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# SCO INTERNATIONAL OLYMPIAD

Official publication-ready academic document for schools, teachers, parents and students

# SCO INTERNATIONAL PHYSICS OLYMPIAD

## Official Question Paper

| | | |
|---|---|---|
| Motion | Force & Laws | Gravitation |
| Work & Energy | Sound | Applied Reasoning |

## Candidate Information

| Candidate Details | |
|---|---|
| Name | ..... |
| Registration ID | ..... |
| Contact No. | ..... |
| School / Organization | ..... |

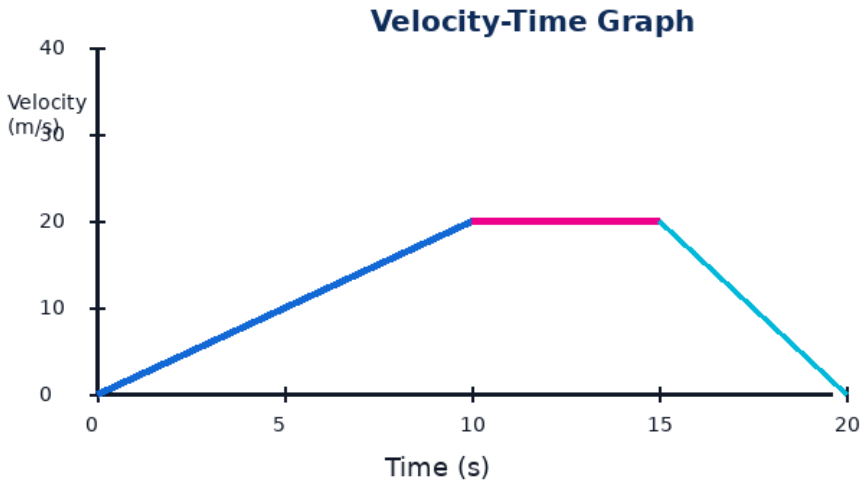
# Question Paper

## General Questions

**Q1.** A runner starts from rest and reaches 12 m/s in 6 seconds with uniform acceleration. What distance does the runner cover in this time?

| | |
|---|---|
| **A.** 24 m | **B.** 36 m |
| **C.** 48 m | **D.** 72 m |

**Q2.** The velocity-time graph shows a vehicle speeding up, then moving at constant speed, then slowing down. What physical quantity is represented by the area under a velocity-time graph?

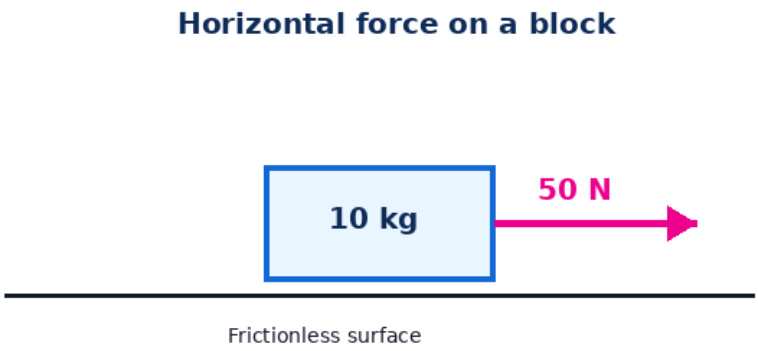



| | |
|---|---|
| **A.** Acceleration | **B.** Distance travelled |
| **C.** Force applied | **D.** Mass of vehicle |

**Q3.** A body moves 40 m east and then 30 m west. What are its distance and displacement?

| | |
|---|---|
| **A.** Distance 70 m; displacement 10 m east | **B.** Distance 10 m; displacement 70 m east |
| **C.** Distance 70 m; displacement 10 m west | **D.** Distance 40 m; displacement 30 m west |

**Q4.** A block of mass 10 kg is pulled horizontally by a 50 N force on a frictionless surface. What is its acceleration?




| | |
|---|---|
| **A.** 2 m/s^2 | **B.** 3 m/s^2 |
| **C.** 5 m/s^2 | **D.** 10 m/s^2 |

**Q5.** A bus suddenly starts moving forward. A standing passenger tends to fall backward. Which concept explains this observation?

| | |
|---|---|
| **A.** Inertia of rest | **B.** Inertia of motion |
| **C.** Conservation of energy | **D.** Reflection of sound |

**Q6.** A 2 kg ball moving at 4 m/s has momentum equal to:

| | |
|---|---|
| **A.** 2 kg m/s | **B.** 4 kg m/s |
| **C.** 6 kg m/s | **D.** 8 kg m/s |

**Q7.** A cricket player lowers his hands while catching a fast ball. Why does this reduce the force on the hands?

| | |
|---|---|
| **A.** It increases the ball's mass | **B.** It increases the time taken to stop the ball |
| **C.** It reduces the ball's initial speed to zero immediately | **D.** It removes gravity from the ball |

**Q8.** When a swimmer pushes water backward, the swimmer moves forward. Which law explains this?

| | |
|---|---|
| **A.** Newton's first law | **B.** Newton's second law |

| | |
|---|---|
| **C.** Newton’s third law | **D.** Law of gravitation |

**Q9.** An object has mass 5 kg. Taking g = 10 m/s^2, what is its weight on Earth?

| | |
|---|---|
| **A.** 5 N | **B.** 10 N |
| **C.** 50 N | **D.** 500 N |

**Q10.** If the distance between two masses is doubled, the gravitational force between them becomes:

| | |
|---|---|
| **A.** twice | **B.** four times |
| **C.** one-half | **D.** one-fourth |

**Q11.** A stone is dropped from rest. Ignoring air resistance, what happens to its speed during free fall?

| | |
|---|---|
| **A.** It stays zero | **B.** It increases uniformly |
| **C.** It decreases uniformly | **D.** It first increases and then stops |

**Q12.** A body of mass 2 kg moves at 5 m/s. What is its kinetic energy?

| | |
|---|---|
| **A.** 10 J | **B.** 20 J |
| **C.** 25 J | **D.** 50 J |

**Q13.** A 4 kg object is lifted to a height of 3 m. If g = 10 m/s^2, what is the gain in potential energy?

| | |
|---|---|
| **A.** 12 J | **B.** 40 J |
| **C.** 80 J | **D.** 120 J |

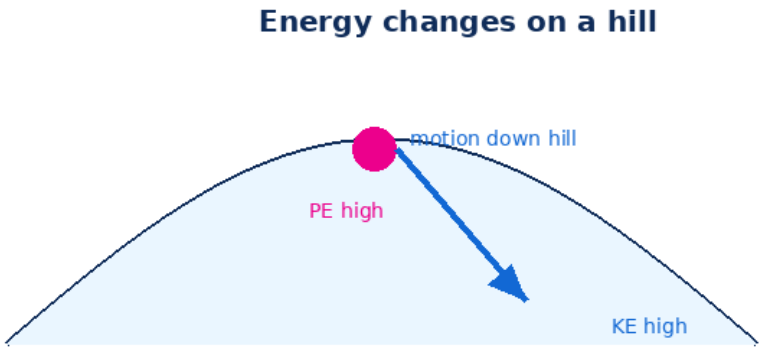
**Q14.** A boy pushes a wall with full effort, but the wall does not move. What is the work done on the wall?

| | |
|---|---|
| **A.** Zero | **B.** Positive and large |
| **C.** Negative | **D.** Equal to his body weight |

**Q15.** A machine does 600 J of work in 20 seconds. What is its power?

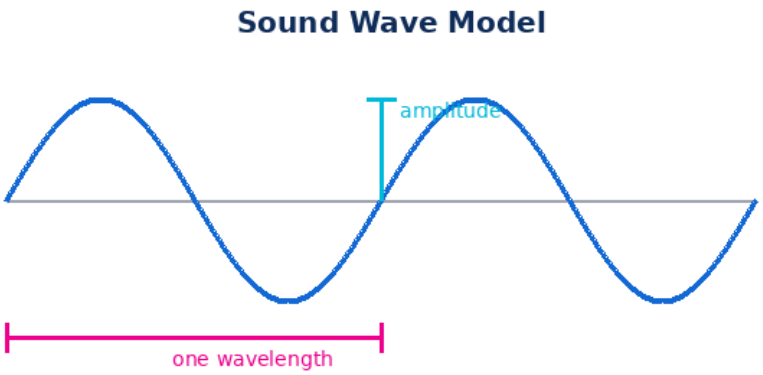
| | |
|---|---|
| **A.** 20 W | **B.** 30 W |
| **C.** 40 W | **D.** 120 W |

**Q16.** The diagram shows energy changes as an object moves down a hill. In the absence of friction, which statement is correct?




| | |
|---|---|
| **A.** Potential energy converts into kinetic energy | **B.** Kinetic energy becomes zero at the bottom |
| **C.** Total mechanical energy increases by itself | **D.** Gravity does no work |

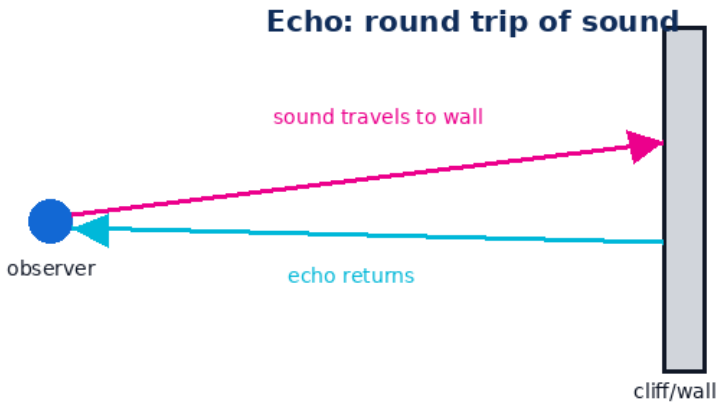
**Q17.** A sound wave has speed 340 m/s and frequency 170 Hz. What is its wavelength?




| | |
|---|---|
| **A.** 0.5 m | **B.** 1 m |

| | |
|---|---|
| **C.** 2 m | **D.** 4 m |

**Q18.** A person hears an echo 2 seconds after shouting. If speed of sound is 340 m/s, how far is the reflecting wall?




| | |
|---|---|
| **A.** 170 m | **B.** 340 m |
| **C.** 510 m | **D.** 680 m |

**Q19.** Which statement about sound is correct?

| | |
|---|---|
| **A.** Sound can travel through vacuum | **B.** Sound is a mechanical wave |
| **C.** Sound travels fastest in air among solids, liquids and gases | **D.** Sound does not need vibrating particles |

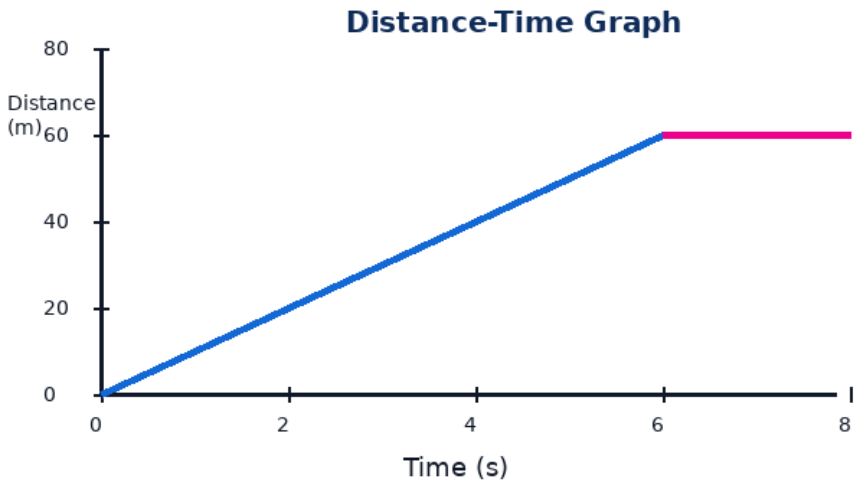
**Q20.** The audible range for a healthy young human ear is approximately:

| | |
|---|---|
| **A.** 2 Hz to 20 Hz | **B.** 20 Hz to 20,000 Hz |
| **C.** 20,000 Hz to 2,00,000 Hz | **D.** Only above 20,000 Hz |

**Q21.** A car covers 150 km in 3 hours. Its average speed is:

| | |
|---|---|
| **A.** 25 km/h | **B.** 30 km/h |
| **C.** 50 km/h | **D.** 75 km/h |

**Q22.** In a distance-time graph, a horizontal line means:




| | |
|---|---|
| **A.** object is moving very fast | **B.** object is at rest |
| **C.** object is accelerating uniformly | **D.** object is moving backward |

**Q23.** A 1 kg and a 5 kg stone are dropped from the same height in vacuum. Which reaches the ground first?

| | |
|---|---|
| **A.** 1 kg stone | **B.** 5 kg stone |
| **C.** Both together | **D.** Depends on colour |

**Q24.** A student says, “Mass and weight are the same.” Which correction is best?

| | |
|---|---|
| **A.** Mass is a force; weight is amount of matter | **B.** Mass is amount of matter; weight is gravitational force |
| **C.** Both are measured in newton | **D.** Weight never changes but mass changes everywhere |

**Q25.** A force of 20 N acts on a body and displaces it by 4 m in the direction of force. Work done is:

| | |
|---|---|
| **A.** 5 J | **B.** 16 J |
| **C.** 24 J | **D.** 80 J |

**Q26.** A 100 W bulb is used for 10 seconds. How much energy does it consume?

| | |
|---|---|
| **A.** 10 J | **B.** 100 J |

| | |
|---|---|
| **C.** 1000 J | **D.** 10,000 J |

**Q27.** The loudness of a sound mainly depends on its:

| | |
|---|---|
| **A.** amplitude | **B.** wavelength only |
| **C.** speed in air only | **D.** direction of travel |

**Q28.** Pitch of sound mainly depends on:

| | |
|---|---|
| **A.** frequency | **B.** amplitude |
| **C.** reflection | **D.** mass of source only |

**Q29.** Why are seat belts useful during sudden braking?

| | |
|---|---|
| **A.** They increase the car's speed | **B.** They provide a force that helps stop the passenger safely |
| **C.** They remove inertia | **D.** They reduce passenger mass |

**Q30.** Which instrument is commonly used to detect or use reflected ultrasound for underwater distance measurement?

| | |
|---|---|
| **A.** Periscope | **B.** SONAR |
| **C.** Barometer | **D.** Telescope |

## Assertion-Reason Questions

**Q31.** Assertion: A body moving with uniform speed in a circle is accelerating. Reason: Its direction of velocity changes continuously.

| | |
|---|---|
| **A.** A. Both true and Reason explains Assertion | **B.** B. Both true but Reason does not explain Assertion |
| **C.** C. Assertion true, Reason false | **D.** D. Assertion false, Reason true |

**Q32.** Assertion: A book kept on a table has zero net force if it is at rest. Reason: The table exerts an upward normal force equal to the book's weight.

| | |
|---|---|
| **A.** A | **B.** B |
| **C.** C | **D.** D |

**Q33.** Assertion: Work done by gravity on a falling object is positive. Reason: The force of gravity and displacement are in the same direction.

| | |
|---|---|
| **A.** A | **B.** B |
| **C.** C | **D.** D |

**Q34.** Assertion: Weight of a body changes from planet to planet. Reason: Mass of the body changes from planet to planet.

| | |
|---|---|
| **A.** A | **B.** B |
| **C.** C | **D.** D |

**Q35.** Assertion: Sound cannot travel through vacuum. Reason: Sound requires particles of a medium to transfer vibrations.

| | |
|---|---|
| **A.** A | **B.** B |
| **C.** C | **D.** D |

**Q36.** Assertion: Momentum has both magnitude and direction. Reason: Momentum is the product of mass and velocity.

| | |
|---|---|
| **A.** A | **B.** B |
| **C.** C | **D.** D |

**Q37.** Assertion: A heavier and a lighter object fall with the same acceleration in vacuum. Reason: Air resistance is absent in vacuum.

| | |
|---|---|
| **A.** A | **B.** B |

| | |
|---|---|
| **C.** C | **D.** D |

**Q38.** Assertion: Power measures the rate of doing work. Reason: Power is calculated as work divided by time.

| | |
|---|---|
| **A.** A | **B.** B |
| **C.** C | **D.** D |

**Q39.** Assertion: Echo is heard when reflected sound reaches the ear after a suitable time gap. Reason: Reflection of sound can occur from hard surfaces.

| | |
|---|---|
| **A.** A | **B.** B |
| **C.** C | **D.** D |

**Q40.** Assertion: Kinetic energy of a body becomes four times if speed is doubled. Reason: Kinetic energy is directly proportional to speed.

| | |
|---|---|
| **A.** A | **B.** B |
| **C.** C | **D.** D |

## Case Study Questions

**Q41.** Case: A delivery robot moves 20 m in the first 5 s, then 30 m in the next 5 s. What is its average speed over the 10 s trip?

| | |
|---|---|
| **A.** 3 m/s | **B.** 4 m/s |
| **C.** 5 m/s | **D.** 6 m/s |

**Q42.** Case: A 50 kg student climbs stairs of vertical height 4 m in 8 s. Take g = 10 m/s^2. What is the student's power output against gravity?

| | |
|---|---|
| **A.** 100 W | **B.** 150 W |
| **C.** 200 W | **D.** 250 W |

**Q43.** Case: A school sound experiment uses a 680 Hz tuning fork. If sound speed is 340 m/s, what is the wavelength?

| | |
|---|---|
| **A.** 0.25 m | **B.** 0.5 m |
| **C.** 1 m | **D.** 2 m |

**Q44.** Case: A ball of mass 0.2 kg is moving at 15 m/s. It is caught and stopped in 0.3 s. What is the average force on the ball?

| | |
|---|---|
| **A.** 5 N | **B.** 10 N |
| **C.** 15 N | **D.** 20 N |

**Q45.** Case: A spacecraft far from planets fires its engine, ejecting gas backward. Why does it move forward?

| | |
|---|---|
| **A.** Due to air pushing it | **B.** Due to equal and opposite reaction force |
| **C.** Due to Earth's magnetism | **D.** Due to sound waves from engine |

## Achievers Section

**Q46.** A train accelerates from 10 m/s to 25 m/s in 5 s, then moves at 25 m/s for 10 s. What total distance is covered?

| | |
|---|---|
| **A.** 287.5 m | **B.** 337.5 m |
| **C.** 362.5 m | **D.** 375 m |

**Q47.** A 600 kg cart moving at 4 m/s collides with a stationary 400 kg cart and they move together. What is their common speed after collision?

| | |
|---|---|
| **A.** 1.6 m/s | **B.** 2.0 m/s |
| **C.** 2.4 m/s | **D.** 4.0 m/s |

**Q48.** A satellite is in circular motion around Earth. Which force provides the centripetal force?

| | |
|---|---|
| **A.** Friction | **B.** Gravity |
| **C.** Tension | **D.** Sound pressure |

**Q49.** A sound pulse sent from a ship returns after 4 s from the seabed. If speed of sound in seawater is 1500 m/s, what is the depth?

| | |
|---|---|
| **A.** 1500 m | **B.** 2000 m |
| **C.** 3000 m | **D.** 6000 m |

**Q50.** A motor lifts 100 kg of water through 5 m in 10 s. If g = 10 m/s^2, what is useful power output?

| | |
|---|---|
| **A.** 50 W | **B.** 100 W |
| **C.** 250 W | **D.** 500 W |

## Answer Key

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

## Detailed Explanations

**Q1 (B):** Acceleration = (12 - 0)/6 = 2 m/s^2. Distance = 1/2 × 2 × 6^2 = 36 m.

**Q2 (B):** The area under a velocity-time graph gives displacement or distance travelled when the motion is in one direction.

**Q3 (A):** Distance is total path = 40 + 30 = 70 m. Net displacement = 40 - 30 = 10 m east.

**Q4 (C):** Using F = ma, acceleration = 50/10 = 5 m/s^2.

**Q5 (A):** The passenger's body tends to remain at rest while the bus moves forward, so the passenger appears to fall backward.

**Q6 (D):** Momentum p = mv = 2 × 4 = 8 kg m/s.

**Q7 (B):** For the same change in momentum, increasing stopping time reduces the average force.

**Q8 (C):** The swimmer exerts a backward force on water, and water exerts an equal and opposite force on the swimmer.

**Q9 (C):** Weight = mg = 5 × 10 = 50 N.

**Q10 (D):** Gravitational force is inversely proportional to the square of distance. Doubling distance makes force 1/4 of the original.

**Q11 (B):** In free fall the stone accelerates due to gravity, so its speed increases uniformly.

**Q12 (C):** Kinetic energy = 1/2 mv^2 = 1/2 × 2 × 5^2 = 25 J.

**Q13 (D):** Potential energy = mgh = 4 × 10 × 3 = 120 J.

**Q14 (A):** Work done = force × displacement. Since displacement of the wall is zero, work done on the wall is zero.

**Q15 (B):** Power = work/time = 600/20 = 30 W.

**Q16 (A):** As the object moves down, height decreases and speed increases, so potential energy changes into kinetic energy.

**Q17 (C):** Wavelength = speed/frequency = 340/170 = 2 m.

**Q18 (B):** Sound travels to the wall and back in 2 s. Total distance = 340 × 2 = 680 m. One-way distance = 340 m.

**Q19 (B):** Sound needs a material medium and travels through particle vibrations; hence it is a mechanical wave.

**Q20 (B):** Human hearing is roughly 20 Hz to 20 kHz. Frequencies above 20 kHz are called ultrasound.

**Q21 (C):** Average speed = total distance / total time = 150/3 = 50 km/h.

**Q22 (B):** A horizontal distance-time graph means distance is not changing with time, so the object is at rest.

**Q23 (C):** In vacuum, all bodies fall with the same acceleration due to gravity, independent of mass.

**Q24 (B):** Mass is the amount of matter and is measured in kg; weight is the gravitational force on mass and is measured in newton.

**Q25 (D):** Work = force × displacement = 20 × 4 = 80 J.

**Q26 (C):** Energy = power × time = 100 × 10 = 1000 J.

**Q27 (A):** Greater amplitude generally means louder sound.

**Q28 (A):** High frequency gives high pitch; low frequency gives low pitch.

**Q29 (B):** During sudden braking, seat belts exert a force on the passenger and increase stopping safety by controlling motion.

**Q30 (B):** SONAR uses reflected sound waves, often ultrasound, to detect underwater objects and measure distance.

**Q31 (A):** In uniform circular motion speed is constant but velocity direction changes, so acceleration exists.

**Q32 (A):** The downward weight is balanced by the upward normal reaction, so net force is zero.

**Q33 (A):** When an object falls downward, gravity and displacement are both downward, so work done by gravity is positive.

**Q34 (C):** Weight depends on local gravity and changes, but mass remains the same unless matter is added or removed.

**Q35 (A):** Sound is a mechanical wave and needs a medium, so it cannot propagate in vacuum.

**Q36 (A):** Velocity is a vector, so mass times velocity gives vector momentum.

**Q37 (A):** Without air resistance, all bodies have acceleration g due to gravity regardless of mass.

**Q38 (A):** The formula P = W/t directly defines power as rate of work done.

**Q39 (A):** A reflected sound from a hard surface can be heard as echo if the time gap is sufficient.

**Q40 (C):** Kinetic energy is proportional to v^2, not v. Doubling speed makes KE four times.

**Q41 (C):** Total distance = 20 + 30 = 50 m. Average speed = 50/10 = 5 m/s.

**Q42 (D):** Work = mgh = 50 × 10 × 4 = 2000 J. Power = 2000/8 = 250 W.

**Q43 (B):** Wavelength = v/f = 340/680 = 0.5 m.

**Q44 (B):** Change in momentum = 0.2 × 15 = 3 kg m/s. Force = 3/0.3 = 10 N.

**Q45 (B):** Rocket motion follows Newton's third law: gas is pushed backward and the rocket is pushed forward.

**Q46 (B):** Acceleration phase distance = average speed × time = (10 + 25)/2 × 5 = 87.5 m. Constant speed distance = 25 × 10 = 250 m. Total distance = 337.5 m.

**Q47 (C):** By conservation of momentum: initial momentum = 600 × 4 = 2400 kg m/s. Combined mass = 1000 kg. Common speed = 2400/1000 = 2.4 m/s.

**Q48 (B):** The gravitational attraction between Earth and satellite provides the centripetal force.

**Q49 (C):** Total sound path = 1500 × 4 = 6000 m. Depth is half of round trip = 3000 m.

**Q50 (D):** Work = mgh = 100 × 10 × 5 = 5000 J. Power = 5000/10 = 500 W.

## Space for Rough Work