ICSE 2027 EXAMINATION

QUESTION BANK

PHYSICS

(Science Paper 1, Class X)

Chapter-wise compilation from past board and specimen papers

Chapters covered

1. Force, Work, Power and Energy
2. Light
3. Sound
4. Electricity and Magnetism
5. Heat
6. Modern Physics

Papers included

Board papers: 2023, 2024, 2025, 2026 | Specimen papers: 2023, 2024, 2025, 2026, 2027 (Physics, Science Paper 1, paper code 521)

How to use this bank

- **Source tags.** Under every question a bold blue tag shows where it appeared. A board paper is tagged with its year, e.g. [2025]. A specimen paper is tagged with its year and S, e.g. [2025S].
- **Merged questions.** If the same question appears in several papers with identical wording (ignoring capital letters, punctuation and the word "the"), it is listed once and every year is shown, e.g. [2023] [2024S] [2026]. If the wording differs even slightly, the questions are listed separately, each with its own tag.
- **Categories.** Each chapter has A. Multiple Choice Questions (1 mark each), B. Short Questions (1 or 2 marks) and C. Long Questions (3 or 4 marks, because the Physics paper has some 4-mark parts). Numbering restarts in each category of each chapter.
- **Marks.** Marks in square brackets are as printed in the paper. Where a paper printed one total for a block of separate fill-in items (for example Q2(i) [6]), each item is listed on its own with its own mark.
- **Figures.** A question that depends on a diagram, graph or circuit has a red line [FIGURE: description — paste from source paper, YEAR 521 Q-number]. YEAR is the year of the paper (S for specimen) and 521 is the Physics paper code. Open that paper to see the figure.
- **Tables.** Data tables, matching tables and option tables are shown as real tables with a caption above.
- **Notes.** Grey italic notes mark items that could not be read clearly from a scanned paper. Check those against the original paper.
- **Scope.** Only questions printed in the papers are included, in their printed wording. There are no answers or marking schemes in this bank.

Chapter 1: Force, Work, Power and Energy

A. Multiple Choice Questions (1 mark each)

1. Clockwise moment produced by a force about a fulcrum is considered to be: [1]
   (a) Positive
   (b) Negative
   (c) Zero
   (d) None of these
   [2023]

2. S.I. unit of moment is: [1]
   (a) kgfm
   (b) Nm
   (c) gfm
   (d) Nem
   [2023S]

3. A door lock is opened by turning the lever (handle) of length 0.2 m. If the moment of force produced is 1 Nm, then the minimum force required is: [1]
   (a) 5 N
   (b) 10 N
   (c) 20 N
   (d) 0.2 N
   [2024]

4. A moment of couple has a tendency to rotate the body in an anticlockwise direction. Then the moment of couple is taken as: [1]
   (a) positive
   (b) negative
   (c) maximum
   (d) zero
   [2024S] [2025S]

5. A body is acted upon by two equal and opposite forces, that are NOT along the same straight line. The body will: [1]
   (a) remain stationary
   (b) have only rotational motion
   (c) have only rectilinear motion
   (d) have both rectilinear and rotational motion
   [2025]

6. Which among the following is a vector quantity? [1]
   (a) work
   (b) power
   (c) energy
   (d) moment of couple
   [2025]

7. For a body to be in dynamic equilibrium, its: [1]
   (a) momentum should be zero
   (b) acceleration should be zero
   (c) kinetic energy should be zero
   (d) velocity should be zero
   [2026]

8. A moment of couple has a tendency to rotate the body in an anticlockwise direction. The moment of couple is taken as: [1]
   (a) positive
   (b) negative
   (c) maximum
   (d) zero
   [2026S]

9. A heavy object and a light object are placed on a seesaw. Which arrangement produces the maximum turning effect about the pivot? [1]
   (a) Both objects near the pivot on opposite sides.
   (b) Heavy object close to the pivot; light object at the far end on the opposite side.
   (c) Light object close to the pivot; heavy object at the far end on the opposite side.
   (d) Both objects at the ends of the seesaw, on opposite sides of pivot.
   [2027S]

10. When the speed of a moving object is doubled, then its kinetic energy: [1]
   (a) remains the same
   (b) decreases
   (c) is doubled
   (d) becomes four times
   [2023]

11. The energy conversion in a washing machine is from _____. [1]
   (a) magnetic to electrical
   (b) electrical to mechanical
   (c) electrical to magnetic
   (d) magnetic to electrical
   [2023]

12. Which of the following is the correct expression for gain in kinetic energy, if initial velocity is not zero? [1]
   [Options (a)–(d) are mathematical expressions that could not be read reliably from the scan — check against the paper.]
   [2023S]

13. When a bell fixed on a cycle rings, then the energy conversion that takes place is: [1]
   (a) gravitational potential energy to sound energy
   (b) kinetic energy to sound energy
   (c) sound energy to electrical energy
   (d) sound energy to mechanical energy
   [2024]

14. A force 'F' moves a load from A to C as shown in the figure below. For the calculation of the work done, which of these lengths would you use as the displacement? [1]

[FIGURE: force F moving a load from A to C along a path with lengths 3 m, 4 m, 5 m and 7 m marked — paste from source paper, 2024 521 Q1(iii)]

(a) 3 m
(b) 4 m
(c) 5 m
(d) 7 m

[2024]

15. The kinetic energy of a given body depends on the: [1]
(a) position
(b) centre of gravity of the body.
(c) momentum
(d) displacement

[2024S] [2025S]

16. For burning of coal in a thermoelectric station, the energy conversion taking place is: [1]
(a) chemical to heat to mechanical
(b) chemical to heat to mechanical to electrical
(c) chemical to heat to light
(d) heat to chemical to mechanical

[2024S] [2025S]

17. What is the correct energy transformation during burning of a candle? [1]
(a) heat → kinetic + potential
(b) heat → chemical + light
(c) chemical → heat + light
(d) mechanical → chemical + heat

[2025]

18. The energy transformation taking place during photosynthesis in plants is: [1]
(a) heat to chemical
(b) chemical to light
(c) light to chemical
(d) chemical to heat

[2026] [2027S]

19. The kinetic energy of a given body depends on the: [1]
(a) position
(b) centre of gravity
(c) momentum
(d) displacement

[2026S]

20. During power production in a coal-based thermoelectric power plant, the correct sequence of energy conversions taking place is: [1]
(a) heat → mechanical → chemical
(b) heat → mechanical → electrical
(c) chemical → heat → light
(d) heat → chemical → electrical

[2026S]

21. Two balls, A and B have the same gravitational potential energy. Ball A is six times the mass of ball B. How do their heights above the ground compare? [1]

(a) Height of A is the same as height of B.
(b) Height of A is twice the height of B.
(c) Height of A is one-sixth the height of B.
(d) Height of A is six times the height of B.

[2027S]

22. Which of the following is a class III lever? [1]

(a) Pair of scissors
(b) Wheelbarrow
(c) Crowbar
(d) Human forearm

[2024]

23. For a lever, a graph is plotted with load on Y-axis and effort on X-axis. Which of the following represents the slope of the graph? [1]

(a) Mechanical advantage
(b) Velocity ratio
(c) 1 / Velocity ratio
(d) 1 / Mechanical advantage

[2025]

24. The adjacent diagram shows the movable block of a block and tackle system with effort in a convenient direction. From the diagram we can conclude that the number of pulleys used in the fixed block are [1]

[FIGURE: movable block of a block and tackle system with the effort applied in a convenient direction — paste from source paper, 2025S 521 Q1(iv)]

(a) 1
(b) 3
(c) 2
(d) 4

[2025S]

25. The Velocity Ratio (VR) of a block and tackle system of two pulleys with the effort in the upward direction is: [1]

(a) 1
(b) 2
(c) 3
(d) 4

[2026]

26. Anita used a single movable pulley to lift a bucket of water from a well. She lubricates the pulley. Which of the following statements is true regarding the performance of the pulley used? [1]

(a) Mechanical Advantage decreases and efficiency increases.
(b) Velocity Ratio increases and efficiency decreases.
(c) Mechanical Advantage remains unchanged and efficiency increases.
(d) Velocity Ratio remains unchanged and efficiency increases.

[2026S]

27. The Velocity Ratio (V.R.) of a block and tackle system of three pulleys with the effort in upward direction is: [1]

(a) 1
(b) 2
(c) 3
(d) 4

[2027S]

28. The energy conversion, when an oscillating pendulum moves from mean to extreme position is: [1]

(a) Kinetic to potential
(b) Potential to kinetic
(c) Potential to kinetic to potential
(d) Kinetic to potential to kinetic

[2023S]

29. A fast-moving cyclist stops pedalling on reaching a hilly track. If he continues to move with the acquired energy, then assuming no loss of energy: [1]

(a) his kinetic energy remains constant at all times.
(b) his potential energy remains constant at all times.
(c) his total mechanical energy continuously increases.
(d) his total mechanical energy remains constant.

[2026]

B. Short Questions (1 or 2 marks)

1. The diagram shows wheel O pivoted at point A. Three equal forces F1, F2 and F3 act at point B on the wheel. [2]

[FIGURE: wheel O pivoted at A with forces F1, F2, F3 acting at point B — paste from source paper, 2023 521 Q2(iii)]

(a) Which force will produce maximum moment about A?
(b) Give a reason for your answer in (a).

[2023]

2. (a) Name the force which produces maximum moment about. [2]

[FIGURE: wheel with a force acting on it and the point about which moments are taken — paste from source paper, 2023S 521 Q2(ii)]

(b) Calculate this moment in SI unit.

[2023S]

3. If the moment of F about the centre of a wheel O is 6Nm then calculate the moment of F about A. F=20N [2]

[FIGURE: wheel with centre O, point A and force F — paste from source paper, 2023S 521 Q2(iv)]

[2023S]

4. A non uniform beam of weight 120 N pivoted at one end is shown in the diagram below. Calculate the value of F to keep the beam in equilibrium. [2]

[FIGURE: non-uniform beam pivoted at one end, force F, centre of gravity marked at 0.80 m — paste from source paper, 2024 521 Q2(iii)]

[2024]

5. (a) What is the position of centre of gravity of a triangular lamina? [2]

(b) When this triangular lamina is suspended freely from any one vertex, what is the moment of force produced by its own weight in its rest position?

[2023]

6. State two factors that affects the centre of gravity of the body. [2]
[2023S]

7. A metre rod made of copper and steel as shown in the diagram. Weights of copper and steel are 10 N and 8 N respectively. [2]
[FIGURE: metre rod made of copper and steel sections — paste from source paper, 2024S 521 Q2(ii)]
(a) On which part does the centre of gravity lie (0 to 50 or 50 to 100).
(b) Justify your answer.
[2024S]

8. A non-uniform kite is hanging freely from the branch of a tree as shown. Study the figure and answer the following: [2]
[FIGURE: non-uniform kite hanging from a branch of a tree with points P, Q, R, S — paste from source paper, 2025 521 Q2(ii)]
(a) Fill in the blank. _____ (P, Q, R or S) is the most probable position of its centre of gravity.
(b) Support your answer to (a) with a reason.
[2025]

9. State two factors on which the position of Center of Gravity of a body depends. [2]
[2026]

10. ABCDE is a regular pentagon with its centre of gravity at O. What will be the most probable position (W, X, Y, Z or O) of the new centre of gravity: [2]
[FIGURE: regular pentagon ABCDE with centre O and points W, X, Y, Z; cut line PQ — paste from source paper, 2026S 521 Q3(iii)]
(a) if a piece of clay is attached at point A?
(b) if the pentagon is cut along the line PQ? (Of the remaining part DCBQPE)
[2026S]

11. ABCDE is a regular pentagon with its centre of gravity (CG) at O. What will be the most probable position (W, X, Y, Z or O) of the new centre of gravity: [2]
[FIGURE: regular pentagon ABCDE with centre O and points W, X, Y, Z; cut line PQ — paste from source paper, 2027S 521 Q3(iii)]
(a) if a piece of clay is attached at point A?
(b) if the pentagon is cut along the line PQ? (CG of the remaining part DCBQPE)
[2027S]

12. Fill in the blanks: [2]
(a) When a stone tied to a string is rotated in a horizontal plane, the tension in the string provides _____ force necessary for circular motion.
(b) Work done by this force at any instant is _____.
[2024]

13. Complete the following by choosing the correct answers from the bracket:
In uniform circular motion the centrifugal force acts _____ [towards the centre / away from the centre / along the tangential direction]. [1]
[2025]

14. Complete the following by choosing the correct answers from the bracket:
A car is moving in uniform circular motion. The direction of friction between the tyres and the path is _____ [towards the centre / tangential to the path]. [1]
[2026]

15. Complete the following by choosing the correct answers from the bracket:
Friction acts _____ [tangential / radial] to a car undergoing circular motion. [1]
[2027S]

16. (a) What should be the angle between the direction of force and the direction of displacement, for work to be negative? [2]

(b) Name the physical quantity obtained using the formula U/h, where U is the potential energy and h is the height.

[2023]

17. Calculate the power spent by a crane while lifting a load of mass 2000 kg, at velocity of 1.5 ms^{-1}. (g = 10 ms^{-2}) [2]

[2023]

18. If kinetic energy of a moving body is 40J then what will be its kinetic energy when its velocity is doubled? [2]

[2023S]

19. Sumit does 600 J of work in 10 min and Amit does 300 J of work in 20 min. Calculate the ratio of the powers delivered by them. [2]

[2024]

20. Two bodies A and B have same kinetic energies. Compare their velocities if mass of A is four times the mass of B. [2]

[2024S]

21. Draw a graph of potential energy vs height from the ground for a body thrown vertically upwards. [2]

[2024S]

22. Complete the following by choosing the correct answers from the bracket:
If the mass as well as the velocity of a body is doubled then the kinetic energy of the body _____ [is doubled / becomes eight times / becomes four times] the initial kinetic energy. [1]

[2025S]

23. Complete the following by choosing the correct answers from the bracket:
Unit of power used in mechanical engineering is _____ [watt / horse power / erg per second] [1]

[2025S]

24. Draw a graph of potential energy vs height for a body thrown vertically upwards. [Assume no friction is present.] [2]

[2025S]

25. A lever is shown below. [2]

[FIGURE: lever with effort, load and fulcrum positions marked — paste from source paper, 2024S 521 Q2(iii)]

(a) Identify the type of lever.

(b) Calculate its mechanical advantage.

[2024S]

26. Complete the following by choosing the correct answers from the bracket:
A _____ [Class I / Class II / Class III] lever will always have M.A. > 1. [1]

[2025S]

27. Case 1: Lata cuts a potato into two halves, using a cutter which belongs to a Class II lever. She needed effort E1.
Case 2: Then she cuts one half of this potato again, but this time she needed effort E2. If E1 > E2 then: [2]

(a) In which case (1st or 2nd) was the potato closer to her hand applying the effort? (Assume normal reaction of the surface of the potato is same in both cases)

(b) Give a reason for your answer in (a) above.

[2026]

28. Complete the following by choosing the correct answers from the bracket:
A _____ [Class II/Class III] lever will always have M.A. > 1. [1]

[2026S]

29. Match the movement of the body part in Column A to the class of lever in Column B. [2]

Movement of the body part and class of lever

Movement of the body part (Column A)	Class of lever (Column B)
(a) Nodding head	1. Class III
(b) Lifting body weight on your toes	2. Class II
	3. Class I

[2026S] [2027S]

30. Meera chose to use a block and tackle system of '9' pulleys instead of a single movable pulley to lift a heavy load. [2]
    (a) What is the advantage of using a block and tackle system over a single movable pulley?
    (b) Why should she connect more number of pulleys in the upper fixed block?

[2024]

31. Complete the following by choosing the correct answers from the bracket:
In a block and tackle system, increase in the weight of the movable block _____ [decreases, does not affect, increases] the efficiency of the pulley system. [1]

[2025S]

C. Long Questions (3 or 4 marks)

1. A metre scale of weight 50 gf can be balanced at 40 cm mark without any weight suspended on it. [3]
    (a) If this ruler is cut at its centre then state which part [0 to 50 cm or 50 to 100 cm] of the ruler will weigh more than 25 gf.
    (b) What minimum weight placed on this metre ruler can balance this ruler when it is pivoted at its centre?

[2023]

2. The adjacent diagram shows a wheel of diameter 40 cm fixed on a wall capable of rotating around its centre O. If the wheel rotates in an anticlockwise direction, then: [3]

[FIGURE: wheel of diameter 40 cm fixed on a wall, centre O, weight of 100 gf and force X — paste from source paper, 2023S 521 Q6(ii)]

    (a) Calculate the clockwise moment.
    (b) State whether X = 100 gf or X < 100 gf or X > 100 gf.
    (c) Give a reason for your answer.

[2023S]

3. Sumit and Sachin went for a trek and during the journey they visited a cottage. They suspended their bags to the two ropes hanging from P and Q on a wheel capable of rotating around O. Sumit suspended his bag to the rope Q and Sachin suspended his bag from the rope P. The wheel remained in equilibrium. [3]

[FIGURE: wheel rotating about O with ropes at P and Q carrying the two bags — paste from source paper, 2024S 521 Q6(i)]

    (a) State with a reason who is carrying a heavier bag.
    (b) Based on the principle of moments, write a mathematical relation that can be used to determine the weight (W) of Sachin's bag, given that the weight of Sumit's bag is 18 kgf.

[2024S]

4. Akash takes a uniform meter scale and suspends a weight of 2 N at one end 'X' and a weight of 5 N on the other end 'Y'. He then balances the ruler horizontally on a knife edge placed at 70 cm from X. Draw a diagram of the arrangement and calculate the weight of the ruler. [3]

[2025]

5. A metal rod AB of length 80 cm is balanced at 45 cm from the end A with 100 gf weights suspended from the two ends. [3]

[FIGURE: metal rod AB with fulcrum at 45 cm and 100 gf weights at each end — paste from source paper, 2025S 521 Q6(i)]

(a) If this rod is cut at the centre C, then compare the weight of AC to the weight of BC.

(b) Give a reason for your answer in (a)

[2025S]

6. The diagram shows a wheel with a handle. Two forces, F1 and F2 of equal magnitudes are acting on the handle as shown in the diagram. [3]

[FIGURE: wheel with a handle and forces F1 and F2 acting on the handle — paste from source paper, 2026 521 Q6(i)]

(a) Which force produces negative moment?

(b) Is the wheel in equilibrium? (Yes or No)

(c) Justify your answer stated in (b).

[2026]

7. A metal rod AB of length 80 cm is balanced at 45 cm from end A with 100 gf weights suspended from the two ends. [3]

[FIGURE: metal rod AB with fulcrum at 45 cm and 100 gf weights at each end — paste from source paper, 2026S 521 Q6(i)]

(a) If this rod is cut at the centre C, compare the weight of AC with the weight of BC (use >, < or =).

(b) Give a reason for your answer in (a).

[2026S]

8. A metal rod AB of length 80 cm is balanced at 45 cm from the end A with 100 gf weights suspended from the two ends. [3]

[FIGURE: metal rod AB with fulcrum at 45 cm and 100 gf weights at each end — paste from source paper, 2027S 521 Q6(i)]

(a) If this rod is cut at the centre C, then compare the weight of AC to the weight of BC. (Use >, < or =)

(b) Give a reason for your answer in (a).

[2027S]

9. (a) Define Centre of Gravity. [3]

(b) A hollow ice cream cone has height 6 cm.

1. Where is the position of its centre of gravity from the broad base?
2. Will its position change when it is filled completely with honey? Write Yes or No.

[2024]

10. A car of mass 120 kg is moving at a speed 18 km/h and it accelerates to attain a speed of 54 km/h in 5 seconds. Calculate: [4]

(a) the work done by the engine.

(b) the power of the engine.

[2023]

11. A coconut of mass 450 g falls from the top of an 80 m high tree. [4]

(a) Calculate the potential energy possessed by the coconut when it is at the top of the tree.

(b) Without calculation, state the kinetic energy with which it strikes the ground and state the principle involved to arrive at the answer in (i). g = 10 ms^{-2}

[2023S]

12. Richa weighing 40 kgf leaves point P on her skateboard and reaches point Q on the ground with velocity 10 ms^{-1}. Calculate: [4]

[FIGURE: skateboard ramp from point P to point Q on the ground, then to R — paste from source paper, 2025 521 Q6(iii)]

(a) the kinetic energy of Richa at point Q.

(b) the vertical height of point P above the ground. (Use g as 10 m/s^2 and neglect friction)

(c) the kinetic energy of Richa at point R. (While moving from Q to R, she loses 500 J of energy against friction.)

[2025]

13. For each of the following scenarios, state whether the work done by gravity is positive, negative, or zero. [3]

(a) A person walks on a levelled road.

(b) A person climbs a ladder.

(c) A car in neutral gear is coming down the slope.

[2025S] [2026S]

14. (a) Name the unit of work done, used in subatomic scale. [3]

[FIGURE: three cases (Case 1, Case 2, Case 3) of a stone tied to a string displaced from A to B, with semicircle AJB — paste from source paper, 2026 521 Q6(ii)]

(b) To which class of lever does a pair of scissors belong?

(c) A stone is tied to a string and displaced from A to B by application of constant force F in three different ways as shown in the diagram below. Arrange the three cases in ascending order of the work done by the force. (Given AJB is a semi-circle, $\theta < 90°$ and AB = 20 m)

[2026]

15. A ball of mass 20 g falls from a height of 45 m. It rebounds from the ground to a height of 40 m. Calculate: [4]

(a) the initial potential energy of the ball.

(b) the speed of the ball at which it hits the ground.

(c) the loss in kinetic energy on striking the ground. [g = 10 m/s^2]

[2026]

16. For each of the following scenarios, state whether the work done by gravity is positive, negative, or zero. [3]

(a) A person walks on a levelled road.

(b) A person climbs a ladder.

(c) A car in a neutral gear is coming down the slope.

[2027S]

17. An empty supermarket trolley of mass 10 kg is moving with a speed of 8 m s^{-1}. An identical trolley is loaded with 10 kg of goods and moves with a speed of 4 m s^{-1}. Both trolleys are brought to rest over the same stopping distance. [4]

(a) Calculate the kinetic energy of the empty trolley.

(b) Calculate the kinetic energy of the loaded trolley.

(c) Compare the braking force required to stop the empty trolley and the loaded trolley.

(d) Name the principle applied in solving part (c).

[2027S]

18. Three levers X, Y, Z of equal lengths are shown in the diagram. [3]

[FIGURE: three levers X, Y and Z of equal lengths — paste from source paper, 2025 521 Q6(ii)]

(a) Which class of lever do these belong to?

(b) Among these (X, Y or Z) which one will give the maximum mechanical advantage? Justify your answer.

[2025]

19. A bar of length 120 cm is used as a lever to raise a load placed at point P. Seven equidistant points are marked along the bar: P, Q, R, S, T, U, and V, each 20 cm apart. You are permitted to place the fulcrum at any of the marked points and exert the effort at a different point. [3]

[FIGURE: bar of length 120 cm with equidistant points P, Q, R, S, T, U and V — paste from source paper, 2027S 521 Q7(i)]

(a) Specify the fulcrum and effort points that yield the greatest mechanical advantage.

(b) Compute the maximum mechanical advantage based on the given distances.

(c) To which class of lever does this arrangement belong?

[2027S]

20. (a) When does the nucleus of an atom tend to become radioactive? [3]

(b) Name a single pulley in which displacement of load and effort is not the same.

(c) State one advantage of this pulley.

[2023]

21. A block and tackle system of pulleys has velocity ratio 4. [3]

(a) Draw a labelled diagram of the system indicating clearly, the direction of the load and the effort.

(b) What is the value of the mechanical advantage of the given pulley system if it is an ideal pulley system?

[2023]

22. The diagram below shows a block and tackle system: [3]

[FIGURE: block and tackle system with fixed and movable blocks — paste from source paper, 2023S 521 Q6(i)]

(a) Copy and redraw the labelled diagram showing the correct connection of tackle, direction of the forces involved to obtain the maximum V.R. and convenient direction.

(b) Calculate the M.A. of this pulley system if its efficiency is 80%.

[2023S]

23. Given are two pulleys. [4]

[FIGURE: two pulleys (one fixed, one movable) to be connected with a tackle — paste from source paper, 2024 521 Q6(iii)]

(a) Copy and complete the labelled diagram connecting the two pulleys with a tackle to obtain Velocity Ratio = 2.

(b) If Load = 48 kgf and efficiency is 80% then calculate:

1. Mechanical Advantage.
2. Effort needed to lift the load.

[2024]

24. The diagram below shows a block and tackle system. [3]

[FIGURE: block and tackle system with fixed and movable blocks — paste from source paper, 2024S 521 Q6(ii)]

(a) Copy and complete the labelled diagram showing the correct connection of the tackle, the direction of the forces involved to obtain maximum V.R. with the convenient direction.

(b) Calculate the M.A. of this pulley system if its efficiency is 80%.

[2024S]

25. Draw a block and tackle system of pulleys with velocity ratio equal to 3. [3]

[2025]

26. A block and tackle system of pulleys has velocity ratio 4. [3]

(a) Draw a labelled diagram of the system indicating clearly, the direction of the load and effort.

(b) Calculate the potential energy of the load 100 kgf lifted by this pulley to a height 5 m. ($g = 10\ ms^{-2}$)

[2025S]

27. To lift a load of 30 kgf, Suhas uses a single fixed pulley, while Radha uses a single movable pulley. The displacement of efforts in both the cases are equal. In an ideal situation calculate the ratio of: [3]

(a) the efforts in the two cases.

(b) the potential energy gained by the loads in the two cases.

(c) the efficiencies in the two cases.

[2026]

28. A block and tackle system of pulleys has velocity ratio 4. [3]

(a) Draw a labelled diagram of the system indicating clearly the direction of load and effort.

(b) Calculate the potential energy gained by a load of 100 kgf lifted by this pulley to a height of 5 m. (g = 10 ms^{-2})

[2026S]

29. Two identical marbles A and B are rolled down along Path 1 and Path 2 respectively. Path 1 is frictionless and Path 2 is rough. [3]

[FIGURE: two curved paths (Path 1 frictionless, Path 2 rough) with marbles A and B — paste from source paper, 2024 521 Q6(ii)]

(a) Which marble will surely reach the next peak?

(b) Along which path/s the mechanical energy will be conserved?

(c) Along which path/s is the law of conservation of energy obeyed?

[2024]

30. The figure below shows a simple pendulum of mass 200 g. It is displaced from the mean position A to the extreme position B. The potential energy at the position A is zero. At the position B the pendulum bob is raised by 5 m. [4]

[FIGURE: simple pendulum of mass 200 g with positions A (mean), B (extreme) and C — paste from source paper, 2025S 521 Q6(iii)]

(a) What is the potential energy of the pendulum at the position B?

(b) What is the total mechanical energy at point C?

(c) What is the speed of the bob at the position A when released from B? (Take g = 10 ms^{-2} and given that there is no loss of energy.)

[2024S] [2025S]

31. A, B, C and D are four points on a hemispherical cup placed inverted on the ground. Diameter BC = 360 cm and AE = R/3 (R is the radius of the cup). A small spherical mass 500 g at rest at the point A, slides down along the smooth surface of the cup. Assuming that there is no loss of energy, calculate its: [4]

[FIGURE: inverted hemispherical cup with points A, B, C, D and E — paste from source paper, 2026S 521 Q6(iii)]

(a) Potential Energy at A relative to B.

(b) Speed at the point B (lowest point).

(c) Kinetic Energy at D (g = 10 ms^{-2}).

[2026S]

Chapter 2: Light

A. Multiple Choice Questions (1 mark each)

1. When a ray of light travels normal to the given surface, then the angle of refraction is: [1]
   (a) 180°
   (b) 90°
   (c) 0°
   (d) 45°
   [2023]

2. While entering from medium A to medium B if light slows down then: [1]
   [Options (a)–(d) compare angle i and angle r; the symbols could not be read reliably from the scan — check against the paper.]
   [2023S]

3. A block of glass is pushed into the path of the light as shown below. Then the converging point X will: [1]
   [FIGURE: converging beam from a lens with a glass block pushed into its path, converging point X marked — paste from source paper, 2024 521 Q1(xv)]
   (a) Move away from the slab
   (b) Move towards the slab
   (c) Not shift
   (d) Move towards the left side of the lens
   [2024]

4. When a ray of light enters from a denser medium to a rarer medium then: [1]
   (a) the light ray bends towards the normal
   (b) the speed of light increases
   (c) the angle of incidence is greater than the angle of refraction
   (d) its wavelength decreases.
   [2024S]

5. When a ray of light passes from one optical medium to another, which of the following physical quantities does NOT change? [1]
   (a) Amplitude of the wave
   (b) Frequency of the wave
   (c) Wavelength of the wave
   (d) Speed of the wave
   [2025]

6. From the figure given below, the refractive index of medium B with respect to medium A ($_a\mu_B$) is: [1]
   [FIGURE: ray passing from medium A to medium B with angles marked — paste from source paper, 2026 521 Q1(iv)]
   (a) sin 45° / sin 30°
   (b) sin 30° / sin 45°
   (c) sin 45° / sin 60°
   (d) sin 60° / sin 45°
   [2026]

7. When objects are viewed through the rising heat of a campfire they appear to shimmer. The optical phenomenon responsible for this effect is: [1]

(a) refraction
(b) reflection
(c) scattering
(d) total internal reflection

[2026S]

8. Small air bubbles rising up a fish tank appear silvery when viewed from some particular angle is due to the: [1]

(a) reflection
(b) refraction
(c) dispersion
(d) total internal reflection

[2023]

9. The phenomenon of light that causes the diamond to glitter is: [1]

(a) Refraction
(b) Total internal reflection.
(c) Reflection.
(d) Absorption.

[2023S]

10. An endoscope uses optical fiber to transmit high resolution images of internal organs without loss of information. The phenomenon of light that governs the functioning of the optical fiber is: [1]

(a) refraction
(b) reflection
(c) scattering
(d) total internal reflection.

[2024S]

11. A ray of light is incident normally on a face of an equilateral prism. The ray gets totally reflected at the second refracting surface. The total deviation produced in the path of the ray is: [1]

(a) 30°
(b) 60°
(c) 90°
(d) 120°

[2025]

12. An endoscope uses optic fiber to transmit high resolution images of internal organs without loss of information. The principle of light that is used by the optic fiber is based on: [1]

(a) refraction
(b) reflection
(c) scattering
(d) total internal reflection.

[2025S]

13. The figure shows a source of light S at the bottom of a trough containing a transparent liquid. Rays X and Y emerge from the source. If ∠SOP = 43°, state the possible angle of incidence of ray Y. [1]

[FIGURE: source of light S at the bottom of a trough of liquid, rays X and Y, point O and normal OP — paste from source paper, 2027S 521 Q1(vi)]

(a) 43°
(b) 45°
(c) 47°
(d) 49°

[2027S]

14. A concave lens produces only _____ image. [1]

(a) real, enlarged
(b) virtual, enlarged
(c) virtual, diminished
(d) real, diminished

[2023]

15. In which of the following diagrams is the refraction not correct: [1]

[FIGURE: four ray diagrams (a) to (d) showing refraction through convex and concave lenses — paste from source paper, 2023S 521 Q1(vi)]

[2023S]

16. Linear magnification (m) produced by a concave lens is: [1]

(a) $m < 1$
(b) $m > 1$
(c) $m = 1$
(d) $m = 2$

[2024]

17. For a convex lens, the minimum distance between an object and its real image in terms of focal length (f) of a given lens must be: [1]

(a) 1.5 f
(b) 2.5 f
(c) 2 f
(d) 4 f

[2024S]

18. For a real image formed by a convex lens, the ratio of I : O = 2 : 5, then the object is: (I is the height of the image and O is the height of the object) [1]

(a) between O and F
(b) beyond 2F
(c) at F
(d) between F and 2F

[2025]

19. A convex lens has focal length 12 cm with an object at a distance of 20 cm in front of the lens. He obtains a blurred image on the screen placed at a distance of 23 cm in front of the lens. In order to obtain the clear image, he has to move the screen [1]

(a) towards the lens.
(b) away from the lens.
(c) to a position very far away from the lens.
(d) either towards or away from the lens.

[2025S]

20. The distance (V) of a virtual image formed by a lens of focal length 15 cm never exceeds a certain finite value, then this value will be: [1]

(a) less than 15 cm
(b) between 15 cm to 30 cm
(c) less than or equal to 30 cm
(d) less than or equal to 15 cm

[2026]

21. A convex lens with a focal length of 12 cm has an object at a distance of 20 cm in front of the lens. A blurred image is obtained on the screen placed at a distance of 23 cm in front of the lens. In order to obtain a clear image, the screen has to be moved: [1]

(a) towards the lens.
(b) away from the lens.
(c) to a position very far from the lens.
(d) either towards or away from the lens.

[2026S]

22. A concave lens diverges light because its upper and lower parts act as: [1]

(a) inverted prisms
(b) upright prisms
(c) upright and inverted prisms respectively
(d) inverted and upright prisms respectively

[2027S]

23. Speed of blue light in water is: [1]

(a) more than green light
(b) more than orange light
(c) more than violet light
(d) more than red light

[2023]

24. When seven spectral colours passes through a glass block from air, then which one of the following statements is correct. [1]

(a) In the glass block, speed of blue light > speed of yellow light.
(b) In the glass block, speed of green light > speed of orange light.
(c) In the glass block, speed of violet light > speed of red light.
(d) In the glass block, speed of orange light > speed of indigo light.

[2023S]

25. White light is dispersed by a prism. Inside the prism, compared to the blue light, the red light [1]

(a) slows down less and refracts more
(b) slows down more and refracts less
(c) slows down more and refracts more
(d) slows down less and refracts less

[2025S]

26. Inside the prism, during the dispersion of white light, compared to blue, red light: [1]

(a) slows down less and refracts more.
(b) slows down more and refracts less.
(c) slows down more and refracts more.
(d) slows down less and refracts less.

[2026S]

27. If red, blue, green and yellow lights are allowed to enter the same glass block with the same angle of incidence (∠i), then for which colour will the angle of deviation be the greatest? [1]

(a) blue
(b) green
(c) yellow
(d) red

[2027S]

28. Which one of the following combinations is the correct ascending order of electromagnetic waves in terms of wavelength? [1]

(a) gamma-rays, visible light, microwaves
(b) microwaves, visible light, gamma-rays
(c) gamma-rays, microwaves, visible light
(d) microwaves, gamma-rays, visible light

[2025]

29. When a blackened bulb thermometer is moved beyond the red region of the visible spectrum, there is a rapid rise in the temperature. This is due to the presence of: [1]

(a) Infrared radiations
(b) Ultraviolet radiations
(c) X-rays
(d) Radio waves

[2026]

30. Assertion (A): Ultraviolet radiations are scattered more as compared to the microwave radiations.
Reason (R): Wavelength of ultraviolet radiation is more than the wavelength of microwave radiation. [1]

(a) Both A and R are true.
(b) A is true but R is false.
(c) A is false but R is true.
(d) Both A and R are false.

[2024]

31. Assertion: Infrared radiations travel long distances through dense fog and mist.
Reason: Infrared radiations undergoes minimal scattering in earth's atmosphere [1]

(a) both assertion and reason are true.
(b) both assertion and reason are false.
(c) assertion is false but reason is true.
(d) assertion is true reason is false.

[2024S]

32. Assertion(A): Infrared radiations travel long distance through a dense fog and mist.
Reason(R): Infrared radiations undergo minimal scattering in earth's atmosphere. [1]

(a) both A and R are true and R is the correct explanation of A.
(b) both A and R are True and R is not the correct explanation of A.
(c) assertion is false but reason is true.
(d) assertion is true but reason is false.

[2025S]

33. Assertion (A): Tiny air molecules scatter blue light more than red light.
Reason (R): The refractive index of a medium is greater for blue light than red light. [1]

(a) (A) is true but (R) is false.
(b) (A) is false but (R) is true.
(c) Both (A) and (R) are true and (R) is the correct explanation of (A).
(d) Both (A) and (R) are true but (R) is not the correct explanation of (A).

[2026]

34. Assertion(A): Soldiers avoid firing at a target in foggy weather conditions.
Reason(R): In foggy weather, light gets scattered by tiny water droplets, reducing visibility. [1]

(a) (A) is true but (R) is false.

(b) (A) is false but (R) is true.

(c) Both (A) and (R) are true and (R) is the correct explanation of (A).

(d) Both (A) and (R) are true, but (R) is not the correct explanation of (A).

[2026S]

35. Statement I: Blue light scatters more than red light in the atmosphere.
Statement II: In Rayleigh scattering, intensity of scattered light is inversely proportional to the fourth power of wavelength. [1]

(a) Both the statements are true.

(b) Both the statements are false.

(c) Statement I is true, but Statement II is false.

(d) Statement I is false, but Statement II is true.

[2027S]

B. Short Questions (1 or 2 marks)

1. Complete the following by choosing the correct answers from the bracket:
Refractive index of a medium is independent of _____ [temperature / angle of incidence / wavelength of light]. [1]

[2025]

2. Complete the following by choosing the correct answers from the bracket:
When a ray of light passes from a denser to a rarer medium, its wavelength _____ [decreases / increases]. [1]

[2026]

3. A ray of light enters a rectangular glass slab submerged in water at an angle of incidence 55°. Does this ray undergo total internal reflection when it moves from water to glass? Justify your answer. (The critical angle for glass-water interface is 54°.) [2]

[2025]

4. (a) Is it possible for a concave lens to form an image of size two times that of the object? Write Yes or No. [2]

(b) What will happen to the focal length of the lens if a part of the lens is covered with an opaque paper?

[2023]

5. A lens X can form an image on the screen. [2]

(a) Name the lens X.

(b) Is it possible for this lens to form magnified image?

[2023S]

6. (a) In a reading glass what is the position of the object with respect to the convex lens used? [2]

(b) Why can we not use concave lens for the same purpose?

[2024]

7. (a) Refer to the diagram given below. A lens with two different refractive indices is shown. If the rays are coming from a distant object, then how many images will be seen? [2]

[FIGURE: lens made of two materials with different refractive indices, rays from a distant object — paste from source paper, 2025S 521 Q3(i)]

(b) A glass lens always forms a virtual, erect and diminished image of an object kept in front of it. Identify the lens.

[2024S] [2025S]

8. The graph below shows the variation of image distance (v) with the object distance (u) when an object is kept in front of a lens. [2]

[FIGURE: graph of image distance v against object distance u for a lens — paste from source paper, 2026 521 Q3(i)]

(a) Identify the type of lens used.

(b) What would be the magnification (more than 1 / less than 1 / equal to 1) if the object is placed between F and 2F of the above lens?

[2026]

9. (a) Refer to the diagram given below. A lens is made of two materials of different refractive indices (μ1, μ2) as shown. If the rays are coming from a distant object, then how many images will be seen? [2]

[FIGURE: lens made of two materials with refractive indices μ1 and μ2, rays from a distant object — paste from source paper, 2026S 521 Q3(i)]

(b) A glass lens always forms a virtual, erect, and diminished image of an object kept in front of it. Identify the lens.

[2026S]

10. (a) Refer to the diagram given below. A lens is made of two materials of different refractive indices (μ1, μ2) as shown. If the rays are coming from a distant object, then how many images will be formed? [2]

[FIGURE: lens made of two materials with refractive indices μ1 and μ2, rays from a distant object — paste from source paper, 2027S 521 Q3(i)]

(b) A glass lens always forms a virtual, erect, and diminished image of an object kept in front of it. Identify the lens.

[2027S]

11. Complete the following by choosing the correct answers from the bracket:
A glass prism is immersed in water. The angle of minimum deviation will _____ [decrease / increase]. [1]

[2027S]

12. Complete the following by choosing the correct answers from the bracket:
A boy uses a GPS device to locate his missing friend in a crowded area; the system primarily uses _____ [ultraviolet waves / microwaves] to track the location. [1]

[2026S]

C. Long Questions (3 or 4 marks)

1. (a) A coin kept inside water [μ = 4/3] when viewed from air in a vertical direction appears to be raised by 3.0 mm. Find the depth of the coin in water. [3]

(b) How is the critical angle related to the refractive index of a medium?

[2023]

2. The above diagram shows that an observer sees the image of an object O at I. [4]

[FIGURE: rectangular glass block with object O, image I and an observer; distances X and Y marked — paste from source paper, 2024S 521 Q4(iii)]

(a) Name and define the phenomenon responsible for seeing the image at a different position.

(b) State the effect on X when:

1. Y increases
2. Y decreases

[2023S] [2024S]

3. (a) Refractive index of glass with respect to water is 9/8. Find the refractive index of water with respect to glass. [3]

(b) Name the principle used to find the value in part (a).

(c) If we change the temperature of water, then will the ratio 9/8 remain the same? Write Yes or No.

[2024]

4. Light travels a distance of '10x' units in time 't1' in vacuum and it travels a distance of 'x' units in time 't2' in a denser medium. Using this information answer the question that follows: [3]

(a) 'Light covers a distance of '20x' units in time 't1' in diamond.' State true or false.

(b) Calculate the refractive index of the medium in terms of 't1' and 't2'.

[2024]

5. A rectangular glass block of refractive index 1.5 has an air bubble trapped inside it as shown in the diagram. When seen from the surface AB, it appears to be 4 cm deep. [3]

[FIGURE: rectangular glass block with an air bubble, surface AB — paste from source paper, 2025 521 Q4(ii)]

(a) Calculate the actual depth of the air bubble from the surface AB.

(b) For which colour of light, blue or yellow, the apparent depth will be greater?

(c) Turning the glass block upside down, DOES NOT change the apparent depth of the air bubble. State True or False.

[2025]

6. A ray of light enters a glass block from air and comes out from the opposite surface. If the angle of refraction at the first surface is not the same as the angle of incidence at the second surface, then: [3]

(a) What is the product of the ratio sin i / sin r at the first surface and at the second surface?

(b) State whether the opposite surfaces are parallel or not parallel.

(c) How did you reach the conclusion in (b) above?

[2026]

7. A type of glass block has a refractive index of 1.8. [3]

(a) Calculate the speed of light in this glass. (Given speed of light in air 3×10^8 ms^{-1})

(b) If the width of this block is doubled, then what will be the speed of light in the block?

[2026]

8. A scientist lowers a metallic ruler vertically into a transparent oil tank. The ruler touches an object placed at the bottom of the tank and gets wet up to the 25 cm mark. If the refractive index of the glycerin is 1.25: [3]

(a) up to which mark will the ruler get wet, if the scientist lowers it up to the image of the object?

(b) how will this length in (a) change if another liquid of $\mu > 1.25$ is used?

[2026S]

9. A diagram shows a ray of light travelling through three different transparent media having refractive indices μ_1, μ_2 and μ_3 as shown. Points Q and S are points on the surfaces separating the media. Given PQ || RS. [3]

[FIGURE: ray PQ, QR, RS through three media with refractive indices μ1, μ2 and μ3 — paste from source paper, 2027S 521 Q4(i)]

(a) Among the three media shown, in which medium is the speed of light minimum?

(b) As the ray of light travels from medium 1 to medium 2, how does the wavelength of light change? (State whether it increases, decreases, or remains constant.)

(c) State the relationship between the refractive indices μ_1 and μ_3 that ensures the emergent ray (RS) is parallel to the incident ray (PQ).

[2027S]

10. Copy the diagram given below and complete the path of the light ray PQ, as it emerges out of the prism by marking necessary angles. The critical angle of glass is 42°. [3]

[FIGURE: prism with light ray PQ incident on one face — paste from source paper, 2023 521 Q4(ii)]

[2023]

11. Redraw and complete the path of the ray AB till it emerges out of the prism of critical angle 42°. [3]

[FIGURE: prism with ray AB incident on one face (angle 30° marked at P) — paste from source paper, 2023S 521 Q4(ii)]

[2023S]

12. (a) Why do we use red colour as a danger signal on the top of a skyscraper? [4]

[FIGURE: path of a blue ray through a prism with angles marked — paste from source paper, 2024 521 Q4(iii)]

(b) The diagram below shows the path of a blue ray through the prism:

1. Calculate the critical angle of the material of the prism for blue colour.
2. What is the measure of the angle of this prism (A)?
3. Which colour should replace the blue ray, for the ray to undergo Total Internal Reflection?

[2024]

13. The diagram below shows a fish in the tank and its image seen in the surface of water. [3]

[FIGURE: fish in a tank with its image seen at the water surface; glass prism with an incident ray — paste from source paper, 2024S 521 Q4(i)]

(a) Name the phenomenon responsible for the formation of this image.

(b) Complete the path of the ray through the glass prism of critical angle 42° till it emerges out of the prism.

[2024S]

14. The refractive index of water is 1.33 at a certain temperature. When the temperature of water is increased by 40°C, the refractive index changes to 'x'. [3]

(a) State whether $x < 1.33$ or $x > 1.33$.

(b) State two differences between normal reflection and total internal reflection.

[2024S] [2025S]

15. (a) Out of the three rays (I, J, H) shown in the diagram, which ray will suffer Total Internal Reflection while inside the prism? (Critical angle of the prism is 42°.) [3]

[FIGURE: prism with three rays I, J and H — paste from source paper, 2025 521 Q4(i)]

(b) Copy the diagram to complete the path of the ray which you have named in (a) till it comes out of the prism.

[2025]

16. The diagram below shows a fish in the tank and its image seen in the surface of water. [3]

[FIGURE: fish in a tank with its image at the water surface; Figure a and Figure b – double convex lens in liquid 1 (μ2) and liquid 2 (μ3) — paste from source paper, 2025S 521 Q4(i)]

(a) Name the phenomenon responsible for the formation of this image.

(b) A double convex lens with refractive index μ1 inside two liquids of refractive indices μ2 and μ3 are shown in the diagrams below. The refractive indices are such that $\mu2 > \mu1$ and $\mu1 > \mu3$. How would a parallel incident beam of light refract when it comes out of the lens in each of the cases shown above?

1. in Fig a.
2. in figure b.

[2025S]

17. O is a luminescent particle trapped inside a glass block. A student traces the path of rays coming out of it and reflecting over a plane mirror as shown in the diagram below.
Complete the table, using the labels from the figure. The first label is done for you. [4]

[FIGURE: luminescent particle O inside a glass block with rays reflecting over a plane mirror, labelled angles and rays — paste from source paper, 2025S 521 Q5(iii)]

Descriptions and labels (to be completed using the figure)

Sr. No	Description	Label
a.	an angle of reflection on the mirror	a
b.	a partially reflected ray in the glass slab	
c.	a critical angle	
d.	a refracted ray	
e.	an angle of refraction of the ray R	

[2025S]

18. (a) Name the electromagnetic radiation used to detect fake currency. [4]

[FIGURE: glass prism with light ray AB incident on one face — paste from source paper, 2026 521 Q4(iii)]

(b) Redraw the diagram given below and complete the path of the light ray AB through the glass prism till it emerges out of the prism. Critical angle of the glass is 42°.

[2026]

19. Advanced optical sensors in air-to-air missiles use fiber optic cables to transmit light signals with minimal loss. This relies on a physical phenomenon that confines light within the fibers, making the system very dependable for guiding the missile precisely. [3]

(a) Name the optical phenomenon that allows light signals to remain confined within the fiber optic cables during transmission.

(b) Explain the two main conditions necessary for this phenomenon to occur.

[2026S]

20. The diagram below shows a fish in the tank and its image seen on the surface of water. [3]

[FIGURE: fish in a tank with its image on the water surface; Figure a and Figure b – double convex lens placed in liquids of refractive indices μ2 and μ3 — paste from source paper, 2026S 521 Q4(i)]

(a) Name the phenomenon responsible for the formation of this image.

(b) A double convex lens with refractive index μ1 is placed inside two liquids of refractive indices μ2 and μ3 as shown in the diagrams below. The refractive indices are such that μ2 > μ1 and μ1 > μ3. How would a parallel incident beam of light refract when it comes out of the lens in each of the cases shown above?

1. in Figure a.
2. in Figure b.

[2026S]

21. Advanced optical sensors in missiles use fibre optic cables to transmit light signals with minimal loss. This relies on a physical phenomenon that confines light within the fibres, making the system very dependable for guiding the missile precisely. [3]

(a) Name the optical phenomenon that allows light signals to remain confined within the fibre optic cables during transmission.

(b) List the two main conditions necessary for this phenomenon to occur.

[2027S]

22. A convex lens of focal length 10 cm is placed at a distance of 60 cm from a screen. How far from the lens should an object be placed so as to obtain a real image on the screen? [3]

[2023]

23. An object of height 20 cm is placed in front of a lens at a distance of 50 cm. Its virtual, diminished image is formed at a distance of 15 cm. [3]

(a) Identify the type of the lens.

(b) Calculate the focal length of the lens.

[2023S]

24. The diagram below shows an object AB kept in front of the lens. The path of one ray coming from the object is shown. [4]

[FIGURE: object AB in front of lens L with 2F, F, O, F, 2F marked and one ray drawn — paste from source paper, 2023S 521 Q5(iii)]

(a) Name the lens L.

(b) Redraw and complete the ray diagram showing the formation of the image.

(c) In which optical instrument is this kind of image formed?

[2023S]

25. The image of a candle flame placed at a distance of 36 cm from a spherical lens, is formed on a screen placed at a distance of 72 cm from the lens. Calculate the focal length of the lens and its power. [3]
[2024]

26. An object is placed at a distance 24 cm in front of a convex lens of focal length 8 cm. [3]
(a) What is the nature of the image so formed?
(b) Calculate the distance of the image from the lens.
[2024S] [2025S]

27. (a) An object is placed at 2F position of a convex lens. Draw a ray diagram showing the formation of the image. [4]
(b) How will the size of the image change if we, ONLY replace the lens in the above arrangement with another lens of a greater focal length?
[2025]

28. An object is placed in front of a concave lens at a distance of 45 cm from it. If its image is formed at a distance of 30 cm from the lens, calculate the focal length of the lens. [3]
[2025]

29. An object placed in front of a convex lens, forms an image of same size on a screen. Moving the object 12 cm closer to the lens results in the formation of a real image which is three times the size of the object. Calculate the focal length of the lens. [3]
[2026]

30. An object is placed at a distance of 24 cm in front of a convex lens of focal length 8 cm. [3]
(a) What is the nature of the image so formed?
(b) Calculate the distance of the image from the lens.
[2026S]

31. A candle and a screen are placed 90 cm apart. Steve placed a lens between them such that a clear image is formed on the screen and the image is twice the size of the object. [4]
(a) Which type of lens is used by Steve?
(b) Write an equation relating the object distance u, image distance v, and the distance between the candle and the screen.
(c) State the ratio between the image distance v and the object distance u.
(d) Calculate the image distance.
[2027S]

32. Draw a ray diagram to show the formation of an image by a concave lens when the object is placed between F and 2F. [3]
[2027S]

33. The diagram below shows the ray OP travelling through an equilateral prism of a certain material. [3]
[FIGURE: ray OP through an equilateral prism (angle 65° marked) with i2 at Q and emergent ray QS — paste from source paper, 2023 521 Q4(i)]
(a) Calculate the value of i_2, if the angle of deviation is 43°.
(b) What is the ray QS called?
[2023]

34. The diagram below shows two parallel rays A (Orange) & B (Blue) incident from air, on air-glass boundary. [4]
[FIGURE: two parallel rays A (orange) and B (blue) incident on an air-glass boundary — paste from source paper, 2023 521 Q4(iii)]
(a) Copy and complete the path of the rays A and B.
(b) How do the speeds of these rays differ in glass?
(c) Are the two refracted rays in glass parallel? Give a reason.
[2023]

35. The diagram (not drawn to the scale) below shows the graphical relation between angle of deviation and angle of incidence, when light passes through a triangular prism of angle 62° of a certain glass material. [3]

[FIGURE: graph of angle of deviation against angle of incidence for a prism of angle 62°, with X marked — paste from source paper, 2023S 521 Q4(i)]

(a) State the angle of minimum deviation of this prism and the corresponding angle of incidence.

(b) Calculate the value of X.

[2023S]

36. The diagram below shows the extreme colours of a visible spectrum (X and Y). [3]

[FIGURE: white light dispersed by a prism with extreme colours X and Y — paste from source paper, 2023S 521 Q5(ii)]

(a) Identify the colours X and Y.

(b) Which colour has greater speed in vacuum?

[2023S]

37. A monochromatic ray of light is incident on an equilateral prism placed at minimum deviation position with an angle of incidence 45° as shown in the diagram. [4]

[FIGURE: equilateral prism with monochromatic ray PQ incident at 45° — paste from source paper, 2024 521 Q5(iii)]

(a) Copy the diagram and complete the path of the ray PQ.

(b) State two factors on which the angle of deviation depends.

[2024]

38. When sunlight passes through water droplets in the atmosphere it gets dispersed into its constituent colours forming a rainbow. A similar phenomenon is observed when white light passes through a prism. [3]

(a) Which colour will show the maximum angle of deviation and which colour will show the minimum angle of deviation?

(b) If instead of sunlight, a green-coloured ray is passed through a glass prism. What will be the colour of the emergent ray?

[2024S] [2025S]

39. Two rays PQ and RS are incident on a rectangular glass block as shown in the diagram. Observe the diagram and answer the questions that follow.
Which of these two rays will: [3]

[FIGURE: rectangular glass block with incident rays PQ and RS — paste from source paper, 2025 521 Q5(ii)]

(a) have greater lateral displacement on emerging out of the block?

(b) travel with greater speed in the block?

(c) scatter more in the atmosphere?

[2025]

40. A monochromatic ray strikes the surface of identical prisms (A, B and C) at different angles of incidence. The diagram below shows their refracted rays. Study the path of these refracted rays and identify in which of the diagrams: [3]

[FIGURE: three identical prisms A, B and C with refracted rays — paste from source paper, 2026 521 Q3(vii)]

(a) the angle of incidence is maximum.

(b) the angle of incidence is minimum.

(c) the angle of incidence is equal to the angle of emergence.

[2026]

41. The diagram below shows two graphs showing variation in angle of deviation against angle of incidence for two colours of light (blue, orange) while passing through the same prism. [Diagrams are not drawn to the same scale.] [3]

[FIGURE: two graphs of angle of deviation against angle of incidence for blue and orange light, minimum deviations a and b — paste from source paper, 2027S 521 Q4(ii)]

(a) State with a reason whether a = b, a < b, or a > b.

(b) If we increase the angle of the prism then what is the effect on the values of a and b?

[2027S]

42. (a) Infrared radiations are used in warfare. Explain with reason, why. [4]

[FIGURE: ray of light incident at 45° on an equilateral prism — paste from source paper, 2023 521 Q5(iii)]

(b) A ray of light is incident at 45° on an equilateral prism in the diagram below.

1. Name the phenomenon exhibited by the ray of light when it enters and emerges out of the prism.
2. State the cause of the above phenomenon mentioned by you.

[2023]

43. Below is an incomplete table showing the arrangement of electromagnetic spectrum in the increasing order of their wavelength. Complete the table. [3]

Electromagnetic spectrum in increasing order of wavelength (incomplete)

Gamma ray	X – ray	U V rays	Visible rays	Infrared	A	Radio waves

(a) Identify the radiation A.

(b) Name the radiation used to detect fracture in bones.

(c) Name one property common to both A and Radio waves.

[2024]

44. (a) Mixture of red+blue+green is passed through a convex lens as shown in the diagram below. State whether the ray passes through a single point or through different points on principle axis after refraction. [4]

[FIGURE: mixture of red, blue and green light passing through a convex lens — paste from source paper, 2024S 521 Q5(iii)]

(b) Name the invisible radiations which can be obtained using quartz prism? State one use of these radiations.

(c) Name one radiations having wavelenght longer than the wavelength of these radiations.

[2024S]

45. [4]

(a) Name the radiations:

1. for which a quartz prism is used to study the spectrum.
2. which are used in remote sensing devices.
3. which are used in traffic signals in India.

(b) Name one property common to all electromagnetic radiations.

[2025]

46. (a) Mixture of red+blue+green is passed through a convex lens as shown in the diagram below. State whether the ray passes through a single point or through different points on the principal axis after refraction. [4]

[FIGURE: mixture of red, blue and green light entering a convex lens — paste from source paper, 2025S 521 Q4(iii)]

(b) Name the invisible radiations which are studied using the quartz prism.

(c) State one use of these radiations.

(d) Name one radiation having the wavelength longer than the wavelength of these radiations.

[2025S]

47. (a) A mixture of red, blue, and green light rays is passed through a convex lens, as illustrated in the diagram below. State whether the ray passes through a single point or through different points on the principal axis after refraction. [4]

[FIGURE: mixture of red, blue and green light rays entering a convex lens — paste from source paper, 2026S 521 Q4(iii)]

(b) Name the invisible radiation which is studied using the quartz prism.

(c) State one use of the radiation mentioned by you in (b) above.

(d) Name one type of radiation with a wavelength greater than that of the radiation mentioned by you in (b) above.

[2026S]

Chapter 3: Sound

A. Multiple Choice Questions (1 mark each)

1. When a body vibrates under a periodic force, the vibrations of the body are always: [1]
   (a) natural vibrations
   (b) damped vibrations
   (c) forced vibrations
   (d) resonant vibrations
   [2023]

2. When the stem of vibrating tuning fork is pressed on a table, the tabletop starts vibrating. These vibrations are definitely an example of: [1]
   (a) resonance
   (b) natural vibrations
   (c) forced vibrations
   (d) damped vibrations
   [2024]

3. Vibrations produced in a body under the influence of the periodic force is; [1]
   (a) forced vibrations
   (b) resonant vibrations
   (c) damped vibrations
   (d) sympathetic vibrations
   [2024S]

4. Assertion (A): As the level of water in a tall measuring cylinder kept under running tap rises, the pitch of sound gradually increases.
   Reason (R): Frequency of sound is inversly proportional to the length of the water column. [1]
   (a) Both (A) and (R) are true and (R) is correct explanation of (A).
   (b) Both (A) and (R) are true and (R) is not the correct explanation of (A).
   (c) (A) is true but (R) is false.
   (d) (A) is false but (R) is true.
   [2025]

5. Equal volumes of water are added to three cylindrical jars A, B and C of same height and radii rA, rB and rC respectively with rB < rA < rC. If you blow air into the mouth of these jars, which tube will produce the shrillest note? [1]
   (a) A
   (b) B
   (c) C
   (d) All will produce the notes of same shrillness
   [2026]

6. Two notes are produced from two different musical instruments, such that they have same loudness and same pitch. The produced notes differ in their: [1]
   (a) Waveform
   (b) Frequency
   (c) Wavelength
   (d) Speed
   [2023]

7. The characteristics of sound which enables to differentiate between two sounds of different intensity is: [1]

(a) Quality
(b) Amplitude
(c) Pitch
(d) Loudness

[2023S]

8. The ratio of the wavelength of A : wavelength of B is: [1]

[FIGURE: displacement–time graphs of waves A and B — paste from source paper, 2023S 521 Q1(viii)]

[Options (a)–(d) are ratios that could not be read reliably from the scan — check against the paper.]

[2023S]

9. Two sound waves X and Y have the same amplitude and the same wave pattern but their frequencies are 60 Hz and 120 Hz respectively, then: [1]

(a) X will be shriller and Y will be grave.
(b) X will be grave and Y will be shriller.
(c) X will differ in quality than Y.
(d) X is louder than Y.

[2024S] [2025S] [2026S]

10. Two sound waves, X and Y have the same amplitude and the same wave pattern, but their frequencies are 60 Hz and 120 Hz respectively, then: [1]

(a) X will be shriller, and Y will be grave.
(b) X will be grave, and Y will be shriller.
(c) X will differ in quality than Y.
(d) X will be louder than Y.

[2027S]

B. Short Questions (1 or 2 marks)

1. Rohan conducted experiments on echo in different media. He observed that a minimum distance of 'x' meters is required for the echo to be heard in oxygen and 'y' meters in benzene. Compare 'x' and 'y'. Justify your answer.
Speed of sound in oxygen: 340 ms^{-1}
Speed of sound in benzene: 200 ms^{-1} [2]

[2024]

2. (a) Name the waves used for echo depth sounding. [2]
(b) Give one reason for their use in the above application.

[2024S]

3. (a) Name the waves used for echo depth sounding. [2]
(b) Give one reason for their use in the above purpose.

[2025S]

4. (a) Name the wave used for echo depth sounding. [2]
(b) Give one reason why the waves mentioned in (a) is used for the above purpose.

[2026S]

5. Complete the following by choosing the correct answers from the bracket:
The minimum distance for distinct echo formation is _____ [greater / lesser] in water as compared to air. [1]

[2027S]

6. A metal foot ruler is held at the edge of a table. It is pressed at its free end and then released. It vibrates. [2]

(a) Name the vibrations produced.

(b) State one way to increase the frequency of these vibrations.

[2023]

7. A freely suspended pendulum in air is disturbed once and left to oscillate on its own: [2]

(a) Name the type of vibrations.

(b) State one way to decrease the frequency of this vibration.

[2023S]

8. (a) Define natural vibrations. [2]

(b) How is this vibration different from damped vibrations in terms of their amplitudes?

[2026]

9. The displacement-time graph of a sound wave produced by a vibrating wire is shown below. [2]

[FIGURE: displacement-time graph of a sound wave with points P and R marked — paste from source paper, 2025 521 Q2(iii)]

(a) How will you adjust the tension in the wire, to reduce the length of PR?

(b) Which characteristic of sound is affected by the reduction in the length of PR?

[2025]

10. Complete the following by choosing the correct answers from the bracket:
Quality of sound depends on its _____ [amplitude / waveform]. [1]

[2026]

11. Complete the following by choosing the correct answers from the bracket:
The threshold of hearing is _____. [0dB, 20Hz] [1]

[2026S]

12. Analyse the displacement position graph and answer the questions that follow.
Find two figures that show: [2]

[FIGURE: displacement–position graphs of sound waves, four figures a, b, c and d — paste from source paper, 2027S 521 Q2(iii)]

(a) sound of same loudness and pitch but different quality.

(b) sound of same pitch but different loudness.

[2027S]

C. Long Questions (3 or 4 marks)

1. (a) Which characteristic of sound is affected due to the larger surface of a school bell? [3]

(b) Calculate the distance covered by the Ultrasonic wave having a velocity of 1.5 kms^{-1} in 14 s, when it is received after reflection by the receiver of the SONAR.

[2023]

2. A person standing in front of a cliff fires a gun and hears its echo after 3 s. If the speed of sound in air is 336 ms^{-1}. [3]

(a) Calculate the distance of the person from the cliff.

(b) After moving a certain distance from the cliff, he fires the gun again and this time the echo is heard 1.5 s later than the first. Calculate distance moved by the person.

[2023S] [2024S]

3. (a) Name the waves used in SONAR. [3]

[FIGURE: Lata standing between two cliffs with distances marked — paste from source paper, 2024 521 Q7(i)]

(b) In the above diagram Lata stands between two cliffs and claps her hands. Determine the time taken by her to hear the first echo. Speed of sound in air 320 ms^{-1}.

[2024]

4. A submarine in the sea, sends ultrasonic ping and a stopwatch is started simultaneously. The stopwatch stops on receiving the reflected wave from an obstacle and reads 1 minute 40 seconds. Calculate the distance of the obstacle from the submarine. (Speed of sound in water 1500 ms^{-1}.) [3]

[2025]

5. A person standing in front of a cliff fires a gun and hears its echo after 3 s. If the speed of sound in air is 336 ms^{-1} [3]

   (a) Calculate the distance of the person from the cliff.

   (b) After moving a certain distance from the cliff, he fires the gun again and this time the echo is heard 1.5 s later than the first. Calculate the distance that the person moved.

[2025S]

6. Two persons A and B are standing in front of a cliff in the same line 170 m apart as shown in the diagram. Person B fires the gun and hears the echo in 3 s. Then the person A standing in front of the person B fires the gun. (The speed of sound in air is 340 m/s.) [4]

   [FIGURE: two persons A and B in a line 170 m apart in front of a cliff — paste from source paper, 2026 521 Q7(iii)]

   (a) Calculate:

      1. the distance of the person B from the cliff.
      2. the minimum time in which B hears the gunshot fired by A.

   (b) Fill in the blank. The echo is softer (less loud) than the original sound due to the decrease in _____ of the wave. (amplitude / frequency)

[2026]

7. A person standing in front of a cliff fires a gun and hears its echo after 3 s. Speed of sound in air is 336 ms^{-1}: [3]

   (a) Calculate the distance of the person from the cliff.

   (b) After moving a certain distance from the cliff, he fires the gun again and this time the echo is heard 1.5 s later than the first. Calculate the distance that the person has moved.

[2026S]

8. A boy is located asymmetrically between two parallel walls, closer to the left wall than the right. If he claps, the time interval between successive echoes is 0.25 s, then find the value of X in metres. [speed of sound in air = 340 m /s.] [3]

   [FIGURE: boy between two parallel walls, closer to the left wall; distance X marked — paste from source paper, 2027S 521 Q7(ii)]

[2027S]

9. We are able to see the T.V. channels clearly when we set T.V. on auto-tuning. [4]

   (a) Which phenomenon led to the clear visibility of the channels, due to auto-tuning?

   (b) Define the above phenomenon mentioned by you.

   (c) Give any one more example of this phenomenon.

[2023]

10. A boy tunes a radio channel to a radio station 93.5 MHz. [4]

    (a) Name and define the scientific wave phenomenon involved in tuning the radio channel.

    (b) Now, what is the frequency of the channel? Convert this frequency into S.I. unit.

[2023S]

11. In the given diagram, a vibrating tuning fork is kept near the mouth of a burette filled with water. The length of the air column is adjusted by opening the tap of the burette. At a length of 5 cm of the air column, a loud sound is heard. [4]

[FIGURE: vibrating tuning fork near the mouth of a burette filled with water — paste from source paper, 2024 521 Q7(iii)]

(a) Name the phenomenon illustrated by the above experiment.

(b) Why is a loud sound heard at this particular length?

(c) If the present tuning fork is replaced with a tuning fork of higher frequency, should the length of the air column increase or decrease to produce a loud sound? Give a reason.

[2024]

12. A boy tunes a radio channel to a radio station 93.5 MHz. [4]

(a) Name and define the scientific wave phenomenon involved in tuning the radio channel.

(b) Name the important characteristics of sound that is affected during this phenomenon.

(c) Convert 93.5 MHz to SI unit.

[2024S]

13. The diagrams given below show two sound boxes A and B with wires of same length (l) and tension (10 kgf) but different cross-sectional areas. Simultaneously, vibrating tuning forks of frequency 300 Hz are placed on the boxes A and B. The paper rider falls off in case of B but not in case of A. [4]

[FIGURE: two sound boxes A and B with wires and a paper rider on each — paste from source paper, 2025 521 Q7(iii)]

(a) Name and explain the phenomenon responsible for the falling off of the paper rider in B.

(b) The wire A resonates with a tuning fork of frequency 'f'. Is 'f' greater than, less than or equal to 300 Hz? Justify your answer.

[2025]

14. The above picture shows a mother pushing her daughter sitting on a swing. The swing is going through the positions A, B, C where A and C are extreme positions and B is the mean position. [4]

[FIGURE: mother pushing a child on a swing, positions A, B (mean) and C — paste from source paper, 2025S 521 Q7(iii)]

(a) Which is the right position i.e. at A, B or C, for the mother to give a constant periodic push to the swing every time in the forward direction to increase the amplitude of the swing?

(b) Name the phenomenon involved in this.

(c) Explain with this example how this phenomenon helps to increase the amplitude of the swing.

[2025S]

15. (a) One end of a plastic foot ruler is held tightly at the edge of a table and the other end is plucked. Name the vibrations produced in the ruler. [3]

(b) Now the ruler is pushed inside partially and plucked again from its free end. State with a reason whether the frequency of vibration increases or decreases.

[2026]

16. The above picture shows a mother pushing her daughter sitting on a swing. The swing is going through the positions A, B, C where A and C are extreme positions and B is the mean position. [4]

[FIGURE: mother pushing a child on a swing, positions A, B (mean) and C — paste from source paper, 2026S 521 Q7(iii)]

(a) Which is the right position i.e. at A, B or C, for the mother to give a constant periodic push to the swing, every time in the forward direction, to increase the amplitude of the swing?

(b) Name the phenomenon involved in this.

(c) On the basis of this example, explain how this phenomenon helps to increase the amplitude of the swing.

[2026S]

17. Two wires A and B of the same material and length are fixed to a wooden board and stretched under the same tension. The cross-sectional area of wire A is greater than that of wire B. When set into vibration using identical tuning forks of frequency 300 Hz, only wire B produces a loud sound. [4]

(a) Name and explain the phenomenon responsible for the loud sound produced by wire B.

(b) A loud sound is heard from wire A when the experiment is repeated using a tuning fork of frequency f. Is 'f' greater than, less than or equal to 300 Hz? Justify your answer.

[2027S]

Chapter 4: Electricity and Magnetism

A. Multiple Choice Questions (1 mark each)

1. The graph shows I against V relation for three conductors A, B and C. Choose the correct relation for the resistors of A, B and C. [1]

   [FIGURE: graph of I against V for three conductors A, B and C — paste from source paper, 2023S 521 Q1(ix)]

   [Options (a)–(d) compare the resistances of A, B and C; the subscripts could not be read reliably from the scan — check against the paper.]

   [2023S]

2. The specific resistance of a conductor depends on its: [1]

   (a) length
   (b) material
   (c) area of cross section
   (d) radius

   [2024]

3. The graph of voltage vs current for four different materials is shown below. Which of these four materials would be used for making the coil of a toaster? [1]

   [FIGURE: graph of voltage against current for four materials P, Q, R and S — paste from source paper, 2024S 521 Q1(ix)]

   (a) Q
   (b) S
   (c) P
   (d) R

   [2024S]

4. The graph of voltage vs current for four different materials is shown below.
   Which of these four materials would be used for making filament of a bulb? [1]

   [FIGURE: graph of voltage against current for four materials P, Q, R and S — paste from source paper, 2025S 521 Q1(x)]

   (a) Q
   (b) S
   (c) P
   (d) R

   [2025S]

5. Choose the correct relation for e.m.f. (ε) and terminal voltage V: [1]

   (a) ε = V (always)
   (b) V > ε [always]
   (c) V < ε [when the cell is in use]
   (d) None of these

   [2023]

6. The potential difference between terminals of a cell in a closed electric circuit is: [1]

   (a) terminal voltage
   (b) electro motive force
   (c) voltage drop
   (d) none of these

   [2024]

7. In a closed circuit containing a bulb and a cell, the electromotive force (ε) and the terminal voltage (V) is related as. (Given I is current and r is internal resistance.) [1]

(a) $V = \varepsilon + Ir$
(b) $V = \varepsilon - Ir$
(c) $V = \varepsilon \div Ir$
(d) $V = \varepsilon \times Ir$

[2025]

8. In the given circuits Y and Z, the resistors, R1 and R2, are connected in: [1]

[FIGURE: two circuits Y and Z each with resistors R1 and R2 — paste from source paper, 2025 521 Q1(xii)]

(a) series in both the circuits
(b) parallel in both the circuits
(c) parallel in Y and series in Z
(d) series in Y and parallel in Z

[2025]

9. In the circuit given below, identify the lamp (L1, L2, L3 or L4) whose failure would not interrupt the power supply to the other lamps. [1]

[FIGURE: circuit with four lamps L1, L2, L3 and L4 — paste from source paper, 2026 521 Q1(ix)]

(a) L1
(b) L2
(c) L3
(d) L4

[2026]

10. The correct formula to calculate the equivalent resistance of two resistors R1 and R2 when connected in parallel, is: [1]

(a) (R1 + R2) / R1R2
(b) R1R2 / (R1 + R2)
(c) (R1 − R2) / R1R2
(d) R1R2 / (R1 − R2)

[2026]

11. In the circuit given below, identify the correct relation between the currents flowing through the 2 Ω, 3 Ω, and 5 Ω resistors: [1]

[FIGURE: circuit with 2 Ω, 3 Ω and 5 Ω resistors — paste from source paper, 2026S 521 Q1(x)]

(a) current through 2 Ω > current through 3 Ω
(b) current through 5 Ω < current through 3 Ω
(c) current through 2 Ω = current through 5 Ω
(d) current through 5 Ω > current through 3 Ω

[2026S]

12. Priya built the circuit as shown in the figure given below. If she wants both bulbs (B1 and B2) to glow, which switches (S1, S2, S3) should be kept ON? [1]

[FIGURE: circuit with bulbs B1 and B2 and switches S1, S2 and S3 — paste from source paper, 2027S 521 Q1(xv)]

(a) S1 and S2 only
(b) S1 and S3 only
(c) S2 and S3 only
(d) S1, S2 and S3

[2027S]

13. When a current I flows through a wire of resistance R for time t then the electrical energy produced is given by: [1]

(a) I^2Rt

(b) IR^2t

(c) IRt

(d) IRt^2

[2023]

14. Which of the following is the correct colour code of the three wires live, neutral and earth? [1]

(a) Live: Green; Neutral: Red; Earth: Yellow

(b) Live: Brown; Neutral: Red; Earth: blue

(c) Live: Brown; Neutral: blue; Earth: Yellow

(d) Live: Blue; Neutral: Brown; Earth: Green

[2023S]

15. Identify the option that displays the correct wiring with correct colour code: [1]

[FIGURE: four wiring diagrams (a) to (d) with colour-coded wires — paste from source paper, 2024 521 Q1(ix)]

[2024]

16. According to the old convention the colour of the earth wire is: [1]

(a) black

(b) green

(c) yellow

(d) red

[2024S] [2025S] [2026S] [2027S]

17. If the strength of the current flowing through a wire is increased, the strength of the magnetic field produced by it: [1]

(a) decreases

(b) increases

(c) remains the same

(d) first increases then decreases

[2023]

18. When a conductor carrying current is placed in a magnetic field, perpendicular to it then the direction of the force experienced can be found out using: [1]

(a) Lenz's law

(b) Fleming's left hand rule

(c) Flemings right hand rule

(d) Right hand thumb rule

[2023S]

19. Current is flowing through a coil as shown in the figure. Which one of the given figures will correctly depict the magnetic polarity and the direction of the lines of force along the axis of the coil. [1]

[FIGURE: current-carrying coil, and four diagrams (a) to (d) showing magnetic polarity and lines of force along the axis — paste from source paper, 2025S 521 Q1(xii)]

[2025S]

20. The diagram below shows the top view of the Wire A shown by a cross (×), carrying current into the plane of the paper. Which of the compasses is correctly aligned with the magnetic field, produced by the current carrying wire? [1]

[FIGURE: top view of Wire A (cross) with two compasses numbered 1 and 2 — paste from source paper, 2026 521 Q1(xiii)]

(a) Only 1 is aligned
(b) Only 2 is aligned
(c) Both 1 and 2 are aligned
(d) Both 1 and 2 are not aligned

[2026]

21. Lenz's law is based on the law of conservation of: [1]

(a) force
(b) charge
(c) mass
(d) energy

[2024S]

22. The following figure shows a small bar magnet falling freely through a copper ring. For the observer at A, the direction of the induced current will be: [1]

[FIGURE: small bar magnet falling freely through a copper ring, observer at A — paste from source paper, 2025 521 Q1(xv)]

(a) clockwise when magnet is above and below the ring
(b) anticlockwise when magnet is above and below the ring
(c) anticlockwise when magnet is above the ring and clockwise when the magnet is below the ring
(d) clockwise when magnet is above the ring and anticlockwise when the magnet is below the ring

[2025]

23. The above diagram shows a strong bar magnet moved towards the coil PQ along its axis, in the direction shown by the arrow. Which option correctly shows the momentary deflection of magnetic needle N_1 and the direction of current through the galvanometer? [1]

[FIGURE: strong bar magnet moved towards coil PQ along its axis, galvanometer and magnetic needle N1 — paste from source paper, 2027S 521 Q1(xiii)]

Options for the deflection of magnetic needle and the direction of current

Option	Deflection of magnetic needle	Direction of current
(a)	P	Q
(b)	Q	P
(c)	P	Q
(d)	Q	P

[2027S]

24. For an ideal step up transformer: [1]

(a) Voltage primary / Voltage secondary > 1
(b) Current primary / Current secondary < 1
(c) no. of turns primary / no. of turns secondary = 1
(d) power primary / power secondary = 1

[2026S]

B. Short Questions (1 or 2 marks)

1. Two copper wires A and B are of same length present at temperature 30°C. Radius of A is twice the radius of B. [2]
   (a) Which wire has greater resistance?
   (b) Which wire will have greater resistivity?
   [2023S]

2. Two copper wires A and B are of the same thickness and are at the room temperature. If the length of A is twice the length of B then: [2]
   (a) Compare their resistances
   (b) Compare their resistivities
   [2024S]

3. A current flows through a metallic conductor for a long period of time. State the change you would expect in its: [2]
   (a) Resistance
   (b) Resistivity
   [2025]

4. Complete the following by choosing the correct answers from the bracket:
   Two copper wires can have the different _____ [resistivity / resistance] but will have same _____ [resistance / resistivity] [2]
   [2025S]

5. Complete the following by choosing the correct answers from the bracket:
   A substance whose resistance becomes almost negligible at a temperature near absolute zero is called a _____ [semiconductor / superconductor]. [1]
   [2026]

6. Complete the following by choosing the correct answers from the bracket:
   Two copper wires can have different resistivity if they have different _____ [lengths / temperatures]. [1]
   [2026S] [2027S]

7. Complete the following by choosing the correct answers from the bracket:
   Emf of a cell is _____ [greater than / less than / equal to] the terminal voltage when the cell is in open circuit. [1]
   [2025]

8. A resistance R is connected across a cell with a switch and a rheostat in series. A voltmeter is connected parallel across the cell. Current in the circuit is increased using the rheostat. [2]
   (a) How will the voltmeter reading change? (increase / decrease / remain the same)
   (b) Justify your answer stated in (a) above.
   [2026]

9. 5 bulbs are connected in series in a room. One bulb is fused. It is removed and remaining 4 bulbs are again connected in series to the same circuit. What will be the effect on the following physical quantities? (Increases, Decreases, Remain Same) [2]
   (a) Resistance
   (b) Intensity of light
   [2024]

10. It is observed that the house circuits are arranged in a parallel combination. Give two advantages of this arrangement. [2]
    [2024S]

11. 'A geyser is rated 240 W – 220 V'. Explain the meaning of this statement. [2]
    [2023]

12. A fuse is rated 5 A. Can it be used with a geyser rated 1540 W, 220 V. Write Yes or No. Give supporting calculations to justify your answer. [2]

[2024]

13. The image given below displays kilowatt-hour meter readings recorded at two distinct points in time. Assuming a continuously running 2000 W air conditioner as the sole electrical device in use, calculate the time interval, in hours, between these two meter readings. [2]

[FIGURE: two kilowatt-hour meter readings recorded at two distinct points in time — paste from source paper, 2027S 521 Q3(ii)]

[2026S] [2027S]

14. (a) Which electrical component protects the electric circuit in case of excess current and which can also be used as a switch? [2]

(b) Name the wire to which this electrical component is connected in an electric circuit.

[2023]

15. (a) Is it possible to switch off an appliance by placing the switch in a neutral wire? [2]

(b) Is it possible for current to flow between a neutral and an earth wire?

[2023S]

16. According to the NEW colour convention which colour of wire is connected to: [2]

(a) the metal body of the appliance

(b) the switch of the appliance?

[2025]

17. If live wire makes an accidental contact with the metal case, which circuit (A or B) in the diagram, illustrating an electric iron, is considered safe for the user (Assuming the fuse is present in the live wire in both circuits)? Justify your answer. [2]

[FIGURE: two circuits A and B of an electric iron with a metal case, live (L) and neutral (N) wires, 220 V supply — paste from source paper, 2025S 521 Q3(ii)]

[2025S]

18. A copper conductor is placed over two stretched copper wires whose ends are connected to a D.C. supply as shown in the diagram. [2]

[FIGURE: copper conductor placed over two stretched copper wires connected to a D.C. supply, with points A and B on either side — paste from source paper, 2023 521 Q3(iii)]

(a) What should be the magnetic poles at the points A and B lying on either side of the conductor to experience the force in the upward direction?

(b) Name the law used to find these polarities.

[2023]

19. State two factors that affect the strength of an electromagnet. [2]

[2023S]

20. State two factors affecting the speed of rotation of the coil in a D.C. motor. [2]

[2024]

21. Copper wire is wound around a steel bar FT. Current is allowed to pass through the coil for some time and then the bar is removed. [2]

[FIGURE: copper wire wound around a steel bar FT — paste from source paper, 2025 521 Q3(v)]

(a) Draw only the magnetised bar FT and mark its poles.

(b) Trace two magnetic lines of force around FT clearly indicating the direction.

[2025]

22. The diagram given below shows a copper wire wound around a U-shape soft iron bar. An iron pin is brought near the arrangement. First Source P and then Source Q are connected across AB, each operating independently. [2]

[FIGURE: copper wire wound around a U-shaped soft iron bar with terminals A and B and an iron pin — paste from source paper, 2027S 521 Q3(iv)]

(a) State True or False: Source P as well as Source Q, when connected across AB, can attract the iron pin.

(b) Justify your answer to (a) with a suitable reason.

[2026S] [2027S]

23. (a) Which of the two, alternating current or direct current, produces a varying magnetic field when it flows through a conductor? [2]

(b) State the frequency of the alternating current supply in India.

[2025]

24. (a) Name the principle of AC generator. [2]

(b) State its one use.

[2025S]

25. In an AC generator, name the part which has the following functions: [2]

(a) intensifies the magnetic field.

(b) maintains electrical contact between the rotating parts and the external circuit.

[2026]

26. A transformer is used to change a high alternating e.m.f. to a low alternating e.m.f. of the same frequency. [2]

(a) Identify the type of transformer used for the above purpose.

(b) State whether the turns ratio of the above transformer is =1 or >1 or <1.

[2024S] [2025S]

27. Complete the following by choosing the correct answers from the bracket:
In a step-up transformer the turns ratio is _____ [more than 1 / less than 1 / equal to 1]. [1]

[2025]

C. Long Questions (3 or 4 marks)

1. (a) Define specific resistance. [3]

(b) What happens to the specific resistance of a conductor if its length is doubled?

(c) Name a substance whose specific resistance remains almost unchanged with the increase in its temperature.

[2023]

2. The voltage - current readings of a certain material are shown in the table given below:
Study the table. [3]

Voltage–current readings of a certain material

Voltage (V)	10 V	20 V	30 V
Current (I)	2 A	3 A	4 A

(a) State whether the conductor used is ohmic or non-ohmic.

(b) Justify your answer.

(c) State Ohm's law.

first column is the row label; the table has no separate header row in the paper

[2024]

3. The circuit depicted in the figure is employed for studying Ohm's Law. Instead of using a standard resistor, a student opts for a glass tube filled with mercury (tube 1), connected to the circuit through two

electrodes E1 & E2. He records the readings of the ammeter and voltmeter, thereby calculates the resistance. The student repeats the experiment by substituting tube 1 with tube 2, where the same amount of mercury fills the tube 2.
Neglecting internal resistance of the cell use (> or < or =) to compare [3]

[FIGURE: circuit with battery, ammeter, voltmeter and mercury tube 1 / tube 2 between electrodes E1 and E2 — paste from source paper, 2025S 521 Q8(i)]

(a) the resistance in both the cases.
(b) the voltmeter readings in both the cases.
(c) the specific resistance in both the cases.

[2025S]

4. The circuit depicted in the figure is employed for studying Ohm's Law. Instead of using a standard resistor, a student opts for a glass tube filled with mercury (tube 1), connected to the circuit through two electrodes E1 & E2. He records the readings of the ammeter and voltmeter, thereby calculates the resistance. The student repeats the experiment by substituting tube 1 with tube 2, where the same amount of mercury fills the tube 2.
Neglecting internal resistance of the cell, use (> or < or =) to compare the following: [3]

[FIGURE: circuit with battery, ammeter, voltmeter and mercury tube 1 / tube 2 between electrodes E1 and E2 — paste from source paper, 2026S 521 Q8(i)]

(a) Resistance in both cases.
(b) Voltmeter readings in both cases.
(c) Specific resistance in both cases.

[2026S]

5. A nichrome wire X with length (l) & cross-sectional area (A) is connected to a 10 V source and another nichrome wire Y with length (2 l) & cross-sectional area (A/2), is connected to a 20 V source. [4]

(a) Compare the resistances of wires X and Y. [Given that the resistivity of nichrome is (ρ).]
(b) Compare the electrical power consumed by each wire.
(c) Compare the masses of these wires. (Given that the density of nichrome is d.)
(d) State True or False: Wire X and wire Y both show the same rise in temperature in the same time.

[2026S]

6. A Nichrome wire X with length (l) and cross-sectional area (A) is connected to a 10 V source and another Nichrome wire Y with length (2 l) and cross-sectional area (A/2), is connected to a 20 V source. [4]

(a) Compare the resistances of wires X and Y. [Given that the resistivity of Nichrome is (ρ).]
(b) Compare the electrical power consumed by each wire.
(c) Compare the masses of these wires. [Given that the density of nichrome is d.]
(d) State True or False: Wire X and wire Y both show the same rise in temperature at the same time.

[2027S]

7. Find the value of current I drawn from the cell. [4]

[FIGURE: circuit with a cell and resistors; current I drawn from the cell — paste from source paper, 2023 521 Q8(iii)]

(a) Calculate the current I.
(b) Calculate the terminal voltage.

[2023]

8. Observe the given circuit diagram and answer the questions that follow: [4]

[FIGURE: circuit with key K, resistors (including 3 Ω) and a 4 V cell — paste from source paper, 2023S 521 Q8(iii)]

(a) Calculate the resistance of the circuit when the key K completes the circuit.
(b) Calculate the current through 3 Ω resistance.

[2023S]

9. Study the diagram: [4]

[FIGURE: circuit diagram with a cell and resistors including 10 Ω and 12 Ω — paste from source paper, 2024 521 Q8(iii)]

(a) Calculate the total resistance of the circuit.

(b) Calculate the current drawn from the cell.

(c) State whether the current through 10 Ω resistor is greater than, less than or equal to the current through the 12 Ω resistor.

[2024]

10. Observe the given circuit diagram and answer the questions that follow: [4]

[FIGURE: circuit with key K, resistors (including 3 Ω) and a cell — paste from source paper, 2025S 521 Q8(iii)]

(a) Calculate the resistance of the circuit when the key K completes the circuit.

(b) Calculate the current through 3 Ω resistance when the circuit is complete.

[2024S] [2025S]

11. Three identical bulbs B1, B2, and B3 each of power rating 18 W, 12 V are connected to a battery of 12 V. [4]

[FIGURE: circuit with three bulbs B1, B2, B3 and a 12 V battery — paste from source paper, 2025 521 Q8(iii)]

(a) Calculate:

1. the resistance of each bulb
2. the current drawn from the cell

(b) If the bulb B3 is removed from the circuit, then will the brightness of the bulb B1 increase, decrease or remain the same?

[2025]

12. In the combinations of resistors shown below, calculate: [4]

[FIGURE: combination of resistors between A and B with a switch S — paste from source paper, 2026 521 Q8(iii)]

(a) the resistance across AB when the switch S is open.

(b) the resistance across AB when the switch S is closed.

[2026]

13. Three bulbs of powers P1, P2 and P3 (P1<P2<P3) are connected in a certain way that P3 glows brightest. [3]

(a) What type of connection exists between these bulbs?

(b) Compare the voltage across these bulbs. (Use >, < or =)

(c) Will the circuit still function if one of the bulbs is fused?

[2026S]

14. The below diagram shows the part of a complete circuit. The ammeter reads 1 A.
Calculate: [3]

[FIGURE: part of a circuit with a 3 Ω resistor, a 6 Ω resistor, a switch S and an ammeter reading 1 A — paste from source paper, 2027S 521 Q8(i)]

(a) the current I1 through the 3 Ω resistor.

(b) the total current I in the circuit.

(c) State True or False: When the switch (S) is opened and the entire current flows through the 6 Ω resistor, the ammeter reading will be (1+I1).

[2027S]

15. Three bulbs of powers P1, P2 and P3 (P1<P2<P3) are connected in a certain way such that P3 glows the brightest. [3]

(a) What type of connection exists between these bulbs?

(b) Compare the voltages (V1, V2, V3) across these bulbs. (Use >, < or =)

(c) Will the circuit still function if one of the bulbs is fused?

[2027S]

16. Bulb A rated 160 W, 40 V and Bulb B rated 40 W, 40 V are connected as shown in the diagram. [3]

[FIGURE: bulb A and bulb B connected in a circuit with voltmeter readings V1 and V2 — paste from source paper, 2026 521 Q8(i)]

(a) Calculate the ratio V1 : V2.

(b) If the bulb A fuses, the current in the circuit remains the same. State True or False.

[2026]

17. An electric iron rated 1100 W, 220 V is operated for 5 hours. Calculate: [3]

(a) the minimum rating of the fuse required.

(b) the energy consumed in kWh.

(c) the cost of the energy consumed, if the rate is ₹ 10 per unit.

[2026]

18. (a) What is the meaning of the statement 'the power rating of an appliance is 60 W, 220 V.'? [3]

(b) In which wire is the fuse connected in a circuit?

(c) State the function of main switch in an electric circuit.

[2023S]

19. Purvi's friend Tim wants to connect a fuse to his oven. He wants to control the oven from two different locations. Shown below is his circuit diagram. [3]

[FIGURE: circuit diagram of an oven with a fuse and two-way control, wires A and B — paste from source paper, 2024S 521 Q8(i)]

(a) Which one of the two, A or B should be a live wire?

(b) In the event of an overload, will the fuse serve its purpose?

(c) What is the meaning of the statement that the bulb is rated 600 W, 220 V?

[2024S]

20. The diagram shows wiring in a meter room of a building. [3]

[FIGURE: wiring in a meter room with devices X, Y and switch Z — paste from source paper, 2025 521 Q8(i)]

(a) What is the current rating of device X?

(b) What is the difference between the switch Z shown in the diagram and the switches you use to operate different appliances at home?

(c) What is the unit of the physical quantity displayed in Y?

[2025]

21. The reverse side of a three-pin plug with incorrect connection of wires is shown in the diagram below. [3]

[FIGURE: reverse side of a three-pin plug with wires connected incorrectly — paste from source paper, 2026 521 Q8(ii)]

(a) Identify the fault in the above connection.

(b) Mention a risk factor involved, if the user operates the appliance without correcting it.

(c) Will the appliance function in the present situation? (Yes or No)

[2026]

22. An appliance with a metal covering, rated at 2 kW, 220 V, is to be connected in a circuit. Given below are four diagrams (P, Q, R & S) depicting different circuit configurations, [3]

[FIGURE: four circuit diagrams P, Q, R and S of an appliance with a metal covering — paste from source paper, 2026S 521 Q8(ii)]

(a) Identify the safest circuit.

(b) Write two reasons, supported by mathematical calculations, where applicable, to justify your choice.

[2026S]

23. An appliance with a metal covering, rated at 2 kW, 220 V, is to be connected in a circuit. Given below are two diagrams (R & S) depicting different circuit configurations. [3]

[FIGURE: two circuit diagrams R and S of an appliance with a metal covering — paste from source paper, 2027S 521 Q8(ii)]

(a) Identify the safest circuit.

(b) Write two reasons, supported by mathematical calculations, where applicable, to justify your choice.

[2027S]

24. The diagram below shows a cardboard on which iron filings are kept. A wire bent in the form of a loop is seen passing through the cardboard. When current flows through it the iron filings arrange themselves as shown below. [4]

[FIGURE: cardboard with iron filings around a current-carrying loop, battery terminals A and B — paste from source paper, 2023 521 Q9(iii)]

(a) State the polarities of the battery at A and B.

(b) State the effect on the magnetic field if an iron rod is held along the axis of the coil.

(c) State one way to:

1. Change the polarity of the coil.
2. Decrease the strength of the magnetic field around the coil.

[2023]

25. (a) State one factor that affects the magnitude of induced current in an AC generator. [4]

[FIGURE: circuit with conductor XY through a cardboard ABCD, compass positions P1 and P2, resistance R — paste from source paper, 2024 521 Q9(iii)]

(b) Given below is a circuit to study the magnetic effect of electric current. ABCD is a cardboard kept perpendicular to the conductor XY. A magnetic compass is placed at the point P of the cardboard. P1 and P2 are the positions of the magnetic compass, before and after passing a current through XY respectively.

1. Name the rule that is used to predict the direction of deflection of the magnetic compass.
2. State the direction of current in the conductor (X to Y or Y to X) when the circuit is complete.
3. If resistance R is increased, then what will be the effect on the magnetic lines of force around the conductor?

[2024]

26. A copper rod PQ carrying current is kept in a magnetic field as shown in the diagram. [4]

[FIGURE: copper rod PQ carrying current in a magnetic field, direction C marked — paste from source paper, 2025 521 Q9(iii)]

(a) The copper rod PQ will move towards C. State True or False.

(b) Name the law used to determine the direction of motion of PQ.

(c) What will be the effect on the force experienced, if the rod PQ is replaced by another copper rod of same length but of greater cross-sectional area?

(d) Justify your answer in (c).

[2025]

27. The diagram below shows a cardboard on which iron filings are kept. A wire bent in the form of a loop is seen passing through the cardboard. When current flows through it the iron filings arrange themselves as shown below with the direction of magnetic field. [4]

[FIGURE: cardboard with iron filings around a current-carrying loop, battery terminals A and B — paste from source paper, 2025S 521 Q9(iii)]

(a) State the polarities of the battery at A and B.

(b) State the effect on the magnetic field if an iron rod is held along the axis of the coil.

(c) State one way to:

1. change the polarity of the coil.
2. decrease the strength of the magnetic field around the coil.

[2025S]

28. The diagram below shows a magnet placed between two coils A and B. The magnet is moved along the axis towards coil B. [4]

[FIGURE: magnet placed between two coils A and B with ends Q and R marked — paste from source paper, 2023S 521 Q9(iii)]

(a) State the polarities induced at the ends Q and R of the coil due to the motion of the magnet.

(b) Name the phenomenon due to which the current is induced in the coils.

(c) Name the law which helps to find the polarities at the ends Q and R.

[2023S]

29. A magnet is released along the axis of a copper coil as shown in the diagram. [4]

[FIGURE: magnet released along the axis of a copper coil, terminals A and B — paste from source paper, 2024S 521 Q9(iii)]

(a) State the polarity at the top end of the coil when the magnet leaves the coil.

(b) The direction of the current is from A to B when magnet enters the coil. What will be the direction of the current when the magnet leaves the coil.

(c) Name the law which can be used to determine the direction of the induced current in the coil?

(d) State one way to increase the magnitude of the induced current in the coil?

[2024S]

30. When the magnet as shown in the diagram, is moved towards the coil at a speed of 5 ms^{-1}, the galvanometer shows a certain deflection to the right. How will the direction and magnitude of deflection change when the coil also moves with a speed of 5 ms^{-1}: [3]

[FIGURE: magnet moving towards a coil connected to a galvanometer (left and right deflection) — paste from source paper, 2026 521 Q9(ii)]

(a) in the direction of the motion of the magnet?

(b) in the opposite direction of the motion of the magnet?

[2026]

31. The given diagram shows the output of an AC generator. If the speed of the generator coil is doubled, then: [3]

[FIGURE: output graph of an AC generator with quantities 'a' and 'b' marked — paste from source paper, 2026S 521 Q9(ii)]

(a) what is the effect on the physical quantity indicated by 'a'?

(b) what is the effect on the physical quantity indicated as 'b'?

(c) give reason for your answer in (b).

[2026S]

32. Study the diagram and answer the following questions: [3]

[FIGURE: two coils A and B, a key, a variable resistance and a galvanometer connected to coil B — paste from source paper, 2027S 521 Q9(ii)]

(a) In the given circuit when the key is closed, the galvanometer in the coil B shows momentary deflection. Give a reason for this deflection.

(b) How will the galvanometer deflect if the variable resistance in the closed circuit is decreased? (in the same direction / in the opposite direction)

(c) Give a reason for your answer to (b).

[2027S]

33. Below is the diagram of a transformer: [3]

[FIGURE: transformer with primary coil, secondary coil and iron core — paste from source paper, 2024 521 Q8(ii)]

(a) Identify the type of transformer.

(b) In this type of transformer which of the wire is thicker, the primary or the secondary? Give a reason.

[2024]

Chapter 5: Heat

A. Multiple Choice Questions (1 mark each)

1. Specific heat capacity of a substance X is 1900 $Jkg^{-1}\,°C^{-1}$ means: [1]
   (a) Substance X absorbs 1900 J for 1°C rise in temperature
   (b) 1 kg of substance X absorbs 1900 J heat for 1°C rise in temperature
   (c) 1 kg of substance X absorbs 1900 J heat to increase the temperature
   (d) 1 kg of substance X absorbs 1900 J heat to cool down by 1°C
   [2023]

2. Which of the following liquids is most suitable for radiators in cars? [1]
   (a) Liquid P with specific heat capacity 4000 $Jkg^{-1}K^{-1}$.
   (b) Liquid Q with specific heat capacity 2000 $Jkg^{-1}K^{-1}$.
   (c) Liquid R with specific heat capacity 1500 $Jkg^{-1}K^{-1}$.
   (d) Liquid S with specific heat capacity 2100 $Jkg^{-1}K^{-1}$.
   [2023S]

3. The graph given below shows heat energy supplied against change in temperature when no energy is lost to the surrounding. The slope of this graph will give: [1]
   [FIGURE: graph of heat energy supplied against change in temperature — paste from source paper, 2024 521 Q1(xiv)]
   (a) Specific heat capacity
   (b) Latent heat of fusion
   (c) Latent heat of vaporization
   (d) Heat capacity
   [2024]

4. Heat capacity of a body is: [1]
   (a) the energy needed to melt the body without the change in its temperature
   (b) the energy needed to raise the temperature of the body by 1°C
   (c) the increase in the volume of the body when its temperature increases by 1°C
   (d) the total amount of internal energy that is constant.
   [2024S]

5. A metal piece of mass 5 g has thermal capacity 2.5 JK^{-1}. If the mass of the metal is tripled, then its specific heat capacity will be: [1]
   (a) 7.5 JK^{-1}
   (b) 2.5 JK^{-1}
   (c) 1.5 $Jg^{-1}K^{-1}$
   (d) 0.5 $Jg^{-1}K^{-1}$
   [2025]

6. Each of the substances given below is supplied with same amount of heat. Which one will attain the highest temperature? [1]
   Specific heat capacity of four substances

Substance	Lead	Aluminium	Copper	Iron
Specific heat capacity (cal/g°C)	0.031	0.21	0.095	0.115

   (a) Aluminium
   (b) Copper
   (c) Iron
   (d) Lead
   [2025]

7. Heat capacity of a body is the: [1]
   (a) energy needed to melt a body without change in its temperature.
   (b) energy needed to raise the temperature of a body by 1°C.
   (c) increase in volume of the body when its temperature increases by 1°C.
   (d) total amount of internal energy that is constant.
   [2025S] [2026S]

8. A metallic wire is stretched in such a way that its new length becomes twice the original length. How does its specific heat capacity change? [1]
   (a) becomes double
   (b) becomes 4 times
   (c) becomes ¼
   (d) remains the same
   [2026] [2027S]

9. Specific latent heat of a substance: [1]
   (a) is directly proportional to the mass
   (b) is directly proportional to the change in the temperature
   (c) depends on the material
   (d) is inversely proportional to the mass
   [2023]

10. Choose the correct statement.
    Latent heat absorbed: [1]
    (a) is independent of the mass of the substance.
    (b) is directly proportional to the increase in the temperature of the substance.
    (c) is directly proportional to the specific heat capacity of the substance.
    (d) is directly proportional to the specific latent heat of the substance.
    [2023S]

11. During melting of ice at 0°C the: [1]
    (a) energy is released and temperature remains constant.
    (b) energy is absorbed and temperature remains constant.
    (c) energy is released and temperature decreases.
    (d) energy is absorbed and temperature increases.
    [2024]

12. The amount of heat energy required to melt a given mass of a substance at its melting point without rise in its temperature is called: [1]
    (a) specific heat capacity
    (b) specific latent heat of fusion
    (c) latent heat of fusion
    (d) specific latent heat of freezing
    [2024S]

13. The amount of heat energy required to melt a given mass of a substance at its melting point without any rise in its temperature is called as the: [1]
    (a) specific heat capacity
    (b) specific latent heat of fusion
    (c) latent heat of fusion
    (d) specific latent heat of freezing
    [2025S]

14. Three substances A, B and C of same mass are present at their respective melting points. On heating, if they melt completely in 5 minutes, 7 minutes and 3 minutes respectively, then which substance has the highest specific latent heat? (Assume heat is absorbed at the same rate) [1]

(a) Substance A
(b) Substance B
(c) Substance C
(d) All the substances have same specific latent heat

[2026]

15. The amount of heat energy required to melt a given mass of a substance at its melting point, without any rise in its temperature is called the: [1]

(a) specific heat capacity.
(b) specific latent heat of fusion.
(c) latent heat of fusion.
(d) specific latent heat of freezing.

[2026S]

16. The amount of heat energy required to melt a given mass of a substance at its melting point, without any rise in its temperature is called the: [1]

(a) specific heat capacity
(b) specific latent heat of fusion
(c) latent heat of fusion
(d) heat capacity

[2027S]

B. Short Questions (1 or 2 marks)

1. Thermal capacities of substances A and B are same. If mass of A is more than mass of B then: [2]

(a) Which substance will have more specific heat capacity?
(b) Which substance will show greater rise in temperature if the same amount of heat is supplied to both?

[2023]

2. A solid of mass 60 g at 100°C is placed in 150 g of water at 20°C. The final steady temperature is 25°C. Calculate the heat capacity of the solid. [sp. heat capacity of water = 4.2 J g^{-1} K^{-1}] [2]

[2024S] [2025S] [2026S]

3. Complete the following by choosing the correct answers from the bracket:
The lid of a calorimeter minimises heat loss by _____ [convection / radiation]. [1]

[2026]

4. A metal piece of thermal capacity 40 JK^{-1}, absorbs 800 J of heat. Calculate the rise in the temperature of this metal piece. [2]

[2026]

5. Complete the following by choosing the correct answers from the bracket:
Unit of specific heat capacity is _____. [$kg^2m^2s^{-2}K^{-1}$ / $m^2s^{-2}K^{-1}$] [1]

[2026S]

6. Complete the following by choosing the correct answers from the bracket:
The CGS unit of specific heat capacity is _____ [erg g^{-1} K^{-1} / cal/g^{-1} K^{-1}]. [1]

[2027S]

7. Blocks of identical material, having masses m, 2m, 3m, 4m, and 5m are heated to 150°C, and then cooled to 50°C. [2]
   (a) Draw the nature of the graph connecting the amount of heat released vs the mass of the blocks.
   (b) Write the mathematical expression that enables the determination of the specific heat capacity using the graph.
   [2027S]

8. Calculate the heat absorbed by 200 g ice at 0°C to change to water at 60°C. [Specific heat capacity of ice = 2100 J kg^{-1} K^{-1}, Specific heat capacity of water = 4200 J kg^{-1} K^{-1}, Specific latent heat of ice = 336000 J kg^{-1}]. [2]
   [2023S]

9. How much heat is required to convert 500 g of ice at 0°C to water at 0°C? The latent heat of fusion of ice is 330 Jg^{-1}. [2]
   [2024]

10. Complete the following by choosing the correct answers from the bracket:
    Heat absorbed during change of phase depends on _____ [mass / change in temperature / specific heat capacity] of the substance. [1]
    [2025]

11. Calcuate the amount of heat absorbed by 200 g of paraffin wax to melt completely at its melting point. [Specific latent heat of fusion of paraffin wax = 146 Jg^{-1}] [2]
    [2025]

C. Long Questions (3 or 4 marks)

1. (a) State the principle of calorimetry. [3]
   (b) Name the material used for making a calorimeter.
   (c) Write one characteristic property of the material chosen for making a calorimeter.
   [2023]

2. A metal piece present at 120°C is quickly dropped in a calorimeter of mass 80 g containing 200 g of water at 30°C. The final temperature attained by the mixture is 40°C. Calculate the thermal capacity of the metal piece. [Specific heat capacity of water = 4.2 Jg^{-1} $°C^{-1}$, Specific heat capacity of calorimeter = 0.4 Jg^{-1} $°C^{-1}$] [3]
   [2023S]

3. (a) A certain amount of heat will warm 1 g of material X by 10°C and 1 g of material Y by 40°C. Which material has higher specific heat capacity? [3]
   (b) Which material, X or Y, would you select to make a calorimeter?
   (c) The specific heat capacity of a substance remains the same when it changes its state from solid to liquid. State True or False.
   [2025]

4. (a) Atmospheric temperature after a hailstorm is greater than the temperature during the hailstorm. State True or False. [3]
   (b) Which thermal physical quantity of a frying pan changes by making its base heavier?
   (c) State the principle of Calorimetry.
   [2026]

5. In an experiment to measure the temperature of the flame of a Bunsen burner, a lump of copper of mass 0.12 kg is heated on the flame for a long time. The copper then is quickly transferred into a beaker of negligible heat capacity containing 0.84 kg of water and the temperature of the water rose from 15°C to 35°C. Calculate the temperature of the flame.
   [Given sp. Heat capacity of copper = 0.4 Jg^{-1} $°C^{-1}$, Sp. Heat capacity of water = 4.2 Jg^{-1} $°C^{-1}$.] [4]
   [2026S] [2027S]

6. Calculate the total amount of heat energy required to melt 200 g of ice at 0°C to water at 100°C. (Specific latent heat of ice = 336 J g^{-1}, specific heat capacity of water = 4.2 J g^{-1} $°C^{-1}$) [3]

[2023]

7. The diagram below shows a cooling curve for a substance: [3]

[FIGURE: cooling curve of a substance (temperature °C against time) — paste from source paper, 2023S 521 Q9(ii)]

(a) State the temperatures at which the substance condenses and solidifies respectively.

(b) The temperature range in which the substance is in liquid state.

(c) Why do we prefer ice to ice-cold water for cooling a drink?

[2023S]

8. 85 g of water at 30°C is cooled to 5°C by adding certain mass of ice. Find the mass of ice required. [Specific heat capacity of water = 4.2 $Jg^{-1}°C^{-1}$, Specific latent heat of fusion = 336 Jg^{-1}] [3]

[2024]

9. (a) Why does it become pleasantly warm when the lakes start freezing? [3]

(b) Water freezes to form ice. What change would you expect in the average kinetic energy of the molecules?

(c) Which will contain more heat energy 1 g of ice at 0°C or 1 g water at 0°C?

[2024]

10. What mass of ice at 0°C added to 2.1 kg water, will cool it down from 75°C to 25°C?
Given Specific heat capacity of water = 4.2 Jg^{-1} $°C^{-1}$, Specific latent heat of ice = 336 Jg^{-1}. [3]

[2024S] [2025S]

11. The diagram below shows a cooling curve for a substance: [3]

[FIGURE: cooling curve of a substance (temperature °C against time; 150 and 60 marked on the temperature axis) — paste from source paper, 2025S 521 Q9(ii)]

(a) State the temperatures at which the substance condenses.

(b) The temperature range in which the substance is in liquid state.

(c) Why do we prefer ice to ice-cold water for cooling a drink?

[2024S] [2025S]

12. 30 g of ice at 0°C is used to bring down the temperature of a certain mass of water at 70°C to 20°C. Find the mass of water. [Specific heat capacity of water = 4.2 $Jg^{-1}°C^{-1}$ and specific latent heat of ice = 336 Jg^{-1}.] [3]

[2025]

13. The given graph represents the cooling curve of a liquid. [4]

[FIGURE: cooling curve of a liquid with regions marked, including QR — paste from source paper, 2026 521 Q5(iii)]

(a) State the freezing temperature of the liquid.

(b) Name the phase change happening at the region QR.

(c) In which state (solid / liquid) does the above substance liberate heat at a faster rate? Justify.

[2026]

14. The diagram below shows a cooling curve for a substance X: [3]

[FIGURE: cooling curve for a substance X (temperature against time) — paste from source paper, 2026S 521 Q5(ii)]

(a) State the temperatures at which the substance condenses.

(b) Mention the temperature range in which the substance is in its liquid state.

(c) State True or False: The amount of heat released when a substance is cooled by 10°C in its liquid state is greater than the heat released when it is cooled by the same amount in its solid state.

[2026S]

15. The diagram below shows a cooling curve for a substance X: [3]

[FIGURE: cooling curve for a substance X (temperature against time) — paste from source paper, 2027S 521 Q5(ii)]

(a) State the temperature at which the substance condenses.

(b) Mention the temperature range in which the substance is in its liquid state.

(c) State True or False: The amount of heat released when a substance is cooled by 10°C in its liquid state is greater than the heat released when it is cooled by the same amount in its solid state.

[2027S]

Chapter 6: Modern Physics

A. Multiple Choice Questions (1 mark each)

1. Which of the following radiations suffer maximum deflection in a magnetic field? [1]
   (a) Alpha radiations
   (b) Beta radiations
   (c) Gamma radiations
   (d) X-radiations
   [2023]

2. Which of the following nuclear radiations can be stopped by a sheet of paper? [1]
   (a) Alpha
   (b) Beta
   (c) Gamma
   (d) None of these
   [2023S]

3. A radioactive nucleus containing 128 nucleons emits a β – particle. After β – emission the number of nucleons present in the nucleus will be: [1]
   (a) 128
   (b) 129
   (c) 124
   (d) 127
   [2024]

4. A radioactive element is placed in an evacuated chamber. Then the rate of radioactive decay will: [1]
   (a) Decrease
   (b) Increase
   (c) Remain unchanged
   (d) Depend on the surrounding temperature
   [2024]

5. A nucleus of an atom consists of 146 neutrons and 95 protons. It decays after emitting an alpha particle. How many protons and neutrons are left in the nucleus after an alpha emission? [1]
   (a) protons = 93, neutrons = 144
   (b) protons = 95, neutrons = 142
   (c) protons = 89, neutrons = 144
   (d) protons = 89, neutrons = 142
   [2024S]

6. A radioactive element P emits one α-particle and transforms to a new element Q. What will be the position of the element Q in the periodic table? [1]
   (a) One group to the left of P
   (b) One group to the right of P
   (c) Two groups to the right of P
   (d) Two groups to the left of P
   [2025]

7. A nucleus of an atom consists of 146 neutrons and 95 protons. It decays after emitting an alpha particle. How many protons and neutrons are left in the nucleus after an alpha emission? [1]

(a) protons = 93, neutrons = 142
(b) protons = 95, neutrons = 144
(c) protons = 93, neutrons = 144
(d) protons = 95, neutrons = 142

[2025S] [2026S]

8. An atom of lithium contains 3 electrons, 3 protons and 4 neutrons. Its mass number is: [1]

(a) 3
(b) 4
(c) 7
(d) 10

[2026]

9. A radioactive nucleus has 90 protons and 140 neutrons. It undergoes two successive alpha decays. What are the mass number and atomic number of the final nucleus? [1]

(a) Mass number = 222, atomic number = 86
(b) Mass number = 226, atomic number = 88
(c) Mass number = 224, atomic number = 86
(d) Mass number = 222, atomic number = 88

[2027S]

B. Short Questions (1 or 2 marks)

1. How is the radioactivity of a radio isotope affected if it undergoes a chemical change? Give a reason for your answer. [2]

[2023]

2. What are background radiations? [2]

[2023S]

3. What is a nuclear waste? State one method to dispose it safely. [2]

[2024S]

4. Complete the following by choosing the correct answers from the bracket:
The nuclear radiation with lowest ionizing power is _____ [α / β / γ]. [1]

[2025]

5. (a) Name the radiations that are emitted during the decay of a nucleus, which has highest penetrating power? [2]

(b) Does the emission of the above-mentioned radiation result in a change in the mass number?

[2025S]

6. Complete the following by choosing the correct answers from the bracket:
_____ radiation deviates minimum in a magnetic field. [Alpha / Beta]. [1]

[2026]

7. (a) Name the radiation that is emitted during the decay of a nucleus that has the highest penetrating power. [2]

(b) Does the emission of the above-mentioned radiation result in a change in the mass number?

[2026S]

8. Copy and complete the nuclear reaction by filling in the blanks.
$_{92}U^{235} + {}_{0}n^{1} \rightarrow {}_{56}Ba___ + ___Kr^{92} + 3\ {}_{0}n^{1}$ [2]

[2024]

9. Give two differences between nuclear fission and nuclear fusion. [2]
[2026]

10. Complete the following by choosing the correct answers from the bracket:
The reaction responsible for the production of energy in the sun is _____. [Nuclear Fusion / Nuclear Fission] [1]
[2026S]

11. Complete the following by choosing the correct answers from the bracket:
Nuclear _____ [fusion / fission] is possible at ordinary temperature and pressure. [1]
[2027S]

12. (a) When $_3Li^6$ is bombarded with a neutron, it produces $_2He^4$ and an isotope of hydrogen. Write the notation for the hydrogen isotope formed. [2]
(b) Fill in the blank: The mass of the reactants in a fission reaction is _____ (greater /less) than the mass of the products.
[2027S]

C. Long Questions (3 or 4 marks)

1. (a) Complete the following nuclear changes: $_{92}P^{238} \rightarrow$ ___Q___ + $_2He^4 \rightarrow$ ___R___ + $_{-1}e^0$ [3]
(b) Name the nuclear radiation which has the highest ionizing power.
[2023]

2. (a) Which nuclear radiation will travel undeviated in an electric field? [3]
(b) How can one stop the radiations escaping from a nuclear reactor in a nuclear power plant?
(c) Name one internal source of background radiations.
[2023]

3. (a) How many pulleys are there in a movable block of a block and tackle system with velocity ratio 5? [3]
(b) A radioactive nucleus emits a beta particle. Does the position of daughter nucleus change in a periodic table as compared to the parent nucleus?
(c) To which electrically charged plate the beta radiations will deflect while passing through an electric field?
[2023S]

4. (a) A radioactive nucleus X emits an alpha particle followed by two beta particles and forms nucleus Y. What is the general name of the elements X and Y? [3]
(b) If the atomic number of Y is 80 then what is the atomic number of X?
(c) If the atomic mass number of Y is 189 then what is the atomic mass number of X?
[2023S]

5. (a) Copy and complete the following nuclear reaction. $_{86}Rn^{222} \rightarrow _{84}Po^{218}$ + ___ [3]
(b) What will be the effect on the radiation emitted in the above reaction when it is allowed to pass through an electric field? [Be specific in your answer]
[2023S]

6. (a) In the following atoms, which one is a radioisotope? Give one use of this isotope. O^{16}, C^{14}, N^{14}, He^4 [3]
[FIGURE: picture of a lever — paste from source paper, 2024 521 Q2(i)]
(b) Name the class of the lever shown in the picture below:
[2024]

7. (a) Complete the following radioactive reaction: $_{91}X^{234} \rightarrow Y + _2He^4 \rightarrow Z + _{-1}e^0$ [3]
(b) Uranium is available in two forms U-235 and U-238. Which of the two isotopes of Uranium is more fissionable?
[2024]

8. (a) Name the principle on which a lever works. [3]

(b) Which radiations that are emitted during the decay of a nucleus, having highest penetrating power?

(c) Does the emission of the above-mentioned radiation result in a change in the mass number?

[2024S]

9. A radioactive nucleus X emits an alpha particle followed by two beta particles to form nucleus Y. [3]

(a) With respect to the element X, where would you position the element Y in the periodic table?

(b) What is the general name of the element X and Y?

(c) If the atomic number of Y is 80 then what is the atomic number of X?

[2024S]

10. (a) Copy and complete the following nuclear reaction. $_{86}Rn^{222} \rightarrow {}_{84}Po^{218} + __X__$ [3]

(b) What will be the effect on the radiation X, emitted in the above reaction when it is allowed to pass through an electric field?

[2024S]

11. Curium is a radioactive element with the symbol $_{96}Cm^{247}$ named in honour of Madam Curie. The graph of number of protons vs number of neutrons for some elements are shown below: [3]

[FIGURE: graph of number of protons against number of neutrons for some elements, points marked — paste from source paper, 2025 521 Q3(vii)]

(a) Which point on the graph indicates the element Cm?

(b) Which point on the graph indicates daughter nucleus after Cm undergoes radioactive decay of 1 α followed by 2 β?

(c) State the mass number of the daughter nucleus.

[2025]

12. The graph (fig A) illustrates the correlation between the number of protons (x-axis) and the number of neutrons (y-axis) for elements A, B, C, D, and E in the periodic table. These elements are denoted by the letters rather than their conventional symbols. When the element C, depicted in the graph, undergoes radioactive decay, it releases radioactive rays. When these rays are directed into the plane of the paper in the presence of a magnetic field, as indicated in the fig B, they experience deflection, causing them to move upwards. [3]

[FIGURE: Fig. A – graph of number of protons against number of neutrons for elements A to E; Fig. B – rays passed into the plane of the paper, deflected upwards — paste from source paper, 2025S 521 Q3(vii)]

(a) Name the radioactive radiations emitted by the element C.

(b) Identify the daughter element from the graph.

(c) Name the law used to identify the radioactive radiations emitted by the element.

[2025S]

13. A radioactive nucleus X emits an alpha particle followed by two beta particles to form nucleus Y. [3]

(a) With respect to the element X, where would you position the element Y in the periodic table?

(b) What is the general name of the elements X and Y?

(c) If the atomic number of Y is 80 then what is the atomic number of X?

[2025S]

14. [4]

(a) 1. Which element is used in the lining of the special aprons worn by workers in nuclear power plants?

2. Why is this element preferred?

(b) $_{11}Na^{24}$ emits a nuclear radiation which does not alter the mass number but is deflected by a magnetic field.

1. Name the type of nuclear radiation emitted by $_{11}Na^{24}$.

2. Write the equation for this radioactive decay.

[2026]

15. The graph (Fig. A) illustrates the correlation between the number of protons (x-axis) and the number of neutrons (y-axis) for elements A, B, C, D, and E in the periodic table. These elements are denoted by the letters rather than their conventional symbols. [4]

[FIGURE: Fig. A – graph of number of protons against number of neutrons for elements A to E — paste from source paper, 2026S 521 Q9(iii)]

(a) Identify the radioactive radiation emitted when element C decays into element E. Represent this using a nuclear reaction.

(b) What is the special name given to elements D and E?

(c) If element C transforms into element B by emitting a radioactive ray, how will this ray behave in an electric field?

[2026S]

16. The graph given below illustrates the correlation between the number of protons (x-axis) and the number of neutrons (y-axis) for elements A, B, C, D, and E in the periodic table. These elements are denoted by the letters rather than their conventional symbols. [4]

[FIGURE: graph of number of protons against number of neutrons for elements A to E — paste from source paper, 2027S 521 Q9(iii)]

(a) Identify the radioactive radiation emitted when element C decays into element E. Represent this using a nuclear reaction.

(b) What is the special name given to elements like D and E?

(c) If element C transforms into element B by emitting a radioactive ray, how will this ray behave in an electric field?

[2027S]

17. Study the diagram given below and answer the questions that follow: [3]

[FIGURE: nuclear reaction diagram with a value X and a missing product Y — paste from source paper, 2025 521 Q8(ii)]

(a) Name the process depicted in the diagram.

(b) What is the value of X?

(c) Identify Y, the missing product of the reaction.

[2025]