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SCRA Exam :2015

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T.B.C. : B-UETC-O-TVF

Test Booklet Series

TEST BOOKLET

PHYSICAL SCIENCES

Paper II

A

Time Allowed : Two Hours

Maximum Marks : 200

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET ***DOES NOT*** HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. **Please note that it is the candidate's responsibility to encode and fill in the Roll Number and Test Booklet Series A, B, C or D carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet. Any omission/discrepancy will render the Answer Sheet liable for rejection.**
3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. ***DO NOT*** write ***anything else*** on the Test Booklet.
4. This Test Booklet contains **120** items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose **ONLY ONE** response for each item.
5. You have to mark all your responses **ONLY** on the separate Answer Sheet provided. See directions in the Answer Sheet.
6. All items carry equal marks.
7. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.
8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator ***only*** the ***Answer Sheet***. You are permitted to take away with you the Test Booklet.
9. Sheets for rough work are appended in the Test Booklet at the end.
10. **Penalty for wrong Answers :**
    THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.
    (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third** of the marks assigned to that question will be deducted as penalty.
    (ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.
    (iii) If a question is left blank i.e., no answer is given by the candidate, there will be **no penalty** for that question.

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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.

1. 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) $ln\left(\frac{mt}{r}\right)$

2. The total distance covered till it stops is

(a) $\frac{mv_0}{r}$

(b) $\frac{mv_0}{2r}$

(c) $\frac{mv_0}{4r}$

(d) $\frac{2mv_0}{r}$

3. 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 ? ($g = 10\ m/s^2$)

(a) 125 m

(b) 100 m

(c) 88 m

(d) 64 m

4. 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) $-\frac{13a\omega}{16}$

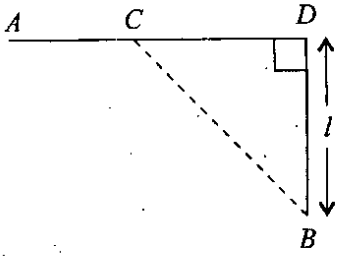
(b) $-\frac{11a\omega}{16}$

(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 η times slower than on the highway. Take $\eta > 1$ so that if the speed of the car on the highway is ηv, it is v in the field.



5. 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) $\frac{l}{\sqrt{\eta^2 - 2}}$

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

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

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

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

(d) None of the above

7. 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) $2\pi\sqrt{\frac{m}{2a^2U_0}}$

8. 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 the 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) $\sqrt{t_1t_2}$

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

9. 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

10. 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) $\frac{mg}{k}\left(1-e^{-\frac{2kt}{m}}\right)$

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11. A vessel contains liquid of density ρ 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 ρ. 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) $\left(\frac{n-1}{m+1}\right)\rho$

12. 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%

13. 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 ω. 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) $\frac{ml\omega^2}{4}$

14. 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) $T_1 = 2T_2$

15. 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) λ

(b) $\frac{\lambda}{2}$

(c) $\frac{\lambda}{4}$

(d) 2λ

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16. Consider 1 cm^3 of air at absolute temperature T at sea level and other 1 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) $\frac{2T}{3}$

(d) Cannot be determined in terms of T from the above data

17. 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

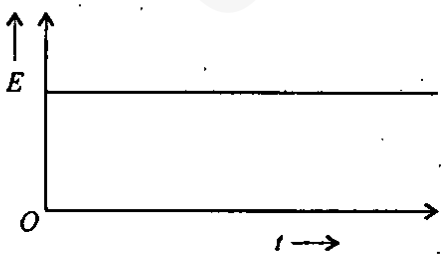
(b) periodic but not simple harmonic

(c) simple harmonic with time period $2\pi/\omega$

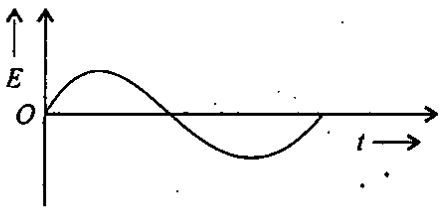
(d) simple harmonic with time period π/ω

18. 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 ?

(a)



(b)



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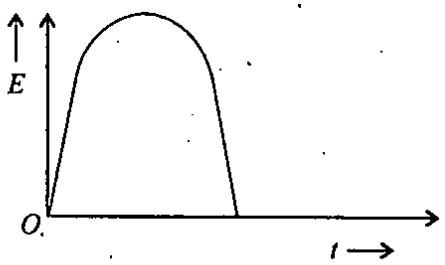

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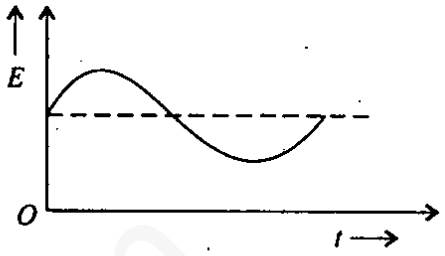

19. Pressure is a scalar quantity because

(a) it is the ratio of force to area and both force and area are vector quantities

(b) it is the ratio of magnitude of force to area

(c) it is the ratio of component of the force normal to the area

(d) it depends on the size of the area chosen

20. The volume of an ideal gas with adiabatic exponent γ varies according to law $V = \frac{a}{T}$ where a is a constant. If the temperature of gas increases by ΔT, then the amount of heat absorbed by the gas is

(a) $\frac{R\Delta T}{\gamma - 1}$

(b) $R\Delta T\left(\frac{1-\gamma}{2-\gamma}\right)$

(c) $R\Delta T\left(\frac{2-\gamma}{\gamma - 1}\right)$

(d) $R\Delta T$

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21. If the coefficient of superficial expansion is x times the coefficient of cubical expansion, then the value of x is

(a) 2

(b) $\frac{3}{2}$

(c) $\frac{2}{3}$

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

22. Consider the following situations :

1. A charged particle moves in the direction of uniform magnetic field.
2. A charged particle moves in the direction perpendicular to uniform magnetic field.
3. 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

23. 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

24. 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) $\frac{1}{2}$

(c) $\frac{3}{2}$

(d) 6

25. 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

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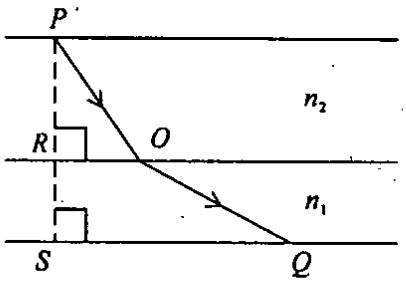
26.



What is the optical path of light ray 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) $\dfrac{8\sqrt{a^2+x^2}+9\sqrt{b^2+y^2}}{6}$

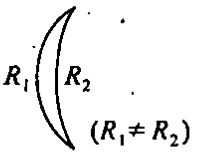
(b) $\dfrac{3\sqrt{a^2+x^2}+\sqrt{8\left(b^2+(y-x)^2\right)}}{\sqrt{6}}$

(c) $\dfrac{3\sqrt{a^2+b^2+x^2+y^2}-4\sqrt{b^2+y^2}}{3}$

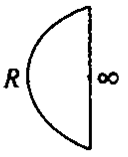
(d) $\dfrac{9\sqrt{a^2+x^2}+8\sqrt{b^2+(y-x)^2}}{6}$

27. Consider the following lenses :

I.

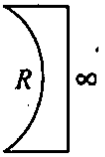


II.



III.

IV.



Which of the above lenses do ***not*** exhibit dispersion ?

(a) II and IV

(b) I

(c) III

(d) None

28. Consider the following statements in respect of quartz (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 increase in wavelength.

Which of the above statements is/are correct ?

(a) 1 only

(b) 2 only

(c) 3 only

(d) 2 and 3

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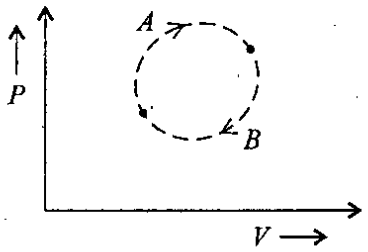
29. Consider the following figure. Let ΔU_1 and ΔU_2 be the change in internal energy in processes A and B respectively, ΔQ be the net heat given to the system in the process $A + B$ and ΔW be the net work done by the system in the process $A + B$.



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

30. 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) $\left(\frac{d}{\sqrt{2}}, 0, 0\right)$

(b) $\left(\frac{d}{2}, 0, 0\right)$

(c) $\left(\sqrt{3}\,d, 0, 0\right)$

(d) $\left(\frac{d}{\sqrt{3}}, 0, 0\right)$

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

1. Wavelength of K_α X-ray of aluminium is greater than that of silver.
2. Wavelength of L_α X-ray of silver is greater than that of gold.
3. Wavelength of K_α X-ray of silver is greater than K_β 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

32. The total energy of an electron in the second excited state of the hydrogen atom is about $-1{\cdot}5$ eV. The kinetic energy and potential energy of the electron in this state are

(a) $1{\cdot}5$ eV and $-3{\cdot}0$ eV

(b) $-1{\cdot}5$ eV and $-1{\cdot}5$ eV

(c) $3{\cdot}0$ eV and $-4{\cdot}5$ eV

(d) $-0{\cdot}75$ eV and $-0{\cdot}75$ eV

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33. 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

34. 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

35. Consider the following statements :

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

Which of the above statements is/are correct ?

(a) 1, 2 and 4 only

(b) 2, 3 and 4 only

(c) 3 only

(d) 1, 2, 3 and 4

36. Consider the following statements in respect of optical fibres :

1. The core has higher refractive index compared to that of cladding.
2. Velocity of light passing through the cladding is more than that through the core.

Which of the above statements is/are correct ?

(a) 1 only

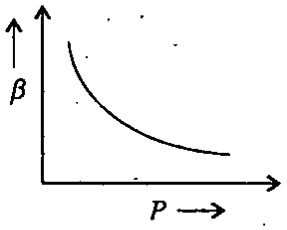
(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

37. Which one of the following graphs represents the variation of $\beta = -\frac{\left(\frac{dV}{dP}\right)}{V}$ with P for an ideal gas at constant temperature ?

(a)



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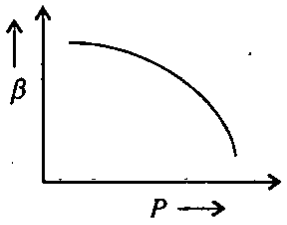

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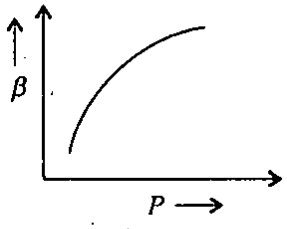

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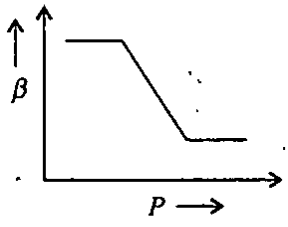

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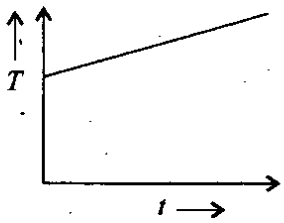
38. Liquid oxygen at 50 K is heated for a long time at constant pressure of 1 atm. The rate of heating is constant. Which one of the following graphs represents the variation of temperature (T) with time (t) ?

(a)



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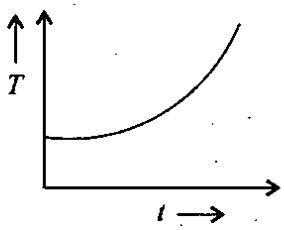

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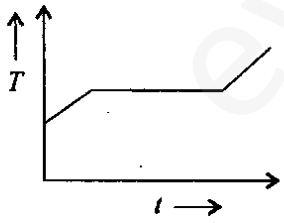

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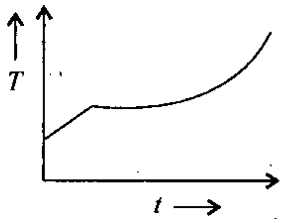

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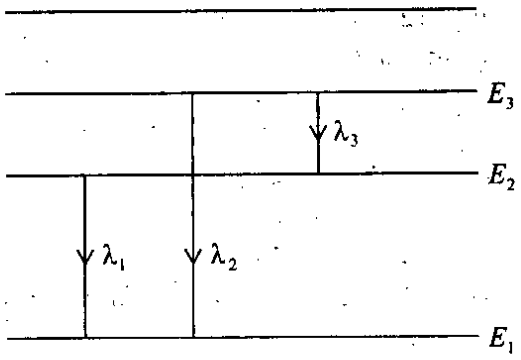

An atom has energy levels as shown in the above figure and $E_1 < E_2 < E_3$. The wavelengths of corresponding transitions are also shown. The relation among the wavelengths is

(a) $\lambda_2 = \lambda_1 + \lambda_3$

(b) $\lambda_1\lambda_3 = \lambda_1\lambda_2 + \lambda_3\lambda_2$

(c) $\lambda_1\lambda_2 = \lambda_1\lambda_3 + \lambda_3\lambda_2$

(d) $\lambda_2\lambda_3 = \lambda_1\lambda_2 + \lambda_3\lambda_1$

40. One mole of gas of specific heat ratio 1·5 being initially at temperature 290 K is adiabatically compressed to increase its pressure 8 times. The temperature of the gas after compression will be

(a) 580 K

(b) 870 K

(c) $290\sqrt{2}$ K

(d) 1160 K

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41. When a nucleus in a radioactive atom undergoes radioactive decay, the electronic energy levels of the atom

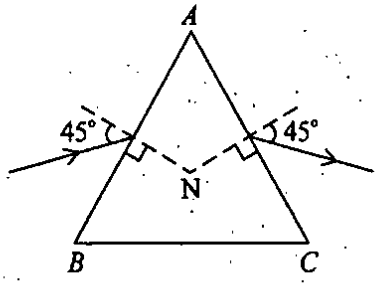
(a) do not change for any type of radioactivity

(b) change for α and β-decay processes but not for γ-decay process

(c) change for γ-decay process but not for α and β-decay processes

(d) change for all types of radioactivity

42.



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° ?

(a) $\sqrt{3}$

(b) $\sqrt{2}$

(c) $\frac{3}{2}$

(d) $\frac{4}{3}$

43. 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 ?

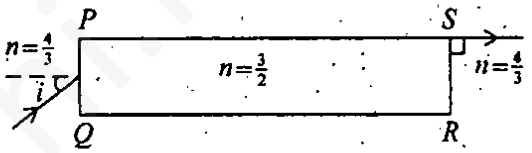
(a) 1

(b) 1·5

(c) 2

(d) 4

44.



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) $\frac{1}{2}$

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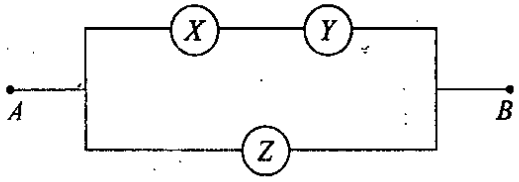
45.



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

46. 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 ?

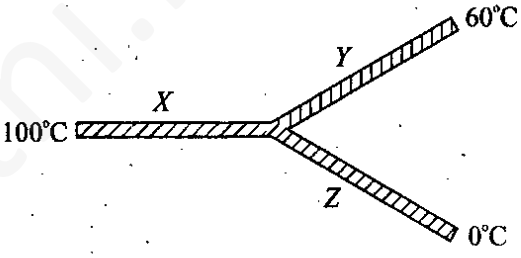
(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

47.



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°C, 60°C and 0°C respectively. What is the temperature of the junction ?

(a) 75°C

(b) 72°C

(c) 70°C

(d) 65°C

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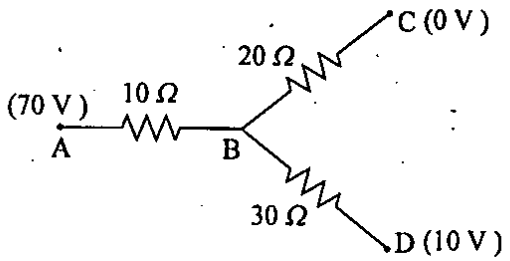
48.



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

49. 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 nor 2

50. 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

51. 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

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52. 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

53. 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

54. 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

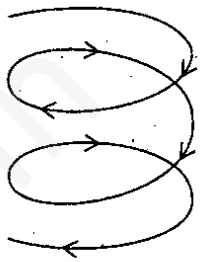
(a) Straight line

(b) Circle

(c) Parabola

(d) Ellipse

55.



A particle is moving with constant speed along a regular helical path as shown above. Which of the following statements are correct ?

1. The magnitude of the acceleration is constant
2. The velocity of particle is constant
3. The acceleration of the particle is constant
4. The direction of acceleration is constant

Select the correct answer using the code given below :

(a) 1 only

(b) 2 and 3 only

(c) 3 only

(d) 1, 3 and 4

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56. Consider two lenses L_1 and L_2. The lens L_1 has focal length of 50 cm and the lens L_2 has a focal length of 2 cm. The two are mounted on an optical bench along a common optical axis. Which one of the following distances between the two lenses results in a telescopic arrangement ?

(a) 26 cm

(b) 52 cm

(c) 102 cm

(d) 48 cm

57. Two bar magnets are taken and the north pole of one is attached to the south pole of the other. According to the inverse square law if the distance between the poles is zero, the force between them should be infinite. However, this is not the case as the two bar magnets can be easily separated. This is because

(a) The force law is valid only for point magnetic charges or poles

(b) The force law is valid only for single poles whereas bar magnet has both north and south poles

(c) When the bar magnets are brought together the surfaces are demagnetised

(d) The poles of the bar magnet do not lie on the surface but inside the bar so that the distance between the poles is never zero

58. Consider a gaseous mixture of oxygen and nitrogen kept in a cylinder at room temperature. As compared to nitrogen molecules, the oxygen molecules will hit the wall of the cylinder

(a) with greater average kinetic energy

(b) with smaller average kinetic energy

(c) with smaller average speed

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

59. 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) $\pi - C$

60. A barometer is placed inside a closed stationary elevator and it reads 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

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

(a) 4

(b) 3

(c) 2

(d) 1

62. 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

63. 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 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. 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 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

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

(a) $5d$

(b) $5f$

(c) $6s$

(d) $6p$

66. The combustion of methane is written as

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$$

The difference between enthalpy change and energy change is equal to

(a) $-2RT$

(b) 0

(c) RT

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

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67. The boiling point of NH_3 is much higher than that of PH_3 because

(a) NH_3 undergoes umbrella inversion

(b) NH_3 has larger molecular weight

(c) NH_3 forms intramolecular hydrogen bonds

(d) NH_3 contains ionic bonds whereas PH_3 contains covalent bonds

68. Consider the following statements with regard to chemical equilibria :

1. Equilibrium constant is independent of initial concentrations of reactants and products.
2. Equilibrium constant for the reverse reaction is equal to the inverse of the equilibrium constant for the forward reaction.
3. Equilibrium constant is independent of temperature.

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

69. Consider the following statements in respect of lyophobic sols :

1. They are sols of inorganic substances like As_2S_3, $Fe(OH)_3$ and platinum.
2. These are reversible.
3. These are easily coagulated by addition of electrolytes.

Which of the above statements is/are correct ?

(a) 1 only

(b) 1 and 2

(c) 1 and 3

(d) 3 only

70. Consider the following reaction :

$$P_4 + 3NaOH + 3H_2O \rightarrow 3NaH_2PO_2 + PH_3$$

In the above reaction,

1. Phosphorus is oxidised.
2. Phosphorus is reduced.

Which of the above is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

71. Consider the nitrogen-oxygen bond lengths in NO_2^+, NO_2^- and NO_3^-. The increasing order of N–O bond lengths is

(a) $NO_2^+ < NO_2^- < NO_3^-$

(b) $NO_2^+ < NO_3^- < NO_2^-$

(c) $NO_3^- < NO_2^- < NO_2^+$

(d) $NO_3^- < NO_2^+ < NO_2^-$

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72. Consider the following reaction :

$H_2(g) + I_2(g) \rightarrow 2HI(g)$ and

$$\text{Rate} = k[H_2][I_2]$$

Which one of the following statements is correct ?

(a) The reaction must occur in a single step

(b) This is a second order reaction overall

(c) Raising the temperature will cause the value of k to decrease

(d) Raising the temperature lowers the activation energy for the reaction

73. Consider the following statements :

Statement I : Phosphorus-32 decays to sulphur-32 with emission of a β 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 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

74. 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

75. 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 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

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

$Fe^{3+} + 3e^- \rightarrow Fe$ with $E^\circ = -0{\cdot}036$ V

$Fe^{2+} + 2e^- \rightarrow Fe$ with $E^\circ = -0{\cdot}44$ V

What would be the standard electrode potential for the reaction

$Fe^{3+} + e^- \rightarrow Fe^{2+}$?

(a) 0·772 V

(b) 0·077 V

(c) −0·404 V

(d) −0·772 V

77. The vapour pressure of pure liquid solvent *A* is 0·80 bar. When a non-volatile substance *B* is added to the solvent, its vapour 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

78. 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

79. 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

Oxygen molecule is paramagnetic because

(a) Bonding electrons are more than anti-bonding electrons

(b) It contains two unpaired electrons

(c) Anti-bonding electrons are more than bonding electrons

(d) Bonding electrons are equal to anti-bonding electrons

81. 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

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82. Consider the following statements in respect of reactivity of hydrogen :

1. Hydrogen is not reactive under ambient conditions.
2. Hydrogen reacts with fluorine violently.
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

83. How many hydrogen bonded water molecules are present in $CuSO_4 \cdot 5H_2O$?

(a) 5

(b) 4

(c) 1

(d) 0

84. 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

85. 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

86. Consider the following chemical reactions 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

87. 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) $NaHCO_3$

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88. 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 filler.
2. Moistened $Ca(H_2PO_4)$ 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 ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

89. 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

90. Consider the following for alumina :

1. In crystalline form, it exists in α and γ forms.
2. α form is the strongest and is known as corundum.
3. α form can be converted to γ form by heating at 1000°C.

Which of the above statements is/are correct ?

(a) 1 only

(b) 2 only

(c) 1 and 2

(d) 2 and 3

91. 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) $Zr[SiO_4]$

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

(a) all reactants and product 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

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

1. distillation
2. dehydration with concentrated H_2SO_4
3. distillation after mixing with 72% $Mg(NO_3)_2$

Which of the above are correct ?

(a) 1 only

(b) 1, 2 and 3

(c) 2 and 3 only

(d) 2 only

94. Consider the following reaction :

$$6FeSO_4 + K_2Cr_2O_7 + 7H_2SO_4 \rightarrow 3Fe_2(SO_4)_3 + Cr_2(SO_4)_3 + K_2SO_4 + 7H_2O$$

How many electrons are involved in the above redox reaction ?

(a) 9

(b) 6

(c) 3

(d) 2

95. Which oxy-acid of sulphur does ***not*** contain S–S bond ?

(a) $H_2S_2O_5$

(b) $H_2S_2O_4$

(c) $H_2S_2O_7$

(d) $H_2S_2O_6$

96. In the manufacture of fluorine by electrolysis of 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

97. 0·222 g of iron ore was brought into solution. Fe^{3+} is reduced to Fe^{2+} with $SnCl_2$. The reduced solution required 20 ml of 0·1 N $KMnO_4$ 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%

98. 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 solid metal.

Which of the above statements is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

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99. In the extraction of aluminium by Hall-Heroult process, the compound which lowers the melting point of Al_2O_3 and improves its conductivity is

(a) $Na_3[AlF_6]$

(b) AlF_3

(c) NaF

(d) None of the above

100. 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

101. Consider the following compound :

$$Ph-CH=CH-\underset{\displaystyle CO_2H}{\underset{|}{CH}}-NH_2$$

What is the number of stereoisomers possible for the above compound ?

(a) 2

(b) 3

(c) 4

(d) 5

102. *n*-butylchloride, *sec*-butylchloride, *iso*-butylchloride and *tert*-butylchloride are examples of

(a) Conformers

(b) Geometrical isomers

(c) Diastereomers

(d) Structural isomers

103. The reaction (–)-2-bromobutane with alcoholic KOH yields

(a) (+)-butan-2-ol

(b) (–)-butan-2-ol

(c) 2-butene

(d) 1-butene

104. In the addition reaction of HBr to 1-butene, the first step involves the addition of

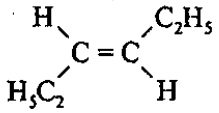
(a) $H^{\oplus}$

(b) $Br^{\ominus}$

(c) $H^{\bullet}$

(d) $Br^{\bullet}$

105. Consider the following transformation :

$H_5C_2-C\equiv C-C_2H_5$ → 

3-hexyne

trans-3-hexane as major product

Which one of the following reagents is suitable for the above transformation ?

(a) H_2 | Lindlar catalyst

(b) $LiAlH_4$

(c) Na, NH_3(liq)

(d) Zn-Hg/HCl

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106. 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) $CH_3CH_2C \equiv C - CH_3$

(c) $CH_3CH_2CH = CH - CH_3$

(d) $CH_3 - CH_2 - \overset{O}{\overset{\|}{C}} - \overset{O}{\overset{\|}{C}} - CH_3$

107. Reaction of aqueous NaOH with $CHCl_3$ gives

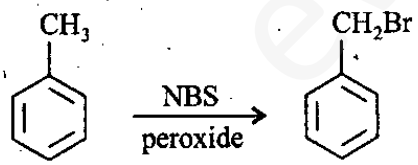
(a) $:CCl_2$

(b) $\oplus CCl_2$

(c) $\ominus CCl_2$

(d) $\cdot CCl_2$

108. Consider the following reaction :



The above reaction is an example of

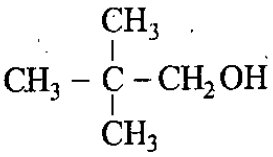
(a) Free-radical reaction

(b) Nucleophilic substitution reaction

(c) Electrophilic substitution reaction

(d) Addition reaction

109. Consider the following compound :



What is the IUPAC name for the above compound ?

(a) 2,2-Dimethyl-1-hydroxyl propane

(b) 2-Methyl-2-hydroxymethy propane

(c) *tert*-butyl methanol

(d) 2,2-Dimethylpropan-1-ol

110. Acetylation of salicylic acid yields

(a) Sulphadiazine

(b) Aspirin

(c) Chloramphenicol

(d) Streptomycin

111. Consider the following compounds :

I. CH_3CH_2OH

II. $CH_3CH_2CH_3$

III. CH_3OCH_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

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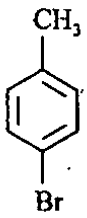
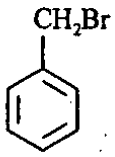
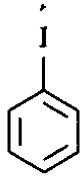
112. Which one of the following halides will undergo hydrolysis in aqueous conditions at room temperature ?

(a) 

(b) 

(c) $CH_2=CH-I$

(d) 

113. Which one of the following substrates 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

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

$C_6H_5NO_2 \rightarrow C_6H_5NHOH$

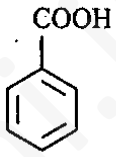
(a) Sn/HCl

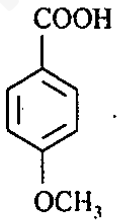
(b) Zn/NH_4Cl, Δ

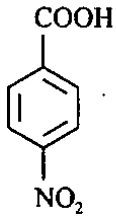
(c) Zn, NaOH, CH_3OH

(d) H_2/Raney Ni

115. Consider the following acids :

I. 

II. 

III. 

What is the correct order of acidity ?

(a) II < I < III

(b) I < II < III

(c) I < III < II

(d) II < III < I

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116. Consider the following statements in respect of cellulose :

1. Cellulose is a linear biopolymer.
2. Glucose units are joined by α-glycogidic linkages.
3. Cotton and paper are largely composed of cellulose.

Which of the above statements is/are correct ?

(a) 1 only

(b) 1 and 2

(c) 2 only

(d) 1 and 3

117. Consider the following molecules :

1. CH_3NH_2
2. CH_3OH
3. CH_3SH
4. $CH_3P(CH_3)_2$

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

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

(a) CH_3CH_2Br

(b) $CH_3CH(Br)CH_3$

(c) $CH_3CH_2CH(Br)CH_3$

(d) $CH_3CH_2CH(Br)CH_2CH_3$

119. 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 ?

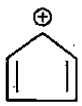
(a) $-NO_2$

(b) $-SO_3H$

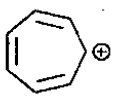
(c) $-COOH$

(d) $-Cl$

120. Which one of the following species is ***not*** aromatic ?

(a) 

(b)

(c) 

(d)

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