Subject: SCIENCE

Subject Code: 086

Day & Date of the Examination: 03.03.2015, Tuesday

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Person with Disabilities: No

If physically challenged, tick the category:

B = Visually Impaired, D = Deaf, H = Handicapped, S = Speech Impaired
C = Cerebral Palsy, A = Autistic

Whether writer provided: No

If Visually challenged, name of software used:

Note: Each letter be written in one box and one box be left blank between each part of the name. In case Candidate’s Name exceeds 24 letters, write first 24 letters.
1) \[ \text{H - C - C - C - H} \text{ No. of covalent bonds} = 10 \]

2) The DNA is found in the nucleus of a cell.

3) Green plants are considered to be producers of food. They convert simple inorganic raw materials to complex organic substances (sugar & starch) in the presence of sunlight and chlorophyll. Hence, the green plants (capable of synthesizing their own food) are placed in the first trophic level.

4) \[ \frac{4}{3} = \text{speed of light in vacuum} \]
\[ \frac{4}{3} \times 2 \times 10^8 = \text{speed of light in glass} \]
\[ \frac{1}{2} \times 2 \times 10^8 = \text{speed of light in vacuum} \]
9) \[ 2.67 \times 10^8 = \text{speed of light in vacuum} \]

10) \[ \frac{3}{2} = \text{speed of light in vacuum} \]
\[ \frac{1.77}{916} \]
\[ \text{speed of light in water} \]
\[ \frac{\text{speed of light in vacuum} \times 2}{3} = \text{speed of light in water} \]
\[ \frac{8 \times 10^8 \times 2}{3} = \text{speed of light in water} \]
\[ \frac{1.78 \times 10^8}{70} \]
\[ = 1.78 \times 10^8 \text{ m/s} \]

5) Encourage the use of composting (or) vermi-composting.

- Spreading awareness about the diseases spread due to improper disposal of wastes and the breeding of mosquitoes.
- Holding staged shows to demonstrate safer ways of disposal and discussing about the health problems (malaria, dengue, jaundice) etc which may arise if harmful pathogens enter our body.
- Organizing clubs and campaigns to clean the neighbourhood every week.
- Encourage the Rs - Recycle, Reuse, Reduce to protect the environment.
- Segregating bio-degradable & non-biodegradable wastes.
- Bio-degradable wastes can be disposed by composting & incinerating.
- Non-biodegradable wastes can be recycled, reused.
- Proper Sewage Treatment.

6) To Water doesn't evaporate.
   To recharge ground water level & nearby wells.
   To provide moisture for the vegetation cover.
   There is no breeding of mosquitoes unlike stagnant water collected in ponds (or) lakes.
Water is protected from contamination by the humans.

7) A series of compounds in which the same functional group substitutes for hydrogen in a carbon-chain is called a homologous series of carbon compounds:

<table>
<thead>
<tr>
<th>Alkynes C(<em>n)H(</em>{2n-2})</th>
<th>Alkenes C(<em>n)H(</em>{2n})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propyne C(_3)H(_4)</td>
<td>C(_3)H(_6) Propene</td>
</tr>
<tr>
<td>Butyne C(_4)H(_6)</td>
<td>C(_4)H(_8) Butene</td>
</tr>
<tr>
<td>Pentayne C(_5)H(_8)</td>
<td>C(<em>5)H(</em>{10}) Pentene</td>
</tr>
</tbody>
</table>

8) Reaction with carbonates/hydrogencarbonates:

Alcohol (Ethanol) doesn't react with carbonates/hydrogencarbonates.

\[(\text{Ethanol})\ (\text{CH}_3\text{CH}_2\text{OH}) + \text{NaHCO}_3 \rightarrow \text{No reaction.}\]

Ethanolic acid (carboxylic acid) reacts with carbonates.
/ hydrogen carbonates to form a salt
(Sodium ethanoate/acetate), CO₂ and H₂O.

\[ CH₃COOH + NaHCO₃ \rightarrow CH₃COONa + CO₂ + H₂O \] (Sodium acetate/ethanoate)

2 CH₃COOH + Na₂CO₃ \rightarrow 2 CH₃COONa + CO₂ + H₂O

The CO₂ gas evolved is passed through lime water & it turns lime water milky. This shows it is carbon-di-oxide

II Reaction with an alkali:

Ethanol (alcohol) does not react with a base.

\[ CH₃CH₂OH + NaOH \rightarrow \text{No reaction} \] (Ethanol)

Ethanoic acid (carboxylic acid) reacts with a base (NaOH - sodium hydroxide) to form salt and water.

\[ CH₃COOH + NaOH \rightarrow CH₃COONa + H₂O \] (Sodium acetate)
Reaction with metal

Ethanol reacts with metal (Na) to form sodium ethoxide & evolution of hydrogen

\[ 2 \text{Na} + 2 \text{CH}_3\text{CH}_2\text{OH} \rightarrow 2 \text{CH}_3\text{CH}_2\text{ONa} + \text{H}_2 \]

Ethanolic acid reacts with metal to form sodium ethanoate & \( \text{H}_2 \)

\[ 2 \text{Na} + 2 \text{CH}_3\text{COOH} \rightarrow 2 \text{CH}_3\text{COONa} + \text{H}_2 \]

9)  

a)  

Be \( \Rightarrow Z = 4 \)  

Mg \( \Rightarrow Z = 12 \)  

Ca \( \Rightarrow Z = 20 \)

Electronic configuration:

\[ K^2, L^2, M^2, N^1 \]

\[ 2, 8, 8, 2 \]

\[ 2, 18, 8, 2 \]

They should be in the II\textsuperscript{nd} group because they have 2 electrons each in their valence shell.

b) Beryllium is the least reactive because as you go down the group, the metallic property increases (electropositive) and they tend to lose electrons easily.
10. Calcium has the largest atomic size because it has 4 shells (K, L, M, N) and the atomic size increases as you go down a group due to addition of new shells.

Electronic configuration

\[ Z = 16 \]

\[ \frac{1}{2}, \frac{5}{8}, \frac{7}{8}, 6 \]

The element is **Sulphur**. It lies in the third period because it has 3 shells (K, L, M). Each occupied shell marks the start of a new period.

It lies in the 16th group (10 + 6). The no. of valence electrons helps us find its group. There are 6 valence electrons, so it belongs to 10 + 6 = 16th group.
The valence electrons are 6. So, in order to attain noble gas configuration, it must gain 2 electrons. So the valency of Sulphur is 2. 

\[(8 - 6) = 2 \Rightarrow \text{Valency}\]

It is a non-metal because it must gain electrons to attain noble gas configuration.

When the no. of valence electrons are 5 and above, to find out the valency subtract the no. of valence electrons from 8. 

\[8 - (\text{no. of valence electrons})\]

1. **Asexual Reproduction**
   - It doesn't involve gamete formation.
   - It involves only one parent.
   - The offspring is identical to the parent. Less variations.

2. **Sexual Reproduction**
   - It involves gamete formation.
   - It involves two parents.
   - The offspring resembles both parents (50% each) More variations.
4) Mitosis - Type of cell division
   Meiosis - (Gametes)
   Mitosis - (Somatic cells)

5) Less chance of evolution
   More chance of evolution

12) To avoid the transmission of
    STDs (sexually transmitted diseases) like
    AIDS, syphilis, warts etc.
    To avoid unnecessary pregnancies.
    To control the population of the Society.
    Controlled population size leads to
    equitable distribution of resources.
    Increase in standard of living.
Incentives for small family norms have lead to control in the population explosion.

The sex ratio has become more balanced in our country because prenatal sex determination has been prohibited & illegal sex-selective abortion has been banned.

Spread of awareness about STDs & usage of contraceptives (Barriers - condoms) have prevented many unwanted pregnancies & has lowered the rate spread of STDs (AIDS, syphilis etc). This was possible mainly due to sex-education.

13) Each gene set is present not as a single long thread of DNA but as separate independent pieces called chromosomes. Each cell has a pair of chromosomes for each characteristic / gene - one from male & other from
female parents. During gamete formation, only one chromosome enters the gamete (either of maternal or paternal origin).

The no. of chromosomes are halved by meiosis (the amount of DNA) -

The Gametes which are haploid in nature combine during fertilisation to form the zygote (diploid in nature).

Thus, the no. of chromosomes & DNA material are restored in the organism ensuring the stability of DNA in the species.

14) \( P_1 \text{ BB (blue)} \times \text{WW (white)} \)

\( G_1 \text{ B B} \)

\( \text{W W} \)
**F1** 
Bw Bw

**Phenotype:** Blue : White

**F2**

<table>
<thead>
<tr>
<th></th>
<th>BB</th>
<th>Bw</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Bw (Blue)</td>
<td>Bw (Blue)</td>
</tr>
<tr>
<td>W</td>
<td>Bw (Blue)</td>
<td>W (White)</td>
</tr>
</tbody>
</table>

**Phenotypic ratio:** Blue : White = 3 : 1.

**Genotypic ratio:** BB : Bw : Ww = 1 : 2 : 1.

b) **Percentage of white flowers = 25%**.

c) **Phenotypic ratio:** Blue : White = 3 : 1.

**Genotype ratio:** BB : Bw = 1 : 2.
15) a) Speciation is the process of formation of new species from pre-existing species.

It depends on
- Natural Selection
- Geographic isolation
- Genetic drift
- Onset of reproductive isolation

The beetles feeding on the bushes are spread over a mountain range. There are many sub-populations in the neighborhood & they mostly reproduce within these sub-populations. They are isolated by a large river.

The Genetic drift & natural selection operate on these isolated groups separately. Eventually they become incapable of reproducing with each other even if (incapable) they happen to meet. New species are formed.
b) Natural selection: For example: A group of red beetles are living in a mountain range among green bushes. There is a variation, a green beetle is born which passes on the green colour to its progeny. Green beetles are not spotted by crows easily & mostly red beetles are eaten.

→ Natural selection changes the frequency of a certain gene in a population.

→ It enables the organism to adapt better to its environment.

→ It directs evolution. Organisms which are fitter survive better.

16) The particles in the environment scatter (colloidal) light and the path of the beam is visible. Colloidal particles are large enough to scatter light. This phenomenon is called Tyndall effect.
The sky appears blue.

The atmosphere contains small particles like dust, smoke, mist and molecules of air that are smaller than the wavelength of visible light. Hence, they scatter light of shorter wavelengths at the blue end. This scattered blue light enters our eye & the sky appears blue.

Reddish appearance of Sun at sunrise

When the Sun is at the horizon, the sunlight has to pass through thick layers of atmosphere & large distances to reach the surface of Earth. Meanwhile, the smaller particles in the atmosphere scatter away lights of shorter wavelength (blue & violet). Hence, only the lights of longer
wavelength (red) reaches our eyes. (The blue light is scattered & eliminated away)

17. Convex mirror

We use it generally in rear-view mirrors of cars to enable the driver to see the traffic behind him/her and to facilitate safe driving. A convex mirror is used because it always gives virtual, diminished images.

It gives a wider field of view so that a larger area can be viewed. This is because the convex mirror is curved outwards.
18) An eco-system consists of humans, plants, animals, micro-organisms and non-living things that interact with each other and maintain a balance in nature.

Eco-system is the structural & functional unit of an environment.

**Biotic components**
- Producers
- Consumers
- Decomposers

**Abiotic components**
- Physical factors
  - Temperature, rainfall, soil
  - Minerals, Wind

Natural eco-systems (ponds, lakes) have self-sustainability. They have decomposers in them unlike aquariums which are artificial eco-systems. Decomposers convert organic substances into inorganic materials which are taken (simple) up by plants once again. They feed on dead remains & waste.
Fossils are preserved traces of living organisms. E.g. If a dead insect gets trapped in hot mud, it doesn't decompose easily. Eventually the mud will harden and retain the impressions of the body parts of the insect. Thus, the insect is fossilised into rocks.

Excavating: This is a relative method. As we dig into the soil, the fossils we find closer to the surface are more recent than the fossils we find in the deeper layers.

Radio Carbon Dating: The ratio of different isotopes of the same element present in the fossil can tell us how old the fossil is.

(products of plants and animals: E.g. Bacteria, Fungi, Saprophytes - )
Fossils give the paleontological evidence for evolution. For e.g.: Dinosaurs fossils reveal that they had feathers millions of years ago to protect them from cold. These feathers have now been adapted by birds for flight. This suggests that dinosaurs and birds were closely related. Fossils thus help us in tracing evolutionary relationships and origins.

20) a) Testis / Testosterone (Hormone)
   "It regulates the formation of sperms"
   "It controls the appearance of the boys seen at the time of puberty."

b) i) Oviduct (fallopian tube)
   ii) Uterine wall

The embryo gets its nourishment from its mother through the placenta. Placenta is a disc-like structure that is embedded in the uterine wall.
The mother's side of the placenta has villi-like structures. The mother's side of the placenta has blood-spaces which surround the villi. The villi-like structures increase the surface area for absorption of materials like glucose & (exchange) oxygen from the mother's blood to the embryo. The embryo also generates wastes which are transported to the mother's blood via the placenta.

21. The degree of convergence (or divergence) achieved by a lens is called the power of a lens. 1 unit = Dioptre. 1 Dioptre is the power of a lens whose focal length is 1 metre. 1 D = 1 m⁻¹.
A. \( f = +10 \text{ cm} \)  Convex lens.
\[
P = \frac{100 \text{ cm}}{f \text{ cm}} = \frac{100}{10} = +10 \text{ D}
\]

B. \( f = -10 \text{ cm} \) Concave lens.
\[
P = \frac{100}{f \text{ cm}} = \frac{100}{-10} = -10 \text{ D}
\]

Convex lens will form a virtual, magnified image of an object when placed at 8 \text{ cm}. 

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**Diagram:**
- A convex lens with focal length 10 cm.
- An object placed at 8 cm from the lens.
- The image is magnified and virtual.
- The lens equation is used to calculate the image position.
Ciliary muscles control the thickness of the lens. If the muscles are relaxed, the lens becomes thin & the focal length increases to help seeing distant objects. If the muscles contract, the lens become thick & the focal length decreases to help seeing nearby objects.

Presbyopia is a convex lens.

The least point of vision which is 25cm in normal individuals gradually recedes away due to weakening of ciliary muscles. Sometimes, people suffer from both distant sightedness and nearsightedness. They need to use bi-focal lens. The upper portion has concave lens to facilitate distant vision. Lower portion has convex lens to facilitate near vision.
(a) Myopia, concave lens.

(b) Teacher and Salman:
Teacher is kind, thoughtful, helpful.
Teacher wants Akshay to learn properly.
and Salman wants his classmate to read comfortably.
The teacher called in Akshay's parents. This shows the concern of the teacher.

(c) Akshay can study properly, be obedient in class and gratify his teacher.
He can help Salman in his studies.

(23) Yes, the lens can produce an image because the light can still pass through the optical centre.
**Convex Lens**

\[ h = 4 \text{ cm} \quad f = 20 \text{ cm} \quad u = -15 \text{ cm} \]

\[ \frac{1}{f} = \frac{1}{v} - \frac{1}{u} \quad \frac{1}{20} = \frac{1}{v} - \frac{1}{15} \]

\[ \frac{1}{20} - \frac{1}{15} = \frac{1}{v} \]

\[ \frac{3 - 4}{60} = \frac{1}{v} \quad \frac{1}{60} = v \]

Image is formed at 60 cm on the left side of the lens.

\[ \frac{h'}{u} = \frac{h}{u} \quad \frac{h'}{4} = \frac{+60}{-15} \]

\[ h' = \frac{60 \times 4}{15} = 16 \text{ cm} \]
\[ m = \frac{1}{u} = \frac{60}{15} = 4 \]

Virtual, Erect, Magnified

Soap: Sodium \( \text{and} \) Potassium salts of long chain carboxylic acids

Detergents: Ammonium \( \text{or} \) Sulphonate salts of long chain carboxylic acids

The soap have two ends with differing (molecules) properties:
- Hydrophylic - dissolves in water
- Hydrophobic - dissolves in hydrocarbons

Dirt is oily in nature and doesn't dissolve in water. In water, the
Soap molecules form special structures called micelles that keep the hydrocarbon portion out of water. The ionic end which is soluble in water faces the surface of the cluster. The hydrocarbon portion faces the interior of the cluster towards the oil droplet. Soap in the form of a micelle is able to clean, since the oily dirt is collected in the centre of the micelle. Micelles stay in a solution as a colloid if do not come together because of ion-ion repulsion. Thus, the dirt is easily cleansed away.

→ Soap reacts with magnesium (or) calcium ions in hard water to form scum (an insoluble substance). So it doesn’t form lather.

→ Detergents are made from synthetic materials which may be harmful to our skin and even clothes. They prove to
Ionic end $\rightarrow$ Hydrophobic end.

be harsh on our skin. They are non-biodegradable unlike soaps which are mostly made of NaOH & glycerol.

B) Radish, Carpet
C) III, IV & V.
D) Lp $> Le > Lr$

B) MS.

D) P & Q.
A) Q & A.

D) $h = 4cm, u = -12$

Convex lens.

\[
\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{24} - \frac{1}{-12} = \frac{1}{24} + \frac{1}{12} = \frac{1 + 2}{24} = \frac{3}{24}
\]
\[ f = \frac{24}{3} = 8 \text{ cm} \]

Move the screen towards the lens. Magnification reduces.

35) \( \text{CO}_2 \rightarrow \) Pass the gas through lime water \( \text{(Ca(OH)}_2) \). (carbon dioxide)

36) a) Fine adjustment screw

b)