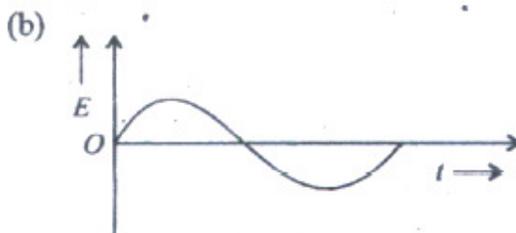
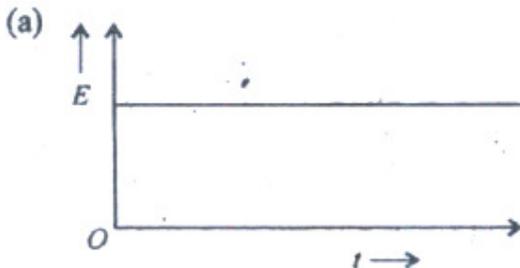
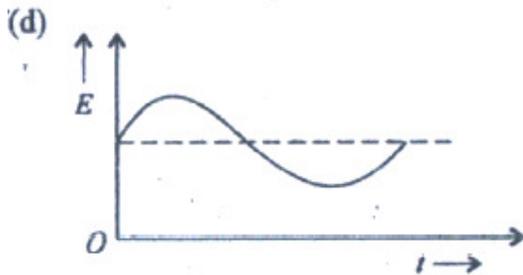
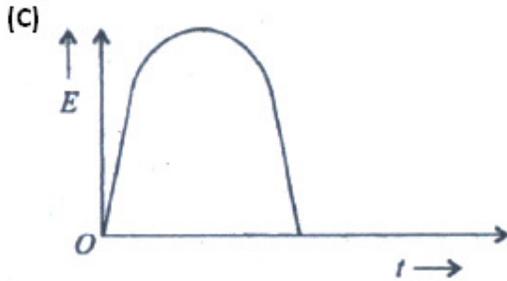


## SCRA 2015

## PHYSICAL SCIENCE

1. Consider  $1 \text{ cm}^3$  of air at absolute temperature  $T$  at sea level and other  $1 \text{ cm}^3$  of air at a height where the pressure is one third atmosphere. The absolute temperature of the sample at that height is
- (a)  $T$  (b)  $\frac{T}{3}$   
(c)  $2T$  (d) Cannot be determined in terms of  $T$  from the above data
2. The displacement of a particle with respect to mean position is represented by the equation  $y = \sin^3 \omega t$ . The motion is
- (a) non-periodic  
(b) periodic but not simple harmonic  
(c) simple harmonic with time period  $2\pi/\omega$   
(d) simple harmonic with time period  $\pi/\omega$
3. Which one of the following diagrams most closely shows the variation of kinetic energy ( $E$ ) of the earth with time ( $t$ ) as it orbits around the sun?





4. Pressure is a scalar quantity because
- it is the ratio of force to area and both force and area are vector quantities
  - it is the ratio of magnitude of force to area
  - it is the ratio of component of the force normal to the area
  - it depends on the size of the area chosen
5. The volume of an ideal gas with adiabatic exponent  $\gamma$  varies according to law  $V = \frac{a}{T}$  where  $a$  is a constant. If the temperature of gas increases by  $\Delta T$ , then the amount of heat absorbed by the gas is
- $\frac{R\Delta T}{\gamma - 1}$
  - $R\Delta T \left( \frac{1 - \gamma}{2 - \gamma} \right)$
  - $R\Delta T \left( \frac{2 - \gamma}{\gamma - 1} \right)$
  - $R\Delta T$
6. If the coefficient of superficial expansion is  $x$  times the coefficient of cubical expansion then the value of  $x$  is
- 2
  - 3/2
  - 2/3
  - 1/2
7. Consider the following situations :
- A charged particle moves in the direction of uniform magnetic field
  - A charged particle moves in the direction perpendicular to uniform magnetic field.
  - A charged particle moves in the direction making some angle with the direction of uniform magnetic field.

In which of the above situations no work is done by the field on the particle

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

8. The resistance of the coil of an ammeter is  $R$ . The shunt required to increase its range  $N$ -fold should have resistance

- (a)  $\frac{R}{(N-1)}$
- (b)  $\frac{R}{N}$
- (c)  $\frac{R}{(N+1)}$
- (d)  $NR$

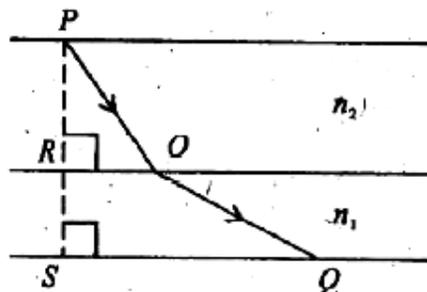
9. Two containers are at the same temperature  $T$ . The first contains gas at pressure  $P$  whose molecules have mass  $m_1$ . The second contains molecules of mass  $m_2$  at pressure  $\frac{P}{2}$ . The average speed of molecules of gas in second container is twice the root mean square speed of molecules of gas in the first container. What is the ratio of  $\frac{m_1}{m_2}$ ?

- (a) 2
- (b)  $1/2$
- (c)  $3/2$
- (d) 6

10. A very small charged metallic ball is attached to a string and a person whirls it above his head so that it moves in a circle in a horizontal plane. Now a strong uniform magnetic field is switched on in a direction perpendicular to the plane of motion of the ball. The tension in the string will

- (a) decrease
- (b) increase
- (c) remain the same
- (d) either increase or decrease.

11.

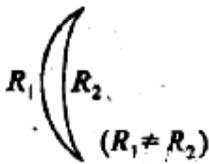


What is the optical path of light my traversing the path POQ across two media of refractive indices  $n_2 = \frac{3}{2}$  and  $n_1 = \frac{4}{3}$  (PR = a, RS = b, RO = x, SQ = y)?

- (a)  $\frac{8\sqrt{a^2+x^2}+9\sqrt{b^2+y^2}}{6}$   
 (b)  $\frac{3\sqrt{a^2+x^2}+\sqrt{8(b^2+(y-x)^2)}}{\sqrt{6}}$   
 (c)  $\frac{3\sqrt{a^2+b^2+x^2+y^2}-4\sqrt{b^2+y^2}}{3}$   
 (d)  $\frac{9\sqrt{a^2+x^2}+8\sqrt{b^2+(y-x)^2}}{6}$

12. Consider the following lenses:

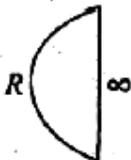
I.



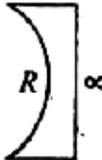
III.



II.



IV.



Which of the above lenses do not exhibit dispersion?

- (a) II and IV  
 (b) I  
 (c) III  
 (d) None

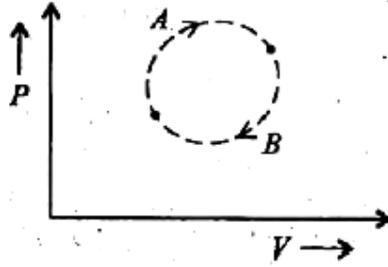
13. Consider the following statement in respect of quartz ( $\text{SiO}_2$ ):

1. The refractive index does not depend on the wavelength of visible light.
2. The refractive index is greater for violet light than for red light.
3. The refractive index decreases with increases in wavelength.

Which of the above statements is/are correct?

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

14. Consider the following figure. Let  $\Delta U_1$  and  $\Delta U_2$  be the change in internal energy in processes A and B respectively,  $\Delta Q$  be the net heat given to the system in the process A + B and  $\Delta W$  be the net work done by the system in the process A + B.



Which of the following are correct?

1.  $\Delta U_1 + \Delta U_2 = 0$
2.  $\Delta U_1 - \Delta U_2 = 0$
3.  $\Delta Q - \Delta W = 0$
4.  $\Delta Q + \Delta W = 0$

Select the correct answer using the code given below:

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

15. Two small objects having same charge  $q$  are kept fixed on the  $z$ -axis at  $(0, 0, d)$  and  $(0, 0, -d)$  respectively. A charge  $Q$  moves along the  $x$ -axis. At what position of the charge  $Q$  would the force on  $Q$  be maximum?

- (a)  $(\frac{d}{\sqrt{2}}, 0, 0)$
- (b)  $(\frac{d}{2}, 0, 0)$
- (c)  $(\sqrt{3}d, 0, 0)$
- (d)  $(\frac{d}{\sqrt{3}}, 0, 0)$

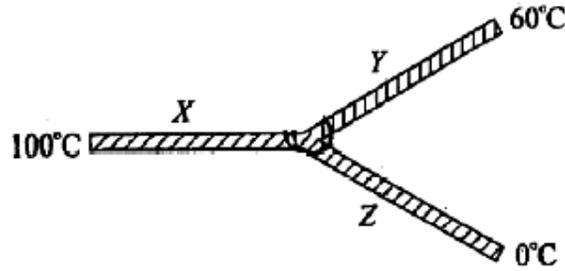
16. Consider the following statements:

1. Paramagnetism occurs in materials where atoms have permanent dipole moments.
2. In diamagnetic materials, atoms having no permanent magnetic dipole moments acquire induced dipole moments when they are placed in an external magnetic field.
3. Ferromagnetism occurs in materials in which atoms have permanent magnetic dipole moments.

Which of the above statements are correct?

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

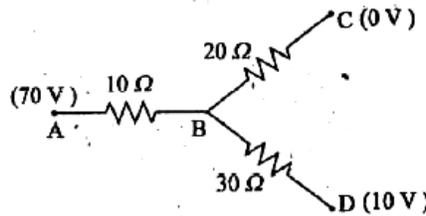
17.



Three rods  $X$ ,  $Y$ ,  $Z$  of same dimension having thermal conductivities  $3K$ ,  $2K$ ,  $K$  respectively are arranged as shown in the above figure. Their ends are at  $100^\circ\text{C}$  and  $0^\circ\text{C}$  respectively. What is the temperature of the junction?

- (a)  $75^\circ\text{C}$
- (b)  $72^\circ\text{C}$
- (c)  $70^\circ\text{C}$
- (d)  $65^\circ\text{C}$

18.



Consider the following in respect of above network:

1. The potential at B is 35 V.
2. The current in the section AB is thrice the current in the section BD.
3. The network draws a total power of 200 Watt.

Which of the above are correct?

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

19. Consider the following statements:

1. A converging lens of focal length  $f$  is placed in front of and coaxially with a convex mirror of focal length  $F$ . A parallel beam of light incident on the lens returns as a parallel beam from the arrangement. The separation between the lens and the mirror is  $|f| - 2|F|$ .
2. A diverging lens of focal length  $f$  is placed in front of and coaxially with a concave mirror of focal length  $F$ . A parallel beam of light incident on the lens returns as a parallel beam from the arrangement. The separation between the lens and the mirror is  $2|F| - |f|$ .

Which of the above statements is/are correct?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 and 2

20. When white light passes through a hollow prism, then

- (a) there is neither dispersion nor deviation
- (b) there is dispersion but no deviation
- (c) there is deviation but no dispersion
- (d) there is both dispersion and deviation

21. Consider the following parameters with regard to hydrogen like atoms:

- 1. Energy of the atom
- 2. Radius of electron orbit,
- 3. Spin of the electron

Which of the above are same for all hydrogen-like atoms and ions in  $n = 1$  state?

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

22. A positively charged thin metal ring of radius  $R$  is fixed in the  $xy$ -plane, with its centre at the origin. A negatively charged particle is released from rest at the point  $P(0, 0, c)$  where  $c > 0$ . Consider the following statements:

- 1. The electric field at  $P$  due to the metallic ring is always directed towards origin.
- 2. The negatively charged particle is accelerated towards origin and undergoes periodic motion.

Which of the above statements is/are correct?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

23. Let  $E$  be the electric field intensity and  $V$  be the potential at a point. Consider the following statements:

- 1. If  $V = 0$ , then  $E$  must be zero.
- 2. If  $V \neq 0$ , then  $E$  cannot be zero.
- 3. If  $E \neq 0$ , then  $V$  cannot be zero.

Which one of the following is correct ?

- (a) Statements 1 and 2 are correct
- (b) Statements 2 and 3 are correct
- (c) Statements 1 and 3 are correct
- (d) None of the statements are correct

24. The position of a particle as a function of time is given by  $\vec{r} = A\hat{i} + Bt^2\hat{j} + ct\hat{k}$ . The shape of the trajectory of the particle will be

- (a) Straight line
- (b) Circle
- (c) Parabola
- (d) Ellipse



- (c) with smaller average speed
- (d) with smaller average speed and smaller average kinetic energy

29. A ray of light travels from an optically denser medium to an optically rarer medium. The critical angle for the two media is  $C$ . What is the maximum possible angle of deviation of the ray?

- (a)  $\frac{\pi}{2} - C$
- (b)  $2C$
- (c)  $\pi - 2C$
- (d)  $\pi - C$

30. A barometer is placed inside a closed stationary elevator and it 760 mm. The elevator starts moving with acceleration in the upward direction. The reading on the barometer will read

- (a) 760 mm
- (b) greater than 760 mm
- (c) less than 760 mm
- (d) will oscillate about 760 mm

**For the next two (02) items that follow:**

A motor boat of mass  $m$  moves along a lake with velocity  $v_0$ . Assume that resistance of water is proportional to velocity of boat as  $\vec{F} = -r\vec{v}$ ,  $r$  being the proportionality constant. At the moment  $t = 0$ , the engine of the boat is shut down.

31. The instantaneous velocity as a function of time  $t$  is proportional to

- (a)  $e^{\frac{rt}{m}}$
- (b)  $-e^{\frac{rt}{m}}$
- (c)  $\ln\left(\frac{rt}{m}\right)$
- (d)  $\ln\left(\frac{mt}{r}\right)$

32. The total distance covered till it stops is

- (a)  $\frac{mv_0}{r}$
- (b)  $\frac{mv_0}{2r}$
- (c)  $\frac{mv_0}{4r}$
- (d)  $\frac{2mv_0}{r}$

33. A ball is dropped from the top of a tower. The distance covered in the last one second is 0.36 times the height of the tower. What is the height of the tower? ( $g = 10 \text{ m/s}^2$ )

- (a) 125 m
- (b) 100m
- (c) 88 m
- (d) 64 m

34. A particle participating simultaneously in two simple harmonic oscillations of same direction  $x_1 = a \sin \omega t$  and  $x_2 = a \sin 2\omega t$ . What is the maximum velocity of the particle?

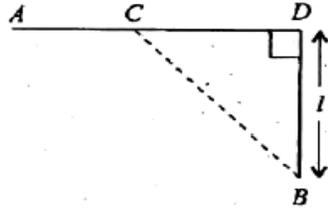
- (a)  $-\frac{13a\omega}{16}$
- (b)  $-\frac{11a\omega}{16}$

(c)  $-\frac{9a\omega}{16}$

(d)  $-\frac{33a\omega}{16}$

**For the next two (02) items that follow:**

From a point  $A$  on a highway, one has to get by car as soon as possible to point  $B$  located in the field at a perpendicular distance  $l$  from the highway. The car moves in the field  $\eta$  times slower than on the highway. Take  $v > 1$  so that if the speed of the car on the highway is  $\eta v$ , it is  $v$  in the field.



35. At what distance from point  $D$ , one must turn off the highway?

(a)  $\frac{l}{\eta}$

(b)  $\frac{l}{\sqrt{\eta^2-1}}$

(c)  $\frac{l}{\sqrt{\eta^2+1}}$

(d)  $\frac{l}{\sqrt{\eta^2-2}}$

36. What is the distance covered by the car in the field during this process?

(a)  $\frac{ln}{\sqrt{\eta^2-1}}$

(b)  $\frac{ln}{\sqrt{\eta^2+1}}$

(c)  $\frac{ln}{\sqrt{\eta^2-2}}$

(d) None of the above

37. A particle of mass  $m$  is located in a uni-dimensional potential field where the potential energy of the particle is given by  $U(x) = U_0(1 - \cos ax)$  where  $U_0$  and  $a$  are constants. The time period of a small oscillation that the particle performs about the equilibrium is given by

(a)  $2\pi\sqrt{\frac{m}{a^2U_0}}$

(b)  $2\pi\sqrt{\frac{2m}{a^2U_0}}$

(c)  $2\pi\sqrt{\frac{m}{aU_0}}$

(d)  $2\pi\sqrt{\frac{m}{2a^2U_0}}$

38. A ball when thrown upward from a tower with a given velocity takes time  $t_1$  to reach the ground. The same ball when thrown downward with same velocity from the tower takes time  $t_2$  to reach ground. If the ball is dropped freely from the same tower, the time taken to reach the ground will be

(a)  $t_1 - t_2$

(b)  $\frac{t_1+t_2}{2}$

(c)  $\sqrt{t_1 t_2}$

(d)  $\sqrt{t_1^2 - t_2^2}$

39. In a Vernier Callipers, there are 20 divisions on the vernier scale that are equal to 19 divisions on the main scale. What is the least count of the instrument? (one main scale division is 1 mm)

- (a) 0.01 cm (b) 0.05 cm  
(c) 0.005 cm (d) 0.5 cm

40. A steel ball of mass  $m$  starts sinking with zero initial velocity in olive oil and experiences frictional force proportional to first power of velocity. If  $k$  is the constant of proportionality, then the instantaneous velocity of the ball will be

- (a)  $\frac{mg}{k} \left(1 - e^{-\frac{kt}{m}}\right)$  (b)  $\frac{mg}{k} e^{-\frac{kt}{m}}$   
(c)  $\frac{mg}{k} \left(1 - e^{-\frac{kt}{2m}}\right)$  (d)  $\frac{mg}{k} \left(1 - e^{-\frac{2kt}{m}}\right)$

41. A vessel contains liquid of density  $\rho$  over another liquid of density  $m\rho$  (where  $m$  is any number). A homogeneous sphere floats with  $\frac{1}{n}$  times (where  $n$  is any number) of its volume in liquid of density  $m\rho$  and remaining portion in liquid of density  $\rho$ . The density of the material of the sphere is

- (a)  $\left(\frac{m-n+1}{n}\right)\rho$  (b)  $\left(\frac{m+n-1}{n}\right)\rho$   
(c)  $\left(\frac{m+n+1}{n}\right)\rho$  (d)  $\left(\frac{n-1}{m+1}\right)\rho$

42. Two identical sonometer wires have a fundamental frequency of 400 Hz when kept under same tension. What fractional increase in the tension of one wire would cause an occurrence of 2 beats per second when both the wires vibrate together?

- (a) 1% (b) 2%  
(c) 3% (d) 4%

43. A tube of length  $l$  is filled completely with an incompressible liquid of mass  $m$  and closed at both ends. The tube is then rotated in horizontal plane about one of its ends with uniform angular velocity  $\omega$ . The force exerted by the liquid at the other end is

- (a)  $ml\omega^2$  (b)  $\frac{3ml\omega^2}{4}$   
(c)  $\frac{ml\omega^2}{2}$  (d)  $\frac{ml\omega^2}{4}$

44. A particle executes simple harmonic motion between  $x = -A$  to  $x = +A$ . The time taken for it to go from  $x = 0$  to  $x = \frac{A}{2}$  is  $T_1$  and to go from  $x = \frac{A}{2}$  to  $A$  is  $T_2$ . Which one of the following is correct?

- (a)  $2T_1 = T_2$   
(b)  $T_1 = T_2$   
(c)  $2T_1 = 3T_2$   
(d)  $T_1 = 2T_2$

45. What is the path difference between the waves  $y_1 = a \sin\left(\omega t - \frac{2\pi x}{\lambda}\right)$  and  $y_2 = a \cos\left(\omega t - \frac{2\pi x}{\lambda}\right)$ ?

- (a)  $\lambda$  (b)  $\frac{\lambda}{2}$   
 (c)  $\frac{\lambda}{4}$  (d)  $2\lambda$

46. Consider the following statements associated with X-ray spectrum:

1. Wavelength of  $K_\alpha$  X-ray of aluminium is greater than that of silver.
2. Wavelength of  $L_\alpha$  X-ray of silver is greater than that of gold.
3. Wavelength of  $K_\alpha$  X-ray of silver is greater than  $K_\beta$  X-ray of silver.

Which of the above statements are correct?

- (a) 1 and 2 only (b) 2 and 3 only  
 (c) 1 and 3 only (d) 1, 2 and 3

47. The total energy of an electron in the second excited state of the hydrogen atom is about  $-1.5$  eV. The kinetic energy and potential energy of the electron in this state are

- (a) 1.5 eV and  $-3.0$  eV (b)  $-1.5$  eV and  $-4.5$  eV  
 (c) 3.0 eV and  $-4.5$  eV (d)  $-0.75$  eV and  $-0.75$  eV

48. The electric flux through a closed surface is zero. It means that

- (a) no electric field lines either leave or enter the surface  
 (b) there are no positive charges present inside the closed surface  
 (c) the algebraic sum of all the charges present inside the surface is zero.  
 (d) the enclosed surface is a region of uniform electric field.

49. In a watch glass, water is taken and it is kept in a non-uniform magnetic field. Water moves from strong field to weak field. The magnetic effect observed is

- (a) antiferromagnetic (b) ferromagnetic  
 (c) diamagnetic (d) paramagnetic

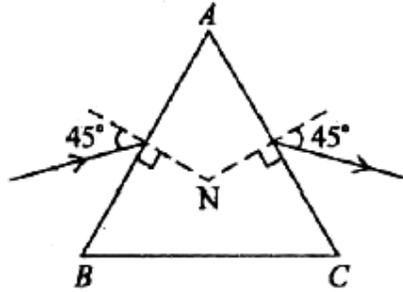
50. Consider the following statements:

1. A neutrino is emitted during  $\beta^-$  decay.
2. Neutrinos have almost zero mass.
3. A neutrino is emitted during  $\beta^+$  decay.
4. It was necessary to postulate existence of neutrinos to account for the conservation of angular momentum during  $\beta$  decay and the energy distribution.

Which of the above statements is/are correct?







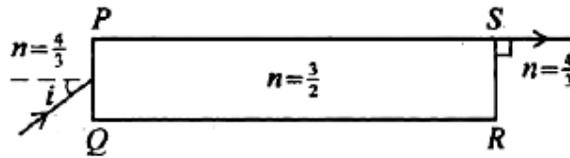
In the above diagram, what is the refractive index of material of the prism with respect to air, when the angle of deviation is  $30^\circ$ ?

- (a)  $\sqrt{3}$
- (b)  $\sqrt{2}$
- (c)  $\frac{3}{2}$
- (d)  $\frac{4}{3}$

58. If  $x$  and  $y$  are the distances of an object and its image from the focus of a spherical mirror of focal length  $f$ , then what is  $\frac{xy}{f^2}$  equal to?

- (a) 1
- (b) 1.5
- (c) 2
- (d) 4

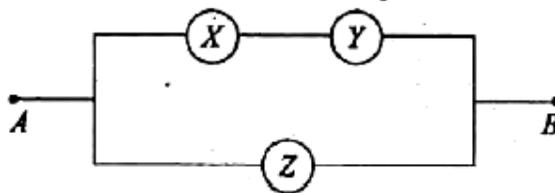
59.



A long thin rectangular slab PQRS having refractive index  $\frac{3}{2}$  is immersed in a liquid having refractive index  $\frac{4}{3}$ . A ray of light is incident at the edge PQ of the slab as shown. What is the sine of angle of incidence  $i$  such that the ray comes out from the slab as shown in the above figure?

- (a)  $\frac{\sqrt{17}}{8}$
- (b)  $\frac{4}{\sqrt{17}}$
- (c)  $\frac{8}{9}$
- (d)  $\frac{1}{2}$

60.



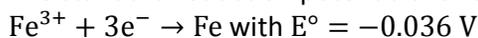
Three voltmeters X, Y, Z all having different resistances are joined as shown above. When some potential difference is applied across the terminals A and B, their readings are x, y, z respectively. Which of the following is/are correct?

1.  $x \neq y$
2.  $x + y = z$
3.  $x = y = z$

Select the correct answer using the code given below:

- |             |            |
|-------------|------------|
| (a) 1 only  | (b) 2 only |
| (c) 1 and 2 | (d) 3 only |

61. The standard reduction potentials for the following reactions are:



What would be the standard electrode potential for the reaction  $\text{Fe}^{3+} + \text{e}^- \rightarrow \text{Fe}^{2+}$ ?

- |              |              |
|--------------|--------------|
| (a) 0.772 V  | (b) 0.077 V  |
| (c) -0.404 V | (d) -0.772 V |

62. The vapour pressure of pure liquid solvent A is 0.80 bar. When a non-volatile substance B is added to the solvent pressure drops to 0.60 bar. What is the mole fraction of component B in the solution?

- |          |          |
|----------|----------|
| (a) 0.75 | (b) 0.50 |
| (c) 1.0  | (d) 0.25 |

63. Consider the following statements:

Statement I : Mass, volume and pressure are extensive properties.

Statement II : Extensive properties depend upon the amount of the substance.

Which one of the following is correct in respect of the above statements?

- (a) Both the statements are true and Statement II is the correct explanation of Statement I
- (b) Both the statements are true but Statement II is not the correct explanation of Statement I
- (c) Statement I is true, but Statement II is false
- (d) Statement I is false, but Statement II is true

64. The enthalpy change of a reaction does not depend on

- (a) Initial and final state of the reaction
- (b) State of the reactants and products

- (c) Nature of the reactants  
(d) Different intermediate states
65. Oxygen molecule is paramagnetic because  
(a) Bonding electrons are more than anti-bonding electrons  
(b) It contains two unpaired electron  
(c) Anti-bonding electrons are more than bonding electrons  
(d) bonding electrons are equal to anti-bonding electrons
66.  $H^+$  ion always gets associated with other atoms or molecules due to  
(a) its positive charge  
(b) absence of any electron in its orbitals  
(c) its resemblance with alkali metal cations  
(d) small size so that it cannot exist free
67. Consider the following statements in respect of reactivity of hydrogen:  
1. Hydrogen is not reactive under ambident conditions.  
2. Hydrogen reacts with fluorine violency.  
3. Hydrogen and chlorine reaction is catalysed by daylight.  
4. Hydrogen and nitrogen can react directly in presence of visible light.  
Which of the above statements are correct?  
(a) 1, 2, 3 and 4  
(b) 1, 2 and 3 only  
(c) 2 and 3 only  
(d) 1 and 4 only
68. How many hydrogen bonded water molecules are present in  $CuO_4 \cdot 5H_2O$ ?  
(a) 5  
(b) 4  
(c) 1  
(d) 0
69. A water sample contains 81 ppm of  $Ca(HCO_3)_2$ , 73 ppm of  $Mg(HCO_3)_2$ , 68 ppm of  $CaSO_4$  and 60 ppm of  $MgSO_4$ . What is the hardness of the water sample? (Atomic weights of calcium, magnesium and sulphur are respectively 40, 24 and 32)  
(a) 50 ppm  
(b) 100 ppm  
(c) 150 ppm  
(d) 200 ppm
70. on electrolysis of brine solution, the amounts of NaOH and  $Cl_2$  produced at cathode and anode respectively are  
(a) 40 parts and 35.5 parts  
(b) 35.5 parts and 40 parts  
(c) 100 parts and 80 parts  
(d) 80 parts and 100 parts

71. Consider the following chemical reaction of  $D_2O$ :

1.  $Mg_3N_2 + 3D_2O \rightarrow 2ND_3 + 3MgO$
2.  $NH_4Cl + D_2O \rightarrow NH_3DCl + HDO$
3.  $SO_3 + D_2O \rightarrow D_2SO_4$

Which of the above are exchange reactions?

- |                  |                  |
|------------------|------------------|
| (a) 1 and 2 only | (b) 2 and 3 only |
| (c) 1 and 3 only | (d) 1, 2 and 3   |

72. In the Solvay process of manufacture of sodium carbonate, the regeneration of ammonia occurs by reaction of  $NH_4Cl$  with  $Ca(OH)_2$ . The by-product obtained in this process is

- |              |               |
|--------------|---------------|
| (a) $CaCl_2$ | (b) $NaCl$    |
| (c) $CaO$    | (d) $NaHCO_3$ |

73. An improved combination of baking powder contains about 40% starch + 30%  $NaHCO_3$  + 20%  $NaAl(SO_4)_2$  + 10%  $Ca(H_2PO_4)_2$ .

Consider the following for these constituents:

1. Starch acts as a filter.
2. Moistened  $Ca(H_2PO_4)_2$  is acidic and generates  $CO_2$  from  $NaHCO_3$ .
3.  $NaAl(SO_4)_2$  slows down the reaction of generation of  $CO_2$  from  $NaHCO_3$ .

Which of the above are correct?

74. Consider the following statements for  $MgSO_4$ :

1. It crystallizes in a form with seven water molecules.
2. Aqueous solution of  $MgSO_4$  when treated with  $NaCl$  gives white precipitate.

Which of the above statements is/are correct?

- |                  |                     |
|------------------|---------------------|
| (a) 1 only       | (b) 2 only          |
| (c) Both 1 and 2 | (d) Neither 1 nor 2 |

75. Consider the following for alumina

1. In crystalline form, it exists in  $\alpha$  and  $\gamma$  forms.
2.  $\alpha$  form is the strongest and is known as corundum.
3.  $\alpha$  form can be converted to  $\gamma$  form by heating at  $1000^\circ C$ .

Which of the above statements is/are correct?

- |             |             |
|-------------|-------------|
| (a) 1 only  | (b) 2 only  |
| (c) 1 and 2 | (d) 2 and 3 |

76. Compound A on ozonolysis yielded a mixture of propanoic acid and acetic acid. The structure of compound A is

- |                                 |
|---------------------------------|
| (a) $CH_3CH_2C \equiv C - H$    |
| (b) $CH_3CH_2C \equiv C - CH_3$ |

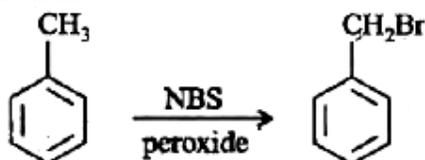
ARYAN CLASSES

- (c)  $\text{CH}_3\text{CH}_2\text{CH}=\text{CH}-\text{CH}_3$   
 $\begin{array}{c} \text{O} \quad \text{O} \\ \parallel \quad \parallel \end{array}$
- (d)  $\text{CH}_3-\text{CH}_2-\text{C}-\text{C}-\text{CH}_3$

77. Reaction of aqueous NaOH with  $\text{CHCl}_3$  gives

- (a)  $:\text{CCl}_2$  (b)  $\oplus\text{CCl}_2$   
 (c)  $\ominus\text{CCl}_2$  (d)  $\cdot\text{CCl}_2$

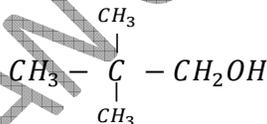
78. Consider the following reaction:



The above reaction is an example of

- (a) Free-radical reaction  
 (b) Nucleophilic substitution reaction  
 (c) Electrophilic substitution reaction  
 (d) Addition reaction

79. Consider the following compound:



What is the IUPAC name for the above compound?

- (a) 2,2-Dimethyl-1-hydroxyl propane  
 (b) 2-Methyl-2-hydroxymethyl propane  
 (c) *tert*-butyl methanol  
 (d) 2,2-Dimethylpropan-1-ol

80. Acetylation of salicylic acid yields

- (a) Sulphadiazine (b) Aspirin  
 (c) Chloramphenicol (d) Streptomycin

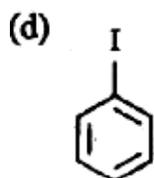
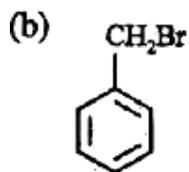
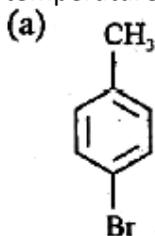
81. Consider the following compounds:

- I.  $\text{CH}_3\text{CH}_2\text{OH}$   
 II.  $\text{CH}_3\text{CH}_2\text{CH}_3$   
 III.  $\text{CH}_3\text{OCH}_3$

What is the correct order of boiling point of the above?

- (a)  $I < II < III$  (b)  $II < I < III$   
 (c)  $II < III < I$  (d)  $III < II < I$

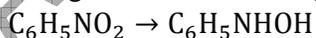
82. Which of the following halides will undergo hydrolysis in aqueous conditions at room temperature?



83. Which one of the following substances will react to give *tert*-butyl ethyl ether as the major reaction product?

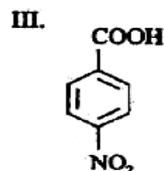
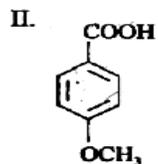
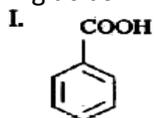
- (a) *tert*-butyl chloride + sodium ethoxide  
 (b) 2-Methyl propene + ethanol + dil. HCl  
 (c) Ethane + *tert*-butanol  
 (d) Ethyl bromide + sodium *tert*-butoxide

84. Which set of reagents is likely to bring about the following reduction?



- (a) Sn/HCl  
 (b) Zn/NH<sub>4</sub>Cl, Δ  
 (c) Zn, NaOH, CH<sub>3</sub>OH  
 (d) H<sub>2</sub>/Raney Ni

85. Consider the following acids



What is the correct order of acidity?

- (a) II < I < III  
 (b) I < II < III  
 (c) I < III < II  
 (d) II < III < I

86. Consider the following statements in respect of cellulose:

- Cellulose is a linear biopolymer.
- Glucose units are joined by  $\alpha$ -glycosidic linkages.
- Cotton and paper

Which of the above statements is/are correct?

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

87. Consider the following molecules:

1.  $\text{CH}_3\text{NH}_2$
2.  $\text{CH}_3\text{OH}$
3.  $\text{CH}_3\text{SH}$
4.  $\text{CH}_3\text{P}(\text{CH}_3)_2$

Which one of the following bonds has the longest bond length in the above molecules?

- (a) C-N (b) C-O  
(c) C-S (d) C-P

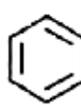
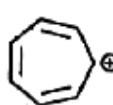
88. Which one of the following compounds has asymmetric carbon in it?

- (a)  $\text{CH}_3\text{CH}_2\text{Br}$  (b)  $\text{CH}_3\text{CH}(\text{Br})\text{CH}_3$   
(c)  $\text{CH}_3\text{CH}_2(\text{Br})\text{CH}_3$  (d)  $\text{CH}_3\text{CH}_2\text{CH}(\text{Br})\text{CH}_2\text{CH}_3$

89. Presence of which one of the following groups in monosubstituted benzene ring will deactivate it and will have ortho and para directing influence on attacking electrophile?

- (a)  $-\text{NO}_2$  (b)  $-\text{SO}_3\text{OH}$   
(c)  $-\text{COOH}$  (d)  $-\text{Cl}$

90. Which one of the following species is not aromatic?

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

91. The number of radial nodes for  $4p$  orbital is

- (a) 4 (b) 3  
(c) 2 (d) 1

92. Why is graphite used as a dry lubricant in machinery?

- (a) Each carbon atom undergoes  $sp^3$  hybridization in graphite  
(b) Graphite has layered structure and it cleaves easily between the layers and therefore it is very soft and slippery

- (c) Graphite is a non-conductor of electricity
- (d) Graphite has two sigma bonds and two pi bonds

93. Consider the following statements:

Statement I : Cesium is useful as electrodes in photoelectric cells.

Statement II : Light energy absorbed by cesium is sufficient to make an atom of cesium lose an electron.

Which one of the following is correct in respect of the above statements?

- (a) Both the statements are true and Statement II is the correct explanation of statement I.
- (b) Both the statements are true and Statement II is *not* the correct explanation of statement I.
- (c) Statement I is true, but Statement II is false
- (d) Statement I is false, but Statement II is true

94. Consider the following statements:

Statement I : Red blood cells burst when placed in water.

Statement II : Water enters into blood cells due to osmosis.

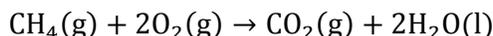
Which one of the following is correct in respect of the above statements?

- (a) Both the statements are true and Statement II is the correct explanation of statement I.
- (b) Both the statements are true and Statement II is *not* the correct explanation of statement I.
- (c) Statement I is true, but Statement II is false
- (d) Statement I is false, but Statement II is true

95. Which one of the following orbitals has the highest energy?

- |          |          |
|----------|----------|
| (a) $5d$ | (b) $5f$ |
| (c) $6s$ | (d) $6p$ |

96. The combustion of methane is written as



The difference between enthalpy change and energy change is equal to

- |            |                    |
|------------|--------------------|
| (a) $-2RT$ | (b) $0$            |
| (c) $RT$   | (d) $\frac{RT}{2}$ |

97. The boiling point of  $\text{NH}_3$  is much higher than that of  $\text{PH}_3$  because

- (a)  $\text{NH}_3$  undergoes umbrella inversion
- (b)  $\text{NH}_3$  has larger molecular weight
- (c)  $\text{NH}_3$  forms intermolecular hydrogen bonds
- (d)  $\text{NH}_3$  contains ionic bonds whereas  $\text{PH}_3$  contains covalent bonds



103. Consider the following statements:

Statement I : Phosphorus-32 decays to sulphur-32 with emission of a  $\beta$  particle.

Statement II : The neutron to proton ratio is less than 1.0 for all light stable nuclides.

Which one of the following is correct in respect of the above statements?

- (a) Both the statements are true and Statement II is the correct explanation of statement I.
- (b) Both the statements are true and Statement II is *not* the correct explanation of statement I.
- (c) Statement I is true, but Statement II is false
- (d) Statement I is false, but Statement II is true

104. A first order reaction is one-fifth completed in 40 minutes. The time required for its 100% completion is

- (a) 100 minutes
- (b) 200 minutes
- (c) 350 minutes
- (d) Infinity

105. Consider the following statements:

Statement I : The conductance depends on the number of ions and ion mobility. The equivalent conductance increases with increase in dilution, the specific conductance diminishes.

Statement II : The total number of ions increases on account of increased ionisation due to dilution, but the number of ions per unit volume decreases.

Which one of the following is correct in respect of the above statements?

- (a) Both the statements are true and Statement II is the correct explanation of statement I.
- (b) Both the statements are true and Statement II is *not* the correct explanation of statement I.
- (c) Statement I is true, but Statement II is false
- (d) Statement I is false, but Statement II is true

106. In which silicate, the central metal has coordination number 6?

- (a)  $Zn_2[SiO_4]$
- (b)  $Be_2[SiO_4]$
- (c)  $Mg_2[SiO_4]$
- (d)  $Zr[SiO_4]$

107. In the manufacture of ammonia by Haber process high pressure is maintained because

- (a) all reactants and products are gases
- (b) reaction is exothermic
- (c) the moles of the product are less than the moles of reactants
- (d) reaction is a reversible reaction.

108.  $HNO_3$  produced Ostwald's method is 60% by weight. Concentrated  $HNO_3$  can be made by

ARYAN CLASSES

1. distillation
  2. dehydration with concentrated  $\text{H}_2\text{SO}_4$
  3. distillation after mixing with 72%  $\text{Mg}(\text{NO}_3)_2$
- Which of the above are correct?
- (a) 1 only (b) 1, 2 and 3  
(c) 2 and 3 only (d) 2 only
109. Consider the following reaction:  
 $6\text{FeSO}_4 + \text{K}_2\text{Cr}_2\text{O}_7 + 7\text{H}_2\text{SO}_4 \rightarrow 3\text{Fe}_2(\text{SO}_4)_3 + \text{Cr}_2(\text{SO}_4)_3 + \text{K}_2\text{SO}_4 + 7\text{H}_2\text{O}$   
 How many electrons are involved in the above redox reaction?
- (a) 9 (b) 6  
(c) 3 (d) 2
110. Which oxy-acid of sulphur does *not* contain S-S bond?
- (a)  $\text{H}_2\text{S}_2\text{O}_5$  (b)  $\text{H}_2\text{S}_2\text{O}_4$   
(c)  $\text{H}_2\text{S}_2\text{O}_7$  (d)  $\text{H}_2\text{S}_2\text{O}_6$
111. In the manufacture of fluorine by electrolysis of  $\text{CaF}_2$ , some amount of KF is also added. The role of KF is to
- (a) increase the yield of fluorine  
(b) control rate of fluorine formation  
(c) increase the conductivity of electrolyte  
(d) catalyze fluorine formation
112. 0.222 g of iron ore was brought into solution.  $\text{Fe}^{3+}$  is reduced to  $\text{Fe}^{2+}$  with  $\text{SnCl}_2$ . The reduced solution required 20 ml of 0.1 N  $\text{KMnO}_4$  solution. The percentage of iron present in the ore is (equivalent weight of iron is 55.5)
- (a) 55.5% (b) 45.0%  
(c) 50.0% (d) 40.0%
113. Consider the following statements:
1. In electrolytic refining method impure metal acts as cathode and pure metal as anode
  2. Zone refining method is used when impurities are more soluble in the melt than in the metal.
- Which of the above statement is/are correct?
- (a) 1 only (b) 2 only  
(c) Both 1 and 2 (d) Neither 1 nor 2
114. In the extraction of aluminium by Hall-Heroult process, the compound which lowers the melting point of  $\text{Al}_2\text{O}_3$  and improves its conductivity is

ARYAN CLASSES

- (a)  $\text{Na}_3[\text{AlF}_6]$  (b)  $\text{AlF}_3$   
 (c)  $\text{NaF}$  (d) None of the above
115. Copper, silver and gold tend to be unreactive. It is due to their  
 (a) high enthalpy of sublimation and low ionisation energy  
 (b) high enthalpy of sublimation and high ionisation energy  
 (c)  $d^{10}$  electronic configuration  
 (d) low enthalpy of sublimation and high ionisation energy
116. Consider the following compound:  

$$\text{Ph} - \text{CH} = \text{CH} - \underset{\substack{| \\ \text{CH}_2\text{O}}}{\text{CH}} - \text{NH}_2$$
 Which is the number of stereoisomers possible for the above compound?  
 (a) 2 (b) 3  
 (c) 4 (d) 5
117. *n*-butylchloride, *sec*-butylchloride, *iso*-butylechloride and *tert*-butylchloride are example of  
 (a) Conformers (b) Geometrical isomers  
 (c) Diastereomers (d) Structural isomers
118. The reaction (–)-2-bromobutane with alcoholic KOH yields  
 (a) (+)-butan-2-ol (b) (–)-butan-2-ol  
 (c) 2-butane (d) 1-butane
119. In the addition reaction of HBr to 1-butene, the first step involves the addition of  
 (a)  $\text{H}^\oplus$  (b)  $\text{Br}^\ominus$   
 (c)  $\text{H}^\bullet$  (d)  $\text{Br}^\bullet$
120. Consider the following transformation:  

$$\text{H}_5\text{C}_2 - \text{C} \equiv \text{C} - \text{C}_2\text{H}_5 \rightarrow \begin{array}{c} \text{H} \quad \text{C}_2\text{H}_5 \\ | \quad | \\ \text{C} = \text{C} \\ | \quad | \\ \text{H}_5\text{C}_2 \quad \text{H} \\ \textit{trans}\text{-3-hexane} \\ \text{as major product} \end{array}$$
 Which one of the following reagents is suitable for the above transformation?  
 (a)  $\text{H}_2$  | Linear catalyst (b)  $\text{LiAlH}_4$   
 (c)  $\text{Na}, \text{NH}_3(\text{liq})$  (d)  $\text{Zn} - \text{Hg}/\text{HCl}$