CBSE
Class X Science
Board Paper – 2015 (Set 1) Solution
Term II

SECTION A

1. There are seven covalent bonds—six C–H bonds and one C–C bond present in the molecule of ethane.

2. Reproduction helps in the growth of the population.

3. On applying the 10% law to the food chain, the organisms of the 2nd trophic level of the food chain will have 1000 joules of energy.

4. Refractive index of glass, $\eta_g = \frac{4}{3}$

$\therefore \eta_g = \frac{\text{Speed of light in vacuum}}{\text{Speed of light in glass}}$

$\frac{4}{3} = \frac{\text{Speed of light in vacuum}}{2 \times 10^8}$

Speed of light in vacuum = $\frac{4 \times 2 \times 10^8}{3}$ = 2.6×10^8 m/s

Refractive index of water, $\eta_w = \frac{3}{2}$

$\eta_w = \frac{\text{Speed of light in vacuum}}{\text{Speed of light in water}}$

$\frac{3}{2} = \frac{2.6 \times 10^8}{\text{Speed of light in water}}$

Speed of light in water = 1.73×10^8 m/s

Because the information provided is wrong, ideally the speed of light in vacuum is 3×10^8 m/s and the speed of light in water is 2.25×10^8 m/s.
The correct solution is

Refractive index of glass, $\eta_g = \frac{3}{2}$

Refractive index of water, $\eta_w = \frac{4}{3}$

Refractive index of glass, $\eta_g = \frac{\text{Speed of light in vacuum}}{\text{Speed of light in glass}}$

$$\frac{3}{2} = \frac{\text{Speed of light in vacuum}}{2 \times 10^8}$$

$$\text{Speed of light in vacuum} = \frac{3 \times 2 \times 10^8}{2} = 3 \times 10^8 \text{ m/s}$$

Refractive index of water, $\eta_w = \frac{4}{3}$

$$\eta_w = \frac{\text{Speed of light in vacuum}}{\text{Speed of light in water}}$$

$$\frac{4}{3} = \frac{3 \times 10^8}{\text{Speed of light in water}}$$

$$\text{Speed of light in water} = \frac{3 \times 3 \times 10^8}{4}$$

Speed of light in water = 2.25×10^8 m/s

5. The pollution of water of River Ganga is caused by the dumping of untreated sewage and industrial wastes into it.

<u>Effects of pollution and contamination of river water:</u>

(a) The contamination of river water leads to the growth of disease-causing microorganisms.

(b) The river water also becomes more acidic because of the discharge of chemical effluents by the industries which makes the soil acidic and affects the productivity of crops.

6. The variety of life forms found in a particular region forms its biodiversity.

<u>Consequences if biodiversity of an area is not preserved:</u>

(a) It can result in environmental disasters such as floods, forest fires and hurricanes.

(b) It can bring about soil erosion and desertification as a result of deforestation.

(c) It can bring about large-scale habitat losses and extinction of vulnerable animal and plant species.

(d) It results in sudden climatic changes and instability in the functioning of the ecosystem.

If biodiversity of an area is not preserved, it will lead to extinction of certain organisms from the trophic levels of a food chain which in turn will disturb the balance of the ecosystem.

7. Carboxylic acid can be distinguished from an alcohol by performing the following tests:

i. **Test with $NaHCO_3$ solution in water.**
On adding carboxylic acid to baking soda, carbon dioxide is liberated with brisk effervescence.
On adding a solution of baking soda to alcohol, no brisk effervescence occurs.

ii. **Test with blue litmus solution.**
Carboxylic acid turns blue litmus red.
There is no change in colour when a blue litmus solution is added to alcohol.

8.

Ethyne burns in air with a sooty flame because of incomplete combustion caused by the limited supply of air.
However, ethyne burns in oxygen with a clean flame with a temperature of 3000°C because of complete combustion.
This oxy-acetylene flame is used for welding.
Such a high temperature cannot be achieved without mixing oxygen.
Therefore, a mixture of ethyne and air is not used for welding.

9.

Characteristic	Comparison
(a) The number of electrons in their atoms	The number of electrons in Q is more compared to P (Q > P).
(b) The sizes of their atoms	The size of atom P is more than atom Q (P > Q).
(c) Their metallic character	P is more metallic than Q (P > Q).
(d) Their tendencies to lose electrons	P will lose electrons more easily than Q.
(e) The formula of their oxides	Oxide of P is P_2O. Oxide of Q is QO.
(f) The formula of their chlorides	Chloride of P is PCl. Chloride of Q is QCl_2.

10. Atomic number of the element = 16
Electronic configuration = 2, 8, 6
The period number is equal to the number of shells which starts filling up in it.
The atom of an element has three shells. So, the period number is 3.
The atom of an element has six valence electrons in the outermost shell. So, the group number of the element will be 16 (6 + 10).
The valency of an element is determined by the number of valence electrons present in the outermost shell. The atom of an element has six valence electrons in the outermost shell, so the valency of the element is 2.

11. Characteristics of sexual reproduction:
(a) Sexual reproduction takes place by the combination of special reproductive cells called sex cells.
(b) It is usually biparental and involves two parents.
(c) It involves the formation of sex cells called gametes followed by the fusion of the gametes.
(d) It is comparatively slower as compared to asexual reproduction.
(e) Meiosis and mitosis occur during gamete formation, while mitosis takes place during the development of the zygote.
(f) Variations appear because of a new combination of genes during crossing over.
(g) Fertilisation is internal in human beings.

12. Chromosomes are thread-like structures found in the nucleus at the time of cell division. They are made of proteins and DNA.
In sexually reproducing organisms, the gametes undergo meiosis, and hence, each gamete contains only half a set of chromosomes. When two gametes fuse, the zygote formed contains the full set of chromosomes. Hence, the formation of gametes by meiosis helps to maintain the number of chromosomes in the progeny.

13. Significance of reproductive health in a society:
(a) It prevents the spread of various sexually transmitted diseases such as AIDS, syphilis etc.
(b) Individuals with sound reproductive health produce better offspring which have better chances of survival.
(c) Better sex education and awareness helps to maintain the population and prevent population explosion.
(d) Unwanted and teen pregnancies can be avoided.
The reproductive health in India has improved tremendously over the past 50 years. The areas in which reproductive health have improved include
(a) Family planning: Better family planning has led to reduction in family size.
(b) Mortality rate: Mother and infant mortality rates have drastically reduced because of better health care facilities.

14.

(a) Homologous organs: Organs which have the same basic structure but different functions are called homologous organs.
Example: The forelimbs of a man, lizard, frog, bird and bat have the same basic design of bones, but they perform different functions. The forelimbs of a man are used for grasping, the forelimbs of a lizard are used for running, the forelimbs of a frog are used to prop up the front ends of the body when at rest and the forelimbs of a bird and bat are modified for flying. Hence, all these organisms use their forelimbs for performing different functions, but the forelimbs have originated from the same structural pattern.

(b) Analogous organs: Organs which have different basic structure but similar appearance and perform similar functions are called analogous organs.
Example: The wings of an insect and a bird have different structures, but they perform the same function of flying. Because the wings of insects and birds have different structures but perform similar functions, they are analogous organs.

(c) Fossils: The remains of dead animals or plants which lived in the remote past are known as fossils. The fossils provide evidence for evolution. For example, a fossil bird called *Archaeopteryx* looks like a bird, but it has many other features which are found in reptiles. It has feathered wings like those of birds but teeth and tail like those of reptiles. Therefore, *Archaeopteryx* is a connecting link between the reptiles and birds and hence suggests that birds have evolved from reptiles.

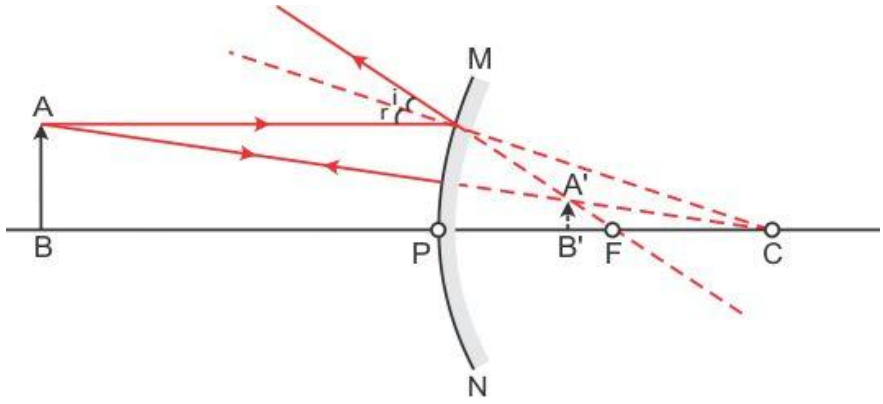
15.

(a) <u>Speciation:</u> The process by which new species develop from the existing species is known as speciation.
<u>The factors which could lead to speciation are</u>

i. Geographical isolation of population caused by various types of barriers such as mountain ranges, rivers and seas. This leads to reproductive isolation because of which there is no flow of genes between separated groups of population.
ii. Genetic drift caused by drastic changes in the frequencies of particular genes by chance alone.
iii. Variations caused in individuals because of natural selection.

(b) <u>Natural Selection:</u> Natural selection is the process of evolution of a species whereby characteristics which help individual organisms to survive and reproduce are passed on to their offspring, and those characteristics which do not help are not passed on.
Charles Darwin proposed the theory of natural selection. According to him, nature selects the fittest.
There are always changes in the progeny when an animal reproduces by sexual reproduction. Example: If one of the progeny of deer is tall and the other is short, then the tall one with long legs will survive. Because the progeny with short height cannot reach the leaves of tall trees and cannot get food, they will starve and hence die. Thus, it proves the theory of natural selection.

16. A convex mirror always produces an erect and diminished image of the object placed in front of it irrespective of the position of the object.
Consider a case in which an object is placed anywhere between pole (P) and infinity in front of a convex mirror. The ray diagram is as shown:



A virtual, erect and diminished image will be formed behind the mirror between the pole (P) and focus (F) of the mirror.
As a convex mirror gives a wide field of view, it is used as a rear view mirror in vehicles. It enables the driver to view a much larger area of the traffic behind. It is also used as shop security mirrors.

17. The phenomenon in which a part of the light incident on a particle is redirected in different directions is called the scattering of light.
The molecules of air and other fine particles in the atmosphere have a size smaller than the wavelength of visible light. So, they are more effective in scattering light of shorter wavelengths at the blue end than light of longer wavelengths at the red end. Thus, when sunlight passes through the atmosphere, the fine particles in the air scatter blue colour (shorter wavelengths) more strongly than red. The scattered blue light enters our eyes, and hence, the clear sky appears blue.

At the time of sunrise and sunset, when the Sun is near the horizon, sunlight travels a greater distance through the atmosphere to reach us. During this, most of the shorter wavelengths present in it are scattered away from our line of sight by the molecules of air and other fine particles in the atmosphere. So, light reaching us directly from the rising or setting Sun consists mainly of the longer wavelength red colour because of which the Sun appears red. Thus, at sunrise and sunset, the Sun as well as the surrounding sky appears red.

18.

Biodegradable wastes	Non-biodegradable wastes
(a) Waste materials which can be broken down to non-poisonous substances in nature in due course of time by the action of microorganisms such as certain bacteria are called biodegradable wastes.	(a) Waste materials which cannot be broken down into non-poisonous or harmless substances in nature are called non-biodegradable wastes.
(b) Examples: Cattle dung, wool, paper, compost	(b) Examples: Plastics, polythene bags, metal articles, glass objects

<u>The changes which people must adopt to dispose non-biodegradable wastes for saving the environment are</u>

(a) Household waste, chemical waste and hospital waste should be disposed of by dumping them in the low-lying areas of the ground called a landfill.

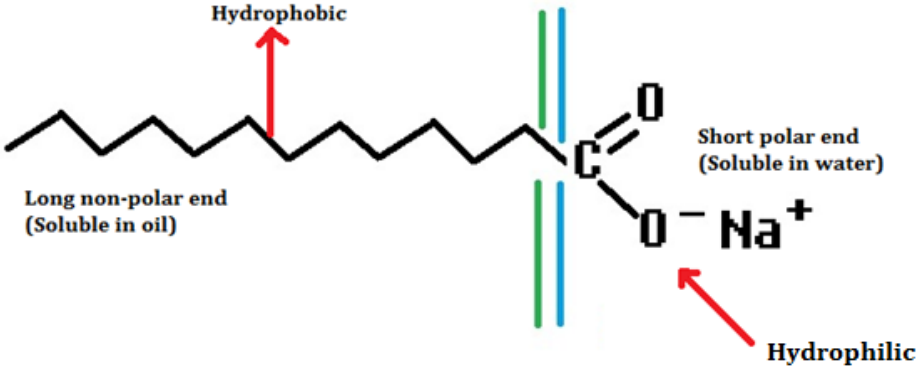
(b) Broken plastic articles such as buckets, bowls, cups, plates etc. should be sent to plastic processing factories.

19. Difference between soap and detergent:

The molecules of soap are sodium or potassium salts of long-chain carboxylic acids. Detergents are generally ammonium or sulphonate salts of long chain carboxylic acids.

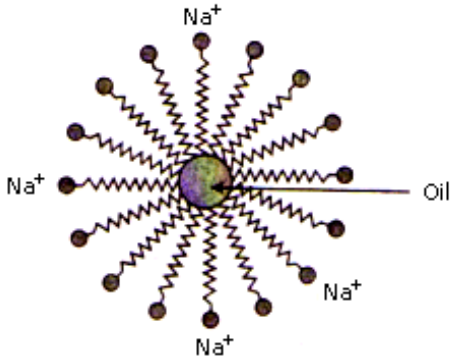
Cleansing action of soap can be described as follows:

- A soap molecule has a tadpole-shaped structure.
- At one end (long non-polar end) of the soap molecule is a hydrocarbon chain which is insoluble in water but soluble in oil.
- At the other end (short polar end) of the soap molecule, there is a carboxylate ion which is hydrophilic, i.e. water soluble but insoluble in oil.



- Soap on mixing with water forms a concentrated solution and causes foaming.
- The long non-polar end of soap gravitates towards and surrounds the dirt and absorbs the dust in it.
- The short polar end with the carboxylate ion repels the water away from the dirt.

- A spherical aggregate of soap molecules is formed in the soap solution in water and is called a micelle.
- Thus, the soap molecule dissolves the dirt and our clothes get clean.



Formation of Micelles

Soaps do not form lather in hard water because
Hard water contains calcium and magnesium salts. Soap molecules react with calcium and magnesium salts to form an insoluble precipitate called scum.
Two problems arise because of the use of detergents instead of soap:

i. Soaps are biodegradable, while detergents are non-biodegradable; hence, detergents accumulate in the environment and cause problems.
ii. Certain phosphate additives are added to detergents. These phosphate additives act as nutrients for algae which form a thick green scum over the river water and upset the animal life in the river.

20.

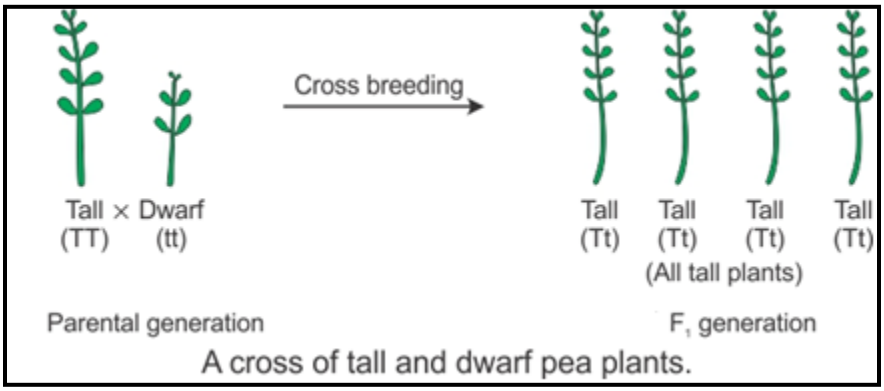
(a) Testes produce sperms and secrete a hormone called testosterone.
The function of testosterone is to control the development of male sex organs and male features such as a deeper voice, moustache, beard and more body hair as compared to females.

(b)

i. Fertilisation takes place in the oviduct or fallopian tubes.
ii. Implantation of the fertilised egg occurs in the uterus.
After implantation, a disc-like special tissue called placenta develops between the uterus wall and the embryo. The placenta helps in the exchange of nutrients, oxygen and waste products between the embryo and the mother. Thus, it provides nourishment to the growing embryo.

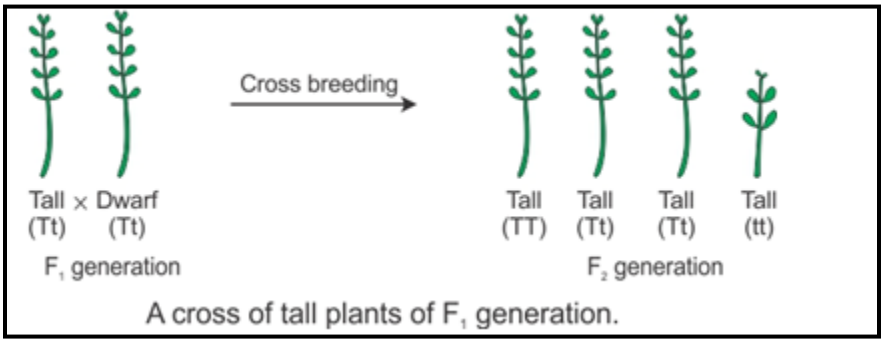
21.

(a) Mendel crossed pure bred tall pea plants with pure bred dwarf pea plants and found that only tall pea plants were produced in the first generation and there were no dwarf pea plants. He concluded that the first generation showed the traits of only one of the parent plants—tallness. The trait of the other parent plant—dwarfness—did not show up in the progeny of the first generation.



A cross of tall and dwarf pea plants.

He then crossed the tall pea plants obtained in the first generation (F_1 generation) and found that both tall plants and dwarf plants were obtained in the second generation (F_2 generation) in the ratio of 3:1. Mendel noted that the dwarf trait of the parent pea plant which disappeared in the first generation progeny reappeared in the second generation. In this way, Mendel's experiments with tall and dwarf pea plants showed that the traits may be dominant and recessive.



A cross of tall plants of F_1 generation.

(b) When Mendel crossed pure-bred tall pea plants with pure-bred dwarf pea plants, he found that only tall pea plants were produced in the F_1 generation. When he further crossed the tall pea plants of the F_1 generation, he found that the tall plants and dwarf plants were obtained in the ratio 3:1 in the F_2 generation. Mendel noted that all the pea plants produced in the F_2 generation were either tall or dwarf. There were no plants with intermediate height (or medium height) in between the tall and dwarf plants. In this way, Mendel's experiment showed that the traits (like tallness and dwarfness) are inherited independently. This is because if the traits of tallness and dwarfness had blended (or mixed up), then medium-sized pea plants would have been produced.

22. The power of a lens is defined as the reciprocal of its focal length. It is represented by the letter P. The power P of a lens of focal length f is given as

$$P = \frac{1}{f}$$

The SI unit of power is dioptre (D).
Given:
Focal length of lens A, F_A = +10 cm = +0.1 m
Focal length of lens B, F_B = −10 cm = −0.1 m

To calculate the power of lens A:

The power of lens A, $P = \frac{1}{F_A(\text{in metres})}$

$$P = \frac{1}{+0.1}$$

∴ P = +10 dioptre or +10 D
The positive sign indicates that it is a converging or convex lens.

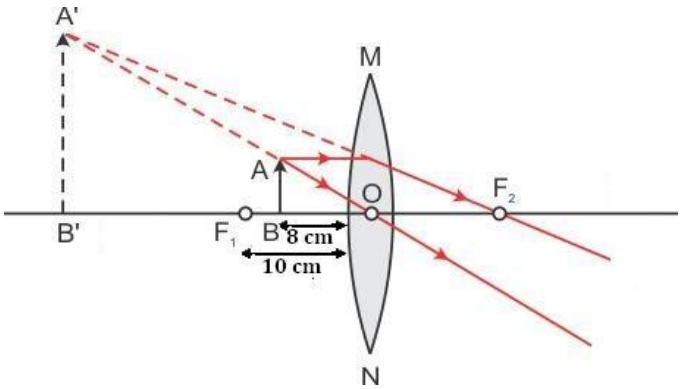
To calculate the power of lens B:

The power of lens B, $P = \frac{1}{F_B(\text{in metres})}$

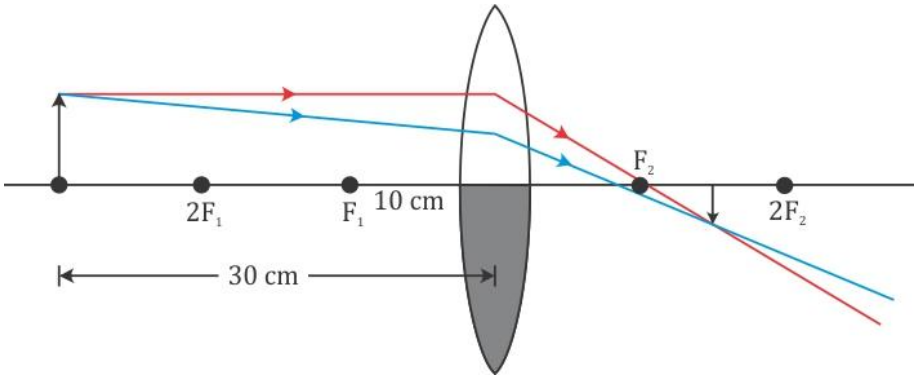
$$P = \frac{1}{-0.1}$$

∴ P = −10 dioptre or −10 D
The negative sign indicates that it is a diverging or concave lens.

In a convex lens, when the object is placed between the pole and focus, the image formed is always virtual and magnified. On the other hand, a concave lens produces virtual, erect but diminished image.
Here the object is placed 8 cm from the lens which is at a distance less than the focal length, i.e. less than 10 cm. Thus, the 8 cm position of the object placed in front of the convex lens will produce a virtual and magnified image.
The diagram for the same is as shown below:



23. A convex lens can produce the complete image of the object even though half of the lens is covered. This is because light coming from the object can be refracted from the other half of the lens. However, the intensity of light will be reduced.



Given:
Height of the object = h = 4 cm
Focal length of the convex lens = f = 20 cm
Object distance = u = −15 cm
Using the lens formula, we get

$$\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$$

$$\therefore \frac{1}{v}=\frac{1}{f}+\frac{1}{u}=\frac{1}{20}-\frac{1}{15}=\frac{3-4}{60}=\frac{1}{60}$$

$$\therefore v=-60 \text{ cm}$$

Hence, the image is formed 60 cm in front of the lens on the same side as the object.
Because v is negative, we can say that the image is virtual.
From the magnification formula for the lens, we get

$$m=\frac{h'}{h}=\frac{v}{u}$$

$$\therefore h'=\frac{vh}{u}=\frac{-60\times 4}{-15}=16 \text{ cm}$$

Hence, the size of the image is h′ = 16 cm.
Because the height of the image is positive and greater than the height of the object, the image is erect and magnified.
So, we can conclude that the image is virtual, erect and magnified.

24. The curvature of the eye lens can be adjusted by the ciliary muscles. This changes the focal length of the lens. The defect which arises because of the gradual weakening of the ciliary muscles is known as presbyopia. A bifocal lens can be used to correct presbyopia.
Answers to the context questions:

(a) Akshay is not able to see from a far distance, so he is suffering from myopia or near-sightedness. A concave lens should be used to correct this defect.

(b) The teacher displayed presence of mind and pro-activeness, and she is of a considerate nature.
Salman displayed the virtue of friendship and is caring in nature.

(c) Akshay should thank the teacher and Salman in front of the entire class.

SECTION B

25. (A) Red litmus remains red and blue litmus turns red.
Acids turn blue litmus paper red. They have no effect on red litmus paper.

26. (D) To favour the precipitation of the soap
During saponification, the soap formed remains in a suspended form in the mixture. It is precipitated as a solid from the suspension by adding common salt to the suspension. This process is called salting out of soap.

27. (A) P and Q
Lather (foam) is formed by the reaction of soap solution with sodium sulphate and potassium sulphate in the test tubes P and Q, respectively. They are dissolved in water to give a neutral solution.
Sulphates, chlorides and bicarbonates of calcium and magnesium make the water hard. Thus, the lather is not formed in the test tubes R and S.

28. (C) III, IV and V
An embryo has two large cotyledons and one embryo axis or tigellum. The upper end of the embryo axis is the plumule, and the lower end of the embryo axis which projects beyond the cotyledons is the radical. The testa is the thick outer seed coat, and the tegmen is the inner transparent seed coat of seeds.

29. (B) Radish and carrot
Radish and carrot are homologous structures as these are modifications of the root. Tomato and okra are fruits. Potato is a modification of the stem.

30. (B) MS
The focal length of a concave mirror is the distance between its pole and principal focus. That is, the distance of the image formed (screen) from the concave mirror will be equal to the focal length of the concave mirror.

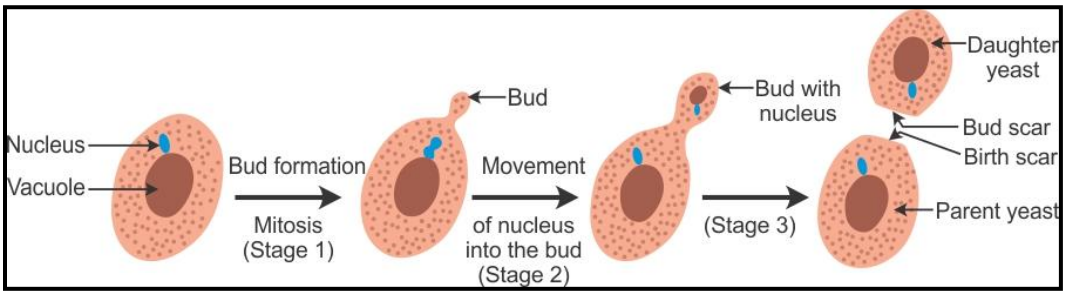
31. (D) This device is a convex lens of focal length 8 cm.
The incident rays after passing through the lens converge at the focus. So, the device 'X' is a converging or a convex lens. The distance between the lens and the screen gives the focal length of the lens.

32. (A) $\angle i = \angle e < \angle r$
In refraction through a rectangular slab, the angle of incidence is equal to the angle of emergence. Also, the angle of refraction should be smaller than the angle of incidence.

33. **(B)** The emergent ray bends at an angle to the direction of the incident ray.
In refraction of light through a glass prism, there is deviation or change in the path of light passing through the prism.

34. Carbon dioxide gas gets liberated.
When a pinch of sodium hydrogen carbonate is added to acetic acid in a test tube, a brisk effervescence is produced because of the liberation of carbon dioxide gas.
When this gas is passed through the lime water, it turns lime water milky. This shows that the gas liberated is carbon dioxide gas.
The chemical reaction can be represented as
$CH_3COOH_{(aq)} + NaHCO_{3(S)} \rightarrow CH_3COONa_{(aq)} + H_2O_{(l)} + CO_{2(g)} \uparrow$

35.
(A) A fine screw is used to focus the slides of budding in yeast under high power of a microscope.
(B) Sequence showing budding in yeast:



36. Given that
Object distance, u = −12 cm
Image distance, v = 24 cm

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\frac{1}{f} = \frac{1}{24} - \frac{1}{(-12)}$$

$$\frac{1}{f} = \frac{}{8}$$

$\therefore$ f = 8 cm

The focal length of the lens is 8 cm.
Now if the object is moved away from the lens, the screen has to be moved towards the lens. This is because when we move the object away from the lens, the object distance is increased. Hence, by the lens formula, the image distance decreases.
Magnification is given as

$$m = \frac{v}{u}$$

Because the image distance (v) decreases, the value of magnification also decreases.