SOLUTION PHYSICS IGCSE P1 V1

Objective Section

Q no:	Correct Answer	Explanation (if any)
1	A. 10 N/kg	The standard gravitational field strength near Earth's surface is approximately 9.8 N/kg often rounded to 10 N/kg for simplicity in calculations.
2	D. 6.0 V	When connected in series, the voltages of the cells add up: 1.5 V × 4 = 6.0
3	B. 20 m/s	Using speed=distance/time=800 m/40 s = 20 m/s.
4	C. Pushing a friend on a swing	A rotation motion occurs when a force is applied away from the pivot point, causing a turning effect.
5	D. Speed	Scalars have magnitude only, not direction. Speed fits this criterion, unlike acceleration, displacement, and force.
6	B. Volume doubles, pressure halves	This follows Boyle's Law: $P \propto (1/V)$ for a constant temperature.
7	C. 1 670 000 J	Energy is calculated using Q = m L where m = 5 kg and L = 3.34×10^5 J/Kg hence, $Q=5\times3.34\times10^5 = 1.67\times10^6$ J. or 1670000 J
8	**A.**	Symbol used to represent a diode
9	A. Cobalt-60	Cobalt-60 emits gamma rays used in radiotherapy for cancer treatment.
10	C. Susceptibility	Magnetic susceptibility measures how much a material becomes magnetized in response to an external magnetic field.
11	B. They are less penetrating than beta particles.	Alpha particles have low penetration power due to their larger mass and charge.
12	A. blue	In visible light, frequency increases from red to violet, with blue having a higher frequency than green, orange, or yellow.
13	A. Dynamo Effect	Earth's magnetic field is generated by the motion of molten iron in its core, described by the dynamo theory.
14	B. Human ears can hear them.	Ultrasonic waves have frequencies above 20,000 Hz, beyond human hearing.
15	**D.**	Shows a step function that remains constant above the time axis, indicating a direct voltage.
16	**B.** Microwaves: Mobile phones	Microwaves are indeed used in mobile phones and microwave ovens.
17	D.	This equation represents beta decay, where a neutron in the Carbon-14 nucleus decays into a proton, emitting an electron (beta particle) and an antineutrino.
18	A.	The light ray bends towards the normal when it enters the glass, which is the correct behavior for refraction from a less dense medium (air) to a denser medium (glass).
19	B. It may happen when a nucleus absorbs a neutron.	Nuclear fission occurs when a heavy nucleus splits after absorbing a neutron.
20	D. It contains neutrons and protons and has a positive charge.	The nucleus is made of protons and neutrons, with protons giving it a positive charge.
21	C. 14 kW	Power wasted = Input power - Useful output power = 20−6=14 kW.
22	B. 250 m/s	Jet airliners typically cruise at speeds around 250 m/s
23	B. gamma rays	Gamma rays have the shortest wavelength and the highest frequency in the electromagnetic spectrum.
24	C. gravitational	Gravitational attraction causes the aggregation of particles into celestial bodies.
25	C. reduces energy losses	High voltage minimizes current, thereby reducing resistive energy losses in transmission lines.

THEORETICAL PORTION:

Q. No. 1:

i)

1. For mercury:

   Given:

- Mass = 6.60 kg = 6600 g
- Volume = 500 cm³

   Density = $\frac{6600 \text{ g}}{500 \text{ cm}^3}$ = 13.2 g/cm³

1. For steel:

   Given:

- Mass = 40 g
- Each edge of the cube = 1.74 cm

   Volume of the cube = $(1.74 \text{ cm})^3$ = 5.21 cm³

   Density = $\frac{40 \text{ g}}{5.21 \text{ cm}^3}$ ≈ 7.68 g/cm³

ii) a)

To find the object's speed using a distance-time graph, you follow these steps:

1. **Identify Two Points on the Line**: Choose two clear points on the graph. These points should be where the line crosses grid lines for both distance (y-axis) and time (x-axis), making it easier to read their values accurately.

2. **Read Off the Coordinates**: For each of the two points, read off the coordinates. This will give you the time and distance for each point. Let's denote these points as $P_1(t_1, d_1)$ and $P_2(t_2, d_2)$, where t represents time and d represents distance.

3. **Calculate the Difference in Distance and Time**: Calculate the difference in distance (Δd) and the difference in time (Δt) between the two points. This is done by subtracting the coordinates of P_1 from P_2, resulting in $\Delta d = d_2 - d_1$ and $\Delta t = t_2 - t_1$.

4. **Calculate the Speed**: Speed is defined as the distance traveled per unit of time. Using the differences calculated in the previous step, calculate the speed (v) using the formula:
   $v = \frac{\Delta d}{\Delta t}$
   This will give you the average speed of the object between the two points on the graph.

5. **Units**: Ensure that the units of speed are consistent with the units used for distance and time on the graph. For example, if distance is in meters and time is in seconds, the speed will be in meters per second (m/s).

b) If the object is moving with constant speed, its position versus time graph would be a straight line with a constant slope. This is because the object covers equal distances in equal intervals of time. So, if the graph is a straight line with a constant slope, it indicates that the object is moving at constant speed.

c) To find the object's acceleration from a speed-time graph, calculate the slope. A horizontal line indicates zero acceleration, a straight line with a non-zero slope indicates constant acceleration and a curved line indicates variable acceleration. The steeper the slope, the greater the acceleration.

iii) When an object is in motion, friction acts in the direction opposite to the direction of motion. This is known as kinetic friction. It acts to oppose the relative motion between the surfaces of the object and the surface it is in contact with, slowing down the object.

Q. No. 2:

i) 1. The net force acting on the object must be zero.

2. The net torque (or moment) acting on the object must be zero.

ii) The four types of energy are:

1. Kinetic energy

2. Potential energy

3. Thermal (heat) energy

4. Chemical energy

iii) 1. Reduction in electricity bills

2. Net metering

3. Incentives and rebates

4. Long-term savings

5. Hedging against future electricity price increases

Q. N o. 3:

a. 2%

b. The renewable sources are water power, wind power, and solar power.

c. Renewable means that the energy source is naturally replenished over a relatively short period, such as sunlight, wind, rain, tides, waves, and geothermal heat.

d. Two other renewable sources are wind power and solar power.

e. While energy is always conserved, it is important to develop renewable sources because non-renewable sources, such as fossil fuels, are finite and will eventually be depleted.

Q. No. 4:

i) Brownian motion is the random motion of particles suspended in a fluid (liquid or gas) as they are constantly bombarded by molecules of the fluid. This motion was first observed by the scientist Robert Brown in 1827 and provided evidence for the existence of atoms and molecules.

To demonstrate Brownian motion, observe particles (e.g., pollen or smoke) suspended in a fluid (e.g., water) under a microscope. The particles will exhibit random, erratic motion due to collisions with the fluid molecules, confirming the kinetic theory of matter.

ii) The water droplets form on the outside of an ice-cold water-filled glass due to condensation. When warm, moist air comes into contact with the cold surface of the glass, the air cools down. As it cools, its ability to hold moisture decreases, causing the excess water vapour in the air to condense into liquid water droplets on the surface of the glass. This process is similar to how dew forms on grass in the morning.

Q. No. 5:

i) White surfaces reflect most of the incoming radiation, while black surfaces absorb most of it. This difference in reflectivity and absorptivity causes white surfaces to appear bright and cool, while black surfaces appear dark and warm.

ii) An echo is a reflected sound wave that arrives at the listener's ear after the direct sound, typically because the sound wave has bounced off a surface such as a wall or a cliff.

The property of sound that is affected by the change in temperature is the speed of sound. This is because sound travels faster in warmer air, where the air particles are moving more quickly and can transmit sound waves more rapidly.

iii) The laws of reflection state that the incident ray, the reflected ray, and the normal to the surface of reflection all lie in the same plane, and the angle of incidence is equal to the angle of reflection.

iv) Some examples of electromagnetic waves include:

1. Radio waves: Used for communication, broadcasting, and radar.

2. Microwaves: Used for cooking, communication, and radar.

3. Infrared radiation: Associated with heat and used in remote controls and thermal imaging.

4. Visible light: The range of electromagnetic waves that are visible to the human eye, used for illumination and vision.

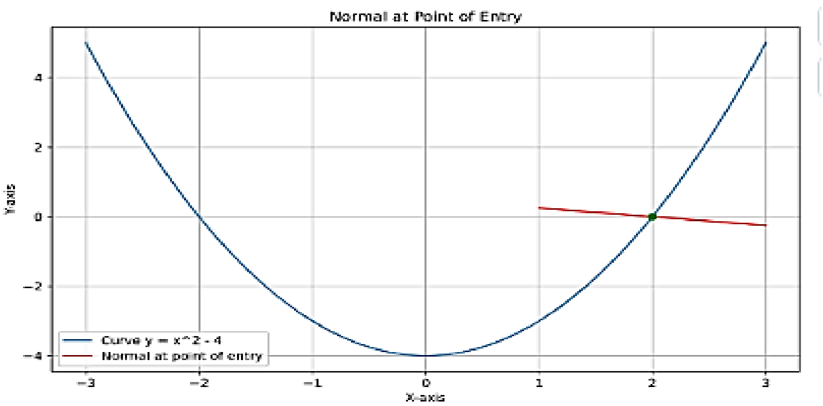
5. Ultraviolet radiation: Responsible for sunburn and used in sterilization and fluorescence.

6. X-rays: Used in medical imaging and security screening.

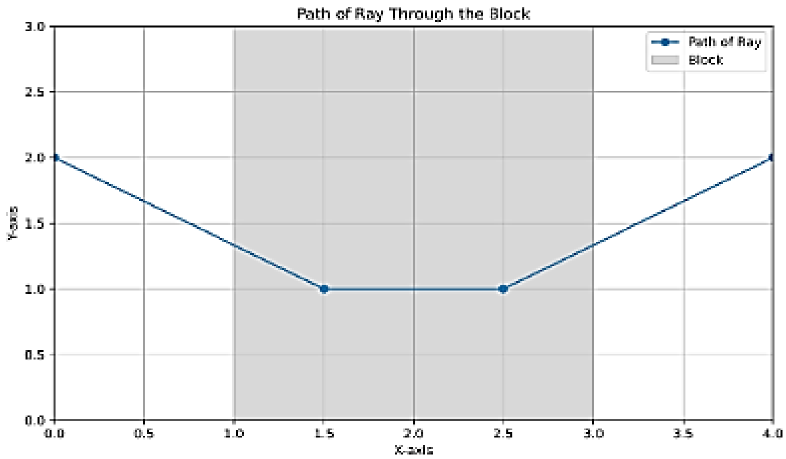
7. Gamma rays: Used in cancer treatment and sterilization.

Q. No. 6:

i) a)



b)



ii) The three rules of magnetism are:

1. Like poles repel, unlike poles attract.

2. The strength of the magnetic force decreases with distance.

3. Magnetic dipoles align with an external magnetic field.

iii) The relationship between charge and field strength is described by Coulomb's law in electrostatics. Coulomb's law states that the force between two point charges is directly proportional to the product of the charges and inversely proportional to the square of the distance between them.

$$F = k \cdot \frac{q_1 \cdot q_2}{r^2}$$

Where:

- F is the force between the charges,
- k is Coulomb's constant ($8.9875 \times 10^9 \, \mathrm{N\,m^2/C^2}$),
- q_1 and q_2 are the magnitudes of the charges,
- r is the distance between the charges.

Q. No. 7:

The total number of neutrons in the nucleus of a given isotope can be determined using the isotope's atomic number (number of protons) and its mass number (sum of protons and neutrons).

The number of neutrons (N) in an isotope can be calculated using the formula:

N = mass number (A) − atomic number (Z)

where:

N is the number of neutrons,

mass number (A) is the total number of protons and neutrons in the nucleus, and

atomic number (Z) is the number of protons in the nucleus

PRACTICAL PORTION:

Q. No. 1:

To investigate the refraction of light using rectangular blocks, semi-circular blocks, and triangular prisms, you can perform the following experiments:

1. <u>Rectangular Blocks</u>:

- Place a rectangular glass block on a flat surface.
- Shine a narrow beam of light (e.g., from a laser pointer) horizontally into the block so that it enters one side of the block.
- Observe the path of the light beam as it travels through the block. You should see the light beam bend (refract) as it enters and exits the block due to the change in the speed of light in the glass.

2. <u>Semi-Circular Blocks</u>:

- Place a semi-circular glass block on a flat surface with the flat side down.
- Shine a narrow beam of light horizontally into the curved surface of the block.
- Observe the path of the light beam as it enters and exits the curved surface. You should see the light beam refract as it enters and exits the curved surface.

3. <u>Triangular Prisms</u>:

- Place a triangular glass prism on a flat surface with one of the triangular faces down.
- Shine a narrow beam of light horizontally into one of the other faces of the prism.
- Observe the path of the light beam as it enters the prism, refracts inside the prism, and exits the prism from the third face.

4. <u>Observations</u>:

- You should observe that the light beam bends (refracts) as it enters and exits the blocks and prisms.
- The amount of bending depends on the angle of incidence, the refractive index of the material, and the shape of the block or prism.

5. <u>Analysis:</u>

- Measure the angles of incidence and refraction for each experiment.
- Use Snell's Law to calculate the refractive index of the material for each block or prism.

6. <u>Conclusion:</u> Compare the refractive indices obtained for the different materials (glass, acrylic, etc.) and shapes (rectangular, semi-circular, triangular) to understand how they affect the refraction of light.

Q. No. 2:

To investigate how extension varies with applied force, you can perform a simple experiment using a spring and a set of weights. Here's how you can set it up:

Materials Needed:

- A helical spring
- A set of calibrated weights
- A retort stand with a clamp or suitable support
- A ruler or measuring tape

- Marker or tape to mark the initial position of the spring
- A notebook for recording data

Procedure:

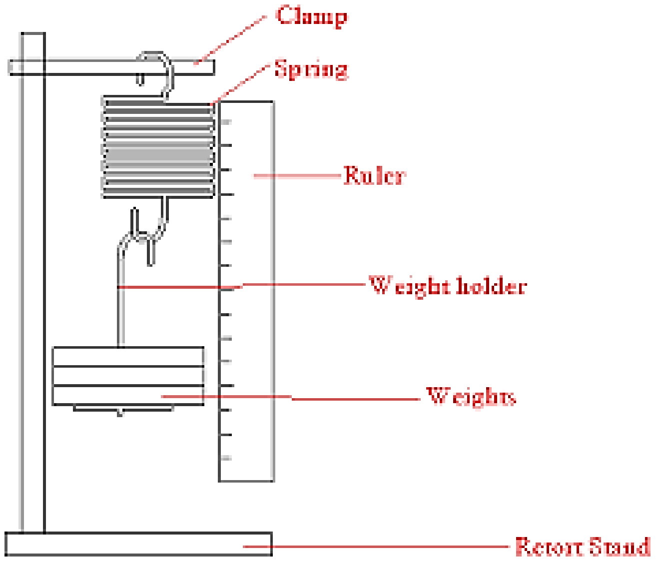
1. Setup:
   - Hang the spring vertically from the retort stand or a similar support using a clamp.
   - Attach the ruler parallel to the spring, ensuring that the zero mark aligns with the bottom of the unloaded spring.
2. Measure Initial Length:
   - Record the initial length of the spring when no weight is attached. Mark this position as the reference point.
3. Add Weights Incrementally:
   - Attach a small weight to the bottom of the spring.
   - Record the new length of the spring using the ruler. Calculate the applied force using $F = mg$ where $g=10$ N/kg.
   - Repeat this process by adding weights incrementally, ensuring each weight is recorded.
4. Avoid Elastic Limit:
   - Add weights only up to the spring's elastic limit, where it can still return to its original shape after the weights are removed. This ensures the validity of Hooke’s Law.
5. Data Collection:
   - For each weight, record the total force applied and the corresponding extension of the spring (new length−original length)

Observations and Analysis:

- Plot a graph of Force (N) vs. Extension (cm).
- A straight-line graph through the origin confirms that the spring obeys Hooke’s Law.
- Any deviation from linearity indicates that the elastic limit has been exceeded.

Safety Notes:

- Ensure weights are securely attached to prevent them from falling.
- Do not overstretch the spring to avoid permanent deformation or snapping.



Q. No. 3:

To investigate the magnetic field pattern for a permanent bar magnet and between two bar magnets, you can use iron filings or a magnetic field sensor. Here's a general procedure:

1. For a Single Bar Magnet:

- Place the bar magnet on a flat surface.
- Sprinkle iron filings evenly around the magnet.
- Gently tap the surface to distribute the filings.
- Observe the pattern formed by the filings. The filings will align along the magnetic field lines, showing the direction and shape of the magnetic field.

2. For Two Bar Magnets:

- Place two bar magnets on a flat surface, with their opposite poles facing each other.
- Sprinkle iron filings evenly around the magnets.
- Gently tap the surface to distribute the filings.
- Observe the pattern formed by the filings between the magnets. You will see how the magnetic fields interact and combine between the two magnets.

3. Observations:

- In the case of a single bar magnet, the magnetic field lines will emerge from one pole (north) and enter the other pole (south) in a continuous loop.
- Between two bar magnets, you will observe how the magnetic field lines from one magnet interact with those from the other magnet, forming complex patterns that show the interaction of the magnetic fields.

4. Analysis:

- Note the direction of the magnetic field lines. They always point from the north pole to the south pole outside the magnet.
- Note the shape of the field lines. They curve outward from one pole and curve inward to the other pole, forming closed loops.

Q. No. 4:

To construct electrical circuits to test series circuits using resistors and filament lamps.

Materials Needed:

- Power supply (e.g., battery or DC source)
- Switch
- Resistors
- Filament lamps
- Connecting wires
- Ammeter (to measure current)
- Voltmeter (to measure voltage)

1. Series Circuit with Resistors:

- Connect the positive terminal of the power supply to one terminal of the switch.
- Connect the other terminal of the switch to one terminal of the first resistor.
- Connect the second terminal of the first resistor to one terminal of the second resistor.

- Connect the second terminal of the second resistor to the negative terminal of the power supply.
- Connect a voltmeter in parallel across each resistor to measure individual voltages and across the entire circuit for total voltage.
- Connect an ammeter in series with the circuit to measure the total current.
- Switch on the circuit and record the voltage and current readings.

2. Series Circuit with Filament Lamps:
- Connect the positive terminal of the power supply to one terminal of the switch.
- Connect the other terminal of the switch to one terminal of the first filament lamp.
- Connect the second terminal of the first filament lamp to one terminal of the second filament lamp.
- Connect the second terminal of the second filament lamp to the negative terminal of the power supply.
- Connect a voltmeter in parallel across each filament lamp to measure individual voltages and across the entire circuit for total voltage.
- Connect an ammeter in series with the circuit to measure the total current.
- Switch on the circuit and record the voltage and current readings.

Observations and Analysis:
- In a series circuit, the total voltage equals the sum of voltages across individual components:
  V(total) = V1 + V2 + …
- The current is the same through all components.
- Adding more components (resistors or lamps) increases the total resistance, reducing the circuit's current.

Safety Tips:
- Ensure all connections are secure and switch off the power supply when adjusting the circuit.
- Avoid exceeding the power ratings of the resistors or filament lamps to prevent damage.