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S·C·R·A–2009

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T.B.C. : Q-TDS-J-QT

Test Booklet Series

Serial No. 116941

A

TEST BOOKLET

PHYSICAL SCIENCES

PAPER II

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.
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5. You have to mark all your responses ***ONLY*** on the separate Answer Sheet provided. See directions in the Answer Sheet.
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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.
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    (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.
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1. A particle of mass m is at $x = 0$ and moving along the x axis with velocity v_0, at time $t = 0$. It is subjected to a frictional force $-bv_x$ where b is a constant and v_x is the velocity in the x-direction. At what position x on the x-axis will it come to rest ?

(a) $x = bv_0$

(b) $x = \frac{bv_0}{m}$

(c) $x = mbv_0$

(d) $x = \frac{mv_0}{b}$

2. A large tank filled with water to a height h is to be emptied through a small hole at the bottom. What is the ratio of the time taken for the level to fall from h to $\frac{h}{2}$ and that taken for the level to fall from $\frac{h}{2}$ to 0 ?

(a) $\sqrt{2}$

(b) $\frac{1}{\sqrt{2}}$

(c) $\sqrt{2} - 1$

(d) $\frac{1}{\left(\sqrt{2}-1\right)}$

3. A body kept on a smooth inclined plane having inclination 1 in l will remain stationary relative to the inclined plane if the plane is given a horizontal acceleration equal to

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

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

(c) $\frac{g}{2\sqrt{l^2-1}}$

(d) $\frac{2g}{\sqrt{l^2-1}}$

4. A body of mass m falling vertically downward with speed v_0 is given an upward impulse $I = F\,\Delta t > mv_0$. What is the maximum height h that it will reach from the location of the impulse source ?

(a) $h = \frac{\left[\left(\frac{I}{m}\right) - v_0\right]^2}{(4g)}$

(b) $h = \frac{\left[\left(\frac{I}{m}\right) - v_0\right]^2}{(2g)}$

(c) $h = \frac{\left[\left(\frac{I}{m}\right) - v_0\right]^2}{g}$

(d) $h = \frac{\left[2\left(\frac{I}{m}\right) - v_0\right]^2}{g}$

5. A body B of mass m moving forward with velocity v along the x-axis, collides elastically with a stationary object C of mass $2m$ at the origin. After the collision, body B moves backward along the x-axis. Given that the kinetic energy of the system is conserved, what is the speed of the object C after the collision ?

(a) $\frac{2v}{3}$

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

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

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

6. A body is moved along a straight line by a machine delivering constant power. The distance moved by the body in time t is proportional to

(a) $t^{1/2}$

(b) $t^{3/4}$

(c) $t^{3/2}$

(d) t^2

7. A body of mass 3 kg is under a force which causes displacement in it, given by $s = \frac{t^2}{3}$ in metre, with time t in seconds. What is the work done by the force between time $t = 0$ and $t = 2$?

(a) 8 J

(b) 5·2 J

(c) 3·9 J

(d) 2·6 J

8. A given object takes n times as much time to slide down a 45° rough incline as it takes to slide down a perfectly smooth 45° incline. What is the coefficient of kinetic friction between the object and the incline ?

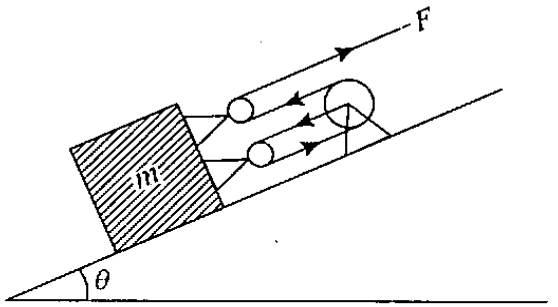
(a) $\frac{1}{\sqrt{1-n^2}}$

(b) $\frac{1}{1-n^2}$

(c) $\sqrt{1-\left(\frac{1}{n^2}\right)}$

(d) $1-\left(\frac{1}{n^2}\right)$

9.



A force F pulls on a mass m using a massless cable and pulley system as shown in the figure given above. What is the acceleration of the block, if the surface is frictionless ?

(a) $a = \left(\frac{F}{m}\right) - g \sin\theta$

(b) $a = 2\left(\frac{F}{m}\right) - g \sin\theta$

(c) $a = 3\left(\frac{F}{m}\right) - g \sin\theta$

(d) $a = 4\left(\frac{F}{m}\right) - g \sin\theta$

10. Consider a simple pendulum of mass m suspended by a thin string. The mass m is subjected to an external horizontal force F. In equilibrium, the string makes an angle θ with the vertical. What is F equal to ?

(a) $F = mg \sin\theta \cos\theta$

(b) $F = mg \cos\theta$

(c) $F = mg \sin\theta$

(d) $F = mg \tan\theta$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11. A satellite is orbiting close to the surface of earth. In order to make it move to infinity, its velocity must be increased by about

(a) 50%

(b) 40%

(c) 30%

(d) 20%

12. A particle is projected upwards with a velocity of 100 m/s at an angle of 60° with the vertical. What is the time when particle moves perpendicular to its initial direction ? ($g = 10\ m/s^2$)

(a) 10 s

(b) 20 s

(c) 5 s

(d) $10\sqrt{3}$ s

13. A particle is projected vertically upward with a velocity $\sqrt{gR}$ where R is radius of earth. What is the maximum height ascended by the particle ?

(a) $\frac{R}{2}$

(b) R

(c) $2R$

(d) $\frac{5R}{4}$

14. A small table is orbiting with a constant angular velocity on a circular track. A glass half full of water is fixed on the table. The surface of water in the glass is

(a) horizontal

(b) inclined with radially outer side being higher

(c) inclined with radially outer side being lower

(d) like a whirlpool with a dip in the centre

15. A particle of mass m moves in a circular path of constant radius r such that its centripetal acceleration a_c varies with time as $a_c = k^2rt^2$ where k is a constant. What is the power delivered to the particle by the forces acting on it ?

(a) mk^2r^2t

(b) $2\,mk^2r^2t$

(c) $2\,mk^2r^2t^2$

(d) $\pi\,mk^2r^2t$

16. A particle P of mass m is tied to a string of length l with one end fixed at the origin. The particle moves around with speed v in a circle in the xy-plane, with radius l and centre at the origin. If the string can withstand a maximum force up to F, at what critical speed v_c of particle P will the string break ?

(a) $v_c = 2\left(\frac{lF}{m}\right)^{1/2}$

(b) $v_c = \left(\frac{lF}{m}\right)^{1/2}$

(c) $v_c = \left(\frac{2lF}{m}\right)^{1/2}$

(d) $v_c = \left(\frac{3lF}{m}\right)^{1/2}$


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17. Consider a particle of mass m in a simple harmonic oscillator potential $V(x) = \frac{(kx^2)}{2}$ in one dimension. At time $t = 0$, it is at $x = x_0$ with velocity v_0. At later time, with $\omega = \left(\frac{k}{m}\right)^{1/2}$, what is the maximum possible displacement of the particle from the origin ?

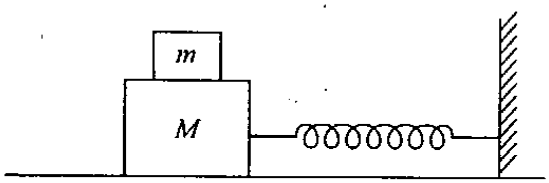
(a) $x_0 + \left(\frac{v_0}{\omega}\right)$

(b) $\left[x_0^2 + \left(\frac{v_0^2}{\omega^2}\right)\right]^{\frac{1}{2}}$

(c) $x_0 + \omega v_0$

(d) $\left[x_0^2 + \left(\frac{2v_0^2}{\omega^2}\right)\right]^{\frac{1}{2}}$

18.



A block m of mass 1 kg is placed over a bigger block M of mass 10 kg as shown in the figure above. The coefficient of static friction between the two blocks is 0·4 and the acceleration due to gravity is 10 m/s^2. The bigger block, connected to a spring of force constant 200 N/m can oscillate on a frictionless table as shown in the figure. What can be the maximum amplitude of simple harmonic motion, if no slippage is to occur between the blocks ?

(a) 0·19 m

(b) 0·22 m

(c) 0·25 m

(d) 0·30 m

19. The work done while stretching an ideal spring of natural length L to stretched length 1·5 L is W. How much energy is needed to compress it to length $\left(\frac{L}{4}\right)$?

(a) 2 W

(b) 1·5 W

(c) 2·25 W

(d) 0·25 W

20. Let C_v be the molar heat capacity of an ideal gas at constant volume. What is the molar heat capacity of this gas, if the gas undergoes the process $Te^{-aV} = T_o$, where a and T_o are constants ?

(a) $C_v + aRV^{-1}$

(b) $C_v + R(aV)^{-1}$

(c) $C_v + aRV^{-2}$

(d) $C_v + 2aRV^{-1}$

where V is the volume.

21. An ice cube of volume Vm^3 and density 0·9 gm/cc, is floating in water. What is the minimum vertical downward force (in Newton) needed to be applied to totally immerse the ice cube into water ?

(a) Vg

(b) 10 Vg

(c) 100 Vg

(d) 0·1 Vg

where g is in m/s^2.

22. The function of hydraulic mechanism in a wheel chair is based on

(a) Pascal's principle

(b) Archimedes' principle

(c) Bernoulli's principle

(d) Stefan-Boltzmann law

23. Take the air density near the earth's surface to be $\rho(h) = \rho_0 e^{-ah}$ where h is the height from the surface, and ρ_0, a are constants. What is the pressure difference at height h and at the surface with $h = 0$?

(a) $\rho_0 gha$

(b) $\rho_0 gh\left(1+e^{-ah}\right)$

(c) $\dfrac{\rho_0 g\left(1-e^{-ah}\right)}{a}$

(d) $\dfrac{2\rho_0 g\left(1-e^{-ah}\right)}{a}$

24. A pendulum clock gains 5 seconds per day at a temperature of 15°C and loses 10 seconds per day at a temperature 30°C. At what temperature, the pendulum clock will neither gain nor lose time ?

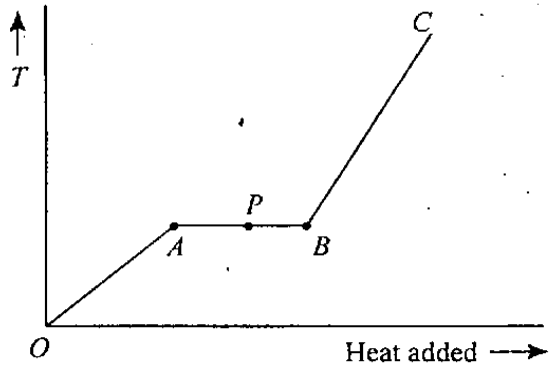
(a) 18°C

(b) 20°C

(c) 22·5°C

(d) 25°C

25.



The variation of temperature (T) of a material as heat is given to it at a constant rate is shown in the above figure. The material is in the solid state at the point O. The state of the material at the point P is

(a) Pure solid

(b) Pure liquid

(c) Mixture of solid and liquid

(d) None of the above

26. What is the change in internal energy of one mole of a gas, when volume changes from V to $2V$ at constant pressure P ?

(a) $\dfrac{R}{(\gamma-1)}$

(b) PV

(c) $\dfrac{PV}{(\gamma-1)}$

(d) $\dfrac{\gamma PV}{(\gamma-1)}$

where γ is the ratio of specific heat of the gas at constant pressure to that at constant volume.

27. An ideal gas with $\gamma = \frac{5}{3}$ is originally of volume V_0 and pressure P_0. If it expands adiabatically to final volume V_1, what is the work done by the gas in this process ?

(a) $\dfrac{3P_0V_0\left[1-\left(\dfrac{V_0}{V_1}\right)^{\frac{3}{2}}\right]}{2}$

(b) $\dfrac{2P_0V_0\left[1-\left(\dfrac{V_0}{V_1}\right)^{\frac{2}{3}}\right]}{3}$

(c) $\dfrac{2P_0V_0\left[1-\left(\dfrac{V_0}{V_1}\right)^{\frac{3}{2}}\right]}{3}$

(d) $\dfrac{3P_0V_0\left[1-\left(\dfrac{V_0}{V_1}\right)^{\frac{2}{3}}\right]}{2}$

28. A metal rod of length l consists of an aluminium sheath (of inner radius r and outer radius R) of resistivity ρ with tungsten core of resistivity 2ρ. What is the resistance of the rod ?

(a) $\dfrac{2\rho l}{\pi\left(R^2-r^2\right)}$

(b) $\dfrac{2\rho l}{\pi\left(2R^2-r^2\right)}$

(c) $\dfrac{2\rho l}{\pi\left(R^2-2r^2\right)}$

(d) None of the above

29. A wooden sphere is being weighed in a liquid whose temperature is continuously increased. What will happen to the apparent weight of the sphere ?

(a) Increases

(b) Decreases

(c) Remains unchanged

(d) Changes erratically

30. A transverse wave is represented by the equation $y = y_0 \sin 2\pi\left[ft-\left(\dfrac{x}{\lambda}\right)\right]$. The maximum particle velocity is equal to four times the wave velocity if

(a) $\lambda = \dfrac{\pi y_0}{4}$

(b) $\lambda = \dfrac{\pi y_0}{2}$

(c) $\lambda = \pi y_0$

(d) $\lambda = 2\pi y_0$

31. The work done in an isothermal expansion from volume V to $10\,V$ is W at temperature T. What is the work done for isothermal expansion from volume $10\,V$ to $100\,V$ at temperature T ?

(a) W

(b) $2{\cdot}3\,W$

(c) $9\,W$

(d) $10\,W$

32. There is a string of length l with ends fixed at $x = 0$ and $x = l$, and c is the velocity of propagation of wave. For the standing waves $A \sin\left(\frac{\omega x}{c}\right)$, what are the resonant angular frequencies ?

(a) $\omega = \frac{\left(n + \frac{1}{2}\right)\pi c}{(2l)}$

(b) $\omega = \frac{\left(n + \frac{1}{2}\right)\pi c}{l}$

(c) $\omega = \frac{n\pi c}{(2l)}$

(d) $\omega = \frac{n\pi c}{l}$

where n is an integer.

33. A concave spherical refracting surface with radius of curvature R separates a medium of refractive index 2·5 from air. As an object is approaching the surface from far away from the surface along the central axis, its image

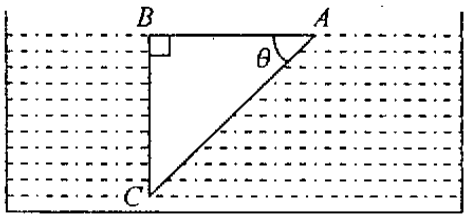
(a) always remains real

(b) always remains virtual

(c) changes from real to virtual at a distance $\frac{2R}{3}$ from the surface

(d) changes from virtual to real at a distance $\frac{2R}{3}$ from the surface

34.



A glass prism having refractive index 1·5 is immersed into water of refractive index $\frac{4}{3}$ as shown in the figure given above. A light beam incident normally on the face AB is totally reflected to reach the face BC if

(a) $\sin\theta > \frac{8}{9}$

(b) $\frac{2}{3} < \sin\theta < \frac{8}{9}$

(c) $\sin\theta < \frac{2}{3}$

(d) None of the above

35. Two plane mirrors are placed making an angle of 120° with each other (like faces of an open Lap Top). A laser beam incident on one mirror at an angle of 65° is then reflected onto the second mirror from which it is again reflected. What is the angle which this doubly reflected emergent beam makes with the normal to the first mirror ?

(a) 55°

(b) 35°

(c) 25°

(d) 5°

36. A point source of light is placed at a distance of 30 cm on the axis of a concave mirror of focal length 20 cm. Now a plane mirror is placed at right angles to the axis facing the concave mirror such that the point source and its image coincide. What is the distance between the two mirrors ?

(a) 20 cm

(b) 30 cm

(c) 45 cm

(d) 60 cm

37. A short linear object of length b lies along the axis of a concave mirror of focal length f at a distance u from the pole of mirror. What is the size of the image approximately equal to ?

(a) $b\left[\frac{(u-f)}{f}\right]^{\frac{1}{2}}$

(b) $b\frac{(u-f)}{f}$

(c) $b\left[\frac{f}{(u-f)}\right]^{\frac{1}{2}}$

(d) $b\left[\frac{f}{(u-f)}\right]^{2}$

38. In an experiment a man looks at a lamp emitting blue light in air (refractive index 1·0). Now the man and the lamp are immersed in water (refractive index 1·4). The colour of light perceived by the man will be

(a) shifted towards red

(b) shifted towards ultraviolet

(c) the same

(d) brighter

39. Two small identical balls (density of the material of the balls is σ) carrying the charges of similar nature are suspended from the same point by insulating threads of equal length L. When the surrounding space was filled with a liquid of density ρ, the divergence angle between the threads remained constant. Which one of the following is correct ?

(a) $\sigma = \frac{\rho\varepsilon}{\varepsilon+1}$

(b) $\sigma = \frac{\rho\varepsilon}{\varepsilon-1}$

(c) $\sigma = \rho$

(d) None of the above

where ε is the permittivity.

40. A stationary charge outside a hollow conductor

(a) produces an electric field in the interior of the hollow

(b) does not produce an electric field in the interior of the hollow

(c) produces magnetic field in the interior of the hollow

(d) None of the above

41. Two solid conducting spheres of radii 5 cm and 20 cm are connected by a thin short wire. 3·14 C charge is given to the system which gets distributed between the two spheres. What is the surface charge density on the bigger sphere ?

(a) 0·63 C/m^2

(b) 2·52 C/m^2

(c) 5·0 C/m^2

(d) 20 C/m^2

42. Two concentric spheres of radii R and r have similar charges with equal surface density (σ). What is the electric potential at their common centre ?

(a) $\frac{\sigma}{\varepsilon_0}$

(b) $\frac{\sigma(R-r)}{\varepsilon_0}$

(c) $\frac{\sigma(R+r)}{\varepsilon_0}$

(d) $\frac{2\sigma}{\varepsilon_0}$

43. A charge q is distributed with constant linear density around a circle of radius b with centre at the origin, in the xy-plane. What is the magnitude of electric field at point (0, 0, z) in cartesian coordinates ?

(a) $\frac{q}{4\pi\varepsilon_0}\ \frac{z}{z^2+b^2}$

(b) $\frac{q}{4\pi\varepsilon_0}\ \frac{b}{\left(z^2+b^2\right)^{3/2}}$

(c) $\frac{q}{4\pi\varepsilon_0}\ \frac{1}{z^2+b^2}$

(d) $\frac{q}{4\pi\varepsilon_0}\ \frac{z}{\left(z^2+b^2\right)^{3/2}}$

44. Point charge Q is kept fixed at the origin. Another particle of mass m and charge q with the same sign as Q, is released at $x = a$, $y = z = 0$ with speed $v_0 = 0$ at time $t = 0$. What is the limiting speed v of charge q for time t tending to infinity ?

(a) $v = \frac{qQ}{4\pi\varepsilon_0}\ \frac{1}{(ma)^{1/2}}$

(b) $v = \left[\frac{qQ}{(2\pi\varepsilon_0 ma)}\right]^{\frac{1}{2}}$

(c) $v = \frac{qQ}{2\pi\varepsilon_0}\ \frac{1}{(ma)^{1/2}}$

(d) $v = \left[\frac{qQ}{(4\pi\varepsilon_0 ma)}\right]^{\frac{1}{2}}$

45. The electric field $\vec{E}$ associated with a current flowing through a straight conductor is

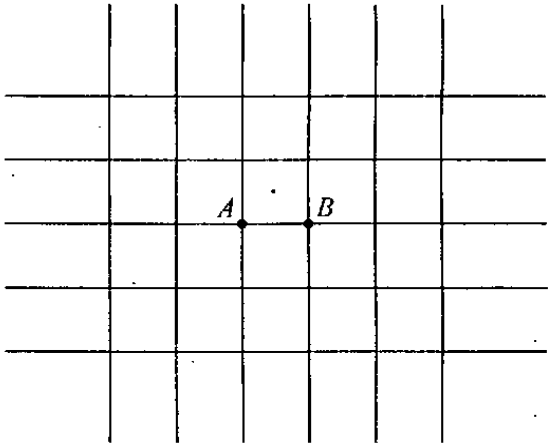
(a) zero, only inside the conductor

(b) zero, inside and outside the conductor

(c) finite inside the conductor and zero outside the conductor

(d) finite inside and outside the conductor

46.



The figure given above shows an infinite wire grid with square cells. The resistance of each wire between neighbouring joint connections is r. What is the resistance of the whole grid between the points A and B ?

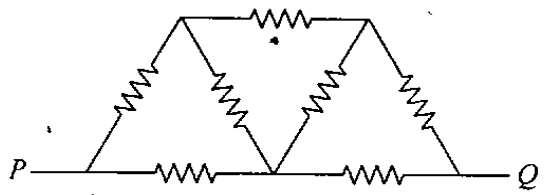
(a) r

(b) $2r$

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

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

47.



Seven resistors, each of 1 Ω resistance are connected as shown in the above figure. What is the effective resistance between P and Q ?

(a) $\frac{4}{7}\ \Omega$

(b) $7\ \Omega$

(c) $\frac{8}{7}\ \Omega$

(d) $\frac{3}{2}\ \Omega$

48. A long straight wire of radius a carries a steady current I. The current is uniformly distributed across its cross section. What is the ratio of the magnetic field at $\frac{a}{2}$ to that at $2a$?

(a) 4

(b) 2

(c) 1

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

49. Two long wires are set parallel to each other. Each carries a current (i) in the same direction and the separation between them is $2r$. What is the intensity of magnetic field midway between them ?

(a) $\frac{4i}{r}$

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

(c) $\frac{i}{r}$

(d) Zero

50. What is the rate at which work is done on a charge q moving with a velocity v in presence of an electric and magnetic fields ?

(a) Zero

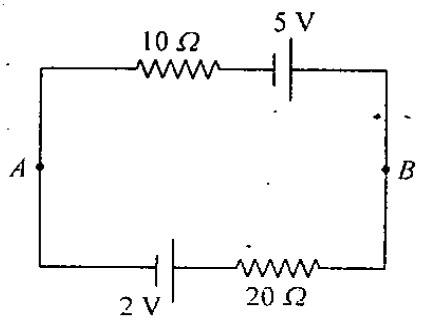
(b) $q\left(\vec{v}\cdot\vec{E}\right)$

(c) $q\left(\vec{v}\cdot\vec{B}\right)$

(d) $q\left(\vec{v}\times\vec{B}\right)$

where $\vec{E}$ is the electric field and $\vec{B}$ is the magnetic field.

51.



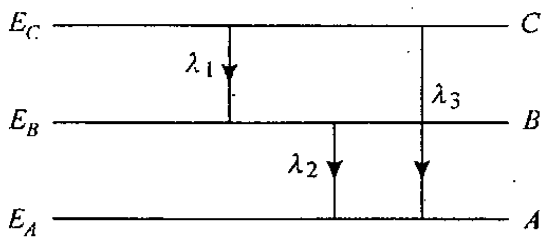
What is the potential difference between the points A and B of the circuit shown above ?

(a) -4 V

(b) 4 V

(c) 8 V

(d) None of the above

52. 

The energy levels of certain atoms are E_A, E_B and E_C such that $E_C > E_B > E_A$. If λ_1, λ_2 and λ_3 are the wavelengths of radiation corresponding to the transitions C to B, B to A and C to A as shown in the figure above, then which one of the following is correct ?

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

(b) $\lambda_3^2 = \lambda_1^2 + \lambda_2^2$

(c) $\lambda_3 = \dfrac{\lambda_1 \lambda_2}{\lambda_1 + \lambda_2}$

(d) $\lambda_3 = \dfrac{(\lambda_1 + \lambda_2)^3}{\lambda_1 \lambda_2}$

53. In a full wave rectifier circuit operating from 50 Hz main frequency, the fundamental frequency in the ripple would be

(a) 25 Hz

(b) 50 Hz

(c) 70 Hz

(d) 100 Hz

54. Each photon in a particular electromagnetic radiation has an energy of 13·2 keV. Then the radiation belongs to the region of

(a) Visible light

(b) UV rays

(c) IR rays

(d) X-rays

55. A nucleus of mass number A emits α-rays with kinetic energy E. What is the recoil energy of the daughter nucleus ?

(a) $\dfrac{4E}{(A-4)}$

(b) $\dfrac{(A-4)E}{A}$

(c) $\dfrac{4E}{(A+4)}$

(d) $\dfrac{4E}{A}$

56. What is the order of the activity of 2 gm of ^{226}Ra whose half life is 1622 years ?

(a) 10^{20} disintegrations per second

(b) 10^{15} disintegrations per second

(c) 10^{10} disintegrations per second

(d) 10^{5} disintegrations per second

57. A uniform rope of mass M and length L hangs from a ceiling. What is the time taken by a transverse wave to travel the full length of rope ?

(a) $\sqrt{\frac{L}{g}}$

(b) $\sqrt{\frac{4L}{g}}$

(c) $\sqrt{\frac{9L}{g}}$

(d) $\sqrt{\frac{L}{4g}}$

58. The amplitude of a wave disturbance propagating in the positive x-direction is given by

$$y = \frac{1}{(1+x^2)} \qquad \text{at } t = 0$$

and $$y = \frac{1}{\{1+(x-1)^2\}} \qquad \text{at } t = 4\text{s}$$

where x and y are in metre. What is the velocity of wave assuming shape of disturbance does not change during propagation ?

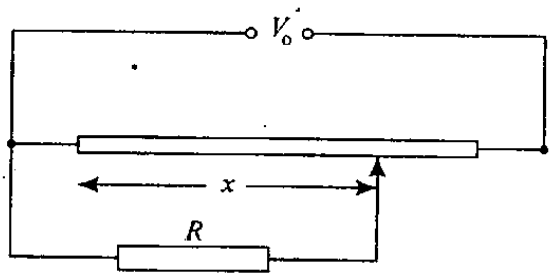
(a) 1 ms^{-1}

(b) 0·5 ms^{-1}

(c) 0·25 ms^{-1}

(d) 0·75 ms^{-1}

59.



The figure given above shows a potentiometric circuit by means of which one can vary a voltage V applied to a certain device possessing a resistance R. The potentiometer has length l and a resistance R_0 and voltage V_0 is applied to its terminals. What is the voltage fed to the device as a function of distance x ?

(a) $V = \frac{V_0 Rx}{\left[lR + R_0 x\left\{1-\left(\frac{x}{l}\right)\right\}\right]}$

(b) $V = \frac{V_0 Rx}{\left[lR - R_0 x\left\{1-\left(\frac{x}{l}\right)\right\}\right]}$

(c) $V = \frac{V_0 Rx}{\left[lR - R_0 x\left\{1+\left(\frac{x}{l}\right)\right\}\right]}$

(d) None of the above

60. A generator develops an emf of 120 V and has a terminal voltage of 110 V when the armature current is 20 A. What is the resistance of the armature ?

(a) 4 Ω

(b) 2 Ω

(c) 1 Ω

(d) 0·5 Ω

61. If the velocity of the electron in the hydrogen atom in its first orbit is $2{\cdot}18 \times 10^6$ ms^{-1}, then what will be the velocity of the electron in the second orbit of Li^{2+} ?

(a) $2{\cdot}18 \times 10^6$ ms^{-1}

(b) $3{\cdot}27 \times 10^6$ ms^{-1}

(c) $6{\cdot}54 \times 10^6$ ms^{-1}

(d) $1{\cdot}45 \times 10^6$ ms^{-1}

62. Consider the following statements about d-block elements :

1. They are all metals.
2. All of them are not coloured.
3. They show variable valency.
4. Most of them form simple salts.

Which of the statements given above are correct ?

(a) 1 and 2

(b) 1 and 3

(c) 2 and 3

(d) 3 and 4

63. The bond angle in H_2O is 104·5° and in H_2S it is 92·5°. The difference is due to

(a) The smaller size of O atom compared to S atom minimizes electron repulsions and allows the bonds in H_2O to be purely p-type

(b) The larger size of S atom compared to O atom minimizes electron repulsions and allows the bonds in H_2S to be purely p-type

(c) The bond pair-lone pair repulsions are large in H_2S

(d) The size of the atom increases and electronegativity decreases while moving from oxygen to sulphur as a result bond pairs closer to the central atom

64. What is the value of internal energy change (ΔE) at 27°C of a gaseous reaction $2A_2(g) + 5B_2(g) \rightarrow 2A_2B_5(g)$ (whose heat change at constant pressure is –50700 J) ?
[$R = 8{\cdot}314$ JK^{-1} mol^{-1}]

(a) –50700 J

(b) –63171 J

(c) –38229 J

(d) +38229 J

65. The concentrations of I^- at the start and after 10 minutes of the reaction $Cl_2 + 2I^- \rightarrow 2Cl^- + I_2$ which is carried in water are 0·60 mol L^{-1} and 0·56 mol L^{-1} respectively. What are the rate of disappearance of I^- and the rate of appearance of Iodine in mol L^{-1} min^{-1} respectively ?

(a) 0·004 and 0·002

(b) 0·002 and 0·004

(c) 0·004 and 0·004

(d) 0·002 and 0·002

66. Consider the following statements regarding chemical equilibrium :

1. For gaseous reaction the equilibrium can be established in open vessel.
2. The state of equilibrium is dynamic in nature but not static.
3. If temperature is kept constant the colour of the reacting system changes with time.

Which of the statements given above are correct ?

(a) 1

(b) 2 only

(c) 3 only

(d) 2 and 3

67. Consider the following statements :

In the Haber method of synthesis of ammonia

1. increase of pressure favours the formation of NH_3
2. decrease of pressure produces more NH_3
3. increase of temperature dissociates NH_3
4. addition of inert gas favours the formation of NH_3

Which of the statements given above are correct ?

(a) 1 and 3

(b) 2 and 4

(c) 1 and 4

(d) 2 and 3

68. Consider the following statements in respect of an ideal solution :

1. Raoult's law is valid for an ideal solution over the whole concentration range.
2. Enthalpy of mixing is zero i.e. $\Delta H_{mix} = 0$.
3. Volume of mixing is not zero i.e. $\Delta V_{mix} \neq 0$.
4. The components of ideal solution cannot be separated by fractional distillation.

Which of the statements given above is/are correct ?

(a) 3 and 4

(b) 1 and 4

(c) 1 and 2

(d) 2 and 3

69. An organic compound of 0·6 g when it dissolves in water of 21·7 g freezes at 272·187 K. The molar mass of the organic compound is close to : (K_f of water is 1·86 deg/molality; freezing point is 273 K)

(a) 61 g mol^{-1}

(b) 63 g mol^{-1}

(c) 65 g mol^{-1}

(d) 67 g mol^{-1}

70. Consider lowering of vapour pressure (Δp), elevation in boiling point (ΔT_b) and depression in freezing point (ΔT_f) of a solvent for the same molar concentration of each of the following three solutes :

1. $BaCl_2$
2. NaCl
3. $MgCl_2$

Which of the following is/are the correct sequence(s) ?

(a) $\Delta p : 3 < 2 < 1$

(b) $\Delta T_b : 1 > 2 > 3$

(c) $\Delta T_f : 3 < 2 < 1$

(d) All of the above

71. Consider the following :

At constant pressure, boiling point of a solution is greater than the boiling point of its pure liquid solvent because

1. solute is non-electrolyte.
2. solute is involatile.
3. chemical potential of solvent in solution is less than the chemical potential of solvent in its pure state at constant pressure.

Which of the above are correct ?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 1 and 3 only

(d) 2 and 3 only

72. A solution containing 10 g of urea (M = 60) per litre is isotonic with a solution containing 5% of solute X. What is the molar mass of the solute X ?

(a) 60

(b) 100

(c) 300

(d) 600

73. What is the osmotic pressure of the solution obtained by mixing 300 cm^3 of 2% (mass-volume) solution of urea with 300 cm^3 of 3·42% solution of sucrose at 20°C ? ($R = 0{\cdot}082$ L atm K^{-1} mol^{-1})

(a) 5·0 atm

(b) 5·2 atm

(c) 2·6 atm

(d) 4·5 atm

74. What is the number of moles of oxygen gas evolved by electrolysis of 180 g of water ?

(a) 2·5

(b) 5·0

(c) 7·5

(d) 10·0

75. The $[Ag^+]$ in a saturated solution of Ag_2CrO_4 is $1{\cdot}5 \times 10^{-4}$ M. What is the solubility product of Ag_2CrO_4 ?

(a) $3{\cdot}375 \times 10^{-12}$ M^3

(b) $1{\cdot}6875 \times 10^{-10}$ M^3

(c) $1{\cdot}6875 \times 10^{-11}$ M^3

(d) $1{\cdot}6875 \times 10^{-12}$ M^3

76. Using the Lewis concept, which one of the following has the strongest acidic strength ?

(a) H_3PO_4

(b) H_3PO_3

(c) H_3PO_2

(d) All are of equal strength

77. Which one of the following will ***not*** function as buffer solution ?

(a) Borax + Boric acid

(b) $NaH_2PO_4 + Na_2HPO_4$

(c) NaCl + NaOH

(d) $NH_4Cl + NH_4OH$

78. The reaction,

$3ClO^-(aq) \rightarrow ClO_3^-(aq) + 5Cl^-$ is an example of

(a) Oxidation reaction

(b) Reduction reaction

(c) Disproportionation reaction

(d) Decomposition reaction

79. If 0·4 Curie be the activity of 1 gram of a radioactive sample whose atomic mass is 226, then what is the half life period of the sample ? (1 Curie = $3{\cdot}7 \times 10^{10}$ disintegrations/sec)

(a) $1{\cdot}2 \times 10^{11}$ s

(b) $1{\cdot}8 \times 10^{11}$ s

(c) $1{\cdot}2 \times 10^{10}$ s

(d) $1{\cdot}8 \times 10^{10}$ s

80. An artificial transmutation was carried out on $_7N^{14}$ by an α particle which resulted in an unstable nuclide and a proton. What is the ratio of the atomic mass to the atomic number of the unstable nuclide ?

(a) $\frac{17}{8}$

(b) $\frac{15}{7}$

(c) $\frac{17}{9}$

(d) $\frac{15}{8}$

81. Given the following reactions for hydrogen atom :

1. It forms covalent bond with another atom of hydrogen $H + H \rightarrow H_2$.
2. By losing an electron it acquires positive charge $HCl \rightarrow H^+ + Cl^-$.
3. It forms H^- by gaining an electron $H + \dot{e} \rightarrow H^-$.

Which of the above reactions point out that hydrogen behaves like halogens ?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1 and 3 only

82. On large scale Tritium is produced by which one of the following nuclear reactions ?

(a) $^{6}_{3}Li + ^{1}_{0}n \rightarrow ^{4}_{2}He + ^{3}_{1}T$

(b) $^{2}_{1}D + ^{2}_{1}D \rightarrow ^{3}_{1}T + ^{1}_{1}H$

(c) $^{14}_{7}N + ^{1}_{0}n \rightarrow ^{12}_{6}C + ^{3}_{1}T$

(d) $^{14}_{7}N + ^{1}_{1}H \rightarrow ^{3}_{1}T$ + other fragments

83. Which one of the following reactions is ***not*** the part of Solvay process for the manufacture of Na_2CO_3 ?

(a) $2NH_4Cl + Ca(OH)_2 \longrightarrow 2NH_3 + CaCl_2 + 2H_2O$

(b) $2NaHCO_3 \xrightarrow{\Delta} Na_2CO_3 + CO_2 + H_2O$

(c) $NH_3 + H_2O + CO_2 \longrightarrow NH_4HCO_3$

(d) $2NaCl + CaCO_3 \longrightarrow Na_2CO_3 + CaCl_2$

84. Sodium bicarbonate on heating decomposes to sodium carbonate, CO_2 and H_2O. If 0·2 moles of sodium bicarbonate are completely decomposed, how many moles of sodium carbonate are formed ?

(a) 0·2

(b) 0·1

(c) 0·05

(d) 0·025

85. Consider the following compounds :

1. $Ba(OH)_2$
2. $Mg(OH)_2$
3. $Ca(OH)_2$

What is the correct order of their alkalinity ?

(a) $Ba(OH)_2 > Mg(OH)_2 > Ca(OH)_2$

(b) $Mg(OH)_2 > Ca(OH)_2 > Ba(OH)_2$

(c) $Mg(OH)_2 > Ba(OH)_2 > Ca(OH)_2$

(d) $Ba(OH)_2 > Ca(OH)_2 > Mg(OH)_2$

86. In borax bead test borax produces

(a) Metal metaborate

(b) Metal oxide

(c) Metal orthoborate

(d) Metal pyroborate

87. Aluminium has very strong affinity for oxygen and the enthalpy of formation of Al_2O_3 is very high. This property has been exploited in

(a) Making synthetic rubies

(b) Making blue sapphires

(c) Thermite reduction of less stable metal oxides

(d) Making spinal ($MgAl_2O_4$)

88. Consider the following statements :

1. Zeolites are aluminosilicates.
2. Aluminium can occupy two adjacent sites in zeolites.

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

89. Consider the following statements about glass :

1. Glass is a solid solution and its composition may vary.
2. For making silica glass very high temperature is required. This can be reduced by adding oxides to the melt.
3. Normal domestic glass for windows is calcium alkali silicate.
4. Al_2O_3 is added to glass to give ruby red colour to it.

Which of the statements given above are correct ?

(a) 1, 2 and 4

(b) 2, 3 and 4

(c) 1, 2 and 3

(d) 1, 3 and 4

90. Which one of the following decomposition reactions provides ammonia as one of the products ?

(a) $(NH_4)_2C_2O_7 \xrightarrow{\text{Heated}}$

(b) $(NH_4)_2SO_4 \xrightarrow{\text{Heated}}$

(c) $NH_4NO_3 \xrightarrow{\text{Heated}}$

(d) $NH_4NO_2 \xrightarrow{\text{Heated}}$

91. The elemental 'P' is made from rock phosphate $Ca_3(PO_4)_2$ by making use of which one of the following reactions ?

(a) $Ca_3(PO_4)_2 + C + CaO \xrightarrow{\Delta}$
$P_4O_{10} \xrightarrow{C} P$

(b) $Ca_3(PO_4)_2 + C + SiO_2 \xrightarrow{\Delta}$
$P_4O_{10} \xrightarrow{C} P$

(c) $Ca_3(PO_4)_2 + C + FeO \xrightarrow{\Delta}$
$P_4O_{10} \xrightarrow{C} P$

(d) $Ca_3(PO_4)_2 + C \xrightarrow{\Delta} P_4O_{10}$
$\xrightarrow{C} P$

92. Excess of concentrated sulphuric acid on heating with copper produces

(a) $CuSO_4 + H_2$

(b) $CuSO_4 + H_2O + SO_2$

(c) $CuO + H_2SO_3$

(d) $CuO + H_2S$

93. The following reactions are used for obtaining I_2 from Chile salt peter :

$$2X + 6HSO_3^- \rightarrow 2Y + 6SO_4^{2-} + 6H^+$$
$$5Y + X \rightarrow 3Z + 3H_2O$$

In these reactions X, Y, Z respectively can be

(a) I^-, IO_4^-, I_2

(b) I^-, IO_3^-, I_2

(c) IO_3^-, I^-, I_2

(d) IO_4^-, I^-, I_2

94. Which of the following quantitative methods for measuring SO_2 in atmosphere are highly developed for environment concern over acid rain ?

1. Reaction of SO_2 with acidified $K_2Cr_2O_7$ and estimated titrimetrically.
2. Reaction of SO_2 with starch iodate paper and estimated calorimetrically.
3. Burning of SO_2 in Hydrogen flame in flame photometer and measuring the spectrum of S_2.

Select the correct answer using the code given below :

(a) 1 only

(b) 1 and 3

(c) 2 and 3

(d) 3 only

95. Helium is used in diving apparatus because

(a) It is lighter than nitrogen

(b) It is completely miscible with oxygen

(c) It is insoluble in blood at high pressure

(d) None of the above

96. The bauxite ore is made up of Al_2O_3 (major) + TiO_2 + SiO_2 + Fe_2O_3. This ore is digested with concentrated NaOH solution at 550 K and 36 bar pressure and solution is filtered hot. In the filterate chemical species present are

(a) $NaAl(OH)_4$ only

(b) $NaAl(OH)_4$ and Na_2SiO_3

(c) $NaFe(OH)_4$ and $NaAl(OH)_4$

(d) $NaAl(OH)_4$ and $Na_2Ti(OH)_6$

97. Which one of the following statements is ***not*** correct ?

(a) Zn is used to extract Ag by solvent extraction from molten lead

(b) Ag and Au are extracted by making soluble cyanide complexes

(c) Argentite is impure AgCl

(d) German silver alloy contains no silver

98. When Cobaltic salt is added to the suspension of bleaching powder

(a) Cobalt metal will be deposited

(b) Oxygen will be evolved

(c) Calcium metal will be deposited

(d) Cobalt chloride will be formed

99. Which one of the following metals is extracted through alloy formation ?

(a) Manganese

(b) Silver

(c) Nickel

(d) Lead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100. Consider the following statements :

1. HF is corrosive and toxic.
2. HF is poor conductor of electricity.

Which of the statements given above is/are correct in respect of the difficulties encountered during electrolysis of anhydrous HF for the manufacture of F_2 ?

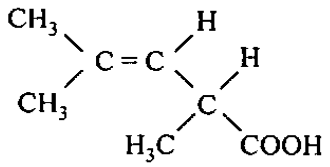
(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

101. Consider the following compound :



The above compound can exhibit

(a) geometrical isomerism only

(b) geometrical and optical isomerisms

(c) optical isomerism only

(d) tautomerism

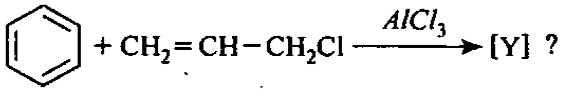
102. Match List I with List II and select the correct answer using the code given below the Lists :

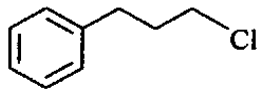
List I *(Property)*	List II *(Product)*
A. Reductive ozonolysis of ethyne	1. Cannizzaro reaction
B. Hydrogenation of carbon	2. Acrolein
C. HCHO + NaOH	3. Glyoxal is one of the main products
D. Heating glycerol with Conc. H_2SO_4	4. Synthetic petrol

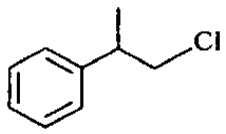
Code :

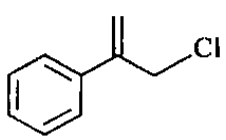
	A	B	C	D
(a)	4	3	1	2
(b)	3	4	2	1
(c)	4	3	2	1
(d)	3	4	1	2

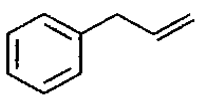
103. What is the major product [Y] of the reaction



(a) 

(b) 

(c) 

(d) 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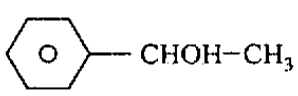
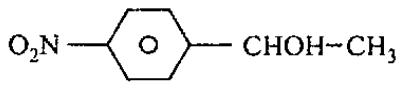
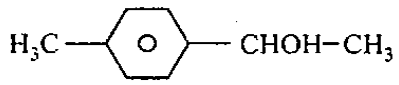
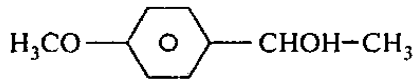
104. Which one of the following alcohols is dehydrated most easily by concentrated H_2SO_4 ?

(a) 

(b) 

(c) 

(d) 

105. Reaction of ethyl formate with excess of PhMgBr followed by hydrolysis gives

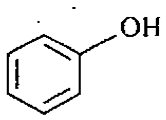
(a) Benzoic acid

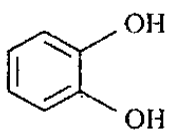
(b) Diphenyl methanol

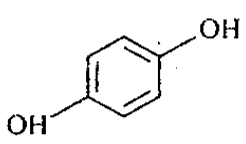
(c) Benzaldehyde

(d) Ethyl benzoate

106. Consider the following compounds :

1. 

2. 

3. 

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

(a) 3 > 1 > 2

(b) 1 > 2 > 3

(c) 3 > 2 > 1

(d) 1 > 3 > 2

107. Match List I with List II and select the correct answer using the code given below the Lists :

List I *(Commercial name)*	List II *(Formula structure)*
A. Chloral	1. Oxirane
B. Epoxide	2. 40% methanal
C. Formalin	3. Ethanal
D. Perspex	4. Acetone

Code :

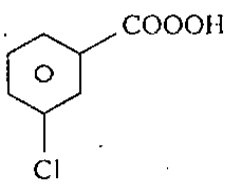
	A	B	C	D
(a)	3	1	2	4
(b)	1	3	2	4
(c)	3	1	4	2
(d)	1	3	4	2

108. Conversion of acetophenone to benzoic acid can be achieved by reaction with

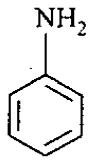
(a) I_2 | NaOH

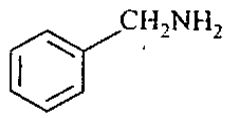
(b) NaOH

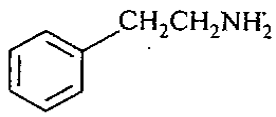
(c) NH_2OH followed by reaction with H_2SO_4

(d) 

109. Consider the following compounds :

I. 

II. 

III. 

What is the correct order of basicity of the above compounds ?

(a) I > II > III

(b) III > I > II

(c) III > II > I

(d) I > III > II

110. Iodobenzene can be prepared by treating

(a) benzene with CH_3I using $FeCl_3$ as a catalyst

(b) bromobenzene with I_2 using $AlCl_3$ as a catalyst

(c) phenol with I_2 in KOH solution

(d) benzene diazonium chloride with KI

111. Consider the following nucleophilic groups :

1. $-O-SO_2-C_6H_5$
2. $-O-\overset{\overset{O}{\|}}{C}-CH_3$
3. $-Cl$
4. $-OCH_3$

What is the correct order of leaving power of the above nucleophilic groups for nucleophilic substitution reactions ?

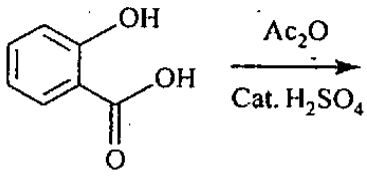
(a) 1 > 2 > 4 > 3

(b) 4 > 3 > 1 > 2

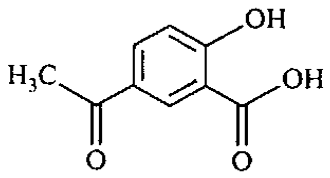
(c) 4 > 3 > 2 > 1

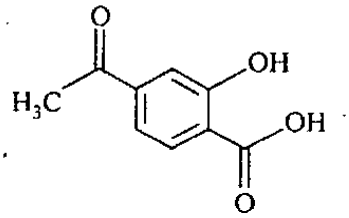
(d) 1 > 2 > 3 > 4

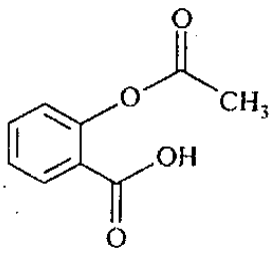
112. What is the major product [**X**] of the reaction ?

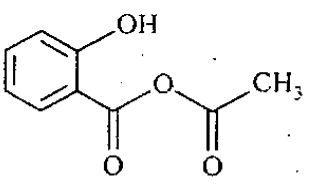


[X] ?

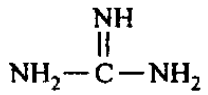
(a) 

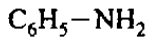
(b) 

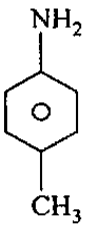
(c) 

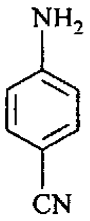
(d) 

113. Consider the following compounds :

1. 

2. 

3. 

4. 

What is the correct order of basic strength of above compounds ?

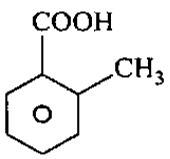
(a) 1 > 3 > 2 > 4

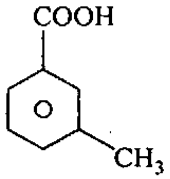
(b) 1 > 3 > 4 > 2

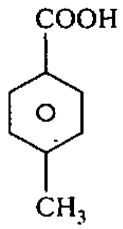
(c) 4 > 2 > 3 > 1

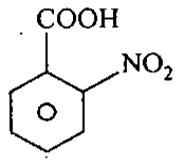
(d) 4 > 2 > 1 > 3

114. Consider the following compounds :

1. 

2. 

3. 

4. 

What is the correct order of decreasing of the acidity of the above compounds ?

(a) 4 > 1 > 3 > 2

(b) 4 > 1 > 2 > 3

(c) 3 > 2 > 1 > 4

(d) 3 > 2 > 4 > 1

115. Consider the following compounds :

1. Phenol
2. Toluene
3. Chlorobenzene
4. Benzene

What is the correct order of reactivity of the above compounds towards bromination ?

(a) 1 > 2 > 3 > 4

(b) 4 > 3 > 2 > 1

(c) 3 > 4 > 2 > 1

(d) 1 > 2 > 4 > 3

116. Consider the following carbanions :

1. $CH_3-\overset{\ominus}{C}H_2$
2. $CH_2=\overset{\ominus}{C}H$
3. $CH\equiv\overset{\ominus}{C}$
4. $C_6H_5-\overset{\ominus}{C}H_2$

What is the correct order of stability of above carbanions ?

(a) 1 > 2 > 3 > 4

(b) 4 > 3 > 1 > 2

(c) 4 > 3 > 2 > 1

(d) 1 > 2 > 4 > 3

117. Consider the following statements :

1. α-D(+) glucose and β-D(+) glucose are anomers.
2. Fructose is reducing sugar and sucrose is non-reducing sugar.
3. Glucose is non-reducing sugar.
4. Maltose shows muta rotation.

Which of the statements given above are correct ?

(a) 1, 2 and 3

(b) 1, 2 and 4

(c) 1, 3 and 4

(d) 2, 3 and 4

118. Consider the following statements :

1. Alkenes are more reactive than alkynes for electrophilic addition.
2. Benzaldehyde is more reactive than acetaldehyde for nucleophilic addition.

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

119. Reaction of acetylene with water in the presence of H_2SO_4 and $HgSO_4$ gives :

(a) Acetone

(b) Acetaldehyde

(c) Acetic acid

(d) Formaldehyde

120. Which one of the following compounds is achiral ?

(a) Glycine

(b) Serine

(c) Alanine

(d) Proline

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