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SCO INTERNATIONAL OLYMPIAD

CLASS 12 PHYSICS OLYMPIAD

Sample Question Paper • Practice Set S

Ready practice paper for schools, teachers, parents and students preparing for the SCO International Physics Olympiad.

- mirrors the official question-paper style while adding clear answer explanations for guided practice
- supports conceptual problem-solving, formula application, graph/diagram reasoning and higher-order Olympiad thinking
- includes selected visual prompts inside question blocks only where they improve understanding

Electrostatics	Circuits	Magnetic Force	Induction	AC Circuits
EM Waves	Optics	Quantum Physics	Nuclei	Electronics

Sample Question Paper

Exam Name	SCO International Physics Olympiad
Class / Grade	Class 12
Paper	Practice Set S — With Answers and Explanations
Duration	60 minutes
Question Type	Objective Type / MCQ
Total Questions	50
Recommended Marking	Q1–Q40: 1 mark each; Q41–Q50: 2 marks each; no negative marking unless separately notified
Important Instruction	Select ONE correct option for each question. Calculators are not allowed unless announced by SCO.

Student Details: Name _____ Registration ID _____ School _____

The questions are arranged to test conceptual understanding, quantitative fluency, diagram interpretation, and real-world application across the Class 12 Physics syllabus.

Section A: Core Physics Concepts

Q1. Two point charges +3 μC and +6 μC are 30 cm apart in air. At what point on the line joining them is the electric field zero?

1. 10 cm from +3 μC towards +6 μC
2. 12.4 cm from +3 μC towards +6 μC
3. 15 cm from +3 μC towards +6 μC
4. 20 cm from +3 μC towards +6 μC

Q2. A closed spherical surface encloses a net charge of 4.0 μC. What is the electric flux through the surface?

1. 4.0 × 10^-6 N m^2/C
2. 4.52 × 10^5 N m^2/C
3. 3.54 × 10^-17 N m^2/C
4. Zero

Q3. A 4 μF capacitor is charged to 100 V. What energy is stored in it?

1. 0.02 J
2. 0.04 J
3. 0.20 J
4. 2.0 J

Q4. Two capacitors of 6 μF and 3 μF are connected in series. What is their equivalent capacitance?

1. 2 μF
2. 3 μF
3. 6 μF
4. 9 μF

Q5. A wire carries a current of 2 A. If 10 C of charge passes through a cross-section, how much time has elapsed?

1. 2 s
2. 5 s
3. 10 s
4. 20 s

Q6. A 12 V battery is connected to resistors of 4 Ω and 8 Ω in series. What is the current in the circuit?

1. 0.5 A
2. 1 A
3. 1.5 A
4. 3 A

Q7. In a balanced Wheatstone bridge, which statement is correct?

1. The galvanometer current is maximum
2. The galvanometer current is zero
3. The battery current is zero
4. All resistances must be equal

Q8. A proton enters a uniform magnetic field at right angles to the field. What is the path of the proton?

1. Straight line
2. Circle
3. Parabola
4. Ellipse with changing speed

Q9. Two long parallel wires carrying currents in the same direction will:

1. Repel each other
2. Attract each other
3. Have zero force
4. Rotate about their centres

Q10. A current loop is placed in a uniform magnetic field. Maximum torque occurs when the plane of the loop is:

1. Parallel to the field
2. Perpendicular to the field
3. At 45° to the field
4. Independent of orientation

Q11. An induced emf appears in a coil when the magnetic flux through it changes. This statement is based on:

1. Coulomb's law
2. Faraday's law
3. Ohm's law
4. Pascal's law

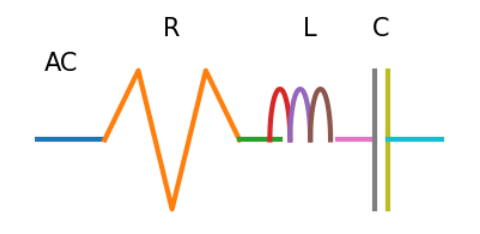
Q12. Lenz's law is a consequence of which conservation principle?

1. Conservation of charge
2. Conservation of momentum
3. Conservation of energy
4. Conservation of mass

Q13. An inductor of inductance 0.5 H is connected to a 50 Hz AC source. What is its inductive reactance?

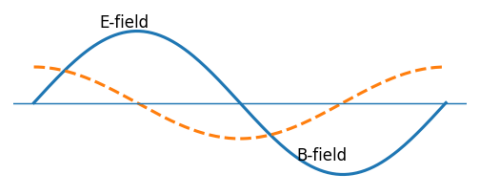
1. 50π Ω
2. 25π Ω
3. 100π Ω
4. 0.5π Ω

Q14. In a series LCR circuit at resonance:



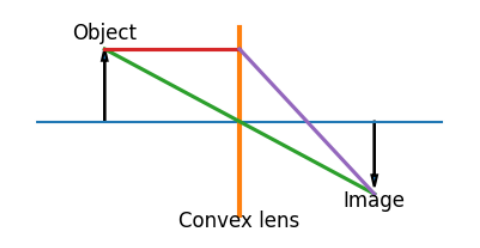
1. Impedance is maximum
2. Current is minimum
3. Inductive and capacitive reactances are equal
4. Power factor is zero

Q15. Which electromagnetic wave has the highest frequency among the following?



1. Radio wave
2. Microwave
3. Visible light
4. Gamma ray

Q16. A convex lens forms a real image of an object placed beyond 2F. Where is the image formed?



1. Between F and 2F
2. At 2F
3. Beyond 2F
4. On the same side as the object

Q17. Total internal reflection can occur when light travels:

1. From rarer to denser medium
2. From denser to rarer medium and incidence angle exceeds critical angle
3. At normal incidence only
4. Only in vacuum

Q18. In Young's double-slit experiment, fringe width β is proportional to:

1. λD/d
2. d/λD
3. D/λd
4. λd/D

Q19. The central maximum in single-slit diffraction becomes narrower when:

1. Slit width decreases
2. Wavelength increases
3. Slit width increases
4. Screen distance decreases to zero

Q20. A Polaroid allows only one plane of vibration of light to pass. This demonstrates:

1. Diffraction
2. Interference
3. Polarization
4. Dispersion

Section B: Application and Data-Based Reasoning

Q21. In the photoelectric effect, increasing the frequency of incident light above threshold mainly increases:

1. Number of emitted electrons only
2. Stopping potential and maximum kinetic energy
3. Work function
4. Threshold frequency

Q22. The de Broglie wavelength of a particle is given by:

1. $\lambda = h/p$
2. $\lambda = hp$
3. $\lambda = p/h$
4. $\lambda = hc/E^2$

Q23. The line spectrum of hydrogen supports the idea that electron energy levels are:

1. Continuous
2. Quantized
3. Random
4. Independent of nucleus

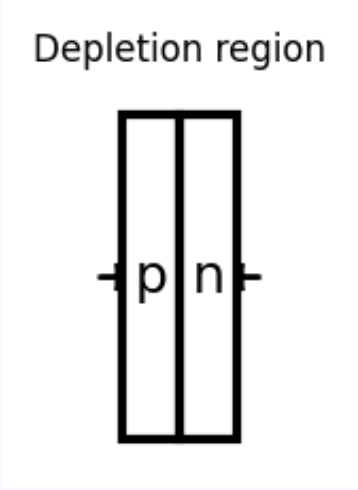
Q24. Mass defect in a nucleus is converted into binding energy according to:

1. $E = mc^2$
2. $F = ma$
3. $V = IR$
4. $p = mv$

Q25. A radioactive sample has half-life 4 hours. What fraction remains after 12 hours?

1. 1/2
2. 1/4
3. 1/8
4. 1/16

Q26. A p-n junction diode conducts significantly when it is:



1. Reverse biased
2. Forward biased
3. Unbiased only
4. Connected without a circuit

Q27. A Zener diode is commonly used as a:

1. Voltage regulator
2. Capacitor
3. Inductor
4. Transformer

Q28. Which logic gate gives output 1 only when all inputs are 1?

1. OR
2. AND
3. NOT
4. NOR

Q29. Modulation in communication systems is mainly used to:

1. Reduce the speed of light
2. Superimpose information on a high-frequency carrier
3. Eliminate antennas
4. Convert AC into DC

Q30. In amplitude modulation, the carrier wave property varied according to the message signal is:

1. Frequency
2. Phase
3. Amplitude
4. Speed in vacuum

Section C: Conceptual and Reasoning Questions

Q31. Assertion: Electric field inside a conductor in electrostatic equilibrium is zero. Reason: Free charges in a conductor redistribute until the internal field is cancelled.

1. Both true and reason explains assertion
2. Both true but reason does not explain assertion
3. Assertion true, reason false
4. Assertion false, reason true

Q32. Assertion: A potentiometer is more accurate than a voltmeter for measuring emf. Reason: It draws no current from the cell at balance.

1. Both true and reason explains assertion
2. Both true but reason does not explain assertion
3. Assertion true, reason false
4. Assertion false, reason true

Q33. Assertion: Magnetic force can change the direction of motion of a charged particle but not its speed. Reason: Magnetic force is perpendicular to velocity.

1. Both true and reason explains assertion
2. Both true but reason does not explain assertion
3. Assertion true, reason false
4. Assertion false, reason true

Q34. Assertion: Eddy currents can be useful in electromagnetic braking. Reason: Induced currents oppose relative motion according to Lenz's law.

1. Both true and reason explains assertion
2. Both true but reason does not explain assertion
3. Assertion true, reason false
4. Assertion false, reason true

Q35. Assertion: A pure inductor consumes no average power over a full AC cycle. Reason: Current and voltage differ in phase by 90° in an ideal inductor.

1. Both true and reason explains assertion
2. Both true but reason does not explain assertion
3. Assertion true, reason false
4. Assertion false, reason true

Q36. A telescope has objective focal length 100 cm and eyepiece focal length 5 cm. Its normal adjustment angular magnification is:

1. 5
2. 10
3. 20
4. 50

Q37. In a double-slit experiment, d = 0.5 mm, D = 1 m and λ = 500 nm. Fringe width is:

1. 0.1 mm
2. 0.5 mm
3. 1.0 mm
4. 2.0 mm

Q38. A photon of wavelength 400 nm has energy approximately:

1. 1.6 eV
2. 3.1 eV
3. 6.2 eV
4. 12.4 eV

Q39. An electron and a proton have the same kinetic energy. Which has the larger de Broglie wavelength?

1. Electron
2. Proton
3. Both equal
4. Cannot be compared

Q40. A nucleus emits an alpha particle. Its mass number and atomic number change by:

1. A decreases by 4, Z decreases by 2
2. A decreases by 2, Z decreases by 4
3. A unchanged, Z increases by 1
4. A increases by 4, Z increases by 2

Section D: Achievers Section

Q41. A capacitor of 2 μF is charged to 200 V and then disconnected. If plate separation is doubled, what happens to capacitance?

1. Doubles
2. Halves
3. Remains same
4. Becomes zero

Q42. A wire's resistance is 5 Ω. Its length is doubled while volume remains constant. What is the new resistance?

1. 5 Ω
2. 10 Ω

3. 20 Ω
4. 2.5 Ω

Q43. A charged particle moving perpendicular to a magnetic field has radius r. If speed doubles, radius becomes:

1. r/2
2. r
3. 2r
4. 4r

Q44. In an AC circuit, Vrms = 220 V and Irms = 2 A with power factor 0.8. Average power is:

1. 176 W
2. 352 W
3. 440 W
4. 550 W

Q45. A convex mirror is used as a vehicle rear-view mirror because it:

1. Forms enlarged real images
2. Gives a wider field of view
3. Has no focal point
4. Always forms inverted images

Q46. The minimum energy needed to eject an electron from a metal surface is called:

1. Binding energy
2. Work function
3. Ionization energy of gas
4. Threshold wavelength

Q47. In a nuclear reactor, a moderator is used mainly to:

1. Absorb all neutrons
2. Slow down fast neutrons
3. Increase gamma rays
4. Stop fission completely

Q48. A full-wave rectifier converts AC into:

1. Pulsating DC
2. Pure sinusoidal AC
3. Zero voltage
4. High-frequency radio waves

Q49. For reliable digital communication, increasing bandwidth generally allows:

1. Higher possible data rate
2. Zero noise automatically
3. No need for modulation
4. Infinite signal speed

Q50. A coil of 200 turns has magnetic flux through each turn changing from 3 × 10^-3 Wb to 1 × 10^-3 Wb in 0.01 s. Magnitude of induced emf is:

1. 20 V
2. 40 V
3. 60 V
4. 80 V

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Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	2	2	2	3	1	4	1	5	2
6	2	7	2	8	2	9	2	10	1
11	2	12	3	13	1	14	3	15	4
16	1	17	2	18	1	19	3	20	3
21	2	22	1	23	2	24	1	25	3
26	2	27	1	28	2	29	2	30	3
31	1	32	1	33	1	34	1	35	1
36	3	37	3	38	2	39	1	40	1
41	2	42	3	43	3	44	2	45	2
46	2	47	2	48	1	49	1	50	2
51	3	52	2						

Detailed Answer Explanations

Q1. Answer: 2. 12.4 cm from +3 μC towards +6 μC

For like charges, the zero-field point lies between them. Set $kq1/x^2 = kq2/(0.30-x)^2$. Solving gives $x \approx 0.124$ m from the +3 μC charge.

Q2. Answer: 2. 4.52 × 10^5 N m²/C

By Gauss's law, electric flux $\Phi = q/\varepsilon_0 = 4.0 \times 10^{-6} / 8.85 \times 10^{-12} \approx 4.52 \times 10^5$ N m²/C.

Q3. Answer: 1. 0.02 J

Energy stored in a capacitor is $U = 1/2\ CV^2 = 1/2 \times 4 \times 10^{-6} \times 100^2 = 0.02$ J.

Q4. Answer: 1. 2 μF

For series capacitors, 1/C = 1/6 + 1/3 = 1/2, so C = 2 μF.

Q5. Answer: 2. 5 s

Current I = Q/t, so t = Q/I = 10/2 = 5 s.

Q6. Answer: 2. 1 A

Series resistance = 4 + 8 = 12 Ω. Current = V/R = 12/12 = 1 A.

Q7. Answer: 2. The galvanometer current is zero

In a balanced bridge, the potentials at the galvanometer terminals are equal, so no current flows through it.

Q8. Answer: 2. Circle

Magnetic force qvB is perpendicular to velocity, supplying centripetal force. Speed remains constant and the path is circular.

Q9. Answer: 2. Attract each other

Parallel currents in the same direction attract due to the magnetic field each wire produces at the location of the other.

Q10. Answer: 1. Parallel to the field

Torque τ = mB sinθ, where θ is between magnetic moment and field. The magnetic moment is normal to the loop plane; maximum torque occurs when the plane is parallel to the field.

Q11. Answer: 2. Faraday's law

Faraday's law states that induced emf is proportional to the rate of change of magnetic flux through a circuit.

Q12. Answer: 3. Conservation of energy

The direction of induced current opposes the change that produces it, preventing spontaneous energy creation.

Q13. Answer: 1. 50π Ω

Inductive reactance $X_L = 2\pi fL = 2\pi \times 50 \times 0.5 = 50\pi\ \Omega$.

Q14. Answer: 3. Inductive and capacitive reactances are equal

At resonance, $X_L = X_C$, the reactive effects cancel and the circuit behaves as purely resistive.

Q15. Answer: 4. Gamma ray

Gamma rays have the highest frequency and shortest wavelength in the given list.

Q16. Answer: 1. Between F and 2F

For a convex lens, an object beyond 2F forms a real, inverted and diminished image between F and 2F.

Q17. Answer: 2. From denser to rarer medium and incidence angle exceeds critical angle

Both conditions are required: light must travel from denser to rarer medium and the angle of incidence must be greater than the critical angle.

Q18. Answer: 1. λD/d

Fringe width $\beta = \lambda D/d$, where λ is wavelength, D is screen distance and d is slit separation.

Q19. Answer: 3. Slit width increases

Angular width of central maximum is proportional to λ/a. Increasing slit width a makes the central maximum narrower.

Q20. Answer: 3. Polarization

Polarization is the restriction of light vibrations to a particular plane.

Q21. Answer: 2. Stopping potential and maximum kinetic energy

For a given metal, $K_{max} = hf - \phi$. Higher frequency increases maximum kinetic energy and stopping potential.

Q22. Answer: 1. λ = h/p

Matter wavelength is $\lambda = h/p$, where h is Planck's constant and p is momentum.

Q23. Answer: 2. Quantized

Discrete spectral lines arise from transitions between fixed, quantized electron energy levels.

Q24. Answer: 1. $E = mc^2$

Einstein's mass-energy relation $E = \Delta mc^2$ links mass defect with nuclear binding energy.

Q25. Answer: 3. 1/8

12 hours equals three half-lives. Remaining fraction = (1/2)^3 = 1/8.

Q26. Answer: 2. Forward biased

Forward bias reduces the barrier potential and allows majority carriers to cross the junction.

Q27. Answer: 1. Voltage regulator

In reverse breakdown, a Zener diode maintains nearly constant voltage, so it is used for regulation.

Q28. Answer: 2. AND

An AND gate produces a high output only when every input is high.

Q29. Answer: 2. Superimpose information on a high-frequency carrier

Modulation varies a property of a carrier wave so that information can be transmitted efficiently.

Q30. Answer: 3. Amplitude

AM changes the amplitude of the carrier while keeping the carrier frequency approximately fixed.

Q31. Answer: 1. Both true and reason explains assertion

In electrostatic equilibrium, free charges move until no net electric field remains inside the conductor.

Q32. Answer: 1. Both true and reason explains assertion

At balance, no current is drawn from the cell, so the measurement is not lowered by internal resistance effects.

Q33. Answer: 1. Both true and reason explains assertion

Because magnetic force is perpendicular to velocity, it does no work and cannot change speed.

Q34. Answer: 1. Both true and reason explains assertion

Electromagnetic braking uses induced currents that oppose motion, converting kinetic energy into heat.

Q35. Answer: 1. Both true and reason explains assertion

Average power $P = V_{rms} I_{rms} \cos\phi$. For $\phi = 90°$, $\cos\phi = 0$, so average power is zero.

Q36. Answer: 3. 20

Magnification of an astronomical telescope in normal adjustment is $f_o/f_e = 100/5 = 20$.

Q37. Answer: 3. 1.0 mm

$\beta = \lambda D/d = (500 \times 10^{-9} \times 1)/(0.5 \times 10^{-3}) = 1.0 \times 10^{-3}$ m = 1.0 mm.

Q38. Answer: 2. 3.1 eV

$E(eV) \approx 1240/\lambda(nm) = 1240/400 = 3.1$ eV.

Q39. Answer: 1. Electron

For equal kinetic energy, $\lambda = h/\sqrt{(2mK)}$. The lighter particle has larger wavelength, so the electron does.

Q40. Answer: 1. A decreases by 4, Z decreases by 2

An alpha particle is a helium nucleus with mass number 4 and charge number 2.

Q41. Answer: 2. Halves

For a parallel-plate capacitor, $C = \varepsilon A/d$. Doubling plate separation halves the capacitance.

Q42. Answer: 3. 20 Ω

With volume constant, doubling length halves area. Since $R = \rho L/A$, resistance becomes four times: 20 Ω.

Q43. Answer: 3. 2r

For circular motion in a magnetic field, $r = mv/qB$. Radius is directly proportional to speed.

Q44. Answer: 2. 352 W

Average power $P = V_{rms} I_{rms} \cos\phi = 220 \times 2 \times 0.8 = 352$ W.

Q45. Answer: 2. Gives a wider field of view

A convex mirror forms diminished, erect images and provides a wide field of view.

Q46. Answer: 2. Work function

The work function is the minimum energy required to liberate an electron from a metal surface.

Q47. Answer: 2. Slow down fast neutrons

Moderators slow fast neutrons so that they are more likely to cause further fission in suitable fuel.

Q48. Answer: 1. Pulsating DC

A full-wave rectifier allows current in the load in the same direction during both half-cycles, producing pulsating DC.

Q49. Answer: 1. Higher possible data rate

Greater bandwidth can support higher information rate, though practical systems must still manage noise and power.

Q50. Answer: 2. 40 V

Induced emf $= N|\Delta\Phi|/\Delta t = 200 \times 2 \times 10^{-3} / 0.01 = 40$ V.

Q51. Answer: 3. 50 Ω

$Z = \sqrt{[R^2 + (XL - XC)^2]} = \sqrt{(30^2 + 40^2)} = 50$ Ω.

Q52. Answer: 2. Balmer

Transitions ending at n = 2 are in the Balmer series.

End of Sample Paper