SOLUTIONS PHYSICS IGCSE P2 V2

Objective Section

Q no:	Correct Answer	Explanation (if any)
1	**A**. A driver of a car that is braking to stop at traffic lights.	Acceleration occurs when there is a change in velocity, which includes slowing down.
2	**D**. The same weight.	Both samples have the same mass, and since they are in the same location, they experience the same gravitational force, hence the same weight.
3	**B**. They have the same mass and the same weight but different volumes.	The spring balance measures weight, and since both have the same weight, they must have the same mass. Different volumes indicate different densities.
4	**D**. The man slowly raises one foot off the ground.	Raising one foot reduces the area in contact with the ground, increasing the pressure.
5	**D.** Both visible light and γ-rays are transverse waves.	In transverse waves, the wave motion is perpendicular to the direction of energy transfer.
6	**B**. 1 and 4.	Infra-red waves are used in remote controllers, and X-rays are used for security checks.
7	**A.** 3/2	The diagram shows a total of 1.5 wavelengths between X and Y.
8	**A.**	Light ray entering the glass block, bending towards the normal as it enters, traveling through the block, and bending away from the normal as it exits. This is due to the refraction of light.
9	**C.**	Light rays converging to a point after passing through the lens, forming a real, inverted image on the other side of the lens.
10	**B.** 0.61s.	The sound travels to the wall and back, so the total distance is 200m. Time = Distance/Speed = 200m/330m/s ≈ 0.61s.
11	**B.** A steel magnet can be demagnetised by heating it.	Heating disrupts the alignment of magnetic domains in steel.
12	**C.** A short, thick wire.	Resistance is lower in shorter and thicker wires.
13	**B**. M and N.	To measure the potential difference across the bell, the voltmeter should be connected across it.
14	**B.**	The ammeter is in series with the resistor, and the voltmeter is in parallel with the resistor, which is the correct configuration for measuring both the current through and the voltage across the resistor.
15	**B.**	The lamp that, when it fails, causes all other lamps to go out, indicating a series circuit.
16	**D.** The lamp works normally.	A 13A fuse will not blow in a lamp that requires a 3A fuse, but it is not safe.
17	**B**. Electrons.	Cathode rays are streams of electrons.
18	**C**. 14	The nucleon number is the total number of protons and neutrons.
19	**A.**	The point where the current remains the same as the original reading. A is the only point where the current remains undivided.
20	**B**. P and S.	Calculate the average speed for each stage and compare. At both P and S the car travels at 0.9km/min
21	**C**. The car is moving at a constant speed.	The forces are balanced, indicating constant speed.
22	**C.** Move the force to the left.	This increases the distance of the applied force from the pivot, increasing the moment and requiring less force to lift the weight.
23	**D**. Nylon.	Nylon is an insulator and will not induce a current.
24	**C**. 150 counts per minute.	At 3 hours: 1200/2 = 600 counts At 4 hours: 600/2= 300 counts At 5 hours: 300/2= **150 counts**

25	**C.**	A relay uses the magnetic effect and one application is allowing a small current to switch on a large current.

THEORETICAL PART:

Q. No. 1:

i) 1. Health Risks: Exposure to radioactive materials can increase the risk of cancer and other health problems, especially if the exposure is prolonged or at high levels.

2. Environmental Impact: Improper disposal of radioactive waste can lead to contamination of the environment, including soil, water, and air, which can have long-lasting effects on ecosystems and human health.

ii) Beta-particle: A beta-particle is a high-energy, high-speed electron or positron emitted during beta decay.

Beta decay: Beta decay is a type of radioactive decay in which a beta-particle (electron or positron) is emitted from an atomic nucleus, changing the nucleus into a different element.

iii) Bohr's Atomic Theory: Bohr's atomic theory, proposed by Niels Bohr in 1913, states that electrons in an atom orbit the nucleus in fixed, circular orbits at specific energy levels. These orbits are stable and do not emit radiation. Electrons can jump from one orbit to another by absorbing or emitting energy in discrete packets called quanta.

iv) Working Principle of Step-Up Transformers: Step-up transformers work on the principle of electromagnetic induction. When an alternating current passes through the primary coil of the transformer, it creates a changing magnetic field. This changing magnetic field induces an electromotive force (EMF) in the secondary coil of the transformer, which causes a current to flow. Step-up transformers increase the voltage of the input alternating current, making them useful for power distribution over long distances.

v) $F = BIL \sin\theta$

where:

F is the magnetic force,

B is the magnetic field strength,

I is the current flowing through the conductor,

L is the length of the conductor in the magnetic field,

θ theta is the angle between the direction of the current and the magnetic field.

Q. No. 2:

i) A parallel circuit is a circuit arrangement where components are connected in such a way that there are multiple paths for current to flow. In a parallel circuit, the voltage across each component is the same, but the current can vary. This circuit arrangement is commonly used in household electrical wiring and in electronic circuits where different components require different currents.

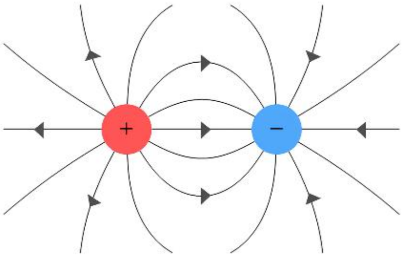
ii) A **conductor** is a material that allows the flow of electric charge with minimal resistance. They easily transfer electrical energy due to the presence of free-moving charge carriers, typically electrons. Examples Include:

Metals: Most metals are excellent conductors of electricity. (Copper, Aluminum etc)

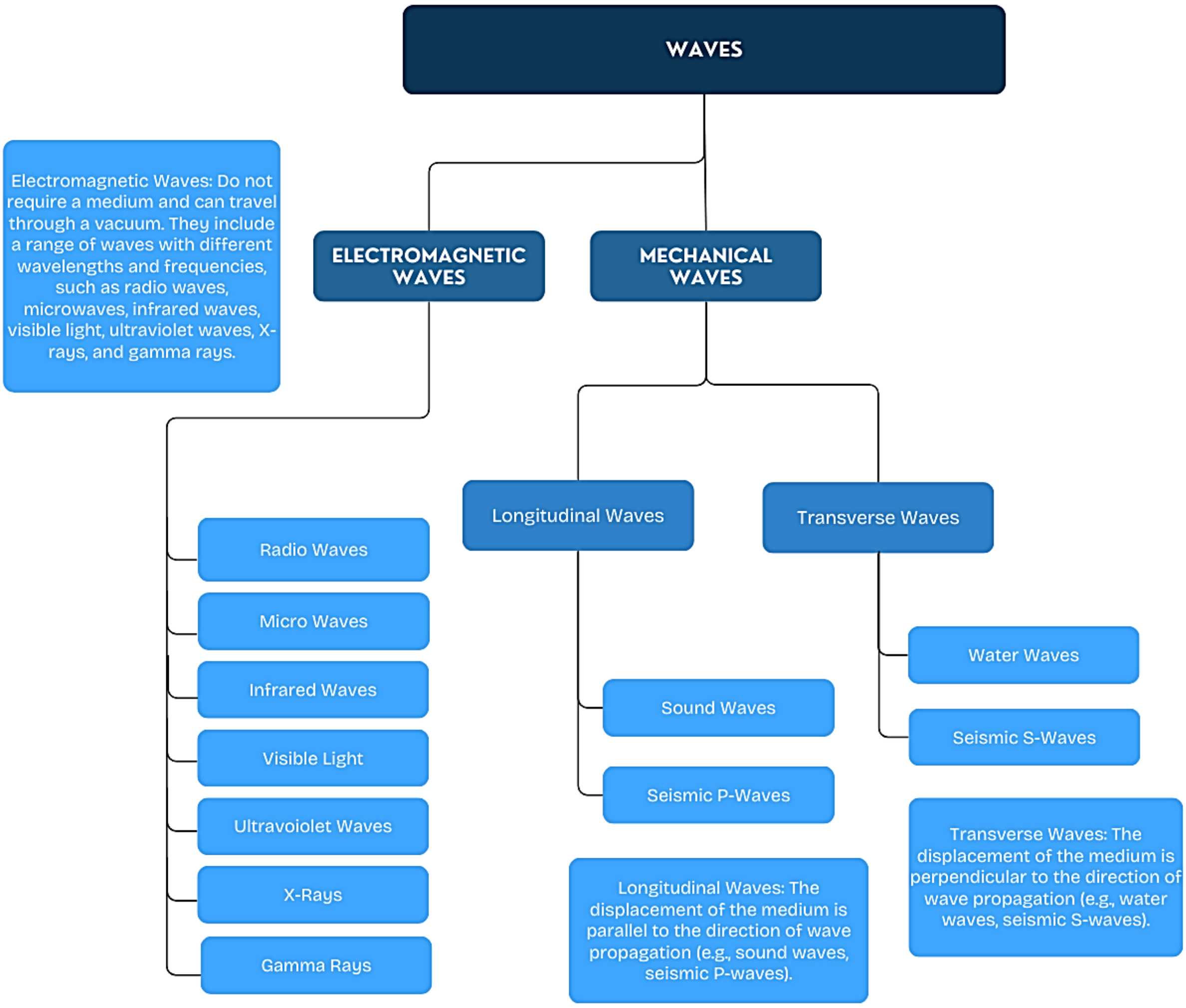
Graphite: A form of carbon that conducts electricity and is used in applications such as electrodes and batteries.
Saltwater: An ionic conductor where the dissolved ions (such as sodium and chloride) facilitate the flow of electric current.

iii)

1. Direction: Emanates from positive charges and terminates at negative charges.
2. Strength: its strength (E) at a point is the Force per unit charge and is measured in volts per meter (V/m) or newtons per coulomb (N/C).
3. Uniformity: Constant strength in a uniform field; varies in a non-uniform field.
4. Superposition Principle: Net field is the vector sum of individual fields.
5. Field Lines: Never intersect; density indicates field strength.



iv)



v)

$$c = \frac{Q}{m\Delta T}$$

Plugging in the values, we get:

$$c = \frac{600\,\mathrm{J}}{0.15\,\mathrm{kg} \times 15\,^{\circ}\mathrm{C}}$$

$$c = \frac{600\,\mathrm{J}}{2.25\,\mathrm{kg}\,^{\circ}\mathrm{C}}$$

$$c = 266.67\,\mathrm{J/kg}\,^{\circ}\mathrm{C}$$

Q. No. 3:

i) The relationship between the temperature and pressure of a gas is described by the ideal gas law, which states:

PV = nRT

where:

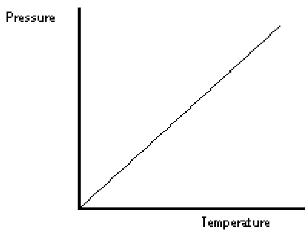
P is the pressure of the gas,

V is the volume of the gas,

n is the number of moles of gas,

R is the ideal gas constant, and

T is the temperature of the gas in Kelvin.



ii) When a body slides against a rough surface, the work done by friction is negative. This is because the force of friction acts in the direction opposite to the direction of motion of the body. As the body slides, friction does negative work on it, which results in the dissipation of energy as heat.

iii) Translational Kinetic Energy, Rotational Kinetic Energy, Vibrational Kinetic Energy

iv)

1. **Net Force:** The vector sum of all the external forces acting on the object must be zero. Mathematically, this can be expressed as:
   $\sum \vec{F} = 0$
   This means that the forces pushing or pulling on the object must be balanced, so there is no overall force causing the object to accelerate.
2. **Net Torque:** If the object is rotating or can rotate, the net torque (or the rotational equivalent of force) acting on the object must also be zero. Mathematically, this can be expressed as:
   $\sum \vec{\tau} = 0$
   This condition ensures that the object is not rotating or spinning due to an unbalanced torque.

v)

$$\text{Number of waves} = \text{Frequency} \times \text{Time}$$

$$\text{Number of waves} = 0.5\,\text{Hz} \times 5\,\text{s}$$

$$\text{Number of waves} = 2.5\,\text{waves}$$

Q. No. 4:

i)

$$\text{Mass} = \frac{\text{Weight}}{\text{Gravitational Field Strength}}$$

$$\text{Mass} = \frac{24\,\text{N}}{10\,\text{N/kg}}$$

$$\text{Mass} = 2.4\,\text{kg}$$

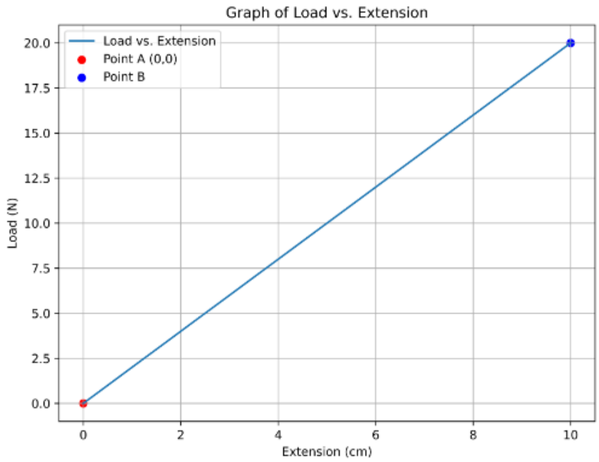
ii) Earthing is essential in everyday life for several reasons:

- Electrical Safety: Earthing helps protect individuals from electric shocks by providing a path of least resistance for fault currents to flow into the ground, rather than through a person's body.
- Equipment Protection: Earthing helps protect electrical equipment and appliances from damage due to electrical faults. By directing fault currents away from sensitive components, earthing can prevent costly repairs or replacements.
- Fire Prevention: Earthing reduces the risk of electrical fires by preventing the buildup of excess voltage that could ignite flammable materials.
- Static Discharge: In certain applications, such as in the electronics industry, earthing is used to safely dissipate static electricity, which can damage sensitive electronic components.

PRACTICAL PORTION:

Q. No. 1:

a) i)



ii) Point B is crucial for understanding the mechanical properties of materials, especially in the context of springs and other elastic materials. It marks the threshold between reversible (elastic) and irreversible (plastic) deformation, providing valuable information about the material's resilience and durability under stress.

b)

$$F(x) = kx$$

$$6.0\,\mathrm{N} = k \times \tfrac{0.15\,\mathrm{m}}{2}$$

$$k = \tfrac{6.0\,\mathrm{N} \times 2}{0.15\,\mathrm{m}}$$

$$k = 80\,\mathrm{N/m}$$

$$W = \int_0^{0.15} 80x\,dx$$

$$W = 80\int_0^{0.15} x\,dx$$

$$W = 80\left[\tfrac{1}{2}x^2\right]_0^{0.15}$$

$$W = 80\left[\tfrac{1}{2} \times (0.15)^2 - \tfrac{1}{2} \times 0^2\right]$$

$$W = 80 \times \tfrac{1}{2} \times 0.0225$$

$$W = 80 \times 0.01125$$

$$W = 0.9\,\mathrm{J}$$

c) i)

$$\Delta l = l - l_0 = 0.06\,\text{m} - 0.04\,\text{m} = 0.02\,\text{m}$$

$$F = k \cdot \Delta l$$

$$F = 80\,\text{N/m} \cdot 0.02\,\text{m}$$

$$F = 1.6\,\text{N}$$

$$F = mg$$

$$1.6\,\text{N} = m \cdot 9.81\,\text{m/s}^2$$

$$m = \frac{1.6\,\text{N}}{9.81\,\text{m/s}^2}$$

$$m = 0.163\,\text{kg}$$

ii)

$$\Delta l = l_0 - l = 0.04\,\text{m} - 0.05\,\text{m} = -0.01\,\text{m}$$

$$V_{\text{displaced}} = V_{\text{object}}$$

The buoyant force can also be expressed as:

$$F_{\text{buoyant}} = k \cdot (-\Delta l)$$

Setting these two expressions for the buoyant force equal to each other, we have:

$$\rho_{\text{liquid}} \cdot g \cdot V_{\text{object}} = k \cdot (-\Delta l)$$

Solving for ρ_{liquid}:

$$\rho_{\text{liquid}} = \frac{k \cdot (-\Delta l)}{g \cdot V_{\text{object}}}$$

Substituting the given values:

$$\rho_{\text{liquid}} = \frac{80\,\text{N/m} \cdot 0.01\,\text{m}}{9.81\,\text{m/s}^2 \cdot V_{\text{object}}}$$

$$\rho_{\text{liquid}} = \frac{80\,\text{N/m} \cdot 0.01\,\text{m}}{9.81\,\text{m/s}^2 \cdot \frac{0.163\,\text{kg}}{\rho_{\text{object}}}}$$

$$\rho_{\text{liquid}} = \frac{0.8\,\text{N}}{9.81\,\text{m/s}^2 \cdot \frac{0.163\,\text{kg}}{\rho_{\text{object}}}}$$

$$\rho_{\text{liquid}} = \frac{0.8\,\text{N} \cdot \rho_{\text{object}}}{9.81\,\text{m/s}^2 \cdot 0.163\,\text{kg}}$$

$$\rho_{\text{liquid}} = \frac{0.8 \cdot \rho_{\text{object}}}{1.6}$$

$$\rho_{\text{liquid}} = 0.5 \cdot \rho_{\text{object}}$$

Q. No. 2:

a) The unit in which electric charge is measured is the coulomb (C).

b) i) The explanation of the charge distribution:

- The smaller sphere is initially uncharged.
- When the smaller sphere is brought near the positively charged larger sphere, the free electrons in the smaller sphere will be attracted towards the side that is closer to the larger sphere because opposite charges attract.
- This leaves the far side of the smaller sphere with a deficit of electrons, hence a positive charge due to the lack of electrons.
- The side of the smaller sphere facing the larger sphere will have an excess of electrons, hence a negative charge.

The result is a separation of charges within the smaller sphere, with the side closest to the larger sphere being negatively charged and the side furthest away being positively charged. This induced charge separation occurs without any actual transfer of charge between the two spheres.

ii) When an earthed metal wire touches the positively charged metal sphere, electrons flow from the earthed wire to the sphere, neutralizing its charge. The sphere becomes electrically neutral as the excess positive charge is balanced by the influx of electrons.

c) The metal wire is an electrical conductor because it is made up of metal atoms arranged in a lattice structure with free electrons that are loosely bound and can move easily through the material in response to an electric field. This allows the metal wire to conduct electricity.

On the other hand, the plastic stand is an electrical insulator because it is made up of molecules with tightly bound electrons that are not free to move easily. The structure of the plastic does not allow for the flow of electrons, so it does not conduct electricity.

Q. No. 3:

a) In liquid water, molecules are closely packed but not rigidly fixed, allowing them to move past each other while maintaining some level of order. The hydrogen bonds between water molecules result in a cohesive force that keeps the molecules relatively close together. However, these bonds are not strong enough to prevent movement, so water can flow and take the shape of its container.

In water vapour, the molecules are much more spaced out compared to liquid water. The molecules move freely and independently of each other, filling the available space. The kinetic energy of the molecules is high enough to overcome the attractive forces between them, allowing them to move independently and exert pressure on the walls of their container.

The transition from liquid water to water vapour occurs when the average kinetic energy of the water molecules is sufficient to break the hydrogen bonds holding them together in the liquid phase. As the water absorbs heat, the molecules gain energy and begin to move more rapidly. Eventually, some molecules gain enough energy to escape the liquid phase and enter the gaseous phase as water vapour.

b) Water in the flask becomes water vapour in the air through the process of evaporation. Molecules of water at the surface of the liquid gain enough kinetic energy to overcome the attractive forces holding them in the liquid phase. These molecules then escape into the air as water vapour. This process continues as more molecules gain enough energy, leading to the gradual conversion of liquid water into water vapour in the air.