Regn. No. 0920

SKD New Standard Coaching Institute

ESTD. 1985

39 YEARS OF TEACHING EXCELLENCE

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// SAMPLE PAPER - 110 //

**Time : 1 : 15 Hr.**   **Question : 60**

// PHYSICS //

01. A particle of mass m moves along the quarter section of the circular path whose centre is at the origin. The radius of the circular path is a. A force $\vec{F} = y\hat{i} - x\hat{j}$ N acts on the particle where x, y denote the coordinates of the position of the particle. Calculate the work done by this force, in taking the particle from point A (a, 0) to point B (0, a), along the circular path.
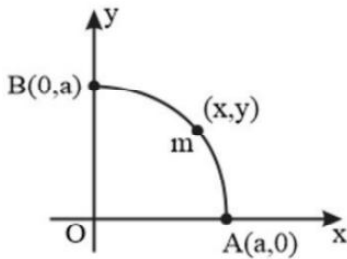
(1) $-\sqrt{2}a^2 J$ (2) $-\dfrac{\pi a^2}{4}$

(3) $-a^2 J$ (4) $-\dfrac{\pi a^2}{2}$

02. One mole of a monatomic ideal gas undergoes the process $A \rightarrow B$, as in the given P – V diagram. The specific heat for this process is
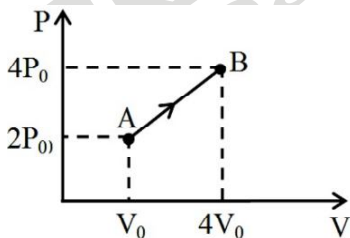
(1) $\dfrac{3R}{2}$ (2) $\dfrac{15R}{7}$ (3) $\dfrac{30R}{7}$ (4) $\dfrac{20R}{7}$

03. An ideal gas (1 mole, monatomic) is in the initial state P (see diagram) on an isothermal curve A at a temperature T_0. It is brought under a constant volume ($2V_0$) process to Q which lies on an adiabatic curve B intersecting the isothermal curve A at (P_0, V_0, T_0). The change in the internal energy of the gas (in terms of T_0) during the process is ($2^{2/3} = 1.587$)
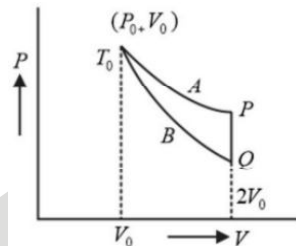

(1) $2.3\,T_0$ (2) $-4.6\,T_0$ (3) $-2.3\,T_0$ (4) $4.6\,T_0$

04. A photoelectric material having work-function ϕ_0 is illuminated with a light of wavelength λ $\left(\lambda < \dfrac{hc}{\phi_0}\right)$. The fastest photoelectron has a de Broglie wavelength λ_d. A change in wavelength of the incident light by $\Delta\lambda$ results in a change $\Delta\lambda_d$ in λ_d. The ratio $\dfrac{\Delta\lambda_d}{\Delta\lambda}$ is proportional to

(1) $\dfrac{\lambda_d^3}{\lambda^2}$ (2) $\dfrac{\lambda_d^3}{\lambda}$ (3) $\dfrac{\lambda_d^2}{\lambda^2}$ (4) $\dfrac{\lambda_d}{\lambda}$

05. A light of wavelength 6328 Å is incident normally on a slit of width 0.2 mm. The angular width of the central maximum on the screen will be

(1) $0.9°$ (2) $0.18°$ (3) $0.54°$ (4) $0.36°$

06. Two identical thin isosceles prisms of refracting angle θ and refractive index μ are placed with their bases touching each other. A parallel beam, of width 2b, is incident on this system, as shown. The distance of the point of convergence from the prism is
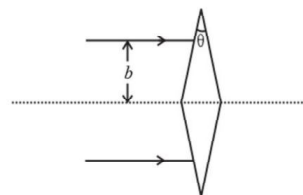
(1) $\dfrac{b}{(\mu-1)\theta}$ (2) $\dfrac{b}{2(\mu-1)\theta}$

(3) $\dfrac{2b}{(\mu-1)\theta}$ (4) $\dfrac{b\theta}{(\mu-1)}$

07. Two thin lenses have a combined power of +9D. When they are separated by a distance of 20 cm, their equivalent power becomes +27/5 D. Their individual powers (in dioptre) are

(1) 4, 5   (2) 3, 6   (3) 2, 7   (4) 1, 8

08. Two objects of same mass m are attached at the end of a light rod of length l and rotating about the axis OO′ as shown in the figure. The moment of inertia of the system about the axis OO′ is
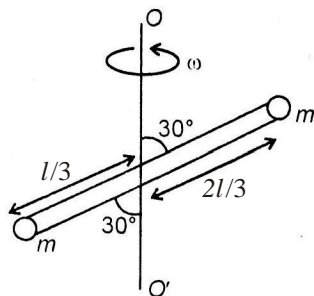

(1) $\dfrac{ml^2}{12}$ (2) $\dfrac{5ml^2}{18}$ (3) $\dfrac{5ml^2}{24}$ (4) $\dfrac{5ml^2}{36}$

09. The ratio of the frequency of revolution around the earth of two satellites at height h_1 and h_2 from the surface of the earth is

(1) $\left(\dfrac{R+h_2}{R+h_1}\right)^{3/2}$ (2) $\left(\dfrac{h_2}{h_1}\right)^{3/2}$

(3) $\left(\dfrac{h_2}{h_1}\right)^{1/2}$ (4) $\left(\dfrac{R+h_2}{R+h_1}\right)^{1/2}$

10. The first and third resonating lengths of an open end organ pipe, when sounded by a funing fork are 33 cm and 99 cm. If the speed of sound in air be 330 m/s, then the frequency of the tuning fork is :

(1) 450 Hz   (2) 500 Hz
(3) 900 Hz   (4) 1000 Hz

11. An infinite number of charges each equal to 4 μC are placed along the x - axis at x = 1 m, 2 m, 4 m, and so on. The electric field at the origin due to given set of charges is from +2μC charge is

(1) 64×10^6 N C^{-1} (2) 3.2×10^3 N C^{-1}
(3) 48×10^3 N C^{-1} (4) 4×10^5 N C^{-1}

12. A system consist of two metallic spheres of radii r_1 and r_2 connected by a thin wire and a switch S. Initially S is open and spheres carry charges q_1 and q_2 respectively. If the switch S is closed, the potential of the system is:
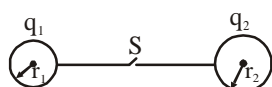
(1) $\dfrac{1}{4\pi \in_0}\left(\dfrac{q_1 . q_2}{r_1 . r_2}\right)$ (2) $\dfrac{1}{4\pi \in_0}\left[\dfrac{q_1 + q_2}{r_1 + r_2}\right]$

(3) $\dfrac{1}{4\pi \in_0}\left[\dfrac{q_1}{r_1} + \dfrac{q_2}{r_2}\right]$ (4) zero

13. The emf and the internal resistance of a battery equivalent to the combinations of batteries shown in figure is :

(1) 7V, 3Ω   (2) 13V, 6Ω
(3) 1V, 3Ω   (4) 1V, ½ Ω
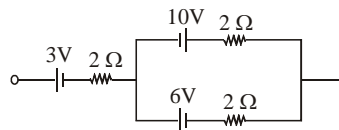
14. In which type of material, the magnetic susceptibility does not depend on temperature ?
(1) Diamagnetic   (2) Paramagnetic
(3) Ferromagnetic   (4) Ferrite

15. A copper rod of length 1 m is rotating about mid point of rod, perpendicular to a uniform magentic field 0.5 T with constant angular velocity 1 rad/s. The potential difference between the two ends is
(1) Zero   (2) 0.5 V
(3) 1 V   (4) 0.25 V

CHEMISTRY

16. The percentage by volume of C_3H_8 in a gaseous mixture of C_3H_8, CH_4 and CO is 20. When 100 ml of the mixture is burnt in excess of O_2, the volume of CO_2 produced is
(1) 90 ml   (2) 160 ml
(3) 140 ml   (4) none of these

17. What is the ratio of time periods (T_1/T_2) in second orbit of hydrogen atom to third orbit of He$^+$ ion?
(1) 8/27   (2) 32/37
(3) 27/32   (4) none of these

18. Consider the real gases reaction $2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$; ΔH = −560 kJ. In 10 L rigid vessel at 500 K, the initial pressure is 70 bar and after the reaction it becomes 40 bar. The change in internal energy is
(1) −557 kJ
(2) −530 kJ
(3) −563 kJ
(4) none of these

19. The freezing point of aqueous solution contains 5% by mass urea, 1.0% by mass KCl and 10% by mass of glucose is ($K_{f\,H_2O}$ = 1.86 K molality^{-1})
(1) 290.2 K   (2) 285.5 K
(3) 269.9 K   (4) 250 K

20. An aqueous solution containing Na^+, Sn^{2+}, Cl^- and SO_4^{2-} ions, all at unit concentration, is electrolyzed between a silver anode and a platinum cathode. What changes occur at the electrodes when current is passed through the cell?
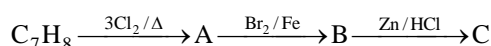
Given $E^°_{Ag^+|Ag} = 0.799\,V$,

$E^°_{Sn^{2+}|Sn} = -0.14\,V$, $\quad E^°_{Cl_2|Cl^-} = 1.36\,V$,

$E^°_{S_2O_8^{2-}|SO_4^{2-}} = 2\,V$, $\quad E^°_{Sn^{4+}|Sn^{2+}} = 0.13\,V$

(1) Sn^{2+} is reduced and Cl^- is oxidized
(2) Ag is oxidized and Sn^+ is reduced
(3) Sn^{4+} is reduced and Sn^{2+} is oxidized
(4) H^+ is reduced and Sn^{2+} is oxidized

21. The compound C is:

$$C_7H_8 \xrightarrow{3Cl_2/\Delta} A \xrightarrow{Br_2/Fe} B \xrightarrow{Zn/HCl} C$$

(1) o-bromotoluene   (2) m-bromotoluene
(3) p-bromotoluene
(4) 3-bromo-2,4,6-trichlorotoluene
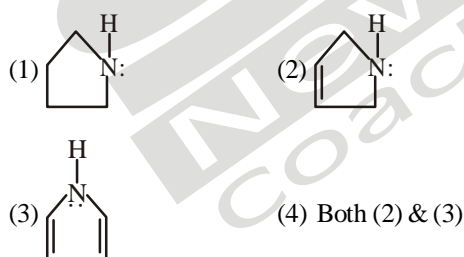
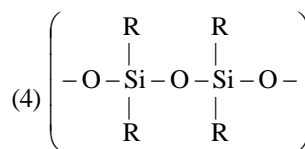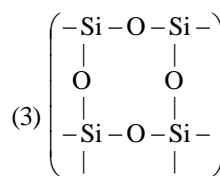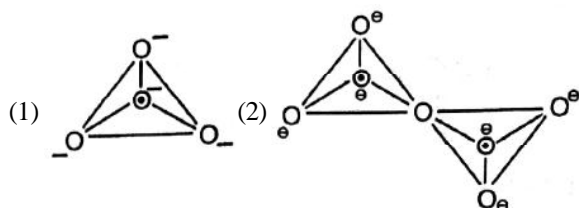22. Among the following, compound having highest dipole moment is

(1) [F-phenyl]   (2) [Cl-phenyl]   (3) [Br-phenyl]   (4) [I-phenyl]
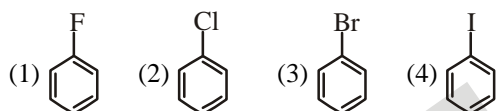
23. Calculate the amount of H_2 which is left unreacted in the given reaction $2H_2 + O_2 \rightarrow 2H_2O$, if 8 g of H_2 is mixed with 16 g O_2.
(1) 3 g   (2) 6 g   (3) 1 g   (4) 4 g

24. In which of the following the hybridization of N-atom is sp^2?

(1) [pyrrolidine structure with H-N:]   (2) [dihydropyrrole structure with H-N:]

(3) [pyrrole structure with H-N:]   (4) Both (2) & (3)

25. The correct structure of pyrosilicate among the following is

(1) [tetrahedral structure]   (2) [two tetrahedra structure]

26. Brown ring test for nitrates depends on
I. the ability of Fe^{2+} to reduce nitrates to nitric oxide.
II. it reacts with Fe^{2+} to form a brown coloured complex.
Which of the above statements regarding brown ring test for nitrates is/are true ? Choose the correct option
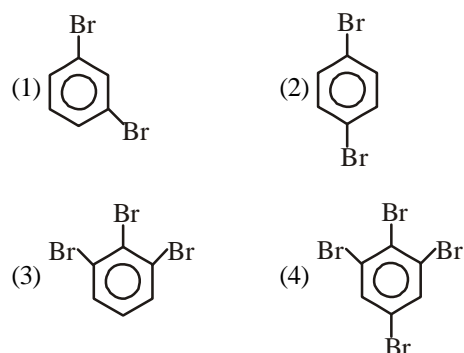(1) Only I   (2) Only II
(3) Both I and II   (4) Neither I nor II

27. Mixture of HCHO and $(CH_3)_3C-CHO$ on reaction with NaOH gives a mixture of
(1) HCOONa and $(CH_3)_3C-COONa$
(2) CH_3-OH and $(CH_3)_3C-COONa$
(3) CH_3-OH and $(CH_3)_3C-CH_2-OH$
(4) HCOONa and $(CH_3)_3C-CH_2-OH$

28. The product (Z) in the following sequence of reactions is

$$Phenol \xrightarrow{pyridine} (X) \xrightarrow[4-7\,atm,\,410\,K]{CO_2} (Y) \xrightarrow{H_3O^+} (Z)$$
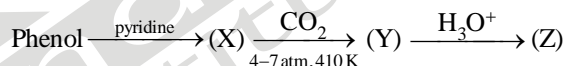
(1) Aspirin   (2) Salicylaldehyde
(3) Benzoic acid   (4) Salicyclic acid

29. The final product of the following reaction sequence is:

$$[aniline] \xrightarrow[\substack{(ii)\,NaNO_2/HCl\,273-278\,K\\(iii)\,Cu/HBr}]{(i)\,Br_2\,water},$$

(1) [1,3-dibromobenzene]   (2) [1,4-dibromobenzene]

(3) [1,2,3-tribromobenzene]   (4) [1,2,3,5-tetrabromobenzene]
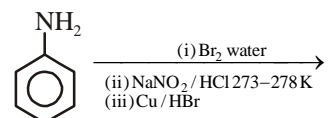
30. Which of these will give alkene as the only product?
(1) $CH_3-C\equiv C-CH_3 \xrightarrow{H_2/Pd-BaSO_4}$
(2) $CH_3-C\equiv C-CH_3 \xrightarrow{Na/NH_3(l)}$
(3) $CH_3-\underset{\underset{O}{|}}{CH}-\underset{}{CH}-CH_3 \xrightarrow{Ph_3P}$
(4) All of these
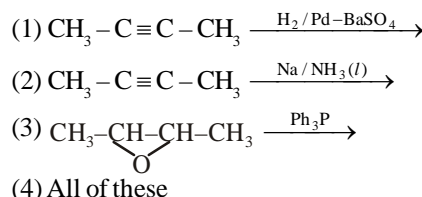
31. Which one of the following symptoms is not due to manganese toxicity in plants?
    (1) Calcium translocation in shoot apex is inhibited
    (2) Deficiency in both iron and magnesium is induced
    (3) Appearance of brown spot surrounded by chlorotic veins
    (4) None of the above

32. During light reaction in photosynthesis the following are formed
    (1) ATP and sugar
    (2) Hydrogen, O_2 and sugar
    (3) ATP, hydrogen donor and O_2
    (4) ATP, hydrogen and O_2 donor.

33. The end product of oxidative phosphorylation is
   (1) NADH   (2) Oxygen
    (3) ADP   (4) ATP + H_2O

34. Match the following :
    (1) IAA   (i) Herring sperm DNA
    (2) ABA   (ii) Bolting
    (3) Ethylene   (iii) Stomatal closure
    (4) GA   (iv) Weed-free lawns
    (E) Cytokinins   (v) Ripening of fruits
    (1) (1)-(iv), (2)-(iii), (3)-(v), (4)-(ii), (E)-(i)
    (2) (1)-(v), (2)-(iii), (3)-(iv), (4)-(ii), (E)-(i)
    (3) (1)-(iV), (2)-(i), (3)-(iv), (4)-(iii), (E)-(ii)
    (4) (1)-(v), (2)-(iii), (3)-(ii), (4)-(i), (E)-(iv)

35. In conifers fibers are likely to be absent in :
    (1) Secondary phloem   (2) Secondary xylem
    (3) Primary phloem   (4) Leaves

36. Mendel's law of independent assortment holds good for genes situated on the:
    (1) Non-homologous chromosomes
    (2) Homologous chromosomes
    (3) Extra nuclear genetic element
    (4) Same chromosome

37. If the base sequence of a codon in mRNA is 5'-AUG-3', the sequence of tRNA pairing with it must be:
    (1) 5'-UAC-3'   (2) 5'-CAU-3'
    (3) 5'-AUG-3'   (4) 5'-GUA-3

38. A plant shows thallus level of organization. It shows rhizoids and is haploid. It needs water to complete its life cycle because the male gametes are motile. Identify the group to which it belongs to:
    (1) Pteridophytes   (2) Gymnosperms
    (3) Monocots   (4) Bryophytes

39. Identify A, B and C in the following figure.
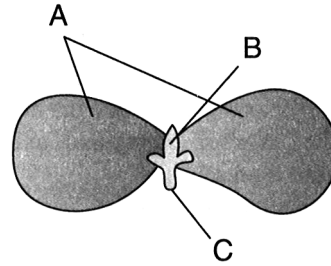
    (1) A–Plumule, B–Cotyledon, C–Radicle
    (2) A–Radicle, B–Cotyledon, C–Plumule
    (3) A–Cotyledon, B–Plumule, C–Radicle
    (4) A–Radicle, B–Plumule, C–Cotyledon

40. Aestivation of petals in the flower of cotton is correctly shown in
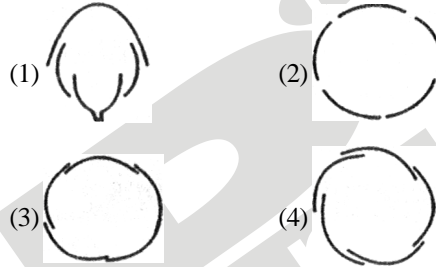
41. Select the correct matching.

	Column–I		Column–II
A.	RER	1.	Hydrolytic enzymes
B.	SER	2.	Protein synthesis
C.	Golgi body	3.	Lipid synthesis
D.	Lysosome	4.	Glycoprotein formation

    (1) A–2, B–3, C–4, D–1   (2) A–1, B–2, C–3, D–4
    (3) A–2, B–4, C–3, D–1   (4) A–3, B–2, C–4, D–1

42. The number of chromosomes present in pollen grains is six. What shall be their number in leaf cells?
    (1) 12   (2) 24   (3) 6   (4) 3

43. Cells which are not dividing are likely to be at
    (1) G_1 (2) G_2 (3) G_0 (4) S phase

44. Example of false fruit
    (1) Apple   (2) Strawberry
    (3) Cashew   (4) All of these

45. Match Column-I (Place) with Column-II (Number of bird species).

	Column–I		Column–II
A.	Colombia	1.	1200
B.	New York	2.	1300
C.	India	3.	1400
D.	Amazonian rain forest	4.	105

    (1) A–3, B–4, C–2, D–1   (2) A–2, B–1, C–4, D–3
    (3) A–2, B–4, C–3, D–1   (4) A–3, B–4, C–1, D–2

ZOOLOGY

46. Which of the following cells are found in areolar tissue?
(1) Mast cells
(2) Plasma cells
(3) Histiocytes
(4) All of these

47. Which one is a matching pair of deficient nutrient and resultant disease characterized by swollen lips, thick pigmented skin of hands and legs and irritability?
(1) Thiamine - Beri-beri
(2) Nicotinamide - Pellagra
(3) Iodine - Goitre
(4) Protein - Kwashiorkor

48. Match the following human spinal nerve in Column-I with the number of pairs in Column-II and choose the correct options

Column-I
A. Carvical nerve
B. Thoracic nerve
C. Lumbar nerve
D. Coccygeal nerves

Column-II
1. 5 pairs
2. 1 pair
3. 12 pairs
4. 8 pairs

(1) A-2, B-4, C-1, D-3
(2) A-4, B-3, C-1, D-2
(3) A-3, B-1, C-2, D-4
(4) A-1, B-4, C-2, D-3

49. A decrease in the level of estrogens and progesterone causes
(1) Growth and dilation of myometrium
(2) Growth of endometrium
(3) Constriction of uterine blood vessels leading to sloughing of endometrium or uterine epithelium
(4) Release of ovum from the ovary

50. Apart from its importance in blood transfusion, study of blood groups is also useful in
(1) personality
(2) settling paternal disputes
(3) both of these
(4) none of these

51. Some common diseases caused by bacteria are
(1) Measles, Mumps and Malaria
(2) Tetanus, Typhoid and Tuberculosis
(3) Syphilis, Smallpox and Sleeping sickness
(4) Pneumonia, Poliomyelitis and Psittacosis

52. Which one of the following statements is correct ?
(1) Heroin accelerates body functions
(2) Malignant tumours may exhibit metastasis
(3) Benign tumours show the property of metastasis
(4) Patients who have undergone surgery are given cannabinoids to relieve pain

53. In each segment, the exoskeleton has hardened plates in cockroach and it is known as
(1) Sclerites
(2) Sternum
(3) Carapace
(4) All of these

54. An organic substance bound to an enzyme and essential for its activity is called
(1) Holoenzyme
(2) Apoenzyme
(3) Isoenzyme
(4) Coenzyme

55. Out of 'X' pairs of ribs in humans only 'Y' pairs are true ribs. Select the option that correctly represents values of X and Y and provide their explanation:

(1)	X = 12, Y = 5	True ribs are attached dorsally to vertebral column and sternum on the two ends
(2)	X = 24, Y = 7	True ribs are dorsally attached to vertebral column but are free on ventral side.
(3)	X = 24, Y = 12	True ribs are dorsally attached to vertebral column but are free on ventral side.
(4)	X = 12, Y = 7	True ribs are attached dorsally to vertebral column and ventrally to the sternum.

56. Calcium is important in skeletal muscle contraction because it
(1) Binds to troponin to remove the masking of active sites on actin for myosin
(2) Detaches the myosin head from the actin filament
(3) Activates the myosin ATPase by binding to it
(4) Prevents the formation of bonds between the myosin cross bridges and the actin filament

57. Introduction of one or more genes into an organism which normally does not possess them or their deletion by using artificial means (not by breeding) comes under
(1) molecular biology
(2) cytogenetics
(3) genetic hybridization
(4) genetic engineering

58. The transgenic animals are those which have
(1) foreign DNA in some of its cells
(2) foreign DNA in all its cells
(3) foreign RNA in all its cells
(4) DNA and RNA both in the cells

59. Among the following sets of examples for divergent evolution, select the incorrect option:
(1) Forelimbs of man, bat and cheetah
(2) Brain of bat, man and cheetah
(3) Heart of bat, man and cheetah
(4) Eye of octopus, bat and man

60. Ectopic pregnancies are referred to as
(1) Implantation of embryo at side other than uterus
(2) Implantation of defective embryo in the uterus
(3) Pregnancies terminated due to hormonal imbalance
(4) Pregnancies with genetic abnormality