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OLYMPIAD EXPLORER

Workbook for

Nationwide Interactive SCIENCE Olympiad *&* Other
National/International Olympiads/Talent Search Exams.
Also useful for Nationwide Biotechnology Olympiad (NBTO)

Based on CBSE, ICSE, GCSE, State Board Syllabus & NCF (NCERT)

100's of Q's with answers
- Chapterwise Practice Q's
- Revision Q's
- Sample Paper

Class
12

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Contents

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SYLLABUS GUIDELINES*

Based on CBSE, ICSE & GCSE Syllabus & NCF guidelines devised by NCERT

PHYSICS

Electrostatics

Electric Charges; Conservation of charges, Coulomb's law-force between two point charges, forces between multiple charges; superposition principle and continuous charge distribution. Electric field, electric field due to a point charge, electric field lines; electric dipole, electric field due to a dipole; torque on a dipole in uniform electric field. Electric flux, Gauss's theorem and its applications to find electric field due to infinitely long straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell (field inside and outside). Electric potential, potential difference, electric potential due to a point charge, a dipole and system of charges; equipotential surfaces, electrical potential energy of a system of two point charges and of electric dipole in an electrostatic field. Conductors and insulators, free charges and bound charges inside a conductor. Dielectrics and electric polarisation, capacitors and capacitance, combination of capacitors in series and in parallel, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, energy stored in a capacitor.

Current Electricity

Electric current, flow of electric charges in a metallic conductor, drift velocity, mobility and their relation with electric current; Ohm's law, electrical resistance, V-I characteristics (linear and non-linear), electrical energy and power, electrical resistivity and conductivity. Carbon resistors, colour code for carbon resistors; series and parallel combinations of resistors; temperature dependence of resistance. Internal resistance of a cell, potential difference and emf of a cell, combination of cells in series and in parallel. Kirchhoff's laws and simple applications. Wheatstone bridge, metre bridge. Potentiometer - principle and its applications to measure potential difference and for comparing emf of two cells; measurement of internal resistance of a cell.

Magnetic Effects of Current and Magnetism

Concept of magnetic field, Oersted's experiment. Biot - Savart law and its application to current carrying circular loop. Ampere's law and its applications to infinitely long straight wire, straight and toroidal solenoids. Force on a moving charge in uniform magnetic and electric fields. Cyclotron. Force on a current-carrying conductor in a uniform magnetic field. Force between two parallel current-carrying conductors-definition of ampere. Torque experienced by a current loop in uniform magnetic field; moving coil galvanometer-its current sensitivity and conversion to ammeter and voltmeter.

Current loop as a magnetic dipole and its magnetic dipole moment. Magnetic dipole moment of a revolving electron. Magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to its axis. Torque on a magnetic dipole (bar magnet) in a uniform magnetic field; bar magnet as an equivalent solenoid, magnetic field lines; Earth's magnetic field and magnetic elements. Para-, dia- and ferro - magnetic substances, with examples. Electro-

magnets and factors affecting their strengths. Permanent magnets.

Electromagnetic Induction and Alternating Currents

Electromagnetic induction; Faraday's law, induced emf and current; Lenz's Law, Eddy currents. Self and mutual inductance. Need for displacement current. Alternating currents, peak and rms value of alternating current/voltage; reactance and impedance; LC oscillations (qualitative treatment only), LCR series circuit, resonance; power in AC circuits, wattless current. AC generator and transformer.

Electromagnetic waves

Electromagnetic waves and their characteristics (qualitative ideas only). Transverse nature of electromagnetic waves. Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, Xrays, gamma rays) including elementary facts about their uses.

Optics

Reflection of light, spherical mirrors, mirror formula. Refraction of light, total internal reflection and its applications, optical fibres, refraction at spherical surfaces, lenses, thin lens formula, lens-maker's formula. Magnification, power of a lens, combination of thin lenses in contact. Refraction and dispersion of light through a prism. Scattering of light - blue colour of the sky and reddish appearance of the sun at sunrise and sunset. Optical instruments: Human eye, image formation and accommodation, correction of eye defects (myopia, hypermetropia, presbyopia and astigmatism) using lenses. Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers. Wave optics: wave front and Huygens' principle, reflection and refraction of plane wave at a plane surface using wave fronts. Proof of laws of reflection and refraction using Huygens' principle. Interference, Young's double slit experiment and expression for fringe width, coherent sources and sustained interference of light. Diffraction due to a single slit, width of central maximum. Resolving power of microscopes and astronomical telescopes. Polarisation, plane polarised light; Brewster's law, uses of plane polarised light and Polaroids.

Dual Nature of Matter and Radiation

Dual nature of radiation. Photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation-particle nature of light. Matter waves-wave nature of particles, de Broglie relation. Davisson-Germer experiment.

Atoms & Nuclei

Alpha-particle scattering experiment; Rutherford's model of atom; Bohr model, energy levels, hydrogen spectrum. Composition and size of nucleus, atomic masses, isotopes, isobars; isotones. Radioactivityalpha, beta and gamma particles/rays and their properties; radioactive decay law. Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number; nuclear fission and fusion.

Electronic Devices

Semiconductors; semiconductor diode – i-v characteristics in forward and reverse bias, diode as a rectifier; i-v characteristics of LED, photodiode, solar cell, and Zener diode; Zener diode as a voltage regulator. Junction transistor, transistor action, characteristics of a transistor; transistor as an amplifier (common emitter configuration) and oscillator. Logic gates (OR, AND, NOT, NAND and NOR). Transistor as a switch.

Communication Systems

Elements of a communication system (block diagram only); bandwidth of signals speech, TV and digital data); bandwidth of transmission medium. Propagation of electromagnetic waves in the atmosphere, sky and space wave propagation. Need for modulation. Production and detection of an amplitude-modulated wave.

CHEMISTRY

Solid State

Classification of solids based on different binding forces: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea), unit cell in two dimensional and three dimensional lattices, calculation of density of unit cell, packing in solids, voids, number of atoms per unit cell in a cubic unit cell, point defects, electrical and magnetic properties.

Solutions

Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, colligative properties – relative lowering of vapour pressure, elevation of B.P., depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties, abnormal molecular mass.

Electrochemistry

Redox reactions, conductance in electrolytic solutions, specific and molar conductivity variations of conductivity with concentration, Kohlrausch's Law, electrolysis and laws of electrolysis (elementary idea), dry cell – electrolytic cells and Galvanic cells; lead accumulator, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells, fuel cells; corrosion.

Chemical Kinetics

Rate of a reaction (average and instantaneous), factors affecting rates of reaction; concentration, temperature, catalyst; order and molecularity of a reaction; rate law and specific rate constant, integrated rate equations and half life (only for zero and first order reactions); concept of collision theory (elementary idea, no mathematical treatment)

Surface Chemistry

Adsorption – physisorption and chemisorption; factors affecting adsorption of gases on solids; catalysis : homogenous and heterogeneous, activity and selectivity: enzyme catalysis; colloidal state: distinction between true solutions, colloids and suspensions; lyophilic, lyophobic, multimolecular and macromolecular colloids; properties of colloids; Tyndall effect, Brownian movement, electrophoresis, coagulation; emulsion – types of emulsions.

General Principles and Processes of Isolation of Elements

Principles and methods of extraction - concentration, oxidation, reduction electrolytic method and refining; occurrence and principles of extraction of aluminium, copper, zinc and Iron.

p-Block Elements

Group 15 elements: General introduction, electronic configuration, occurrence, oxidation states, trends in physical and chemical properties; nitrogen - preparation, properties and uses; compounds of nitrogen: preparation and properties of ammonia and nitric acid, oxides of nitrogen (structure only); Phosphorous-allotropic forms; compounds .of phosphorous: preparation and proper-

ties of phosphine, halides (PCl_3, PCl_5) and oxoacids (elementary idea only)

Group 16 elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; dioxygen: preparation, properties and uses; simple oxides; Ozone. Sulphur - allotropic forms; compounds of sulphur: preparation, properties and uses of sulphur dioxide; sulphuric acid: industrial process of manufacture, properties and uses, oxoacids of sulphur (structures only).

Group 17 elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; compounds of halogens: preparation, properties and uses of chlorine and hydrochloric acid, interhalogen compounds, oxoacids of halogens (structures only).

Group 18 elements: General introduction, electronic configuration. Occurrence, trends in physical and chemical properties, uses.

d and f Block Elements

General introduction ,electronic configuration, occurrence and characteristics of transition metals, general trends in properties of the first row transition metals – metallic character, ionization enthalpy, oxidation states, ionic radii, colour catalytic property, magnetic properties, interstitial compounds, alloy formation. Preparation and properties of $K_2Cr_2O_7$ and $KMnO_4$.

Lanthanoids - electronic configuration, oxidation states, chemical reactivity and lanthanoid contraction.

Actinoids - Electronic configuration, oxidation states.

Coordination Compounds

Coordination compounds - Introduction, ligands, coordination number, colour, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds. bonding; isomerism, importance of coordination compounds (in qualitative analysis, extraction of metals and biological systems).

Haloalkanes and Haloarenes

Haloalkanes: Nomenclature, nature of C-X bond, physical and chemical properties, mechanism of substitution reactions.

Haloarenes: Nature of C-X bond, substitution reactions (directive influence of halogen for monosubstituted compounds only) Uses and environmental effects of - dichloromethane, trichloromethane, tetrachloromethane, iodoform, freons, DDT.

Alcohols, Phenols and Ethers

Alcohols: Nomenclature, methods of preparation, physical and chemical properties (of primary alcohols only); identification of primary, secondary and tertiary alcohols; mechanism of dehydration, uses, some important compounds - methanol and ethanol. **Phenols :** Nomenclature, methods of preparation, physical and chemical properties, acidic nature of phenol, electrophillic substitution reactions, uses of phenols.

Ethers: Nomenclature, methods of preparation, physical and chemical properties, uses.

Aldehydes, Ketones and Carboxylic Acids

Aldehydes and Ketones: Nomenclature, nature of carbonyl group, methods of preparation, physical and chemical properties, and mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes; uses.

Carboxylic Acids: Nomenclature, acidic nature, methods of preparation, physical and chemical properties; uses.

Organic compounds containing Nitrogen

Amines: Nomenclature, classification, structure, methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines.

Cyanides and Isocyanides - will be mentioned at relevant places in context.

Diazonium salts: Preparation, chemical reactions and importance in synthetic organic chemistry.

Biomolecules

Carbohydrates - Classification (aldoses and ketoses), monosaccahrides (glucose and fructose), oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen); importance.

Proteins - Elementary idea of a - amino acids, peptide bond, polypeptides proteins, primary structure, econdary structure, tertiary structure and quaternary structure (qualitative idea only), denaturation of proteins; enzymes.

Vitamins -Classification and functions.

Nucleic Acids: DNA & RNA .

Polymers Classification - natural and synthetic, methods of polymerization (addition and condensation), copolymerization. Some important polymers: natural and synthetic like polythene, nylon, polyesters

BIOLOGY

Sexual Reproduction

Pollination and fertilization in flowering plants. Development of seeds and fruits. Human reproduction: reproductive system in male and female, menstrual cycle. Production of gametes, fertilization, implantation, ,embryo development, pregnancy and parturation. Reproductive health - birth control, contraception and sexually transmitted diseases.

Genetics and evolution

Mendelian inheritance. Chromosome theory of inheritance, deviations from Mendelian ratio (gene interaction- Incomplete dominance, co-dominance, complementary genes, multiple alleles). Sex determination in human beings: XX, XY. Linkage and crossing over. Inheritance pattern of haemophilia and blood groups in human beings. DNA: replication, transcription, translation. Gene expression and regulation. Genome and Human Genome Project. DNA fingerprinting. Evolution: Theories and evidences.

Biology and Human welfare

Animal husbandry. Basic concepts of immunology, vaccines. Pathogens, Parasites. Plant breeding, tissue culture, food production. Microbes in household food processing, industrial production, sewage treatment and energy generation. Cancer and AIDS. Adolescence and drug/alcohol abuse.

Biotechnology and its Applications

Recombinant DNA technology. Applications in Health, Agriculture and Industry Genetically modified (GM) organisms; biosafety issues. Insulin and Bt cotton

Ecology & Environment

Ecosystems: components, types and energy flow. Species, population and community. Ecological adaptations. Centres of diversity and conservation of biodiversity, National parks and sanctuaries. Environmental issues.

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BIOLOGY QUESTION BANK

1. Which statement is false?
   (a) A ribosome is smaller than a centriole
   (b) The nucleus has one membrane surrounding it
   (c) Plant cells contain mitochondria
   (d) A centriole contains microtubules

2. A scientist put some plant cells in a solution of glucose and, after 30 minutes, measured the concentration of glucose inside the cells. When she repeated the experiment using double the concentration of glucose in the solution, the concentration of glucose inside the cells also doubled. Which of the following principles does this experiment demonstrate?
   (a) glucose enters plant cells by active transport
   (b) glucose enters plant cells by endocytosis
   (c) glucose enters plant cells by some type of diffusion
   (d) plant cells cannot synthesize glucose

3. Which statement best explains why protozoans that live in pond water must use exocytosis to get rid of excess water in their cytoplasm?
   (a) the pond water is hypotonic to the protozoan cytoplasm
   (b) the pond water is hypertonic to the protozoan cytoplasm
   (c) the pond water is isotonic to the protozoan cytoplasm
   (d) water cannot diffuse across the protozoan plasma membrane

4. Plant cells can often grow larger than animal cells because:
   (a) photosynthesis produces more energy than does respiration.
   (b) plant cells need less food than animal cells.
   (c) plants use their energy for growth while animals spend much of their energy on movement.
   (d) the large central vacuole of plant cells reduces the depth of the cytoplasm and allows entering molecules to rapidly diffuse from the plasma membrane to all parts of the cytoplasm.

5. Which of the following cell types provide mechanical support for plants?
   (a) tracheids, sclerenchyma fibres, collenchyma
   (b) sclerenchyma fibres, cork, cortex
   (c) sieve tubes, vessel elements, epidermis
   (d) sclerenchyma fibres, pith cells, epithelial cells

6. Water can move from the soil and up through the world's tallest living tree (which is 110 metres high) by which of the following process(es)?
(a) osmosis
(b) root pressure
(c) pressure flow
(d) adhesion and cohesion of water molecules

7. Which statement about the function of the Casparian strip is correct?
(a) It prevents excess transpiration from leaves.
(b) It regulates ion movement into the root vascular cylinder.
(c) It prevents disease organisms from invading the plant.
(d) It prevents ions from leaking out of the xylem into leaves.

8. What path does a carbon atom take in going from the atmosphere into the cell wall of a root cap cell?
(a) stoma—proplastid—chloroplast—vessel element—procambium—apical meristem—root cap
(b) stoma—chloroplast—phloem—apical meristem—procambium—root cap
(c) stoma—chloroplast—vessel element—procambium—apical meristem—root cap
(d) stoma—chloroplast—sievetube—procambium—apical meristem—root cap

9. The plant growth regulator involved in aging and ripening of fruit is:
(a) cytokinin.   (b) auxin.
(c) gibberellin.   (d) ethylene.

10. Which of the following provides the best evidence that all known forms of life descended from a common ancestor?
(a) DNA   (b) chloroplasts
(c) the genetic code   (d) the homeobox sequence

11. Two cells which are exactly like the original cell result from:
(a) gamete formation.   (b) meiosis.
(c) mitosis.   (d) sexual reproduction.

12. Imagine that in a plant, hairy leaves are dominant to smooth leaves, and blue flowers are dominant to white. You cross a pure breeding hairy-leaved, blue-flowered strain with a pure breeding smooth-leaved, white-flowered strain. You allow the offspring to self-fertilize, and observe that the F_2 offspring are 69% hairy-leaved and blue-flowered, 19% smooth-leaved and white-flowered, 6% hairy-leaved and white-flowered, and 6% smooth-leaved and blue-flowered. Based on these observations you can conclude that the two genes:

(a) are in the same biochemical pathway
(b) segregate independently
(c) exhibit typical Mendelian ratios
(d) are on the same chromosome

13. Recently, scientists induced a single diploid cell from an adult sheep (the "mother") to grow into a lamb, named Dolly. How closely are Dolly and her "mother" related?
(a) they are completely unrelated.
(b) they are about as related as a brother and a sister would be.
(c) they are about as related as fraternal twins.
(d) they are about as related as identical twins.

14. You are moving to Africa and you have heard that the Green Fever virus disease is common there. Before you leave, you visit your doctor for advice. Which of the following is your doctor most likely to recommend? You should:
(a) take a large supply of antibiotics with you.
(b) wash your food in an antiseptic before you eat it.
(c) get vaccinated against the disease.
(d) not worry as viruses only cause diseases in plants.

15. A hospital technician, while doing some routine culturing of micro-organisms in a lab, noticed a bacterial colony growing on a culture medium containing three different antibiotics. He identified the bacterium as one that did not cause a human disease, but he still reported his observation to the hospital administration. Which statement is correct? He was worried because:
(a) he had no way of killing this bacterium now that it was resistant to antibiotics.
(b) resistance to antibiotics could be transferred to disease-causing bacteria by transduction or conjugation.
(c) the bacterium might feed on the antibiotics and therefore be able to grow in people taking these antibiotics.
(d) there should be no bacteria inside a hospital.

16. Which statement is false?
(a) Viruses primarily contain nucleic acids and protein.
(b) All viruses are parasites.
(c Bacteria are usually less than 2 micrometres in diameter.
(d) Bacteria can only fix nitrogen when they are inside the root nodules of leguminous plants, such as peas and beans.

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ANSWERS

1. (b) 2. (c) 3. (a) 4. (d) 5. (a) 6. (d) 7. (b)
8. (d) 9. (d) 10. (c) 11. (c) 12. (d) 13. (d) 14. (c)
15. (b) 16. (d)

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CHEMISTRY QUESTION BANK

1. The hydrolytic constant K_h for the hydrolytic equilibrium $H_2PO_4^- + H_2O \rightarrow H_3PO_4 + OH^-$ is 1.4×10^{-12}. What is the value of the ionization constant for the $H_3PO_4 + H_2O \rightarrow H_2PO_4^- + H_3O^+$?
(a) 1.4×10^{-7} (b) 7.1×10^{-3} (c) 7.1×10^{-7} (d) 1.4×10^{-5}

2. Given the equilibrium constants
$HgCl^+ + Cl^- \rightarrow HgCl_2$; $K_1 = 3 \times 10^6$
$HgCl_2 + Cl^- \rightarrow HgCl_3^-$; $K_2 = 8.9$
The equilibrium constant for the disproportionation equilibrium
$2HgCl_2 \rightarrow HgCl^+ + HgCl_3^-$ is
(a) $\sim 3.3 \times 10^5$ (b) 3×10^{-5} (c) 3.3×10^5 (d) $\approx 3 \times 10^{-6}$

3 A certain ion B^- has an Arrhenius constant for basic character 2.8×10^{-7}. The equilibrium constant for acidic character of HB is :
(a) 2.8×10^{-7} (b) 2.8×10^7 (c) 3.57×10^6 (d) 3.57×10^{-6}

4. The dissociation constant K_a of a weak monobasic acid is 10^{-7}. What is the approximate pH of a 0.1 M solution of the acid?
(a) 1   (b) 2   (c) 3   (d) 4

5 Equilibrium constant k_p and k_c are related as
(a) $k_c = k_p (RT)^{\Delta n}$ (b) $k_p = k_c(RT)^{\Delta n}$
(c) $k_p = \left(\dfrac{k_c}{RT}\right)^{\Delta n} n$ (d) $k_p - k_c = (RT)^{\Delta n}$

6. At $298°A$, the molar equilibrium concentrations of Ag^+, NH_3 and $Ag(NH_3)_2^+$ in the following equilibrium $Ag^+ + 2NH_3 \rightleftharpoons Ag(NH_3)_2^+$ were found to be 10^{-1}, 10^{-3} and 10^{-1} respectively. Which one of the following is the numerical value of the equilibrium constant for this equilibrium at $298°A$?
(a) 10^{-6} (b) 10^6 (c) 2×10^3 (d) 5×10^4

7. The k_p for the gas phase reaction $A + B \rightleftharpoons D$ is 10 atm^{-1}. The k_p for $2D = 2A + 2B$ is
(a) 10^2 atm^{-2} (b) 10^{-2} atm^{-2} (c) 10^4 atm^{-2} (d) 0.1 atm^{-1}

8. In the reaction $HCN + H_2O \rightleftharpoons H_3O^+ + CN^-$, the conjugate acid-base pair is
(a) HCN, H_3O^+ (b) H_2O, CN^- (c) CN^-, H_3O^+ (d) HCN, CN^-

9. In the reaction $PCl_5 \rightleftharpoons PCl_3 + Cl_2$, the amount of PCl_5, PCl_3 and Cl_2 at equilibrium are 2 moles each and the total pressure is 3 atmospheres, the equilibrium constant k_p is
(a) 1.0 atm   (b) 2.0 atm   (c) 3.0 atm   (d) 6.0 atm

10. The most favourable conditions of temperature and pressure for the oxidation of SO_2 into SO_3 are
(a) low temperature and high pressure
(b) low temperature and low pressure
(c) high temperature and high pressure
(d) high temperature and low pressure.

11. For the reaction $H_2(g) + I_2(g) \rightleftharpoons 2HI (g)$ the equilibrium constant k_p changes with
(a) total pressure   (b) catalyst
(c) the amounts of H_2 and I_2 present
(d) temperature

12. The k_{sp} values of $CaCO_3$ and CaC_2O_4 in water are 4.7×10^{-9} and 1.3×10^{-9} at 25°C. If a mixture of two is washed with H_2O, what is the Ca^{2+} ion concentration in water?
(a) 7.746×10^{-5} (b) 5.831×10^{-5}
(c) 6.856×10^{-5} (d) 3.606×10^{-5}

13. For the reaction $2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$ $k_c = 1.8 \times 10^{-6}$ at 1850°C. At 1850°C, the value of k_c for the reaction
$NO(g) + 1/2 O_2(g) \rightleftharpoons NO_2(g)$ is
(a) 0.9×10^6 (b) 7.5×10^2 (c) 1.95×10^{-3} (d) 1.95×10^3.

14. Under which set of conditions the ionic product of water k_w, is constant at a given temperature in aqueous systems?
(a) in dilute acidic but not dilute alkaline solutions
(b) in dilute alkaline but not dilute acidic solutions
(c) in both dilute acidic and alkaline solutions
(d) only at the equivalence point of a strong acid-strong alkali titration

15. According to the Le-Chatelier principle, the formation of NO_2 at equilibrium in the reaction $2NO + O_2 \rightleftharpoons 2NO_2 +$ heat, should be favoured by
(a) high temperature, high pressure
(b) low temperature, low pressure
(c) low temperature, high pressure
(d) high temperature

16. 50 ml of 5×10^{-4} M Ca $(NO_3)_2$ gives a precipitate of CaF_2 on mixing which of the following solutions. k_{sp} of CaF_2 is 1.7×10^{-10}
(a) 50 ml of 2×10^{-4} M NaF   (b) 50 ml of 1.66×10^{-3} M NaF

(c) 50 ml of 5×10^{-4} M NaF (d) 100 ml of 1×10^{-3} M NaF.

17. In the hydrolytic equilibrium

$A^- + H_2O \rightleftharpoons HA + OH^-$ where $k_a = 1.0 \times 10^{-5}$. The degree of hydrolysis of 0.001 M solution of the salt is

(a) 10^{-3} (b) 10^{-4} (c) 10^{-5} (d) 10^{-6}

18. The solubility product of AgCl is 1.0×10^{-10} at 25°C. The solubility in gl^{-1} is (molar mass of AgCl = 143.5)

(a) 1.43×10^{-5} (b) 1.0×10^{-5}

(c) $1.0 \times 10^{-5}/143.5$ (d) 1.43×10^{-3}

19. The pH of a 10^{-10} M NaOH solution is nearest to

(a) 10   (b) 7   (c) 4   (d) –10

20. The equilibrium constant for muta rotation of α-D-glucose (–) β-D-glucose is 1.8. What percent of the a form remains under equilibrium?

(a) 35.7   (b) 64.3   (c) 55.6   (d) 44.4

21. Which one of the following acids is stronger ?

(a) boric acid $k_a = 5.80 \times 10^{-10}$ (b) acetic acid $k_a = 1.8 \times 10^{-5}$

(c) benzoic acid $k_a = 6.3 \times 10^{-5}$ (d) hydrocyanic acid $k_a = 7.2 \times 10^{-10}$

22. Sulphide ion in alkaline solution reacts with solid sulphur to form polysulphide ions having formulae $S_2^{-2}, S_3^{-2}, S_4^{-2}$ and so on. The equilibrium constant for the formation of S_2^{-2} is 12 and for the formation of S_3^{2-} is 130, both from S and S^{2-}. What is the equilibrium constant for the formation of S_3^{2-} from S_2^{2-} and S?

(a) 11   (b) $- 0.092$ (c) 1560   (d) none of these

23. In the reaction $HNO_3 + H_2O \rightleftharpoons H_3O^+ + NO_3^-$, the conjugate base of HNO_3 is

(a) H_2O (b) H_3O^+ (c) NO_3^- (d) H_3O^+ and NO_3^-

24. For the equilibrium $2NO_{(g)} + Cl_2 (g) \rightleftharpoons 2NOCl(g)$, k_p and k_c are related as :

(a) $k_p = k_c (RT)^{-1}$ (b) $k_p = k_c (RT)^2$

(c) $k_p = k_c (RT)$ (d) $k_p = k_c$

25. When ammonia is heated in 0.50 litre vessel at 430°C and 100 atm pressure it decomposes into nitrogen and hydrogen $2NH_{3(g)} \rightleftharpoons N_{2(g)} + 3H_{2(g)}$ If, after heating a pure sample of ammonia, the equilibrium mixture is found to contain 0.30 moles of $NH_3(g)$, 0.90 moles of $H_{2(g)}$ and 0.30 moles of $N_{2(g)}$, which of the following pair of values is correct?

	Initial moles of NH_3	k_c at 430°C for ammonia formation
(a) A	0.80	0.37
(b) B	0.90	0.92
(c) C	0.80	0.92
(d) D	0.90	3.70

26. Dissociation of phosphorous pentachloride is favoured by

(a) high temperature and high pressure

(b) high temperature and low pressure

(c) low temperature and low pressure

(d) low temperature and high pressure

27. For the homogenous gas reaction $4NH_3 + 5O_2 \rightleftharpoons 4NO + 6H_2O$ the equilibrium constant k_c has the units (concentrations are expressed as mol l^{-2})

(a) mol l^{-1} (b) $(mol/l)^{-1}$

(c) $mol^2 l^{-2}$ (d) It is dimensionless.

28. A certain weak acid has a dissociation constant of 1×10^{-4}. The equilibrium constant for reaction with a strong base is

(a) 1×10^{-4} (b) 1×10^{-10} (c) 1×10^{10} (d) 1×10^{14}

29. The degree of dissociation of anilinium acetate is

(a) independent of initial concentration

(b) directly proportional to initial concentration

(c) inversely proportional to critical concentration

(d) inversely proportional to square root of the initial concentration

30. What are the units in which the solubility product of $Ca_3 (PO_4)_2$ is expressed?

(a) mol/dm^3 (b) mol^2/dm^6 (c) mol^3/dm^9 (d) mol^5/dm^{15}.

31. The hydrolysis constant for the salt of a weak acid and weak base is (k_w = ionic product of water, k_a = dissociation constant of acid, k_b = dissociation constant of base)

(a) directly proportional to k_w, k_a and k_b

(b) directly proportional to k_a and inversely proportional to k_b

(c) directly proportional to k_a and k_b and inversely proportional to k_w

(d) directly proportional to k_w and inversely proportional to k_a and k_b
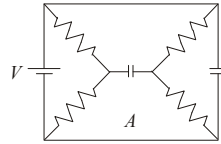
☺☺☺

ANSWERS

1. (b)   2. (d)   3. (c)   4. (d)   5. (b)   6. (b)   7. (b)
8. (d)   9. (a)   10. (a)   11. (d)   12. (a)   13. (b)   14. (c)
15. (c)   16. (b)   17. (a)   18. (d)   19. (b)   20. (a)   21. (c)
22. (a)   23. (c)   24. (a)   25. (b)   26. (b)   27. (a)   28. (c)
29. (d)   30. (d)   31. (d)

☺☺☺

PHYSICS QUESTION BANK

1. What is the voltage across resistor A in the following circuit? Each resistor has a resistance of 2 M Ω and the capacitors have capacitance of 1 μF. The battery voltage is 3 V.

   (a) 0 V   (b) 0.5 V
   (c) 0.75 V   (d) 1.5 V

2. The diagram shows a cell E, connected to a pure resistor R and pure self induction L of negligible resistance. If at time $t = 0$, the switch S is closed, the self induced emf 'e' across the self inductor varies with time as in


   (a)

   (b)

   (c)

   (d)
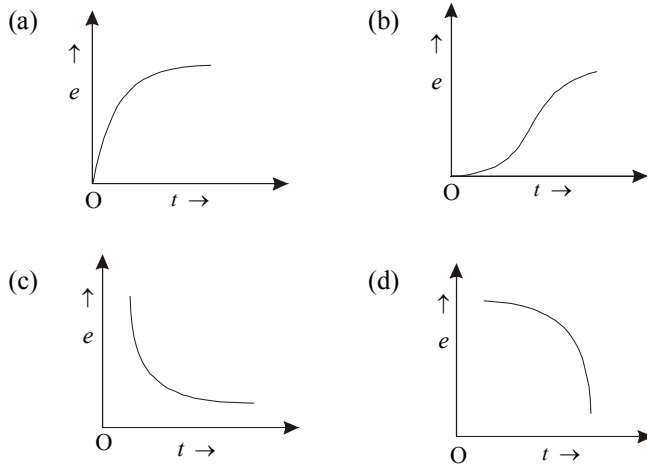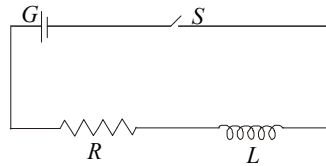
3. A semi-inifinite insulation rod has a linear charge density λ. The electric field at P is

   (a) $\dfrac{\lambda}{2\sqrt{2}\pi\varepsilon_0 y}$ along AP

   (b) $\dfrac{\sqrt{2}\lambda}{4\pi\varepsilon_0 y}$ at an angle of 45° with AP or 135° with AB.
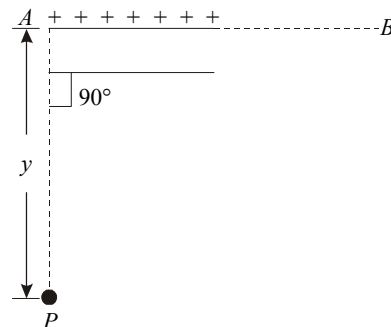
(c) $\dfrac{\lambda}{4\pi\varepsilon_0 y}$ along AP

(d) $\dfrac{\sqrt{2}\lambda}{2\pi\varepsilon_0 y}$ at an angle of 45° with AP or 45° with AB.

4. The distance between the plates of a plane capacitor is 4 cm. An electron begins to move from the negative plate the same moment as a proton begins to move from the positive plate. At what distance from the positive plate will they meet?

   (a) 1.2 mm   (b) 0.2 mm   (c) 2 mm   (d) 0.5 mm

5. A potential difference of 150 V is applied across the plates of a plane capacitor 5 mm apart. One of the plates is in contact with a plane parallel porcelain plate 3 mm thick ($\varepsilon_r = 6$). Then the ratio of the electrical field in air and porcelain is:

   (a) 6   (b) 1/6   (c) 2.5   (d) 5

6. Figure shows a cross-section of two infinitely long rectilinear conductors with current. The distance AB between the conductors is 10 cm, $I_1 = 20$ A, $I_2 = 30$ A. If $AM_2 = 4$ cm, the resultant field at M is

   (a) 10^{-4} T   (b) 2×10^{-4} T   (c) 3×10^{-4} T   (d) 4×10^{-4} T
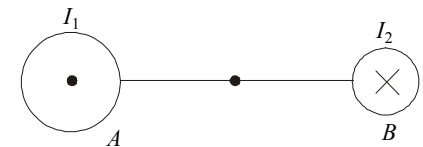
7. A and B are two spherical conductors of the same extended size. A is solid and B is hollow. Both are charged to the same potential. If the charges on A and B are Q_A and Q_B respectively, then

   (a) $Q_A = Q_B$ (b) $Q_A > Q_B$ (c) $Q_A < Q_B$ (d) None of these.

8. A thin wire is bent in the form of a circle and is placed with its plane perpendicular to a uniform magnetic field. The circle increases its radius (r) linearly with respect to time (t) from time t_1 to time t_2 as shown in the figure and remains constant thereafter. Choose from the following graphs, the qualitatively correct one, representing the relation between the induced emf (e) in the coil and the time (t).


   (a)

   (b)

(c)

(d)
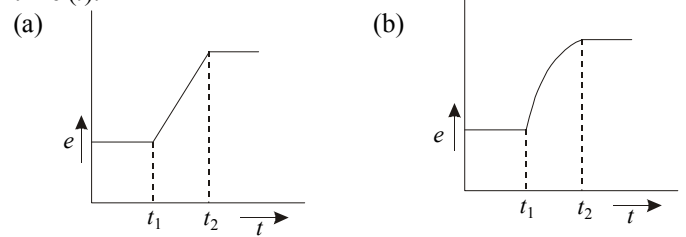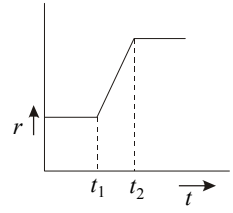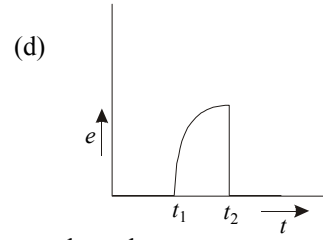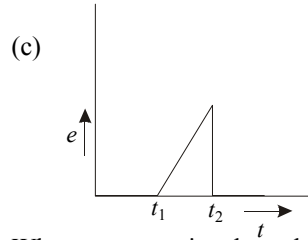
9. When a magnet is released from rest along the axis of a hollow conducting cylinder situated vertically as shown in the figure,

  (a) the direction of induced current in the cylinder anti-clockwise as seen from the above
  (b) the magnet moves with an acceleration less than $g = 9.8$ m/sec^2.
  (c) the cylinder gets heated
  (d) the magnet attains a terminal speed inside the cylinder if the cylinder is very long
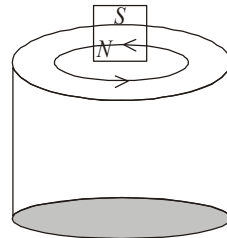
10. The flux through a loop varies with time according to the relation 0.1 $(t^2 - 6t)$ T – m^2 where t is in seconds. The induced e.m.f. in the loop varies with time according to the graph

(a)

(b)


(c)

(d)
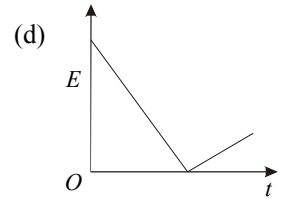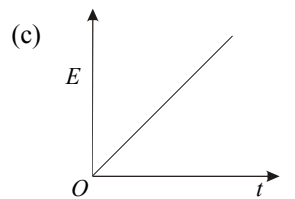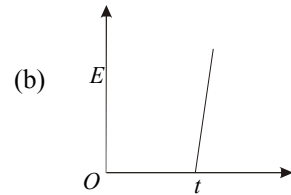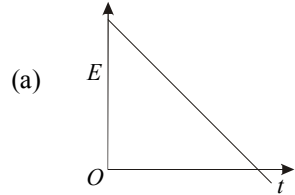
11. The capacitive reactance of a capacitor varies with frequency ω, of an a.c. supply, as

(a)

(b)

(c)

(d)
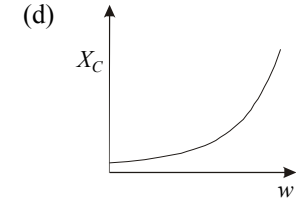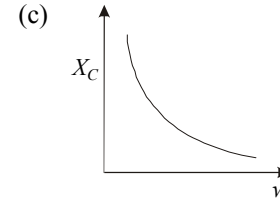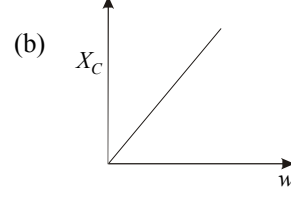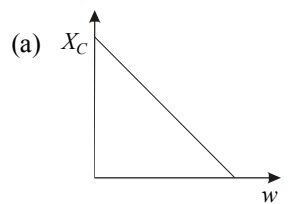
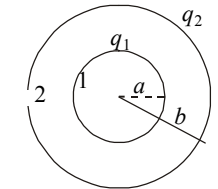**12.** A triode valve has mutual characteristic curves in the form of parallel lines in the region of interest. For $V_P = 200$ V, the plate current is given by $i_P = 3$ $V_g + 10$ mA, and for $V_P = 150$ V, $i_P = 3$ $V_g + 6$ mA. The amplication function of the valve is
  (a) 12.5   (b) 4.33   (c) 15.5   (d) 37.5

13. An electron is shot into a liquid placed in a uniform magnetic field, in a plane perpendicular to the magnetic field. Then:
  (a) The trajectory of the electron is circle.
  (b) The trajectory of the electron is an inward winding spiral.
  (c) The kinetic energy of the electron decreases.
  (d) The revolution – frequency remains constant.

14. A point charge Q is enclosed by a thick conducting spherical shell as shown in figure. The charge on the inside surface of the shell is

  (a) 0   (b) Q
  (c) – Q   (d) 0.5 Q
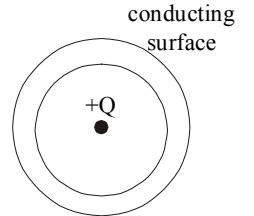
15. Two conducting spheres having radii a and b charged to q_1 and q_2 respectively. The potential difference between 1 and 2 will be

  (a) $\dfrac{q_1}{4\pi\varepsilon_0 a} - \dfrac{q_2}{4\pi\varepsilon_0 b}$

  (b) $\dfrac{q_2}{4\pi\varepsilon_0}\left(\dfrac{1}{a} - \dfrac{1}{b}\right)$

  (c) $\dfrac{q_1}{4\pi\varepsilon_0}\left(\dfrac{1}{a} - \dfrac{1}{b}\right)$

  (d) None of these.

☺☺☺

ANSWERS

1. (d)   2. (c)   3. (b)   4. (b)   5. (a)   6. (b)   7. (a)
8. (d)   9. (a,b,c,d)   10. (a)   11. (c)   12. (d)   13. (d)
14. (c)   15. (c)

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NATIONWIDE INTERACTIVE
SCIENCE OLYMPIAD (NISO)
SAMPLE PAPER

Total duration : 60 Minutes   **Total Marks :** 50

SECTION - A : GENERAL I.Q.

1. Direction :
   In a certain code language,
   (A) '*pit dar na*' means '*you are good*'
   (B) '*dar tok pa*' means '*good and bad*';
   (C) '*tim na tok*' means '*they are bad*''.
   In that language, which word stands for 'they'?
   (a) na   (b) tok   (c) tim   (d) None of these

2. A + B means A is the son of B; A – B means A is the wife of B; A × B means A is the brother of B; A ÷ B means A is the mother of B and A = B means A is the sister of B.
   What does P + R – Q mean ?
   (a) Q is the father of P   (b) Q is the son of P
   (c) Q is the uncle of P   (d) Q is the brother of P

3. Sitting in a row in front of a camera, Mr. X is on the left of the person sitting in the centre but is on the right of Mr. Y. Mr. P is on the right of Mr. Z and Mr. R is on the right of Mr. P. Mr. R is the second person from the person sitting in the centre. Who is the person sitting in the centre?
   (a) Mr. X   (b) Mr. Y
   (c) Mr. Z   (d) None of these

4. Gaurav walks 20 metres towards North. He then turns left and walks 40 metres. He again turns left and walks 20 metres. Further, he moves 20 metres after turning to the right. How far is he from his original position?
   (a) 20 metres   (b) 30 metres
   (c) 60 metres   (d) None of these

5. Pointing to a man in the photograph, a woman said, "His brother's father is the only son of my grandfather'. How is the woman related to the man in the photograph?
   (a) Mother (b) Aunt   (c) Sister (d) Daughter

6. Standing on a platform, Amit told Sunita that Aligarh was more than ten kilometres but less than fifteen kilometres from there. Sunita knew that it was more than twelve but less then fourteen kilometres from there. If both of them were correct, which of the following could be the distance of Aligarh from the platform?
   (a) 11 km (b) 12 km (c) 13 km   (d) None of these

7. In the following question there are given some statements followed by conclusions that can be drawn from them. Choose the conclusion which appeals to you to be the most correct.
   The Taj is in Agra. Agra is in India. Therefore, the Taj is in India.
   (a) True   (b) Probably false
   (c) False   (d) Can't say

8. Following question consists of five figures marked A, B, C, D and E called the Problem figures followed by four other figures marked (a), (b), (c) and (d) called the Answer Figures. Select a figure from amongst the answer figures which will continue the same series as established by the five problem figures.
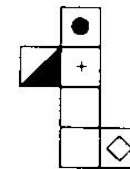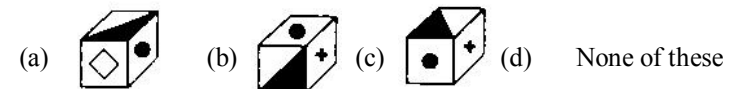   **Problem figure.**

   A   B   C   D   E

   Answer figure

   (a)   (b)   (c)   (d) None of these
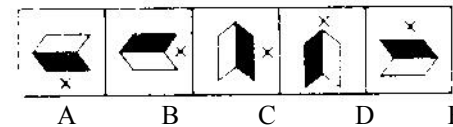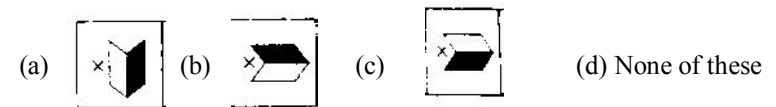
9. In the figure (X) given below, the problem, is folded to form a box. Choose from amongst the alternatives (a), (b), (c) and (d), the boxes that are similar to the box formed.
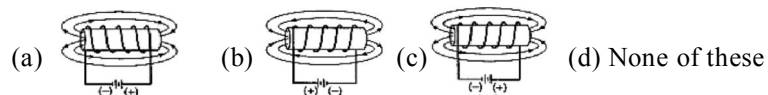

   (X)

   (a)   (b)   (c)   (d)   None of these

10. DDT is related to Abbreviation in the same way as LASER is related to
    (a) Antithesis   (b) Acronym
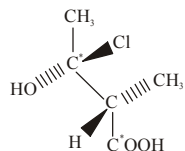   (c) Epigram   (d) None of these

SECTION - B : PHYSICS & CHEMISTRY

11. In which diagram of a current-carrying solenoid is the magnetic field correctly represented?

(a) (b) (c) (d) None of these

12. The most efficient agent for the absorption of SO_3 is
(a) 98% H_2SO_4 (b) 80% H_2SO_4 (c) 20% Oleum (d) None of these

13. The configuration of the chiral carbon atoms are


(a) 2R 3R   (b) 2R 3S   (c) 2S 3R   (d) None of these

14. Insulin contains 3.4% sulphur. The minimum molecular weight of insulin is
(a) 350   (b) 940   (c) 560   (d) None of these

15. The nucleus of an atom can be assumed to be spherical. The radius of the nucleus of mass number A is given by $1.25 \times 10^{-13} \times A^{1/3}$ cm. Radius of atom is 1Å. If the mass number is 64, then the fraction of the atomic volume that is occupied by the nucleus is
(a) 5.0×10^{-5} (b) 1.25×10^{-13}
(c) 2.5×10^{-2} (d) None of these

16. The compound is known by which of the following names?
(a) Bicyclo – [2, 2, 2] octane. (b) Bicyclo – [2, 2, 1] octane
(c) Bicyclo – [1, 2, 1] octane (d) None of these

17. The ammonia evolved from the treatment of 0.30 g of an organic compound for the estimation of nitrogen was passed in 100 ml of 0.1M sulphuric acid. The excess of acid required 20 ml of 0.5M sodium hydroxide solution for complete neutralization. The organic compound is
(a) Urea   (b) Benzamide
(c) Acetamide   (d) None of these

18. Arrange S, O and Se in ascending order of electron affinity
(a) Se < S < O   (b) Se < O < S
(c) S < O < Se   (d) None of these

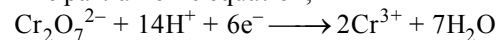**19.** Benzene vapour mixed with air when passed over V_2O_5 catalyst at 775 K gives.
(a) Glyoxal   (b) Maleic anhydride
(c) Fumaric acid   (d) None of these

20. Philosopher's wool when heated with BaO at 1100°C gives a compound. Identify the compound.
(a) $BaCdO_2$ (b) $BaO_2 + Zn$
(c) $BaZnO_2$ (d) None of these

21. The partial ionic equation,
$$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$$
suggests that the equivalent weight of $Cr_2O_7^{2-}$ will be equal to its formula weight divided by
(a) 3   (b) 6   (c) 1   (d) None of these

22. 10 ml of conc. H_2SO_4 (18 molar) is diluted to 1 litre. The approximate strength of dilute acid could be
(a) 0.18 N   (b) 0.36 N   (c) 0.09 N   (d) None of these

23. K_p for the following reaction at 700K is 1.3×10^{-3} atm^{-1}. The K_c at same temperature for the reaction $2SO_2 + O_2 \rightleftharpoons 2SO_3$ will be
(a) 1.1×10^{-2} (b) 7.4×10^{-2}
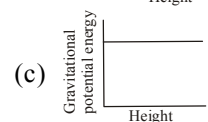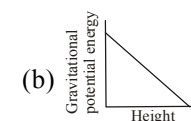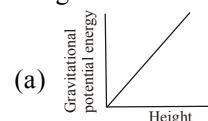(c) 5.2×10^{-2} (d) None of these

24. Only two isomers of monochloro product is possible for
(a) n-butane   (b) 2,4-dimethyl pentane
(c) Benzene   (d) None of these

25. Two identical guitar strings are tuned to the same pitch. If one string is plucked, the other nearby string vibrates with the same frequency. This phenomenon is called
(a) resonance   (b) reflection
(c) refraction   (d) destructive interference

26. Which graph best represents the relationship between the gravitational potential energy of a freely falling object and the object's height above the ground near the surface of Earth?

(a)   (b)

(c)   (d) None of these

27. The enthalpy of combustion of methane, graphite and dihydrogen at 298 K are -890.3 kJ mol^{-1}, -393.5 kJ mol^{-1} and -285.8 kJ mol^{-1} respectively. Enthalpy of formation of CH_4(g) will be
(a) $+52.26$ kJ mol^{-1} (b) -74.8 kJ mol^{-1}
(c) $+74.8$ kJ mol^{-1} (d) None of these

**28.** Which order is correct for the decreasing reactivity to ring monobromination of the following compound.

$$C_6H_5CH_3 \quad C_6H_5COOH \quad C_6H_6 \quad C_6H_5NO_2$$
$$\text{I} \qquad\qquad \text{II} \qquad\qquad \text{III} \qquad \text{IV}$$

(a) I > II > III > IV   (b) I > III > II > IV
(c) II > III > IV > I   (d) None of these

29. A beam of monochromatic light ($f = 5.09 \times 10^{14}$ hertz) passes through parallel sections of glycerol, medium X, and medium Y as shown in the diagram below.
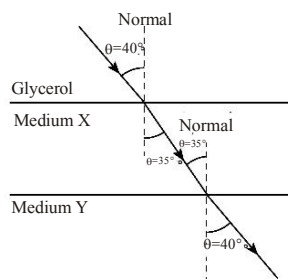

What could medium X and medium Y be?
(a) X could be flint glass and Y could be corn oil.
(b) X could be corn oil and Y could be flint glass.
(c) X could be water and Y could be glycerol.
(d) None of these

30. What is the relationship between the average velocity (v), root mean square velocity (u) and the most probable velocity (α)
(a) $\alpha : v : u :: 1.128 : 1 : 1.224$ (b) $\alpha : v : u :: 1.128 : 1.224 : 1$
(c) $\alpha : v : u :: 1.124 : 1.128 : 1$ (d) None of these

31. The major product obtained when Br_2/Fe is treated with

is
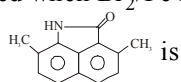
(a) (b) (c) (d) None of these

32. Which statement is a valid conclusion based on the information in the graph below?
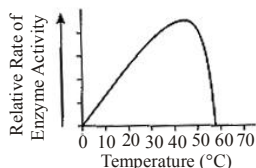
(a) The maximum rate of human digestion occurs at about 45°C.
(b) The maximum rate of human respiration occurs at about 57°C.
(c) Temperature can influence the action of an enzyme
(d) None of these

33. Which statement about enzymes is *not* correct?
(a) Enzymes are composed of polypeptide chains.
(b) Enzymes form a temporary association with a reactant.
(c) Enzymes are destroyed when they are used and must be synthesized for each reaction. (d) None of these

SECTION - C : MATHS

34. At a distance $2x$ from the foot of a tower of height x, the tower and a pole at the top of the tower subtend equal angle. Height of the pole should be
(a) $\dfrac{4x}{3}$ (b) $\dfrac{5x}{3}$ (c) $\dfrac{2x}{3}$ (d) None of these

35. For a symmetrical distribution $Q_1 = 10.9$ and $Q_3 = 29.3$, then the median is
(a) 20 (b) 20.1 (c) 9.2 (d) None of these

36. Two girls appeared in an examination. The probability that first girl will qualify the examination is 0.05 and second girl will qualify the examination is 0.10. The probability that both will qualify the examination is 0.02. Then the probability that the two girls will not qualify the examination is
(a) 0.78 (b) 0.98 (c) 0.87 (d) None of these

37. If $f : R \to R$ and $g : R \to R$ are given by
$f(x) = \sin x$ and $g(x) = 4x^3$ then
(a) fog $\neq$ gof (b) fog=gof (c) fog+gof=0 (d) None of these

38. The value of $\cos^{-1}\left[\cos\left(-\dfrac{17\pi}{15}\right)\right]$ is equal to
(a) $-\dfrac{17\pi}{15}$ (b) $\dfrac{13\pi}{15}$ (c) $-\dfrac{13\pi}{15}$ (d) None of these

39. If e is the eccentricity of $\dfrac{x^2}{a^2} - \dfrac{y^2}{b^2} = 1$ and θ be the angle between the asymptotes then $\tan^2\dfrac{\theta}{2}$ is
(a) e^2 (b) $e^2 - 1$ (c) $e - 1$ (d) None of these

40. If the A.M. of the roots of a quadratic equation is $\dfrac{8}{5}$ and A.M of their reciprocal is $\dfrac{8}{7}$ then the equation is given by
(a) $5x^2 - 16x + 7 = 0$ (b) $7x^2 + 16x + 5 = 0$
(c) $5x^2 - 6x + 5 = 0$ (d) None of these

41. Let $f : [\alpha, \beta] \to R$ be a continuous function on $[\alpha, \beta]$ and differentiable on (α, β). Then there exists some c in (α, β) such that $f'(c)$ is equal to
(a) 0 (b) $\dfrac{f(\alpha) - f(\beta)}{\alpha - \beta}$ (c) $\dfrac{f(\beta) - f(\alpha)}{\beta - \alpha}$ (d) None of these

42. If α, β and γ are the roots of equation $y^3 - 3y^2 + y + 5 = 0$ then $x = \alpha^2 + \beta^2 + \gamma^2 + \alpha\beta\gamma$ satisfies the equation
(a) $x^3 + 2x^2 - x - 3 = 0$ (b) $x^2 - x + 3 = 0$
(c) $x^3 - x^2 - x - 2 = 0$ (d) None of these

43. The coefficient of x^r in $(a + bx + cx^2)\, e^{nx}$ is equal to

(a) $\dfrac{a^r n^r}{r!} + \dfrac{bn^{r-1}}{(r-1)} + \dfrac{cn^{r-2}}{(r-2)!}$

(b) $\dfrac{n^r}{r!} + \dfrac{bn^{r-1}}{(r-1)} + \dfrac{cn^{r-2}}{(r-2)!}$

(c) $\dfrac{an^r}{r!} + \dfrac{bn^{r-1}}{(r-1)!} + \dfrac{cn^{r-2}}{(r-2)!}$

(d) None of these

SECTION - C : BIOLOGY

34. Which statement about genetic disorders in humans is **FALSE**?
   (a) The frequency of the allele for sickle cell anaemia is higher in native populations of wet, tropical countries because carriers have a better chance of surviving malaria.
   (b) Aneuploidies, such as Down syndrome, results from errors in DNA replication during the S phase.
   (c) Colour blindness is rare in females because the condition is recessively inherited and the gene is sex linked.
   (d) None of these

35. A population of mountain goats originally inhabited the foothills of a mountain range. Over many thousands of years, increased competition by a lowland population of yaks drove the goat population to higher altitudes in the mountains. What change in haemoglobin is most likely to be associated with the goat population being physiologically adapted to higher altitudes?
   (a) An increase in the number of haeme groups.
   (b) Higher percentage of O_2 saturation for a given O_2 partial pressure.
   (c) Lower affinity for O_2.   (d) None of these

36. A botanist is having difficulty getting seeds to germinate. What hormone could she apply to the seeds to help induce germination?
   (a) Auxin   (b) Abscisic acid
   (c) Gibberellin   (d) None of these

Base your answers to questions 37 to 38 on the diagram below, which is a concept map that shows the relationship between photosynthesis and respiration.
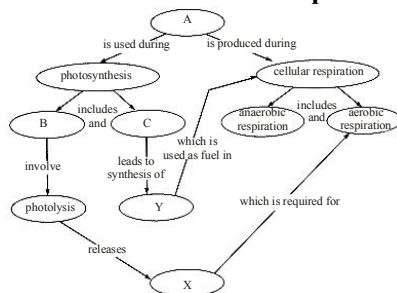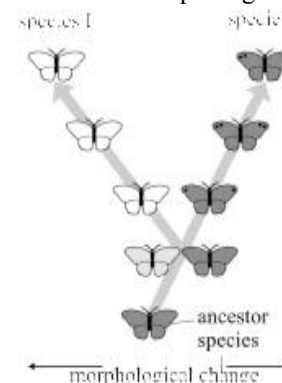

37. Which molecule belongs in area A?
   (a) Adenosine Triphosphate   (b) Deoxyribonucleic acid
   (c) PGAL   (d) None of these

38. Which molecule belongs in area X?
   (a) Lactic acid   (b) Oxygen
   (c) Carbon dioxide   (d) None of these

39. The illustration below shows the morphological change of two species.

Which statement explains why species 1 and species 2 are different?
   (a) An individual changed itself to suit the environment.
   (b) Natural selection can cause gradual speciation changes.
   (c) Interbreeding of species 2 results in no genetic mutations.
   (d) None of these.

Base your answers to question 40 on the diagram below, which represents some components involved in cellular protein synthesis, and on your knowledge of biology.
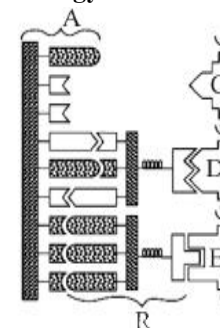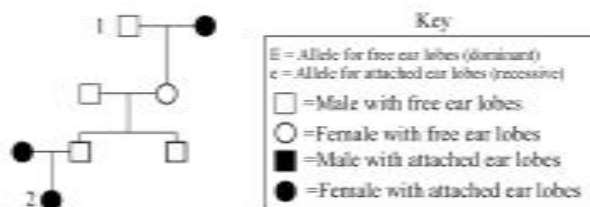

40. Molecules C, D, and E will combine to form part of
   (a) A polypeptide   (b) DNA
   (c) A polysaccharide   (d) None of these

Base your answers to questions 41 on the pedigree chart below, which

shows a history of ear lobe shape, and on your knowledge of biology.

41. The genotype of individual 1 could be
(a) *EE,* only (b) *Ee*, only (c) *EE* or *Ee* (d) None of these

42. Which statement about water transport in plants is false**?**
(a) Root pressure alone is insufficient to explain water transport in plants.
(b) Water moves from a cell with higher (less negative) water potential to a cell with lower (more negative) water potential.
(c) The transport of water is carried out by the xylem which consists of sieve-tube cells and companion cells.
(d) None of these.

43. Which of the following pairs does not match?
(a) Ozone shield depletion– increased radiation reaching the surface of Earth
(b) Greenhouse effect – rise in atmospheric CO_2
(c) Eutrophication – decreased net primary productivity
(d) None of these

SECTION - D : INTERACTIVE SECTION

These questions are designed that they can be performed in the class / lab and can be used by the Coordinator Teacher to enhance

44. The diagram shows a student seated on a rotating circular platform, holding a 2.0-kilogram block with a spring scale. The block is 1.2 meters from the centre of the platform. The block has a constant speed of 8.0 meters per second. [Frictional forces on the block are negligible].
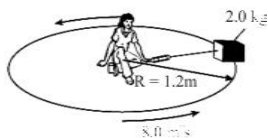
Which statement best describes the block's movement as the platform rotates?
(a) Its velocity is directed tangent to the circular path, with an inward acceleration.
(b) Its velocity is directed tangent to the circular path, with an outward

acceleration.
(c) Its velocity is directed perpendicular to the circular path, with an outward acceleration.
(d) None of these

Base your answers to questions 45 and 46 on the information and diagram below.
The diagram shows a compressed spring between two carts initially at rest on a horizontal frictionless surface. Cart *A* has a mass of 2 kilograms and cart *B* has a mass of 1 kilogram. A string holds the carts together.
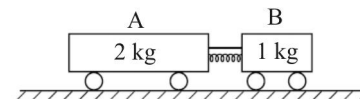
45. What occurs when the string is cut and the carts move apart?
(a) The magnitude of the acceleration of cart *A* is one-half the magnitude of the acceleration of cart *B*.
(b) The length of time that the force acts on cart *A* is twice the length of time the force acts on cart *B*.
(c) The magnitude of the force exerted on cart *A* is one-half the magnitude of the force exerted on cart *B*.
(d) None of these

46. An incandescent light bulb is supplied with a constant potential difference of 120 volts. As the filament of the bulb heats up, its resistance
(a) Increases and the current through it decreases
(b) Increases and the current through it increases
(c) Decreases and the current through it decreases
(d) None of these

47. The diagram below represents monochromatic light incident on a pair of slits, S_1 and S_2, that are separated by a distance of 2×10^{-6} meter. *A*, *B*, and *C* are adjacent antinodal areas that appear on a screen 1.0 meter from the slits. The distance from *A* to *B* is 0.34 meter.
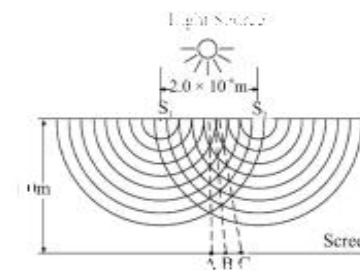
What is the wavelength of the incident light?
(a) 6.8×10^{-7}m   (b) 1.7×10^{5} m

(c) 5.9×10^{-6}m   (d) None of these

48. Read the following text and answer the question that follows.

The salt treatment with dil. HCl gives a pungent smelling gas and a yellow precipitate. The salt gives green flame when tested. The salt solution gives a yellow precipitate with potassium chromate. The salt is

(a) $NiSO_4$ (b) BaS_2O_3 (c) PbS_2O_3 (d) None of these

49. Read the passage below and answer the question that follows.

A yellow colouration or precipitation is obtained when phosphate salts are boiled with nitric acid and then treated with ammonium molybdate. The yellow colouration or precipitation is due to the formation of

(a) $(NH_4)_3\ PO_4 . 12MoO_3$ (b) $(NH_4)_2\ PO_4 . 12MoO_3$
(c) $(NH_4)_3\ PO_4 . 13MoO_3$ (d) None of these

50. The diagram below represents shallow water waves of wavelength, passing through two small openings, A and B, in a barrier.
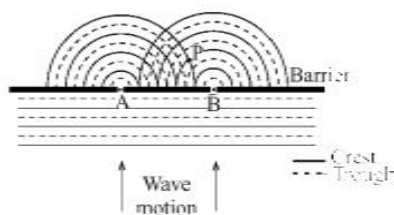
How much longer is the length of path AP than the length of path BP?

(a) 1λ (b) 2λ (c) 3λ (d) None of these

☺ END OF THE EXAM ☺

ANSWERS

1. (c)	**2.** (a)	**3.** (c)	**4.** (c)	**5.** (c)
6. (c)	**7.** (a)	**8.** (c)	**9.** (b)	**10.** (b)
11. (a)	**12.** (a)	**13.** (b)	**14.** (b)	**15.** (b)
16. (a)	**17.** (a)	**18.** (a)	**19.** (b)	**20.** (c)
21. (b)	**22.** (b)	**23.** (b)	**24.** (a)	**25.** (a)
26. (a)	**27.** (b)	**28.** (b)	**29.** (a)	**30.** (d)
31. (a)	**32.** (c)	**33.** (c)	**34.** (b)	**35.** (b)
36. (c)	**37.** (a)	**38.** (b)	**39.** (b)	**40.** (a)
41. (c)	**42.** (c)	**43.** (c)	**44.** (c)	**45.** (a)
46. (a)	**47.** (a)	**48.** (b)	**49.** (a)	**50.** (b)

☺☺☺