YOUNG SCIENTIST ACTIVITY BOOK

CLASS - XI

Sample Pages

EDUHEAL FOUNDATION

• LEARNING FOR LIFE •

DISCOVER ● INVENT ● EXPERIMENT ● EXPLORE

CLASS - XI

SYLLABUS GUIDELINES

PHYSICS

Physical World and Measurement

Physics - scope and excitement; nature of physical laws; Physics, technology and society. Need for measurement: Units of measurement; systems of units; SI units, fundamental and derived units. Length, mass and time measurements; accuracy and precision of measuring instruments; errors in measurement; significant figures. Dimensions of physical quantities, dimensional analysis and its applications.

Kinematics

Frame of reference. Motion in a straight line: Position-time graph, speed and velocity. Uniform and non-uniform motion, average speed and instantaneous velocity. Uniformly accelerated motion, velocity-time, position-time graphs, relations for uniformly accelerated motion (graphical treatment). Elementary concepts of differentiation and integration for describing motion. Scalar and vector quantities: Position and displacement vectors, general vectors and notation, equality of vectors, multiplication of vectors by a real number; addition and subtraction of vectors. Relative velocity. Unit vector; Resolution of a vector in a plane - rectangular components. Motion in a plane. Cases of uniform velocity and uniform acceleration-projectile motion. Uniform circular motion.

Laws of Motion

Intuitive concept of force. Inertia, Newton's first law of motion; momentum and Newton's second law of motion; impulse; Newton's third law of motion. Law of conservation of linear momentum and its applications. Equilibrium of concurrent forces. Static and kinetic friction, laws of friction, rolling friction. Dynamics of uniform circular motion: Centripetal force, examples of circular motion (vehicle on level circular road, vehicle on banked road).

Work, Energy and Power

Scalar product of vectors. Work done by a constant force and a variable force; kinetic energy, work-energy theorem, power. Notion of potential energy, potential energy of a spring, conservative forces: conservation of mechanical energy (kinetic and potential energies); non-conservative forces: elastic and inelastic collisions in one and two dimensions.

Motion of System of Particles and Rigid Body

Centre of mass of a two-particle system, momentum conversation and centre of mass motion. Centre of mass of a rigid body; centre of mass of uniform rod. Vector product of vectors; moment of a force, torque, angular momentum, conservation of angular momentum with some examples. Equilibrium of rigid bodies, rigid body rotation and equations of rotational motion, comparison of linear and rotational motions; moment of inertia, radius of gyration. Values of moments of inertia for simple geometrical objects (no derivation). Statement of parallel and perpendicular axes theorems and their applications.

Gravitation

Keplar's laws of planetary motion. The universal law of gravitation. Acceleration due to gravity and its variation with altitude and depth. Gravitational potential energy; gravitational potential. Escape velocity. Orbital velocity of a satellite. Geo-stationary satellites.

Properties of Bulk Matter

Elastic behaviour, Stress-strain relationship, Hooke's law, Young's modulus, bulk modulus, shear, modulus of rigidity. Pressure due to a fluid column; Pascal's law and its applications (hydraulic lift and hydraulic brakes). Effect of gravity on fluid pressure. Viscosity, Stokes' law, terminal velocity, Reynold's number, streamline and turbulent flow. Bernoulli's theorem and its applications.

Surface energy and surface tension, angle of contact, application of surface tension ideas to drops, bubbles and capillary rise. Heat, temperature, thermal expansion; specific heat - calorimetry; change of state - latent heat. Heat transfer-conduction, convection and radiation, thermal conductivity, Newton's law of cooling.

Thermodynamics

Thermal equilibrium and definition of temperature (zeroth law of thermodynamics). Heat, work and internal energy. First law of thermodynamics. Second law of thermodynamics: reversible and irreversible processes. Heat engines and refrigerators.

Behaviour of Perfect Gas and Kinetic Theory

Equation of state of a perfect gas, work done on compressing a gas. Kinetic theory of gases - assumptions, concept of pressure. Kinetic energy and temperature; rms speed of gas molecules; degrees of freedom, law of equipartition of energy (statement only) and application to specific heats of gases; concept of mean free path, Avogadro’s number.

Oscillations and Waves

Periodic motion - period, frequency, displacement as a function of time. Periodic functions. Simple harmonic motion (S.H.M) and its equation; phase; oscillations of a spring–restoring force and force constant; energy in S.H.M.-kinetic and potential energies; simple pendulum–derivation of expression for its time period; free, forced and damped oscillations (qualitative ideas only), resonance.

Wave motion. Longitudinal and transverse waves, speed of wave motion. Displacement relation for a progressive wave. Principle of superposition of waves, reflection of waves, standing waves in strings and organ pipes, fundamental mode and harmonics, Beats, Doppler effect.

CHEMISTRY

Some Basic Concepts of Chemistry

General Introduction: Importance and scope of chemistry. Historical approach to particulate ature of matter, laws of chemical combination. Dalton’s atomic theory: concept of elements, atoms and molecules. Atomic and molecular masses. Mole concept and molar mass: percentage composition, empirical and molecular formula; chemical reactions, stoichiometry and calculations based on stoichiometry.

Structure of Atom

Discovery of electron, proton and neutron; atomic number, isotopes and isobars. Thomson’s model and its limitations, Rutherford’s model and its limitations. Bohr’s model and its limitations, concept of shells and subshells, dual nature of matter and light, De Broglie’s relationship, Heisenberg uncertainty principle, concept of orbitals, quantum numbers, shapes of s, p, and d orbitals, rules for filling electrons in orbitals - Aufuau principle, Pauli exclusion principle and Hund’s rule, electronic configuration of atoms, stability of half filled and completely filled orbitals.

Classification of Elements and Periodicity in Properties

Significance of classification, brief history of the development of periodic table, modern periodic law and the present form of periodic table, periodic trends in properties of elements -atomic radii, ionic radii, inert gas radii. Ionization enthalpy, electron gain enthalpy, electro negativity, valence.

Chemical Bonding and Molecular Structure

Valence electrons, ionic bond, covalent bond: bond parameters. Lewis structure, polar character of covalent bond, covalent character of ionic bond, valence bond theory, resonance, geometry of covalent molecules, VSEPR theory, concept of hybridization, involving s, p and d orbitals and shapes of some simple molecules, molecular orbital; theory of homo nuclear diatomic molecules (qualitative idea only), hydrogen bond.

States of Matter: gases and liquids

Three states of matter. Intermolecular interactions, type of bonding, melting and boiling points. Role of gas laws in elucidating the concept of the molecule, Boyle’s law. Charles law, Gay Lussac’s law, Avogadro’s law. Ideal behaviour, empirical derivation of gas equation, Avogadro’s number. Ideal gas equation. Derivation from ideal behaviour, liquefaction of gases, critical temperature.

Liquid State - Vapour pressure, viscosity and surface tension (qualitative idea only, no mathematical derivations).

Thermodynamics

Concepts Of System, types of systems, surroundings. Work, heat, energy, extensive and intensive properties, state functions. First law of thermodynamics - internal energy and enthalpy, heat capacity and specific heat, measurement of ΔU and ΔH, Hess's law of constant heat summation, enthalpy of: bond dissociation, combustion, formation, atomization, sublimation. Phase transition, ionization, and dilution. Introduction of entropy as a state function, free energy change for spontaneous and nonspontaneous process, equilibrium.

Equilibrium

Equilibrium in physical and chemical processes, dynamic nature of equilibrium, law of mass action, equilibrium constant, factors affecting equilibrium - Le Chatelier's principle; ionic equilibrium - ionization of acids and bases, strong and weak electrolytes, degree of ionization, concept of pH. Hydrolysis of salts (elementary idea). Buffer solutions, solubility product, common ion effect (with illustrative examples).

Redox Reactions

Concept of oxidation and reduction, redox reactions, oxidation number, balancing redox reactions, applications of redox reactions.

Hydrogen

Position of hydrogen in periodic table, occurrence, isotopes, preparation, properties and uses of hydrogen; hydrides - ionic, covalent and interstitial; physical and chemical properties of water, heavy water; hydrogen peroxide-preparation, reactions and structure; hydrogen as a fuel.

s-Block Elements (Alkali and Alkaline earth metals)

Group 1 and Group 2 elements:

General introduction, electronic configuration, occurrence, anomalous properties of the first element of each group, diagonal relationship, trends in the variation of properties (such as ionization enthalpy, atomic and ionic radii), trends in chemical reactivity with oxygen, water, hydrogen and halogens; uses.

Preparation and properties of some important compounds:

Sodium carbonate, sodium chloride, sodium hydroxide and sodium hydrogen carbonate, biological importance of sodium and potassium. CaO, CaCO3 and industrial use of lime and limestone, biological importance of Mg and Ca

Some p-Block Elements

General Introduction to p-Block Elements

Group 13 elements: General introduction, electronic configuration, occurrence. Variation of properties, oxidation states, trends in chemical reactivity, anomalous properties of first element of the group; Boron- physical and chemical properties, some important compounds: borax, boric acids, boron hydrides. Aluminium: uses, reactions with acids and alkalies.

Group 14 elements: General introduction, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous behaviour of first element, Carbon - catenation, allotropic forms, physical and chemical properties; uses of some important compounds: oxides.

Important compounds of silicon and a few uses: silicon tetrachloride, silicones, silicates and zeolites.

Organic Chemistry - Some Basic Principles and Techniques

General introduction, method, qualitative and quantitative analysis, classification and IUPAC nomenclature of organic compounds Electronic displacements in a covalent bond: inductive effect, electromeric effect, resonance and hyper conjugation. Homolytic and heterolytic fission of a covalent bond: free radicals, carbocations, carbanions; electrophiles and nucleophiles, types of organic reactions

Hydrocarbons

Classification of hydrocarbons

Alkanes - Nomenclature, isomerism, conformations (ethane only), physical properties, chemical reactions including free radical mechanism or halogenation, combustion and pyrolysis.

Alkenes - Nomenclature, structure of double bond (ethene) geometrical isomerism, physical properties, methods of preparation; chemical reactions: addition of hydrogen, halogen, water, hydrogen halides (Markovnikov's addition and peroxide effect), ozonolysis, oxidation, mechanism of electrophilic addition.

Alkynes - Nomenclature, structure of triple bond (ethyne), physical properties. Methods of preparation, chemical reactions: acidic character of alkynes, addition reaction of - hydrogen, halogens, hydrogen halides and water.

Aromatic hydrocarbons: Introduction, IUPAC nomenclature; Benzene: resonance aromaticity ; chemical properties: mechanism of electrophilic substitution. – nitration sulphonation, halogenation, Friedel Craft's alkylation and acylation: directive influence of functional group in mono-substituted benzene; carcinogenicity and toxicity.

Environmental Chemistry

Environmental pollution - air, water and soil pollution, chemical reactions in atmosphere, smog, major atmospheric pollutants; acid rain, ozone and its reactions, effects of depletion of ozone layer, greenhouse effect and global warming - pollution due to industrial wastes; green chemistry as an alternative tool for reducing pollution, strategy for control of environmental pollution.

BIOLOGY

I Diversity in Living World

Diversity of living organisms

Classification of the living organisms (five kingdom classification, major groups and principles of classification within each kingdom). Systematics and binomial System of nomenclature Salient features of animal (non chordates up to phylum level and chordates up to class level) and plant (major groups; Angiosperms up to subclass) classification. Botanical gardens, herbaria, zoological parks and museums.

II Structural Organisation in Animals and Plants

Tissues in animals and plants. Morphology, anatomy and functions of different parts of flowering plants: Root, stem, leaf, inflorescence, flower, fruit and seed. Morphology, anatomy and functions of different systems of an annelid (earthworm), an insect (cockroach) and an amphibian (frog).

III CELL: STRUCTURE AND FUNCTION

Cell: cell wall, cell membrane and cell organelles' (plastids, mitochondria, endoplasmic reticulum, Golgi bodies/ dictyosomes, ribosomes, lysosomes, vacuoles, centrioles) and nuclear organization.

Mitosis, meiosis, cell cycle. Basic chemical constituents of living bodies. Structure and functions of carbohydrates, proteins, lipids and nucleic acids. Enzymes: types, properties and function.

IV Plant Physiology

Movement of water, food, nutrients and gases, Plants and Water Mineral nutrition, Respiration, Photosynthesis, Plant growth and development.

V Human Physiology

Digestion and absorption.

Breathing and respiration.

Body fluids and circulation.

Excretory products and elimination.

Locomotion and movement.

Control and coordination.

Trick Birthday Candles

Have you ever seen a trick candle? You blow it out and it 'magically' re-lights itself in a few seconds, usually accompanied by a few sparks. The difference between a normal candle and a trick candle is what happens just after you blow it out. When you blow out a normal candle, you will see a thin ribbon of smoke rise up from the wick. This is vaporized paraffin (candle wax). The wick ember you get when you blow out the candle is hot enough to vaporize the paraffin of the candle, but it isn't hot enough to re-ignite it. If you blow across the wick of a normal candle right after you blow it out, you might be able to get it to glow red-hot, but the candle won't burst into flame.

Trick candles have a material added to the wick that is capable of being ignited by the relatively low temperature of the hot wick ember.

When a trick candle is blown out, the wick ember ignites this material, which burns hot enough to ignite the paraffin vapour of the candle. The flame you see in a candle is burning paraffin vapour.

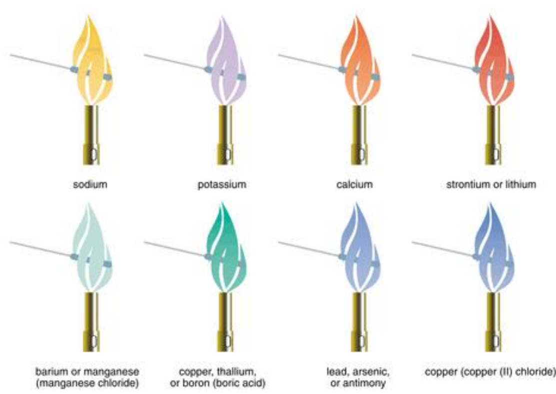
What substance is added to the wick of a magic candle? It's usually fine flakes of the metal magnesium. It doesn't take too much heat to make magnesium ignite (800° F or 430° C), but the magnesium itself burns white-hot and readily ignites the paraffin vapour. When a trick candle is blown out, the burning magnesium particles appear as tiny sparks in the wick. When the 'magic' works, one of these sparks ignites the paraffin vapour and the candle starts to burn normally again. The magnesium in the rest of the wick doesn't burn because the liquid paraffin isolates it from oxygen and keeps it cool.

So next time when you cut your birthday cake surprise all guest with your magical candle.

Trial by Fire

What is the flame test?

Have you ever noticed that some substances give characteristic smell or colour when burnt. This property is used by scientists to recognise the unknown metal in an ionic salt. This type of testing is called flame test.



The flame test is used to visually determine the identity of an unknown metal of an ionic salt based on the characteristic colour the salt turns the flame of a bunsen burner.

How is the test performed?

First, you need a clean wire loop! Platinum or nickel-chromium loops are most common. They may be cleaned by dipping in hydrochloric or nitric acid, followed by rinsing with distilled or deionized water. Test the cleanliness of the loop by inserting it into a bunsen burner flame. If a burst of colour is produced, the loop was not sufficiently clean. Ideally, a separate loop is used for each sample to be tested, but a loop may be carefully cleaned between tests.

The clean loop is dipped in either a powder or solution of an ionic (metal) salt. The loop with sample is placed in the clear or blue part of the flame and the resulting colour is observed.

What metals do colours indicate?

Colour	Metal
Red	Carmine: Lithium compounds, masked by barium or sodium. Scarlet or Crimson: Strontium compounds, masked by barium. Yellow-Red: Calcium compounds masked by barium.
Yellow	Sodium compounds, even in trace amounts. A yellow flame is not indicative of sodium unless it persists and is not intensified by addition of 1% NaCl to the dry compound.
White	White-Green: Zinc
Green	Emerald: Copper compounds, other than halides. Thallium. Blue-Green: Phosphates, when moistened with H_2SO_4 or B_2O_3. Faint Green: Antimony and NH_4 compounds. Yellow-Green: Barium, molybdenum.
Blue	Azure: Lead, selenium, bismuth, $CuCl_2$ and other copper compounds moistened with hydrochloric acid. Light Blue: Arsenic and some of its compounds. Greenish Blue: $CuBr_2$, antimony
Violet	Potassium compounds other than borates, phosphates, and silicates. Masked by sodium or lithium. Purple-Red: Potassium, rubudium, and/or cesium in the presence of sodium when viewed through a blue glass.

What are the limitations of this test?

There are some limitation of this test hence this is also performed as preliminary test. The value of the flame test is limited by interference from other brighter colours and by ambiguities where certain different metals cause the same flame colour. Sodium, in particular, is present in most compounds and will colour the flame. Sometimes a coloured glass is used to filter out light from one metal. Cobalt glass is often used to filter out the yellow of sodium.

A Spoiled Fruit

You must have heard the saying, 'one bad apple spoils the whole bushel'? It's true. Bruised, damaged, or overripe fruit gives off a hormone that accelerates the ripening of the other fruit.

Plant tissues communicate by means of hormones. Hormones are chemicals that are produced in one location that have an effect on cells in a different location. Most plant hormones are transported through the plant vascular system, but some, like ethylene, are released into the gaseous phase, or air.

Ethylene is produced and released by rapidly-growing plant tissues. It is released by the growing tips of roots, flowers, damaged tissue, and ripening fruit. The hormone has multiple effects on plants. One is fruit ripening. When fruit ripens, the starch in the fleshy part of the fruit is converted to sugar. The sweeter fruit is more attractive to animals, so they will eat it and disperse the seeds. Ethylene initiates the reaction in which the starch is converted into sugar.

Iodine solution binds to starch, but not to sugar, forming a dark-coloured complex. You can estimate how ripe a fruit is, by whether or not it darkens after painting with an iodine solution. Unripe fruit is starchy so it will be dark. The more ripe the fruit is, the more starch will have been converted to sugar. Less iodine complex will be formed, so the stained fruit will be lighter.

Materials

- 8 sealable plastic bags, large enough to contain a whole apple and banana
- 4 ripe bananas
- 8 unripe pears or 8 unripe apples (pears usually are sold unripe, so they may be a better choice than apples)

- potassium iodide (KI)
- iodine (I)
- distilled water
- graduated cylinders
- large brown glass or plastic bottle (not metal)
- shallow glass or plastic tray or dish (not metal)
- knife for cutting fruit

Prepare the Test & Control Groups

1. If you are not sure your pears or apples are unripe, test one using the staining procedure outlined below before continuing.
2. Label the bags, numbers 1-8. Bags 1-4 will be the control group. Bags 5-8 will be the test group.
3. Place one unripe pear or apple in each of the control bags. Seal each bag.
4. Place one unripe pear or apple and one banana in each of the test bags. Seal each bag.
5. Place the bags together. Record your observations of the initial appearance of the fruit.
6. Observe and record the changes to the appearance of the fruit each day.
7. After 2-3 days, test the pears or apples for starch by staining them with the iodine stain.

Precautions

- Do not use metal utensils or containers for preparing or for storing the iodine solutions. Iodine is corrosive to metals.
- The iodine solutions will stain skin and clothing so handle carefully.

Make the Iodine Stain Solution

1. Dissolve 10 g potassium iodide (KI) in 10 ml of water
2. Stir in 2.5 g iodine (I)
3. Dilute the solution with water to make 1.1 litres
4. Store the iodine stain solution in a brown or blue glass or plastic bottle. It should last for several days.

Stain the Fruit

1. Pour the iodine stain into the bottom of the shallow tray, so that it fills the tray about half a centimetre deep.
2. Cut the pear or apple in half (cross section) and set the fruit into the tray, with the cut surface in the stain.
3. Allow the fruit to absorb the stain for one minute.
4. Remove the fruit and rinse the fruit with water. Record the data for the fruit, then repeat the procedure for the other apples/pears.
5. Add more stain to the tray, as needed.

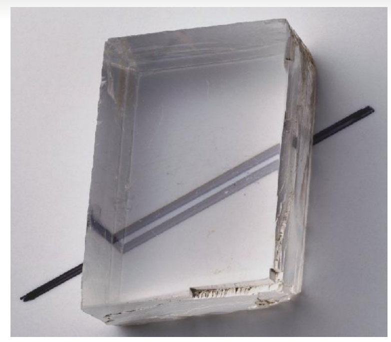
Fruit Ripening Experiment - Analyze the Data

Examine the stained fruit. The best way to compare the data is to set up some sort of scoring. Compare the levels of staining for unripe versus ripe fruit. The unripe fruit should be heavily stained, while fully ripe or rotting fruit should be unstained. How many levels of staining can you distinguish between the ripe and unripe fruit?

Test Your Hypothesis

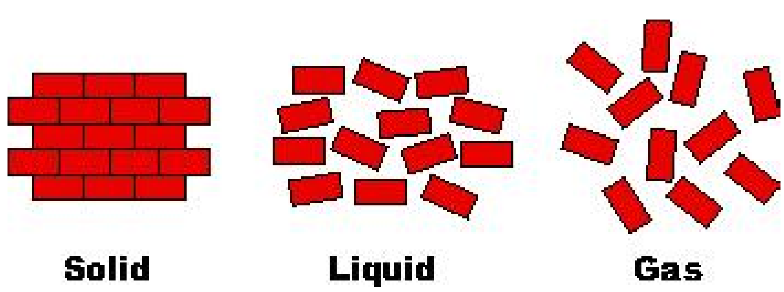
If the ripening of the fruit was unaffected by storing it with a banana, then both the control and test groups should have the same level of ripeness.

What makes glass transparent?



Glass is so common that most of us take it completely for granted. But just what is it about glass that makes it transparent? Why can we see through a window and not through the wooden frame that surrounds it?

You have probably noticed that most liquids and gases are transparent. Water, cooking oil, rubbing alcohol, air, natural gas, etc. are all clear. That's because of a fundamental difference between **solids**, **liquids** and **gases**. When a substance is in its solid state, normally its molecules are highly organized in relation to one another, strengthening the bond between them and giving the substance rigidity. As the substance changes from a solid to a liquid, however, the strength of the bond lessens and the molecules begin to align themselves randomly. If we follow the substance's progression to a gas, we see that the molecular bond is greatly weakened and the relationship of the molecules to one another is almost completely random.



This progression from ordered to random organization is the primary reason that light can pass through liquids and gases. Just like bricks stacked neatly on top of one another, the ordered molecules of most solids are virtually impenetrable to light waves. Depending on the substance, the light waves will be reflected, scattered, absorbed or, more likely, some combination of the three. But as the substance changes to liquid or gas and the molecules are not stacked neatly anymore, gaps and holes occur that allow portions of the light waves to pass through. The greater the randomness of the molecular organization of the substance, the easier it is for the light to pass through.

Another factor happens at the **sub-atomic level**. The atoms that bind together to make the molecules of any particular substance have electrons, usually lots of them. When photons come in contact with these electrons, the following can occur:

- An electron absorbs the energy of the photon and transforms it (usually into heat)
- An electron absorbs the energy of the photon and stores it (this can result in **luminescence**, which is called fluorescence if the electron stores the energy for a short time and phosphorescence if it stores it for long time)
- An electron absorbs the energy of the photon and sends it back out the way it came in (reflection)
- An electron cannot absorb the energy of the photon, in which case the photon continues on its path (transmitted)

Most of the time, it is a combination of the above that happens to the light that hits an object. The electrons in different materials vary in the range of energy that they can absorb. For example, a lot of glass, blocks out **ultraviolet** (UV) light. What happens is the electrons in the glass absorb the energy of the photons in the UV range while ignoring the weaker energy of photons in the visible light spectrum. If the electrons absorb the energy of any portion of the visible spectrum, the light that transmits through will appear coloured according to the portion of the spectrum absorbed. In fact, the colour of any object is a direct result of what levels of energy the electrons in the substance will absorb!

Although forms of glass, such as **obsidian** or **volcanic glass**, can occur naturally. Glass is generally a manmade substance. Here is the basic way to make glass:

- Take the most common glass material, **silica**, which is just plain old sand like you would find on the beach.
- Heat it to an extreme temperature until it becomes liquid, then cool it.

The resulting substance has a molecular structure that is very random like a liquid yet that retains the strong bond and rigidity of a solid. This is a simplification of the process. Usually you add both a substance to make the silica melt quicker and something else to stabilize it so that the glass is not brittle and easily broken. The temperature, heating time and cooling method must all be very exact.

The materials used for glass-making cool to form an amorphous mix of molecules (like a liquid) and have electrons that do not absorb the energy of photons in the visible spectrum. This is why you can see through glass, but not wood, metal or stone, which are all solids.

A similar method, called **quenching**, is used with plastics to make them transparent or translucent. Quenching causes the **polymers** (long-chain molecules) in the plastic to settle into a random pattern that allows light to pass through. You can even use this process with organic substances. Clear or translucent candy is created by heating the ingredients of the recipe and then rapidly cooling them.

Notice that clear glass, clear plastic and clear candy are all solids that are melted and then cooled in the same process!

Thousands of different substances are used to make various forms of glass. How much and what type of light is transmitted depends on the type and purity of the substance used. Silica, in its purest form, transmits light well. Very little of the light wave is absorbed, but some of it is usually reflected. Look at almost any window and you will see this is true.

Other materials used to make glass may transmit or block specific types of light, such as **ultraviolet light**, or even parts of the visible spectrum. You have probably seen glass that was black or some other opaque colour. Most often the colour is caused by microscopic particles suspended in the glass, like the impurities we talked about in some liquids and gases. Another way to change the properties of the glass, such as filtering specific wavelengths of light, is to slow down the cooling process enough to allow the molecules to partially crystallize, or form pattern. And finally, some materials are chosen because they can be shaped and made to transmit and/or refract light in specific ways to use, for instance, as eyeglass lenses or as a magnifying glass.

Nationwide Interactive Science Olympiad, 2007

Sample Paper

SCIENCE

1. A person sitting in an open car at constant velocity throws a ball vertically up into the air. The ball falls
   (a) in the car behind the person
   (b) in the car ahead of the person
   (c) outside the car
   (d) exactly in the hand which threw it up.

2. A bullet of mass 0.1 kg is fired with a speed of 100 m/s, the mass of gun being 50 kg. The velocity of recoil is
   (a) 0.5 m/s (b) 0.1 m/s (c) 0.2 m/s (d) 0.05 m/s.

3. The electrical conductivity of earth's atmosphere increases with altitude due to
   (a) refraction of atmosphere (b) ionization of atmosphere
   (c) radiation of atmosphere (d) reflection of atmosphere.

4. The boiling point of water is exceptionally high because
   (a) there is covalent bond between H and O
   (b) water molecules associate due to hydrogen bonding
   (c) water molecule is not linear
   (d) water molecule is linear

5. Compressed air in the tube of a wheel of a cycle at normal temperature suddenly starts coming out from a puncture. The air inside
   (a) starts becoming hotter
   (b) remains at the same temperature
   (c) starts becoming cooler
   (d) may become hotter or cooler depending upon the amount of water vapour present.

6. A medium is said to be dispersive if
   (a) light of different wavelength propagate at different speeds
   (b) light of different wavelength propagate at same speed but has different frequencies
   (c) light is gradually bent rather than sharply refracted at an interface between the medium and air
   (d) light is never totally reflected internally.

7. Ampere hour is a unit of
   (a) quantity of electricity (b) strength of current
   (c) power (d) energy.

8. The metal purifies by *Zone refining* is
   (a) Sb (b) Ge (c) Hg (d) Sn

9. At what position, the value of g is minimum?
   (a) at the centre of the earth
   (b) in an aeroplane at a height of 2 km
   (c) in a mine which is 3 km deep
   (d) on the surface of the earth.

10. Which one is called king of chemicals
   (a) Oil of vitriol (b) Nitric acid + H_2SO_4
   (c) Aqua regia (d) None of these

11. At ordinary temperature and pressure, graphite is .... stable than diamond.
   (a) more (b) less (c) equal (d) slight less.

12. Which metal is heavist (dense) in periodic table
   (a) Os (b) Pt (c) Pb (d) W

13. Which element does not follow Aufbau's principle?
   (a) Mo(at.no.42) (b) Pd(at.no.46)
   (c) Ag (at.no.47) (d) All

14. pH of 10^{-8} m acid solution is

(a) 6.96 (b) 8.0 (c) 7.63 (d) 1.0

15. The species in which the central atom uses sp^2 hybrid orbital is

(a) PH_3 (b) SO_2 (c) SbH_3 (d) $\overline{C}H_3$

MENTAL ABILITY

16. A placed three sheets with two carbons to get two extra copies of the original. Then he decided to get more carbon copies and folded the paper in such a way that the upper half of the sheets were on top of the lower half. Then he typed. How many carbon copies did he get?

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

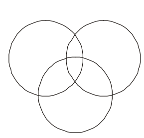
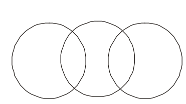
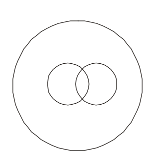
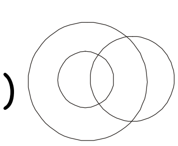
17. **Direction :** Study the following number sequence and answer the question given below it :

How many odd numbers are there in the sequence which are immediately followed by an odd number?

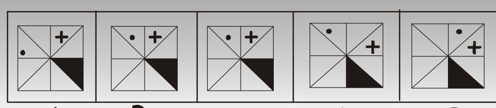
5 1 4 7 3 9 8 5 7 2 6 3 1 5 8 6 3 8 5 2 2 4 3 4 9 6

(a) 1 (b) 2 (c) 3 (d) more than 4

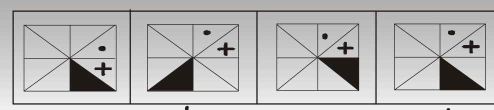
18. Which is the most suitable Venn diagram among the following, which represents interrelationship among **Antisocial elements, Pick pockets and Black mailers?**

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

Direction : In the following question consist of five figures marked A, B, C, D and E called the problem figure followed by five other figures marked 1, 2, 3, 4 and 5 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.

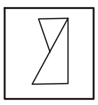
19. 

A B C D E

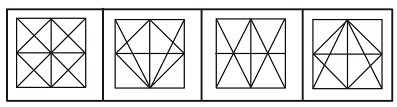


a b c d

Direction : In the each question below, you are given a figure (X) followed by four figures (a), (b), (c) and (d) such that (X) is embedded in one of them. Trace out the correct alternative.

20. 

(X)



a b c d

COMPUTER

21. Which command is used to copy all files from drive A with extension. TXT to the currently logged drive and directory?
(a) COPY a : *TXT (b) COPY *.TXT A:
(c) COPY *. TXT C : (d) COPY *TXT ALL.TXT

22. An instruction is selected by the .... register, read into the ....register, and interpreted by the.............................. register. The three missing terms in order are
(a) Sequence, instruction, decoder
(b) Address, storage, accumulator
(c) Decoder, address, storage
(d) Decoder, accumulator, address

23. Pick up the wrong statement about program flow chart
(a) It is a detailed picture of how steps are to be performed within a CPU to produce the needed output
(b) It enhances communication and understanding
(c) It is better able to express the total sequence of events to solve a problem
(d) It is a powerful tool for defining complex program logic.

24. Match the following Boolean expressions with their propositional forms.

(1) Y	A. Has either multimedia or internet
(2) X + Y	B. Does not have multimedia and internet
(3) (X•Y)'	C. Has internet

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

25. A library charges a fine for books returned late. Following are the fines :

First five days	:	40 paise per day
Six to ten days	:	65 paise per day
Above ten days	:	80 paise per day

A program in BASIC is designed to calculate the fine assuming that a book is returned N days late as given below.

```
10  INPUT "no. of days"; N
20  If N , = 5 Then F = 40 * 5
30  If N > 5 and N < = 10 Then
    F = 40 * 5 + (N – 5) * 65
40  If N > 10 Then F = 40 * 5 + 65 + 5 + (N – 10) * 80
50  PRINT " Fine = "; F
60 END
```

Is the given program written in BASIC correct?

(a) Yes (b) No
(c) Can't say (d) Information incomplete

Answer key :-

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