SOLUTIONS PHYSICS IGCSE P2 V3

Objective Section

Q no:	Correct Answer	Explanation (if any)
1	C. 115.20 seconds	The difference between the start and end times on the stopwatch
2	C. N, Kg	Weight is measured in Newton while mass in Kilogram
3	D. The resultant force on the boat is zero.	The boat is traveling at a steady speed in a straight line, indicating balanced forces.
4	D. Wind	Wind energy is renewable and does not release carbon dioxide when generating electricity.
5	**C**. Lifting a 2 kg mass through 2 m.	Resulting in 39.2 J of work done. Using F x d
6	D. the fish In bottom portion of tank filled with sea-water	Seawater is denser than fresh water. As against fish C, pressure in a fluid increases with depth due to the weight of the fluid above. The deeper you go, the more water there is above you, and thus the greater the pressure.
7	A. Smoke particles are hit by air molecules.	Brownian motion is caused by the random collisions of air molecules with smoke particles.
8	A. Condensation	Water forms on the outside of the glass due to condensation.
9	A. The plate that is dull and black.	Dull and black surfaces radiate thermal energy at the greatest rate.
10	D. The speed of the light changes.	Light changes direction when it enters a different medium due to a change in speed.
11	D.	The labelled arrow that represents the distance from the center of lens to the focal point.
12	B.	White light enters the prism, refracts inside, and exits as a spectrum of colors, spreading outwards.
13	C. It has lost electrons.	The rod becomes positively charged by losing electrons.
14	D.	Magnetic field lines curving outward from the north pole and inward to the south pole, forming closed loops.
15	A. Larger, Greater	When the engineer adjusts the alarm to produce a louder note of a higher pitch, the amplitude of the sound increases (making it louder), and the frequency increases (making the pitch higher).
16	C. Loud speaker	Loudspeaker produces waves where particles move parallel to the direction of wave propagation.
17	A. 4.0A	Using Ohm's law, the current in the 2.0Ω resistor is calculated.
18	A. It is impossible to know because radioactive decay is random.	Radioactive decay is a random process.
19	A. different, same, different	Isotopes of an element have the same number of protons but different numbers of neutrons. Therefore, the number of nucleons (protons + neutrons) will also be different.
20	D. To use a small current to switch on a large current.	Relays use a small current to control a larger current.
21	B.	The relative charge of an electron is -1, a neutron is 0, and a proton is +1.
22	B. It increases from 0V to 12V.	As the sliding terminal moves, the voltage increases.
23	B. A thermistor	A thermistor changes resistance with temperature, controlling the current to the fan
24	C. increases, decreases	When the brightness of the light falling on the LDR decreases, the resistance of the LDR increases. As a result, the reading on the ammeter decreases because the current in the circuit is inversely proportional to the resistance.
25	**C**. the circuit does not break at 2A, and it breaks in less than 0.01 seconds at 18A.	When the current is 2A, the circuit does not break because the current is within the normal operating range. When the current is 18A, the circuit breaks in less than 0.01

		seconds because the current is significantly higher than the normal operating range, triggering the circuit breaker to act quickly.

THEORETICAL PART:

Q. No. 1:

i) 1. Medical Applications: Radioactive isotopes are used in medicine for diagnostic and treatment purposes.

2. Power Generation: Nuclear power plants use the energy released by nuclear reactions to generate electricity. This process is called nuclear fission.

ii) A gamma particle: It is a high-energy photon emitted during radioactive decay.

A gamma decay: It is the process where an unstable atomic nucleus emits a gamma particle to transition to a lower energy state.

iii) Heisenberg's uncertainty principle states that it is impossible to simultaneously determine, with arbitrary precision, both the momentum and the position of a particle.

iv) The working principle of a step-down transformer is based on **Faraday's law of electromagnetic induction**. When an alternating current (AC) passes through the primary coil of the transformer, it creates a changing magnetic field around the coil. This changing magnetic field induces an electromotive force (EMF) or voltage in the secondary coil according to Faraday's law. In a step-down transformer, the number of turns in the secondary coil is fewer than in the primary coil, resulting in a lower voltage output in the secondary coil compared to the primary coil.

v) The electromagnetic fields (EMFs) that we encounter in daily life, such as those from power lines, household appliances, and wireless devices, are generally considered safe at typical exposure levels. However, prolonged and intense exposure to EMFs, such as those from certain industrial processes or very close to high-voltage power lines, can damage body tissues and can cause other potential health effects.

Q. No. 2:

i) The circuit that draws the smallest current from the cell is the circuit with the highest total resistance. According to Ohm's Law (V = IR), the current flowing through a circuit is inversely proportional to the total resistance of the circuit. Therefore, a circuit with higher resistance will draw less current from the cell compared to a circuit with lower resistance, assuming both circuits are connected to identical cells.

ii) A semiconductor is a material that has electrical conductivity between that of a conductor and an insulator. Its conductivity can be controlled and modified by adding impurities or applying external electrical fields. Semiconductors are essential components in electronic devices. Examples include silicon (Si) and germanium (Ge), which are widely used in the semiconductor industry to manufacture transistors, diodes, and integrated circuits.

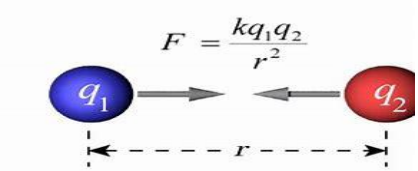
iii) Coulomb's Law states that the electrostatic force between two point charges is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance between them. Mathematically, it is represented as:

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

where:

- F is the electrostatic 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.

The direction of the force is along the line joining the two charges. The force is attractive if the charges are of the opposite sign and repulsive if the charges are of the same sign.



iv) Amplitude: The maximum displacement of a wave from its equilibrium position.

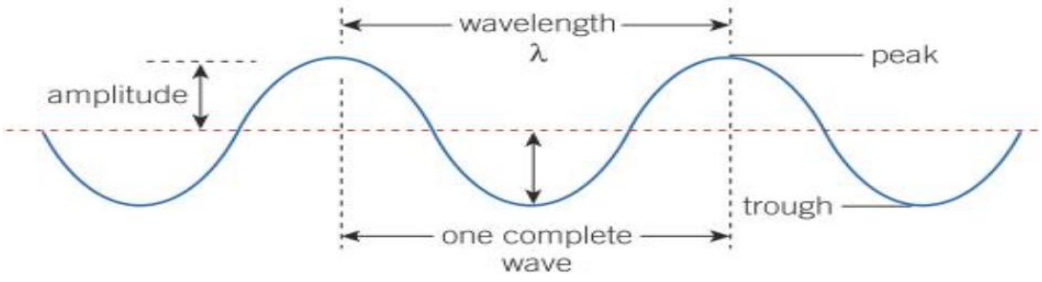
Wavelength: The distance between two consecutive points in a wave that is in phase (e.g., two peaks or two troughs).

Frequency: The number of complete cycles of a wave that occur in one second, measured in hertz (Hz).

Speed: The rate at which a wave propagates through a medium, calculated as the product of frequency and wavelength.

Period: The time taken for one complete cycle of a wave to pass a given point.

Phase: Describes the position of a point in a wave cycle relative to a fixed reference point, often measured in degrees or radians.



v)

$$427.5\ \mathrm{J} = 75\ \mathrm{g} \times c \times 30\ ^\circ\mathrm{C}$$

$$c = \frac{427.5\ \mathrm{J}}{75\ \mathrm{g} \times 30\ ^\circ\mathrm{C}}$$

$$c = \frac{427.5\ \mathrm{J}}{2250\ \mathrm{g} \cdot ^\circ\mathrm{C}}$$

$$c = 0.19\ \mathrm{J/g^\circ C}$$

Q. No. 3:

i) Expansion, Compressibility, Low density, Diffusion, Pressure, Temperature and Movement.

ii) In the scenario where Superman stops a truck from moving downhill by applying force to it, the truck does not move in the direction of the applied force (he is merely holding the car to prevent its descent down the hill.). Since there is no displacement in the direction of the force, no work is done according to the physics definition. Therefore, this is not an example of work being done.

iii) The Law of Conservation of Energy states that the total energy of an isolated system remains constant over time. Energy cannot be created or destroyed, only transformed or transferred from one form to another. This principle is fundamental in physics and has broad applications across various fields, including mechanics, thermodynamics, and electromagnetism.

iv) 1. Hang the plane lamina from a point near its edge using vertical support, ensuring that it can freely swing like a pendulum.

2. Attach the plumb line to the edge of the lamina using the sharp pencil or nail, so that the plumb line hangs vertically downwards.

3. Allow the lamina to come to rest, ensuring that it is not swinging.

4. Mark the position where the plumb line intersects the lamina.

5. Repeat steps 1-4 for different orientations of the lamina (e.g., rotate it 90 degrees each time).

6. The centre of mass of the lamina is located at the point where the lines intersect when the lamina is in equilibrium. This point represents the balance point of the lamina, where its weight is evenly distributed on either side.

v) A doctor may choose to use an ultrasound scan instead of an X-ray to measure the kidneys because ultrasound scans do not use ionizing radiation, making them safer, especially for pregnant women and children. Ultrasound allows for real-time imaging, enabling doctors to observe the kidneys' structure and function as they move and work.

Q. No. 4.

i)

$$\text{power} = \text{potential difference} \times \text{current}$$

$$1.1\ \text{W} = 230\ \text{V} \times \text{current}$$

$$\text{current} = \frac{1.1\ \text{W}}{230\ \text{V}}$$

$$\text{current} = 0.0048\ \text{A}$$

ii) Radioactive Contamination: Nuclear waste remains radioactive for thousands of years and can contaminate the environment if not stored properly, leading to health risks and environmental damage.

Long-term Storage: Secure storage facilities must be maintained for thousands of years to contain the radioactive waste, raising concerns about the feasibility and cost of long-term management.

Public Concern: There is public opposition to the transportation and storage of nuclear waste due to fears of accidents, leaks, and potential health hazards, leading to controversy and debate over the safest disposal methods.

PRACTICAL PORTION:

Q. No. 1:

i) The distance between the two voltage pulses on the screen can be measured using the graticule lines. Each division on the graticule represents a certain voltage or time interval, depending on the setting. By counting the number of divisions between the two pulses and multiplying by the appropriate scale factor, you can determine the distance in volts or time units.

The distance on the screen between the two voltage pulses is: 6cm

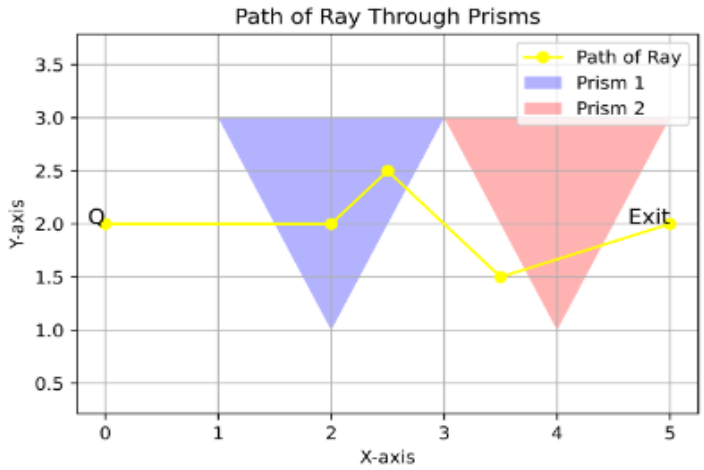
ii) With the time-base control set at 5.0 ms/cm, the time interval between the voltage pulses can be calculated by measuring the distance between them on the screen in centimetres and multiplying by the time-base setting.

Time Interval = Distance × Time-Base Setting
Time Interval = 6cm × 5.0 ms/cm
Time Interval = 30 ms

iii) A c.r.o. can be used to measure small time intervals in various applications, such as in physics experiments to measure the period of oscillations, in electronics to measure the duration of voltage pulses, or in telecommunications to measure signal timing.

Q. No. 2:

a)



b) The image of PQ seen by the person looking into the lower prism is virtual, upright, and laterally inverted. It appears as if it is formed behind the prism and on the opposite side of the actual object.

c) There is no change in the direction of the ray from P at points A, C, D, and F because the ray is incident normal to the surfaces at these points. When light travels from one medium to another along the normal (perpendicular) to the interface, it does not undergo refraction. Therefore, the direction of the ray remains unchanged at these points.

d)

$$n = \frac{c}{v}$$

$$v = \frac{c}{n}$$

$$v = \frac{3 \times 10^8}{1.5}$$

$$v = 2 \times 10^8 \text{ m/s}$$

e) Ray AB reflects through 90° at point B due to total internal reflection (TIR). This phenomenon occurs when a ray of light travelling from a medium with a higher refractive index (such as glass) to a medium with a lower refractive index (such as air) strikes the interface at an angle greater than the critical angle. The critical angle is the angle of incidence that produces an angle of refraction of 90°.

In this case, the ray AB enters the prism and strikes the boundary between the glass prism and the air at an angle greater than the critical angle. As a result, instead of refracting out of the prism, the ray undergoes total internal reflection at point B, reflecting into the prism and eventually exiting the prism at point C.

Q. No. 3:

a) i) Ionizing radiations like α, β, and γ particles interact with gas atoms, stripping electrons and creating ions. This process leads to the formation of positively charged ions (cations) and free electrons.

ii) Alpha (α) particles are considered better ionizers of gas than beta (β) particles because α particles are much more massive and carry a double positive charge. This means they have a higher ionisation potential and can cause more ionisation events per unit distance traveled.. β particles, on the other hand, are lighter and carry a single negative charge, which makes them less effective at ionizing gas atoms compared to α particles.

b) i) 1. Medical imaging: Radioactive isotopes such as technetium-99m are used in nuclear medicine for diagnostic imaging. They can be injected into the body and tracked using detectors to visualize organs and tissues, helping in the diagnosis of various medical conditions.

2. Sterilization: Radioactive isotopes like cobalt-60 are used in sterilization processes for medical equipment, food, and other products. The high-energy gamma rays emitted by cobalt-60 can penetrate packaging materials and kill bacteria, viruses, and other microorganisms, ensuring the safety of the sterilized items.

ii) In medical imaging, radioactive isotopes like technetium-99m are injected into the body and emit gamma rays. A gamma camera detects these rays, creating a 3D image that helps diagnose conditions.

Q. No. 4:

a) The wave pattern to the right of the barrier appears incorrect. The wave should exhibit diffraction and interference patterns, with the wavefronts spreading out after passing through the gap. However, the image shows the wavefronts continuing in a straight line as if the barrier did not exist.

b)