Question bank

Chapter-1 Topic 1 Energy and society

Q-1 **Explain the term geothermal energy and briefly outline the principle by which this energy source is used.**

Q-2 **Give one difference between food and fuel.**

Q-3 **What is a demographic trap?**

Q-4 **Using your own words in good English, explain the greenhouse effect.**

Chapter-2 Topic 2 Conversion of energy

Q-1 **Why do you think we shiver when we are cold?**

Q-2 **What does photovoltaic mean?**

Q-3 **A generator can be described as an electric motor working backwards. Briefly explain this.**

Q-4 **What is a transducer?**

Q-5 **What is an armature?**

Q-6 **What is a semiconductor? Give two examples of semiconductors.**

Chapter-3 Topic 3 Properties of waves

Q-1 **What is superposition? What properties of waves are explained by superposition?**

a) What is superposition?

b) What properties of waves are explained by superposition?

Q-2 **What are coherent waves?**

Q-3 **The word laser is an acronym. What words make up the word laser?**

Q-4 **Who invented lasers?**

Q-5 **What is the mathematical relationship between speed, frequency and wavelength?**

Q-6 **What is one hertz (Hz)?**

Q-7 **In a perfect or ideal camera, the best photographs would be obtained with the widest aperture setting of the lens. Briefly explain this.**

Q-8 **Name three ways in which light may become polarised.**

Q-9 **Solve these :**

a) Small bats emit squeaks of frequency 80 kHz for echolocation. If the speed of sound in air is 340 m/s, calculate the wavelength of these squeaks.

b) Would lower-frequency squeaks help the bats echo-locate? Explain your answer.

Multiple Choice Questions

Q-1 **Light may become polarised by (tick only one option): (i) passing through certain types of crystal (ii) reflection (iii) scattering (iv) passing through a keyhole (v) passing through empty space.**

(a) All of the above

(b) None of the above

(c) i), ii) and iii) are correct

(d) i), iii) and v) are correct

Chapter-4 Topic 4 Electromagnetic waves

Q-1 **Show the seven electromagnetic waves in order of increasing frequency.**

Q-2 **Calculate the frequency of infrared waves if the distance between three successive peaks is 60 μm.**

Q-3 **Give two similarities and two differences between gamma rays and X-rays.**

Q-4 **Calculate the range of frequencies for visible light whose wavelengths are from 380 nm to 750 nm.**

Q-5 **Radio station Beat FM broadcasts on 99.9 MHz.**

a) Will remote signals of wavelength 0.075 m interfere with Beat FM? Explain with a calculation.

b) Calculate the wavelengths of Beat FM (99.9 MHz) and Radio Nigeria 1 (657 kHz) and explain why reception differs in a valley.

Q-6 **Give two uses for each of the following:**

a) infrared waves

b) X-rays

Q-7 **Which electromagnetic wave is used to 'see' objects in the dark? Calculate its frequency if the trough spacing is 20 μm.**

Q-8 **List three advantages of using microwaves instead of radio waves in satellite telecommunication.**

Q-9 **Briefly explain why plastic and paper containers do not get very hot when used in microwave ovens.**

Multiple Choice Questions

Q-1 **Which of the following is (are) the differences between an electromagnetic wave and a mechanical wave? (i) Mechanical waves need a medium for transmission, while electromagnetic waves do not. (ii) Mechanical waves can be either longitudinal or transverse, while all electromagnetic waves are transverse. (iii) Mechanical waves cannot be polarised while electromagnetic waves can be polarised.**

(a) all of i), ii) and iii)

(b) only i) and ii)

(c) only ii)

(d) only i) and iii)

Q-2 **Which one of the following set of electromagnetic waves is shown correctly in order of increasing frequency?**

(a) radio waves, ultraviolet waves, visible light, X-rays

(b) infrared waves, visible light, X-rays, gamma rays

(c) gamma rays, ultraviolet light, microwaves

(d) microwaves, infrared waves, ultraviolet waves, X-rays

Q-3 **Which one of the following wavelengths corresponds to electromagnetic waves of frequency 3.0 GHz travelling in air?**

(a) 0.1 μm

(b) 0.1 nm

(c) 0.1 m

(d) 1.0 m

Q-4 **Which one of the following electromagnetic waves will be diffracted the most when passed through the same single slit?**

(a) ultraviolet waves

(b) microwaves

(c) visible light

(d) X-rays

Q-5 **The wavelengths of the visible spectrum are:**

(a) Larger than the wavelengths of infrared waves, but smaller than the wavelengths of microwaves.

(b) Larger than the wavelengths of infrared waves, but smaller than the wavelengths of ultraviolet light.

(c) Larger than the wavelengths of X-rays, but smaller than the wavelengths of ultraviolet light.

(d) Larger than the wavelengths of X-rays, but smaller than the wavelengths of microwaves.

Chapter-5 Topic 5 Gravitational field

Q-1 **In the context of astronomy, what do we associate with Copernicus?**

Q-2 **What does heliocentric mean?**

Q-3 **What does geocentric mean?**

Q-4 **State Newton's law of universal gravitation, and set it out mathematically.**

Q-5 **How do astronomers categorise the Sun?**

Q-6 **What are Population I and Population II stars?**

Q-7 **How does the Sun produce its energy?**

Q-8 **Briefly explain the difference between a planet and a dwarf planet. Give one example of a dwarf planet.**

Q-9 **What is an astronomical unit? Give the definition and the magnitude of the unit.**

Q-10 **Where do comets come from?**

Q-11 **What is the name of the most famous comet? What is its period?**

Q-12 **State Kepler's first law of planetary motion.**

Chapter-6 Topic 6 Electric field

Q-1 **Use a labelled diagram of a single cell of a lead accumulator battery to explain how the battery changes chemical energy into electrical energy.**

Q-2 **Four identical cells each have an emf of 2 V and internal resistance 1 Ω. Two of them are connected in parallel with each other, and this combination is connected in series with the remaining two cells. This arrangement of four cells is connected to a 3.5 Ω resistor.**

a) Determine the current that flows through each cell.

b) If the resistor is replaced with a light bulb rated 6 V and 10 W, will the light bulb glow at its maximum brightness? Support your answer with calculations, and assume that the resistance of the light bulb is constant.

Q-3 **The diagram at the top alongside shows a battery of emf 20 V and internal resistance 2 Ω connected to three resistors. Calculate the current in the 4 Ω resistor when:**

a) the switch S is open

b) the switch S is closed

Q-4 **In the diagram on top alongside, the cell has an emf of 1.5 V and negligible internal resistance. The voltmeter has a resistance of 200 Ω and the ammeter has a negligible resistance of 0.01 Ω.**

a) Calculate the resistance of the resistor.

b) If, by mistake, the voltmeter was connected in series with the ammeter, and the cell, what would be the readings of the voltmeter and ammeter?

Q-5 **A current of 0.5 A flows in a wire of resistance 6 Ω when it is joined to a cell. When the wire is joined with a second wire of resistance 8 Ω, the current becomes 0.24 A. Determine the emf and internal resistance of the cell.**

Q-6 **A micro-ammeter has a resistance of 1 kΩ and a full-scale deflection of 10 μA. With the aid of a circuit diagram, calculate the resistance required to convert the micro-ammeter into an ammeter that reads 10 mA.**

Q-7 **The galvanometer below has a resistance of 10 Ω and a full-scale deflection of 1 mA. The galvanometer has to be converted into a voltmeter with three separate ranges of 0–1 V, 0–10 V, and 0–100 V, with full-scale deflection. Determine the values of the series resistances required for the conversion into a voltmeter with these ranges.**

Q-8 **A wire 2.0 m long has a diameter of 0.40 mm and a resistance of 8.0 Ω. A second wire, made of the same material as the first, is 1.5 m and has a diameter of 0.30 mm. What is the resistance of the second wire?**

Q-9 **The resistance of a piece of tungsten wire is 100.0 Ω at 11.5 °C. The conductivity of tungsten is 1.90 × 10■ (Ω·m)■¹, while its temperature coefficient of resistance is 0.0045 (°C)■¹.**

a) What is the resistance of the tungsten wire at a room temperature of 25.0 °C?

b) What is the length of the wire at 25.0 °C if its diameter is 1.0 mm?

c) How much current will pass through the wire at 25.0 °C if it is connected to a 1.5 V cell of negligible internal resistance?

Q-10 **The diagram below shows a metre bridge. The galvanometer has a zero reading when the length of the wire XP is 32.4 cm. The length of the wire XY is 100 cm, and the battery has negligible internal resistance. Determine the resistance of the unknown resistor.**

Q-11 **Determine the resistance of the unknown resistor in the Wheatstone bridge circuit shown below.**

Q-12 **A copper voltameter containing copper sulphate is connected in series with a silver voltameter containing silver nitrate. When the same current is passed through both voltameters, 2 g of silver is deposited. What mass of copper was deposited in the same time? The relative atomic mass of copper is 63 g, while that of silver is 108 g. The valency of copper is 2, while that of silver is 1.**

Q-13 **State Coulomb's law. How is this law different from Newton's law of universal gravitation? How is this law similar to Newton's law of universal gravitation?**

Q-14 **Two point charges of charge +3.2 nC and +5.6 nC are situated 10 cm apart in air. Find the resultant electric field at a point midway between the two charges.**

Q-15 **A pith ball of mass 0.5 g and magnitude of charge 50 μC is held by a massless string in a uniform electric field of intensity E. If the ball makes an angle of 10° with the vertical, calculate the value of E and the sign of the charge Q.**

Q-16 **The electric potential at a distance of 45.0 cm from the centre of a charged sphere is 5.6 × 10■ V. How far from the centre of the sphere will the electric potential have a value of 2.8 × 10■ V?**

Q-17 **You are given a number of 8 μF capacitors, each designed to operate at a potential difference of 250 V. Show how you can combine these capacitors to get an equivalent 4 μF capacitor operating at 1 000 V.**

Multiple Choice Questions

Q-1 **The molecular theory of matter is based on: (i) the random motion of the molecules in a solid (ii) very weak forces of attraction between the molecules of gases (iii) small spaces between the molecules of a liquid. Which one(s) of the above statements is/are true?**

(a) (i), (ii), and (iii)

(b) (i) and (ii) only

(c) (ii) and (iii) only

(d) (i) and (iii) only

Q-2 **When you blow up a balloon:**

(a) The volume of the balloon increases and the pressure inside the balloon decreases.

(b) The pressure inside the balloon increases because the number of air molecules inside it increases.

(c) The volume of the balloon increases but the pressure inside the balloon is always equal to atmospheric pressure.

(d) The pressure inside of the balloon remains constant because the temperature of the balloon remains constant.

Q-3 **When the cohesive forces are smaller than the adhesive forces, a liquid will: (i) wet the surface on which it is dropped (ii) form a convex meniscus (iii) rise up a narrow capillary tube. Which one(s) of the above statements is/are true?**

(a) (i), (ii) and (iii)

(b) (i) and (ii) only

(c) (ii) and (iii) only

(d) (i) and (iii) only

Q-4 **The diagrams show three capillary tubes in liquids: pure water, soap solution, mercury. (i) (ii) (iii) The corresponding liquids are:**

(a) (i)=water, (ii)=soap solution, (iii)=mercury

(b) (i)=water, (ii)=mercury, (iii)=soap solution

(c) (i)=mercury, (ii)=soap solution, (iii)=water

(d) (i)=soap solution, (ii)=mercury, (iii)=water

Q-5 **In which one of the situations below will the rate of diffusion be the greatest?**

(a) Ammonia and fumes of hydrochloric acid diffusing into each other.

(b) Naphthalene diffusing into the atmosphere.

(c) Crystals of potassium permanganate diffusing into water.

(d) Metallic gold and metallic lead diffusing into each other.

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Q-7 **Which of the following is (are) the differences between an electromagnetic wave and a mechanical wave? (i) Mechanical waves need a medium for transmission, while electromagnetic waves do not need a medium. (ii) Mechanical waves can be either longitudinal or transverse, while all electromagnetic waves are transverse. (iii) Mechanical waves cannot be polarised while electromagnetic waves can be polarised.**

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(d) Larger than the wavelengths of X-rays, but smaller than the wavelengths of microwaves.

Q-12 **The chemical used to form the anode of a zinc chloride dry cell is:**

(a) zinc

(b) ammonium chloride

(c) manganese dioxide

(d) zinc chloride

Q-13 **You are given the following batteries: (i) 3.7 V lithium ion battery (ii) 9 V alkaline battery (iii) 12 V lead accumulator battery. Which of the above batteries is made of secondary cells?**

(a) (i), (ii) and (iii)

(b) (i) and (ii) only

(c) (ii) and (iii) only

(d) (i) and (iii) only

Q-14 **Three identical dry cells, each of emf ε and internal resistance r, are connected in parallel. The emf and internal resistance of the combination will be:**

(a) 3 ε, 3 r

(b) ■ ε, 3 r

(c) ε, 3 r

(d) ε, ■ r

Q-15 **Each of the resistors below has a resistance of 6 Ω. What is the equivalent resistance of the network?**

(a) 3.4 Ω

(b) 6.3 Ω

(c) 2 Ω

(d) 5 Ω

Q-16 **The battery below has negligible internal resistance. (40 V source, resistors 3, 10, 8, 10, 6 Ω as shown) The current through the battery is:**

(a) 4.0 A

(b) 5.0 A

(c) 6.5 A

(d) 10 A

Q-17 **A 12 V battery with internal resistance r is connected to a variable resistor R and a voltmeter V. How will the voltmeter reading change when R is increased if the switch is open vs closed?**

(a) remain constant / decrease

(b) increase / increase

(c) remain constant / increase

(d) remain constant / remain constant

Q-18 **A galvanometer can be converted into a voltmeter by connecting a resistor:**

(a) of small resistance in series with the galvanometer

(b) of large resistance in series with the galvanometer

(c) of small resistance in parallel with the galvanometer

(d) of large resistance in parallel with the galvanometer

Q-19 **A galvanometer has a coil resistance of 24 Ω and full-scale deflection at 180 μA. To make an ammeter with full scale at 10.0 A, the required shunt resistor is:**

(a) 234 μΩ

(b) 342 μΩ

(c) 432 μΩ

(d) 423 μΩ

Q-20 **In a Wheatstone bridge (8 Ω, 3 Ω, R, galvanometer) a zero reading indicates: (i) V■BC■=V■CD■ (ii) I■ABC■=I■ADC■ (iii) R=12 Ω. Which is/are correct?**

(a) (i), (ii) and (iii)

(b) (i) and (ii) only

(c) (ii) and (iii) only

(d) (i) and (iii) only

Chapter-7 Topic 7 Magnetic fields

Q-1 **What is the chemical name of magnetite?**

Q-2 **Who is regarded as having introduced the idea of a field into physics?**

Q-3 **Who first showed that a compass needle is deflected by a current-carrying wire placed next to it?**

Q-4 **What formula is used to determine the force on a single charge moving in a magnetic field?**

Q-5 **What name is given to the unit of magnetic field strength?**

Q-6 **A proton of mass 1.67 × 10■²■ kg and electric charge 1.60 × 10■¹■ C is injected into a magnetic field B = 20 mT, with velocity 1.7 × 10■ m/s at right angles to the field. What is the magnetic force on the proton?**

Q-7 **A single electron carries a charge of 1.6 × 10■¹■ C. The electron moves at 5 × 10■ m/s at right angles to a magnetic field of 12 mT. Calculate the force on the electron. Show your working.**

Q-8 **Write True (T) or False (F):**

a) Physicists are able to isolate individual magnetic monopoles.

b) The Earth's magnetic poles move.

c) The 'right-hand rule' allows us to determine the direction of the field around a current-carrying wire.

d) Electric charge and magnetic field ('B') are both scalars.

Chapter-8 Topic 8 Electromagnetic field

Q-1 **The figure below shows the cross-section of a straight wire carrying a current out of the page, placed between the poles of two magnets. If the wire is 80 cm long and carries a current of 5.0 A and the flux density of the magnets is 0.6 T, determine the electromagnetic force exerted on the wire.**

a) Copy the diagram into your book and draw the magnetic field lines of both the wire and the magnets.

b) Draw another diagram to show the resultant magnetic field and the direction of the electromagnetic force acting on the wire.

Q-2 **A long straight wire of resistance 1.4 Ω is connected to a 6 V battery. The wire is placed in a magnetic field such that it makes an angle of 30° with the field. If the wire experiences a force of magnitude 0.9 N·m■¹, determine the intensity of the magnetic field.**

Q-3 **The figure below shows a simple d.c. motor.**

a) Name the parts labelled X and Y, and state the function of each.

b) What is the direction of the force acting on segment AB of the coil when the switch is closed?

Q-4 **A long straight wire AB carries 12.0 A from A to B and is parallel to a rectangular loop carrying 5.0 A clockwise. The distance between AB and the near side of the loop is 3.0 cm; the loop measures 10.0 cm × 20.0 cm. Find the net force exerted by the loop on wire AB.**

Q-5 **A square coil of 100 turns and sides 7.0 cm has its face perpendicular to a uniform magnetic field. The coil is pulled quickly out of the magnetic field in 0.2 s. If the resistance of the coil is 15 Ω and a current of 12 mA is induced in the coil, calculate the magnitude of the magnetic field.**

Q-6 **A circular coil of wire of radius 5.5 cm and 50 turns sits in a magnetic field such that the plane of the coil is at 60° with the direction of the field.**

a) At what rate must the magnetic field change to produce a current of 4.0 A in the coil if its resistance is 40.0 Ω?

b) What is the direction of the current in the coil?

Q-7 **Two solenoids are placed next to each other, one connected to a battery and switch and the other to a galvanometer, as shown below. Explain, with reasons, the direction of the current through the galvanometer (use the symbols A and B):**

a) at the instant the switch is closed

b) when the switch is kept closed

c) at the instant the switch is opened

Q-8 **The figure below shows a simple a.c. generator, with the coil being rotated in a clockwise direction, as viewed from the front.**

a) What is the function of the slip rings?

b) What is the current in segment AB at the instant shown? Explain your answer.

c) Draw a graph to show how the current varies with the angle of rotation, starting with the position shown as 0°.

Q-9 **Solve These**

a) Explain why a transformer operates on a.c., but not on d.c.

b) Explain why the core of a transformer is laminated.

Q-10 **The figure below shows an ideal multi-tap transformer, with many secondary coils. The primary coil has 100 turns and the input emf is fixed at 200 V. A resistor of 100 Ω is connected in turn across the terminals AB, BC, AC and AD. Copy and complete the table below.**

Q-11 **Give the functions of the following components of an induction coil:**

a) iron core

b) armature

c) capacitor

d) secondary coil

Q-12 **What is an eddy current?**

a) Why are eddy currents not desirable in electrical equipment?

b) Give two uses of eddy currents.

Q-13 **In diagram (a), a Waltenhofen pendulum made of copper sheeting is set into oscillations between the poles of two magnets and comes to a stop after a few oscillations. When the same pendulum has slits cut into it (diagram b), it oscillates for a longer time before stopping. Give an explanation for this.**

Multiple Choice Questions

Q-1 **A current-carrying wire in an external magnetic field will experience an electromagnetic force due to:**

(a) interaction between the electric field of the wire and the external magnetic field

(b) interaction of the electric and magnetic fields of the wire

(c) interaction of the magnetic field of the wire with the external magnetic field

(d) interaction of the eddy currents in the wire with the external magnetic field

Q-2 **A 2.0 m length of wire carrying a current of 1.5 A is placed at 50° to a magnetic field of 0.4 T in the plane of the page. The magnitude and direction of the force on the wire is:**

(a) 0.92 N out of the page

(b) 0.92 N into the page

(c) 1.2 N into the page

(d) 1.2 N out of the page

Q-3 **Two parallel wires 8.0 cm apart carry equal currents of 4.0 A in opposite directions. The force per unit length on each is:**

(a) 4.0×10■■ N·m■¹, attractive

(b) 4.0×10■■ N·m■¹, repulsive

(c) 4.0×10■■ N·m■¹, attractive

(d) 4.0×10■■ N·m■¹, repulsive

Q-4 **A split-ring commutator in a d.c. motor is used to:**

(a) lead the current in and out of the coil

(b) prevent eddy currents from forming in the coil

(c) increase the strength of the couple on the coil

(d) change the direction of the current in the coil every half turn

Q-5 **To increase the speed of a d.c. motor, we can increase: (i) the number of loops in the coil (ii) the flux density of the external field (iii) the size of the brushes. Which are correct?**

(a) (i) only

(b) (i) and (ii) only

(c) (i) and (iii) only

(d) (i), (ii) and (iii)

Q-6 **Which components are generally used in a moving-coil galvanometer? (i) control springs (ii) a permanent magnet (iii) slip rings**

(a) all of (i), (ii) and (iii)

(b) (i) and (ii) only

(c) (i) and (iii) only

(d) (ii) and (iii) only

Q-7 **A rectangular coil 3.0 cm by 5.0 cm with 100 turns makes an angle of 55° with a 0.35 T field. The magnetic flux through the coil is:**

(a) 3.0×10■■ Wb

(b) 3.0×10■² Wb

(c) 4.3×10■■ Wb

(d) 5.3×10■² Wb

Q-8 **A coil of 200 turns and area 0.05 m² in a 3.0 T field normal to its plane has the field reduced to zero in 5.0 s. The induced emf is:**

(a) 0.15 kV

(b) 6.0 V

(c) 10 mV

(d) 50 mV

Q-9 **For a stationary circuit to induce current in an independent stationary circuit, the first circuit must have:**

(a) a steady current

(b) a changing current

(c) a large current

(d) a direct current

Q-10 **In an a.c. generator, if the coil area is doubled and rotation speed halved, the maximum emf:**

(a) is the same

(b) doubles

(c) increases eightfold

(d) decreases fourfold

Q-11 **Loops P, Q, R, S each have a perpendicular field B that is increasing or decreasing as shown. Which loop shows the indicated direction of induced current?**

(a) P

(b) Q

(c) R

(d) S

Q-12 **The device with brushes and commutator shown is:**

(a) an a.c. generator

(b) a d.c. generator

(c) an a.c. motor

(d) a d.c. motor

Q-13 **A 12 V battery is connected to the primary of a transformer with turns ratio 2:1. The secondary output emf is:**

(a) 0 V

(b) 4 V

(c) 6 V

(d) 24 V

Q-14 **The iron core of an induction coil is laminated to:**

(a) increase the core's magnetic field

(b) increase secondary current

(c) prevent sparking at contacts

(d) minimize eddy currents in the core

Q-15 **Eddy currents: (i) arise from changing flux (ii) can be used for damping/braking (iii) are described by both Faraday's and Lenz's laws. Which are correct?**

(a) (i) and (ii) only

(b) (i) and (iii) only

(c) (ii) and (iii) only

(d) all of (i), (ii) and (iii)

Chapter-9 Topic 9 Simple a.c. circuits

Q-1 **A 60 W light bulb is connected to the 240 V mains supply. Determine the peak and r.m.s. currents through the light bulb.**

Q-2 **A loudspeaker of resistance 9.6 Ω and an 8.5 W resistor are connected in series to an audio amplifier producing 15 V r.m.s. What is the average power delivered to the loudspeaker?**

Q-3 **Determine the peak current through a 50 pF capacitor connected to a 100 V r.m.s. source operating at 50 Hz.**

Q-4 **An inductance coil is connected to the 240 V, 50 Hz mains supply. If the current through the coil is 12.8 A r.m.s., what is the inductance of the coil?**

Q-5 **A 150 Ω resistor is connected in series with a 12 μF capacitor and a 200 V r.m.s. source operating at 400 Hz. Determine:**

a) the peak current through the circuit

b) the power delivered by the source

Q-6 **A 200 Ω resistor is connected in series with a 250 mH inductor and an a.c. source. The p.d. across the resistor is given by VR = 40.0 V sin((700 rad/s) t). Determine:**

a) the peak current through the circuit

b) the p.d. across the inductor

c) the power delivered by the source

Q-7 **A series circuit consists of a 150 Ω resistor, an inductor of 250 mH, a capacitor of 2.0 μF and an a.c. source providing 210 V peak p.d. at 50 Hz. Calculate:**

a) the peak current

b) the phase angle

c) p.d. across each component

d) the power transferred to each component

Q-8 **A series circuit has a 14.8 mH inductor, a 44 Ω resistor, and a variable capacitor. a) What must be the value of the capacitance to tune into a radio station at 3 600 Hz? b) What will be the maximum current in the circuit if the peak p.d. across the source is 150 V?**

Q-9 **An inductor of inductance 420 mH, a capacitor of capacitance 4.7 μF and a 500 Ω resistor are connected in series to a 50 Hz a.c. source. If a peak current of 250 mA flows in the circuit, calculate:**

a) the peak voltage across the terminals of the source

b) the power factor

Multiple Choice Questions

Q-1 **The following statements are made about the root mean square potential difference, Vrms: (i) It is obtained by dividing the peak potential difference by √2. (ii) It is equivalent to a direct current potential of the same value. (iii) It can have both positive and negative values. Which is/are correct?**

(a) all of (i), (ii) and (iii)

(b) only (i) and (ii)

(c) only (i) and (iii)

(d) only (ii) and (iii)

Q-2 **An a.c. generator supplies 22 Vrms to a 30 Ω resistor at 50 Hz. What is the maximum current in the resistor?**

(a) 0.52 A

(b) 1.0 A

(c) 3.3 mA

(d) 21 mA

Q-3 **A resistor is connected to an a.c. generator. As the generator frequency is increased, the current through the resistor:**

(a) increases

(b) decreases

(c) remains the same

(d) increases or decreases depending on the resistance

Q-4 **If the r.m.s. current in an a.c. circuit is doubled, the peak current will be:**

(a) doubled

(b) increased by a factor of √2

(c) decreased by a factor of √2

(d) decreased by a factor of 2

Q-5 **In which one of the following a.c. circuits will the p.d. lead the current by 90°?**

(a) purely resistive

(b) purely inductive

(c) purely capacitive

(d) containing both a capacitor and inductor

Q-6 **A 15 Ω resistor is connected across a sinusoidal source with peak 75 V. The average power delivered is approximately:**

(a) 0.19 kW

(b) 0.38 kW

(c) 0.75 kW

(d) 75 W

Q-7 **A 500 W toaster is plugged into 240 V mains. What is the peak current in the toaster?**

(a) 0.12 A

(b) 1.45 A

(c) 2.10 A

(d) 2.95 A

Q-8 **An inductor is connected to a variable-frequency a.c. source. When the frequency is doubled, the inductive reactance will:**

(a) remain the same

(b) be doubled

(c) be halved

(d) increase by a factor of four

Q-9 **A 20 μF capacitor is connected to a 12 Vrms supply at 5.0 kHz. What is the r.m.s. current in the capacitor?**

(a) 1.2 A

(b) 7.5 A

(c) 8.4 A

(d) 11 A

Q-10 **At what frequency will the reactance of a 1.5 mH inductor equal 5.0 Ω?**

(a) 0.53 kHz

(b) 0.13 kHz

(c) 3.3 kHz

(d) 21 kHz

Q-11 **At what frequency would the reactance of a 1.0 mH inductor be twice that of a 10 μF capacitor?**

(a) 1.1 kHz

(b) 2.2 kHz

(c) 3.2 kHz

(d) 10 kHz

Q-12 **An inductor across an a.c. generator (170 V max) at 3000 Hz draws 5.0 A rms. What is the inductance?**

(a) 1.8×10■³ H

(b) 1.3×10■³ H

(c) 8.0×10■³ H

(d) 9.2×10■■ H

Q-13 **A capacitor across an a.c. generator (170 V max) at 3000 Hz has a peak current of 12 A. What is the capacitance?**

(a) 1.8×10■■ F

(b) 2.4×10■■ F

(c) 2.6×10■■ F

(d) 3.7×10■■ F

Q-14 **Which diagram correctly shows the phasor relationship in a series RLC circuit where VR, VL, and VC are indicated?**

(a) VR ■ VC

(b) VR ■ VL

(c) VL ■ VC

(d) VR, VL, VC in quadrature

Q-15 **The average power delivered to a series circuit is maximum when the phase angle is:**

(a) between 0 and 90°

(b) between 0 and –90°

(c) equal to 90°

(d) equal to 0°

Chapter-10 Topic 10 Models of the atom

Q-1 **What does the word atom mean?**

Q-2 **Give two pieces of experimental evidence supporting the idea of atoms.**

Q-3 **Who discovered the electron?**

Q-4 **What is an alpha particle?**

Q-5 **How are cations and anions formed?**

Q-6 **What are isotopes?**

Q-7 **Write True (T) or False**

a) John Dalton provided a mathematical theory to account for Brownian movement.

b) The most important thing about a scientific model is that it must be testable.

c) An electron has about the same mass as a proton, but a very much smaller (and opposite) charge.

d) Rutherford's model of the atom destroyed Thomson's model of the atom.

e) The fact that atoms give out light only at definite wavelengths provided strong support for Rutherford's model of the atom.

Q-8 **In which decade of the 20th century was the neutron discovered?**

Q-9 **Briefly explain why modern theories on atomic structure have become very complex and 'mathematical'.**

Multiple Choice Questions

Q-1 **The experiment with alpha particles suggested that (tick only one of the following options): (i) Most of an atom is 'empty space' (ii) The charges in an atom are free to move (iii) The nucleus makes up most of the atom's volume (iv) The nucleus is positively charged.**

(a) All the above are correct

(b) i), ii) and iii) are correct

(c) i) and iv) are correct

(d) None of the above

Chapter-11 Topic 11 Nucleus

Q-1 **Why are most of the nuclides found in nature unstable? Name some methods in which they can become stable naturally.**

Q-2 **One of the radioactive decay modes is electron capture. Use an appropriate equation to explain how this occurs.**

Q-3 **You are given the following radioactive decay series: $\rightarrow$ ^{2}■■■Pb.**

a) Determine the particles/nuclides labelled (a) to (f).

b) If the half-life of ^{21}■■■Pb is 27 minutes, that of ^{21}■■■Bi is 19.9 minutes, that of ^{21}■■■Pb is 22 years, and that of ^{21}■■■Bi is 5 days, which nuclide will be present in the greatest amount after one day if all were initially equal? Show your working.

Q-4 **Cobalt-60, used in industrial radiotherapy, has a half-life of 5.2 years. The molar mass of cobalt is 58.9 g/mol and Avogadro's number is 6.023×10^{23} particles/mol.**

a) What fraction of the original sample remains after 9 months?

b) If you start with 10 g of cobalt-60, what will its activity be after 1 year?

Q-5 **The iodine isotope ^{131}■■I is used to diagnose thyroid disorders. If 500 µg is ingested by a patient:**

a) What is the activity immediately after ingestion?

b) What is the activity 1 hour later when the thyroid is tested?

Q-6 **The activity of a sample drops by a factor of 10 in 6.5 minutes. What is its half-life?**

Q-7 **Neutrons produced in the upper atmosphere by cosmic rays react with nitrogen nuclei via ^{1}■n + ^{1}■■N $\rightarrow$ ^{1}■H + X.**

a) What is the common name for ^{1}■H?

b) Determine element X (mass and atomic numbers).

c) Why are neutrons more likely than protons to react with nuclei?

Q-8 **Consider the nuclear fission reaction ^{1}■n + ^{23}■■■U $\rightarrow$ ■^{2}yKr + x■■Ba + 3 ^{1}■n:**

a) Determine x and y.

b) Calculate the Q-value. (M(^{23}■■■U)=235.043923 u; M(■^{2}yKr)=91.9262 u; M(■■Ba)=140.9144 u; M(^{1}■n)=1.008665 u; c^2=931.5 MeV/u.)

Q-9 **Consider a fission nuclear reactor:**

a) Name the fuel isotope.

b) What is the moderator's function, and give one example.

c) What is the control rods' function.

d) Why is the core enclosed in strong concrete.

e) Why must reactor waste be safely disposed of.

Multiple Choice Questions

Q-1 **The force that holds the nucleons together is:**

(a) the electrical force

(b) the gravitational force

(c) the weak nuclear force

(d) the strong nuclear force

Q-2 **When an excited nuclide returns to the ground state, it ejects:**

(a) a beta plus particle

(b) a beta minus particle

(c) a gamma ray

(d) an alpha particle

Q-3 **The daughter nuclide formed when ^{23}■■■Th decays by giving off an alpha particle is:**

(a) ^{23}■■■U

(b) ^{22}■■■Ra

(c) ^{23}■■■Ac

(d) ^{23}■■■Pa

Q-4 **The nuclide ^{23}■■■Pa is formed as a result of beta-minus decay. The parent nuclide is:**

(a) ^{23}■■■Th

(b) ^{23}■■■U

(c) ^{233}■■Pa

(d) ^{233}■■U

Q-5 **A nuclide which has too many protons compared to the number of neutrons would most probably undergo:**

(a) an alpha decay

(b) a beta minus decay

(c) a beta plus decay

(d) a gamma decay

Q-6 **If alpha, beta and gamma rays are arranged in order of penetrating power, starting with the most penetrative, the most usual order would be:**

(a) alpha, beta, gamma

(b) beta, alpha, gamma

(c) gamma, alpha, beta

(d) gamma, beta, alpha

Q-7 **The missing particle in the nuclear reaction ■■He + ■■Be → ¹²■C + ? is:**

(a) an electron

(b) a neutron

(c) a proton

(d) deuterium

Q-8 **The isotope strontium-90 has a half-life of 28.8 yr. Its decay constant is approximately:**

(a) 2.4 × 10■² s■¹

(b) 2.4 × 10■¹■ s■¹

(c) 7.6 × 10■¹■ s■¹

(d) 8.7 × 10■¹■ s■¹

Q-9 **The control rods in a nuclear reactor are made of cadmium because cadmium:**

(a) slows down the neutrons

(b) reflects the neutrons

(c) produces neutrons

(d) absorbs neutrons

Q-10 **A radioactive sample has a half-life of 10 min. What fraction of the sample is left after 40 minutes?**

(a) 1/4

(b) 1/8

(c) 1/16

(d) 1/32

Chapter-12 Topic 12 Energy quantization

Q-1 **Explain why a line emission spectrum confirms the existence of quantized energy levels in an atom.**

Q-2 **A hydrogen atom in the ground state is excited to the third energy level by absorbing a photon. Determine the wavelength of the photon.**

Q-3 **A photon of red light has a wavelength of 691 nm.**

a) Determine the energy of this photon.

b) On the mercury energy-level diagram, indicate between which two levels this photon would be absorbed.

Q-4 **A hypothetical gas of single-electron atoms has a ground-state energy of −20 eV and a first excited state of −10 eV. When white light is passed through the cold gas, one atom is excited to the first excited state.**

a) Find the energy, in joules, of the absorbed photon.

b) Calculate the frequency of the absorbed photon.

Q-5 **The work function for sodium metal is 3.8×10■¹■ J.**

a) Explain what this statement means.

b) Find the cut-off wavelength for sodium.

c) If light of 306 nm is radiated on sodium, find the maximum kinetic energy of the ejected photoelectrons.

Q-6 **Electrons are ejected from a metal surface with speeds up to 4.60×10■ m/s when illuminated with 625 nm light. (m■=9.1×10■³¹ kg)**

a) Calculate the work function of the metal.

b) Find the threshold frequency for this metal.

Q-7 **The threshold wavelength for electron emission from a surface is 350 nm. What is the maximum kinetic energy of the photoelectrons when the surface is radiated with light of:**

a) 270 nm

b) 360 nm

Q-8 **A simple photocell is used to investigate the photoelectric effect.**

a) Is the electrode marked X the anode or the cathode?

b) When 592 nm light yields zero-kinetic-energy electrons, determine the work function and identify the metal.

c) How does the ammeter reading change if wavelength decreases but intensity is constant? Explain.

d) How does the reading change if wavelength is fixed at 580 nm but intensity decreases? Explain.

Q-9 **What are the similarities and differences between the photoelectric effect and X-ray production?**

Q-10 **Explain the difference between characteristic X-rays and braking (bremsstrahlung) radiation X-rays.**

Q-11 **Electrons in an X-ray tube are accelerated through 10.0 kV before striking a target.**

a) Determine the kinetic energy of the electron on impact.

b) If one photon is produced per electron impact, find the minimum wavelength of the X-rays.

Q-12 **The energy of the K shell of the tungsten atom is 4 keV, while that of the M shell is 6.4 keV.**

a) Determine the wavelength of the X-ray emitted when an M-shell electron drops into the K-shell.

b) What minimum energy must the incident electron have to eject the K-shell electron?

Multiple Choice Questions

Q-1 **The following experimental finding supports the existence of quantized energy levels in an atom:**

(a) the ejection of electrons from the surface of a metal when light falls on the metal

(b) the production of a continuous X-ray spectrum formed by fast moving electrons being stopped by a metal target

(c) the absorption spectrum of elements having dark lines in them

(d) the ejection of an electron during a beta minus decay

Q-2 **Light of wavelength 411 nm is observed from a hydrogen discharge tube. Which atomic transition produces this emission? (E■■■ = –13.6 eV)**

(a) n = 3 $\rightarrow$ n = 1

(b) n = 6 $\rightarrow$ n = 2

(c) n = 3 $\rightarrow$ n = 2

(d) n = 5 $\rightarrow$ n = 1

Q-3 **An electron in a hydrogen atom jumps from n = 5 to n = 3. Is a photon absorbed or emitted, and what is its wavelength?**

(a) absorbed, 1 280 nm

(b) absorbed, 605 nm

(c) emitted, 605 nm

(d) emitted, 1 280 nm

Q-4 **In the photoelectric effect, the work function depends on the:**

(a) light intensity

(b) metal that the light strikes

(c) applied potential

(d) incident wavelength

Q-5 **Potassium has a work function of 2.3 eV. Which is the longest wavelength for which photoemission occurs?**

(a) 400 nm

(b) 450 nm

(c) 500 nm

(d) 600 nm

Q-6 **A metal has a work function of 2.0 eV. Its approximate threshold frequency is:**

(a) 5×10^{13} Hz

(b) 5×10^{1}■ Hz

(c) 2×10^{1}■ Hz

(d) 5×10^{1}■ Hz

Q-7 **Ultraviolet light is more likely to cause photoelectric emission from a metal surface than visible light because:**

(a) it has a larger frequency

(b) it has a larger wavelength

(c) it travels faster through air

(d) it has a larger intensity

Q-8 **Which statements about X-rays are correct? (i) produced when accelerated electrons are stopped by a metal target (ii) absorbed by bone tissue (iii) can discharge a charged electroscope**

(a) all of (i), (ii) and (iii)

(b) (i) and (ii) only

(c) (i) and (iii) only

(d) (ii) and (iii) only

Q-9 **If you increase the potential difference across the electrodes in an X-ray tube, the wavelength of the characteristic X-ray formed will:**

(a) increase

(b) decrease

(c) remain the same

(d) increase and then decrease

Q-10 **Gamma rays and X-rays are similar in that: (i) both travel at the same speed in a vacuum (ii) both come from the same source (iii) both can cause chemical and biological damage to living tissues. Which is/are correct?**

(a) all of (i), (ii) and (iii)

(b) (i) and (ii) only

(c) (i) and (iii) only

(d) (ii) and (iii) only

Chapter-13 Topic 13 Duality of matter

Q-1 **What is regarded as James Clerk Maxwell's main contribution to physics?**

Q-2 **What is the equation, developed by Max Planck, that includes a package of energy? (Identify the quantities you give in the equation.)**

Q-3 **What effect, correctly explained by Einstein in 1905, provided evidence for a particulate nature of light? What was this light particle called?**

Q-4 **Who is credited with first putting the idea of wave–particle duality on a sound theoretical footing?**

Q-5 **Why does an electron microscope need to operate in a vacuum?**

Q-6 **How much more powerful are electron microscopes than light microscopes?**

Q-7 **It was considered significant, in terms of the nature of light, that light of long wavelength would not knock electrons off a metal plate, even if the light was allowed to shine on the surface for a long time. Explain why this finding was considered important.**

Chapter-14 Topic 14 The battery

Q-1 **Explain, in your own words and good English, the electrochemical series.**

Q-2 **Give two alternative names for an electric cell.**

Q-3 **Explain what is meant by a redox reaction.**

Q-4 **Explain what a hydrogen electrode is used for.**

Q-5 **Explain what happens at the cathode of a cell.**

Q-6 **Name two metals commonly used as an anode.**

Chapter-18 Topic 18 Uses of machines

Q-1 **Which famous actor played the lead role in the 'Terminator' series? (To earn full marks you must spell his name correctly!)**

Q-2 **What is a very simple definition of a 'machine'?**

Q-3 **What does it mean to 'split the atom'? Why is the process important?**

Q-4 **Mention a major downside (disadvantage) of being so dependent on machines in daily life.**

Q-5 **What is a 'GMO'? (You weren't told this in the topic. Look it up if necessary.)**

Chapter-19 Topic 19 Repairs and maintenance of machines

Q-1 **Why is it important to keep a 'log book' when using a machine?**

Q-2 **Why is it important to check the condition of electrical equipment?**

Q-3 **Why might an owner or manager decide to 'write off' a machine, even if it were still working? Give two reasons.**

Q-4 **What is 'planned obsolescence'? Why do manufacturers include it in the design of certain items?**

Chapter-20 Topic 20 Dams and energy production

Q-1 **What two factors (variables) are especially important in determining the ability of a hydroelectric dam to supply power?**

Q-2 **What is a turbine? How does it differ from a propeller?**

Q-3 **Which is the biggest dam and hydroelectric facility in Nigeria?**

Q-4 **Briefly explain what it means to say that a dam is 'in equilibrium'.**

Q-5 **The Mambilla Power Station is expected to come into operation in the near future. What power output is it designed to deliver?**

Chapter-21 Topic 21 Rockets and satellites

Q-1 **What is a hypergolic fuel?**

Q-2 **What is the fundamental principle on which a rocket works?**

Q-3 **How does a rocket engine differ from a jet engine?**

Q-4 **What determines the minimum height at which an artificial satellite can be in stable orbit?**

Q-5 **What is a geostationary orbit? What other name is given to a geostationary orbit?**

Q-6 **At what altitude, roughly, does the Hubble Space Telescope orbit the Earth?**

Chapter-22 Topic 22 NigerSAT-1

Q-1 **Who was the second man to orbit Earth, and what was his nationality?**

Q-2 **What was the name of the first successful artificial satellite? When was it launched? (Give month and year.)**

Q-3 **What does NASRDA stand for?**

Q-4 **In the context of artificial satellites, what do the letters DMC stand for?**

Q-5 **NigerSAT-1 was classed as a microsatellite. What is the mass range of a microsatellite?**

Q-6 **What was the mass of NigerSAT-1?**

Q-7 **In which year was NigerSAT-1 put into service?**

Q-8 **For how many years did NigerSAT-1 serve the people of Nigeria?**

Q-9 **If you had a circular swimming pool 25 m in diameter, could it be 'seen' by NigerSAT-1? Briefly explain your answer.**

Q-10 **How and when did Yuri Gagarin die?**

Q-11 **Briefly explain why a satellite in low orbit does not have a long life expectancy compared with satellites in higher orbits.**

Q-12 **Explain why a sun-synchronous orbit is convenient for monitoring any given place on the ground.**

Chapter-23 Topic 23 NigcomSAT-1

Q-1 **At what altitude did NigComSAT-1 orbit Earth?**

Q-2 **How was the replacement satellite, NigComSAT-1R paid for?**

Q-3 **What was the mass of NigComSAT-1R?**

Q-4 **In which country was NigComSAT-1 built?**

Q-5 **When was NigComSAT-1 launched (month and year)?**

Q-6 **What is a transponder?**

Q-7 **What is the name of the satellite bus on which NigComSAT-1 was built?**

Q-8 **What was the expected service life of NigComSAT-1?**

Q-9 **What is the wavelength range of microwaves?**

Q-10 **What range of wavelengths was covered by NigComSAT-1's communication system?**

Q-11 **Briefly explain why a satellite needs rocket engines.**

Q-12 **All geostationary orbits are geosynchronous, but not all geosynchronous orbits are geostationary. Briefly explain this statement.**

Q-13 **What is a gigahertz?**

Q-14 **Name one feature of NigComSAT-1R in which it is superior to the satellite it replaced.**

Q-15 **What determines the service life of a communications satellite?**

Q-16 **What is the name of the company that owns NigComSat-1R?**