



BJNP

Learning with the Speed of Mumbai and the Tradition of Kota

Max Marks: 40
Time: 2 HRS

Date: 00.00.2022
Seat No.

(SSC)SCIENCE I : SAMPLE PAPER 1(Sol)

Q.1 A. Choose the correct alternative

(5)

- The value of gravitational acceleration decreases as the height of the object from the surface of the earth _____.
a) **Increases.** b) Decreases. c) Remains same d) Becomes zero.
- The aquatic animals and plants can survive in cold regions because of _____.
a) Relative humidity. b) Regelation.
c) **Anomalous behaviour of water** d) Melting point of water.
- When a current carrying conductor is placed in a magnetic field, the direction of the force on the conductor is determined by _____.
a) **Flemings Left hand rule.** b) Right hand thumb rule.
c) Flemings Right hand rule. d) Ohm's law.
- The IUPAC name of $\text{CH}_3 - \text{CH}_3$ is _____.
a) Ethene **b) Ethane**
c) Ethyne d) Ethylene.
- The specific heat capacity of _____ is the maximum.
a) **Water** b) Aluminium c) Copper d) Silver.

B. Solve the following

(5)

- Find the odd one out :
Insulator, fuse wire, **generator**, rubber gloves.
- Complete the correlation
SI unit of electric charge : Coulomb :: SI unit of electric current : _____.

Ans. **Ampere**

- Sate true and false
A unidirectional current is called direct current. **- True**
- The valency of carbon is _____. **4**
- Name the person who introduced the theory of electromagnetic induction.

Ans. **Michael Faraday**

Q.2 A. Give scientific reasons: (Any 2)

(4)

- The weight of a person decreases as the person goes higher into space

Ans. The weight of a person decreases as the person goes higher up into space because

- Weight = mass x gravitational acceleration.
- gravitational acceleration = $M \times G / R^2$, where M = mass of the earth, G = Universal gravitational constant and R = distance between the object and the centre of the earth.
- as the object moves away from the surface of the earth, its distance from the centre of the earth

increases thereby reducing the value of the gravitational acceleration.

(d) as the value of the gravitational acceleration decreases, the weight of the person decreases.

2. In the polar regions, the rocks crack during winter.

Ans. In polar regions, rocks crack during winter because the water which is accumulated in the cracks of the rocks starts expanding as the atmospheric temperature starts dropping below 4 degree. This occurs because of the Anomalous behaviour of water. As the water expands, it exerts pressure on the walls of the rock causing it to crack due the stress developed.

3. Tungsten is used as a filament in an electric bulb.

Ans. Tungsten is used as filament in electric bulbs because

(a) electric bulb works on the principle of heating effect of electric current.

(b) when a current flows through the filament, it gets heated and emits light.

(c) Tungsten has a very high melting point of around 3400 degree Celsius and does not melt even when the current flows through it for longer duration of time. Hence tungsten is used a filament in electric bulbs.

B. Answer the following (Any 3)

(6)

1. What is escape velocity ? Write the formulae for calculating the escape velocity.

Ans. If an object is thrown upwards, the minimum initial velocity required to overcome the downward pull by the earth and to escape the earth forever so as to not fall back on the earth is called Escape velocity. Escape velocity = $\sqrt{2GM/R} = \sqrt{2gR}$ Where G= universal gravitational constant, M = mass of the earth, R = radius of the earth, g = gravitational acceleration

2. The melting point of a fuse wire is low. Why?

Ans. (a)The fuse wire works on the principle of heating effect of electric current.

(b) It is made up of alloys of low melting points.

(c) if there is a sudden surge in the electric current in the circuit, the excess heat produced would cause the fuse wire to melt.

(d) this would ensure that the excess current would not reach the domestic appliances and protect them from damage.

3. Define Specific latent heat of fusion and melting point.

Ans. Specific latent heat of fusion – the amount of heat energy absorbed at constant temperature by unit mass of a solid to convert into liquid phase is called specific latent heat of fusion. Melting point – The constant temperature at which a solid converts into a liquid is called the melting point.

4. What is the Kepler's third law of planetary motion? What is the value of the Universal gravitational constant?

Ans. The square of its period of revolution around the Sun is directly proportional to the cube of the mean distance of a planet from the Sun. Thus, if r is the average distance of the planet from the Sun and T is its period of revolution then,

$$T^2 \propto r^3 \text{ i.e } \frac{T^2}{r^3} = \text{constant} = K \dots(1)$$

Kepler obtained these laws simply from the study of the positions of planets obtained by regular observations. He had no explanation as to why planets obey these laws. We will see below how these laws helped Newton in the formulation of his theory of gravitation.

Value of Universal gravitational constant – Show that in SI units, the unit of G is Newton m² kg⁻². The value of G was first experimentally measured by Henry Cavendish. In SI units its value is 6.673 x 10⁻¹¹ N m² kg⁻².

5. Equal heat is given to two objects A and B of mass 1 kg each. Temperature of object A increases by 5 degree C and object B by 3 degree C. Which object has more specific heat and by what factor?

Ans. Given : Mass of object A = $M_a = 1 \text{ Kg}$, Mass of object B = $M_b = 1 \text{ Kg}$, temperature increase for A = $\Delta T_a = 5^\circ$, temperature increase in B = $\Delta T_b = 3^\circ$

To Find : $C_a = ?$, $C_b = ?$

Solution : As given, $Q_a = Q_b$

$M_a \times C_a \times \Delta T_a = M_b \times C_b \times \Delta T_b$

$1 \times C_a \times 3 = 1 \times C_b \times 5$

$3 \times C_a = 5 \times C_b$

$C_a = 5/3 C_b$

Answer : Specific heat of A is more than B. It is greater by a factor of 5/3.

Q.3 Answer the detail (Any 5)

(15)

1. An object takes 5 sec to reach the ground from a height of 5 m on a planet. What is the value of 'g' on the planet? Assume gravitational acceleration as 9.8 m/s^2 .

Ans. Given : Distance = $S = 5 \text{ m}$., Time = $t = 5 \text{ sec}$., Initial velocity = $u = 0 \text{ m/s}$.

To find : gravitational acceleration = $g = ?$

Solution : Applying the formula $S = ut + \frac{1}{2} gt^2$

$5 = 0 \times 5 + \frac{1}{2} \times g \times 5^2$

$5 = 0 + 25g/2$

$5 \times 2 = 25g$

$g = 10/25$

$g = 0.4 \text{ m/s}^2$

2. What is anomalous behaviour of water? How and where do we see the affects of it?

Ans. If we heat water from 0°C upto 4°C , it contracts instead of expanding. At 4°C its volume is minimum. If heated further, it expands and its volume increases. The behaviour of water between its temperature from 0°C to 4°C is called anomalous behaviour of water. Its affects can be seen in cold countries where the water pipelines crack during winter and the rocks also crack during winter. Aquatic animals can survive because the water at the surface of the water bodies freeze due to extreme cold but there is water at the bottom in which the aquatic animals can survive.

3. An electric heater rated 800W is used daily for half an hour in the month of February, 2020. The cost of one unit of electricity is Rs. 6.00. What is the cost of using the heater?

Ans. Given : Power = $P = 800 \text{ W} = 0.8 \text{ kW}$, time = $t = 0.5 \text{ hrs}$., unit cost of electricity = Rs. 6.00 per unit.

To find : Total cost = ? Solution : Total energy consumed in 1 day = $P \times t = 0.8 \times 0.5 = 0.4 \text{ kWh}$

Energy consumed in February 2020 (28 days) = $0.4 \times 28 = 11.2 \text{ units}$

Total cost = total energy consumption x rate = $11.2 \times 6 = \text{Rs. } 67.2$

4. Differentiate between Mass and weight.

Ans Mass

a. Mass is the amount of matter present the object.

b. Mass does not change with place

c. SI unit is Kg, CGS unit is gm

d. Mass is a scalar quantity

e. Mass cannot be zero.

Weight

Weight is the force with which the earth in attracts the object.

weight changes from place to place.

SI unit is Newton, CGS unit is dyne

Weight is a vector quantity.

Weight can be zero.

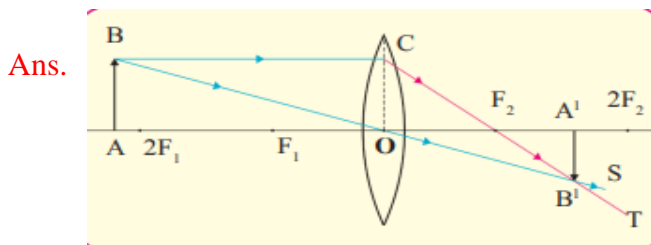
5. How does the value of 'g' change along the surface of the earth and with height. Explain.

Ans. A. Change along the surface of the earth: Will the value of g be the same everywhere on the surface of the earth? The answer is no. The reason is that the shape of the earth is not exactly spherical and so the distance of a point on the surface of the earth from its centre differs somewhat from place to place. Due to its rotation, the earth bulges at the equator and is flatter at the poles. Its radius is largest at the equator and smallest at the poles. The value of g is thus highest (9.832 m/s²) at the poles and decreases slowly with decreasing latitude. It is lowest (9.78 m/s²) at the equator.

B. Change with height : As we go above the earth's surface, the value of r in equation (5) increases and the value of g decreases. However, the decrease is rather small for heights which are small in comparison to the earth's radius. For example, remember that the radius of the earth is 6400 km. If an aeroplane is flying at a height 10 km above the surface of the earth, its distance from the earth's surface changes from 6400 km to 6410 km and the change in the value of g due to it is negligible. On the other hand, when we consider an artificial satellite orbiting the earth, we have to take into account the change in the value of g due to the large change in the distance of the satellite from the centre of the earth. Some typical heights and the values of g at these heights are given in the following table.

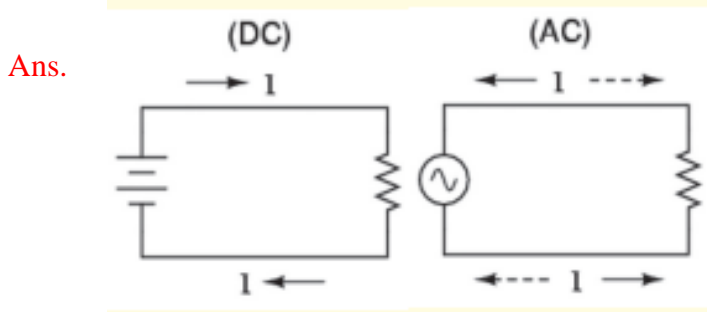
C. Change with depth: The value of g also changes if we go inside the earth. The value of r in equation (5) decreases and one would think that the value of g should increase as per the formula. However, the part of the earth which contributes towards the gravitational force felt by the object also decreases. Which means that the value of M to be used in equation (5) also decreases. As a combined result of change in r and M, the value of g decreases as we go deep inside the earth.

6. Draw a neat ray diagram of the image formed by a converging lens when the object is kept beyond 2F.



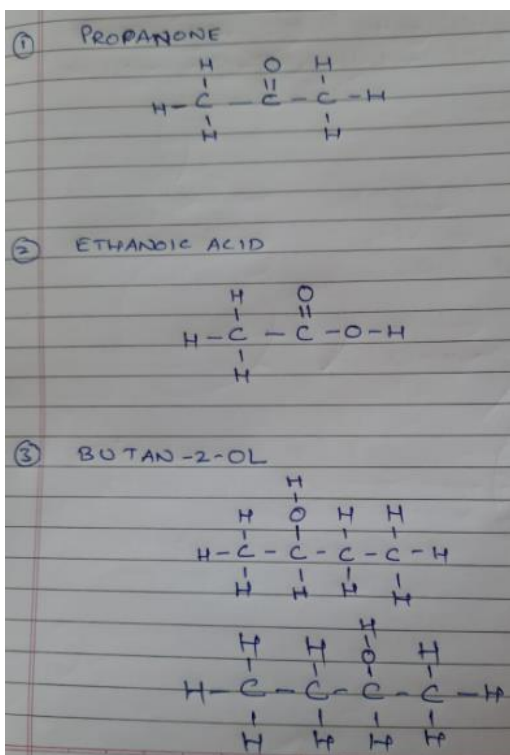
7. Draw neat labeled diagrams for

1) circuit for direct current 2) circuit for alternating current.



8. Write the structural formula for the following:
 a) Propanone b) Ethanoic acid c) Butanol.

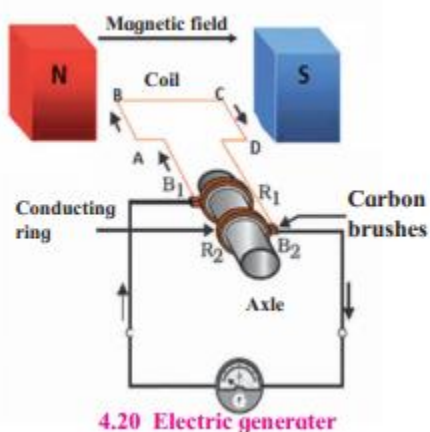
Ans.



Q.4 Answer any one of the following

(5)

1. Explain the working of an AC generator with the help of a neatly labeled diagram.



Ans.

Fig 4.20 shows a copper wire coil ABCD, kept between the two pole pieces of a magnet. The two ends of the coil are connected to the conducting rings R1 and R2 via carbon brushes. Both the rings are fixed to the axle, but there is a resistive coating in between the ring and the axle. The axle is rotated with the help of a machine from outside. Because of this, the coil ABCD starts rotating. The stationary carbon brushes B1 and B2 are connected to a galvanometer, which shows the direction of current in the circuit. Upon rotating the axle, the branch AB goes up and the branch CD goes down (i.e. the coil ABCD rotates clockwise). According to Fleming's right hand rule, electric current is produced in the branches AB and CD in the direction A B and C D. Thus, the current flows in the direction A B C D (as shown by arrows in the figure). In the external circuit, the current flows from B2 to B1 through the galvanometer. If instead of one loop coil, a coil consisting of several turns is used, the current of magnitude several times flows. After half rotation, the branch AB takes the place of branch CD and the branch CD takes the position of the branch AB. Therefore, the induced current goes as D C B A . But, the branch BA is always in contact with the brush B1 and branch

DC in the contact with B2. Hence, in the external circuit current flows from B1 to B2 i.e. opposite to the previous half rotation. This repeats after every half rotation and alternating current is produced. This is what is called an AC generator.

OR

2. Explain the process of extraction of Aluminium from its ore Bauxite.

Ans.

- i. Concentration of bauxite ore:

Bauxite is the main ore of aluminium. Silica (SiO_2), ferric oxide (Fe_2O_3) and titanium oxide (TiO_2) are the impurities present in bauxite. Separation of these impurities is done by leaching process using either Bayer's method or Hall's method. In both these methods finally the concentrated alumina is obtained by calcination.

In the Bayer's process the ore is first ground in a ball mill. Then it is leached by heating with concentrated solution of caustic soda (NaOH) at 140 to 150°C under high pressure for 2 to 8 hours in a digester. Aluminium oxide being amphoteric in nature, it reacts with the aqueous solution of sodium hydroxide to form water soluble sodium aluminate. This means that bauxite is leached by sodium hydroxide solution.

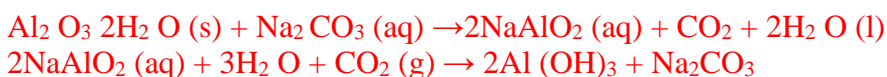


The iron oxide in the gangue does not dissolve in aqueous sodium hydroxide. It is separated by filtration. However, silica in the gangue dissolves in aqueous sodium hydroxide to form water soluble sodium silicate.

Aqueous sodium aluminate is diluted by putting in water and is cooled to 50°C. This results in precipitation of aluminium hydroxide.



In the Hall's process the ore is powdered and then leached by heating with aqueous sodium carbonate in the digester to form water soluble sodium aluminate. Then the insoluble impurities are filtered out. The filtrate is warmed and neutralised by passing carbon dioxide gas through it. This results in the precipitation of aluminium hydroxide.



The precipitate of Al(OH)_3 obtained in both, Bayer's and Hall's processes is filtered, washed, dried and then calcined by heating at 1000°C to obtain alumina.



- ii. Electrolytic reduction of alumina

a. In this method electrolysis of molten mixture of alumina (melting point > 2000°C) is done in a steel tank. The tank has a graphite lining on the inner side. This lining does the work of a cathode. A set of graphite rods dipped in the molten electrolyte works as anode. Cryolite (Na_3AlF_6) and fluorspar (CaF_2) are added in the mixture to lower its melting point upto 1000°C

b. Aluminium is deposited on the cathode on passing electric current. Molten aluminium being heavier than the electrolyte, is collected at the bottom of the tank. It is taken out from there from time to time, Oxygen gas is liberated at the anode.

The electrode reactions are as shown below.

Anode reaction $2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}^-$ (Oxidation)

Cathode reaction $\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al (l)}$ (Reduction)

The liberated oxygen reacts with the anodes to form carbon dioxide gas. The anodes have to be changed from time to time as they get oxidised during the electrolysis of alumina
