $(1 - x^2) \frac{d^2 y}{dx^2} - x \frac{dy}{dx} =$
 a) 1 b) 0 c) $2y$ d) none
112. If $y = x^3 + \tan x$, then $\frac{d^2 y}{dx^2} =$
 a) $3x^2 + \sec^2 x$ b) $3x^2 - \sec^2 x$
 c) $2\sec^2 x + \tan x$ d) none of these
113. The maximum area of the rectangle that can be inscribed in a circle of radius r is
 a) πr^2 b) r^2
 c) $\frac{\pi r^2}{4}$ d) none

114. The principal value of $\cot^{-1}\left(\frac{-1}{\sqrt{3}}\right)$ is

- a) $\frac{2\pi}{3}$ b) $\frac{\pi}{2}$ c) $\frac{\pi}{3}$ d) none

115. $\tan^{-1}\frac{1}{2} + \tan^{-1}\frac{2}{11} =$

- a) $\pi/4$ b) 1 c) $\tan^{-1} 3/4$ d) none

116. Let R be the relation on the set R of all real numbers defined by aRb iff $|a - b| \leq 1$. The R is

- a) reflexive and symmetric b) symmetric only
c) transitive only d) none of these

117. The identity element for the binary operation

* defined by $a * b = \frac{ab}{2} \forall a, b \in Q_0$ (the set of all

non-zero rational numbers) is

- a) 1 b) 0 c) 2 d) none

118. The radius of spherical balloon is changing at

the rate of $\frac{1}{4\pi}$ m/sec. The value of radius of the

balloon when its volume changes at the same rate as its surface area

- a) 4m b) $\frac{1}{2}$ m c) 2m d) none

119. Equation of the line passing through (1, 1, 1) and parallel to the plane $2x + 3y + z + 5 = 0$ is

a) $\frac{x-1}{1} = \frac{y-1}{2} = \frac{z-1}{1}$

b) $\frac{x-1}{-1} = \frac{y-1}{1} = \frac{z-1}{-1}$

c) $\frac{x-1}{3} = \frac{y-1}{2} = \frac{z-1}{1}$

d) $\frac{x-1}{2} = \frac{y-1}{3} = \frac{z-1}{1}$

e) none of these

120. The value of k so that $\frac{x-1}{-3} = \frac{y-2}{2k} = \frac{z-3}{2}$ and

$\frac{x-1}{3k} = \frac{y-1}{1} = \frac{z-6}{-5}$ may be perpendicular is

given by

a) $-7/10$

b) $-10/7$

c) -10

d) $10/7$

e) none of these

Space for rough work

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