# Indian School Al Wadi Al Kabir
## Assessment – I (2025-2026)

Class: XI | Subject: Physics (042) | Max. marks: 70
Date: 25/09/2025 | Set- I | Time: 3 Hours

**General Instructions:**

(1) There are 33 questions in all. All questions are compulsory.
(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
(3) All the sections are compulsory.
(4) **Section A** contains **sixteen questions, twelve MCQ and four assertion reasoning based of 1 mark each**, **Section B** contains **five questions of two marks each**, **Section C** contains seven questions of three marks each, **Section D** contains **two case study-based questions of four marks each,** and **Section E** contains **three long answer questions of five marks each**.
(5) There is no overall choice. However, an internal choice has been provided in two questions in Section B, one question in Section C and all three questions in Section E. You have to attempt only one of the choices in such questions.
(6) Use of calculators is not allowed.

**SECTION A**

| Q. No. | Question | Marks |
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| 1. | Which of the following statements regarding dimensional analysis is incorrect?<br>(A) Dimensionally consistent equations are always physically correct.<br>(B) Physical quantities can only be added or subtracted if they have the same dimensions.<br>(C) The arguments of trigonometric functions must be dimensionless.<br>(D) Dimensional analysis can be used to deduce relations among physical quantities. | 1 |
| 2. | Match the dimensional formulae in Column I with the physical quantities in Column II.<br><br>**Column I** / **Column II**<br>1. $[M^0 L^1 T^{-1}]$ — A. Acceleration<br>2. $[M^1 L^1 T^{-2}]$ — B. Volume<br>3. $[M^0 L^1 T^{-2}]$ — C. Velocity<br>4. $[M^0 L^3 T^0]$ — D. Force<br><br>(A) 1-C, 2-D, 3-A, 4-B (B) 1-A, 2-B, 3-C, 4-D<br>(C) 1-C, 2-A, 3-D, 4-B (D) 1-B, 2-D, 3-A, 4-C | 1 |

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| 3. | The time dependence of a physical quantity 'p' is given by $p=p_o \exp(-\alpha t^2)$ where α is a constant and t is the time. The constant α<br>(A) Is dimensionless.<br>(B) Has dimensions $T^{-2}$<br>(C) Has dimensions $T^{+2}$<br>(D) None of the above. | 1 |
| 4. | Consider the following statements for one-dimensional motion:<br>1. An object with zero speed at an instant may have non-zero acceleration at that instant.<br>2. An object with zero speed may have non-zero velocity.<br>3. An object with constant speed must have zero acceleration.<br>4. An object with a positive value of acceleration must be speeding up.<br><br>Which of the above statements are true?<br>(A) 1 and 3 only<br>(B) 1, 3 and 4 only<br>(C) 1, 2 and 3 only<br>(D) All are true | 1 |
| 5. | A train starting from rest accelerates uniformly to a speed of 20 m/s in 10 seconds. What is the distance covered by the train during this time?<br>(A) 50 m<br>(B) 100 m<br>(C) 200 m<br>(D) 20 m | 1 |
| 6. | The path length traversed by an object between two points is:<br>(A) Always equal to the magnitude of the displacement.<br>(B) Always greater than the magnitude of the displacement.<br>(C) Always less than the magnitude of the displacement.<br>(D) Greater than or equal to the magnitude of the displacement. | 1 |
| 7. | The direction θ of a vector A with components Ax and Ay, with respect to the positive x-axis, is given by:<br>(A) $\tan\theta = \frac{A_y}{A_x}$<br>(B) $\sin\theta = \frac{A_y}{A_x}$<br>(C) $\cos\theta = \frac{A_y}{A_x}$<br>(D) $\tan\theta = \frac{A_x}{A_y}$ | 1 |
| 8. | The acceleration of an object in uniform circular motion is always directed:<br>(A) Along the tangent to the circular path of the motion.<br>(B) Away from the centre of the circular path motion.<br>(C) Towards the centre of the circular path of motion.<br>(D) In the direction of the object's instantaneous velocity vector. | 1 |

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| 9. | Which of the following pairs correctly matches a term with its definition?<br>(A) Momentum: The quantity of matter in a body.<br>(B) Impulse: The change in velocity per unit time.<br>(C) Inertia: The force that opposes motion.<br>(D) Equilibrium: Net external force is zero. | 1 |
| 10. | A car of mass 1000 kg accelerates from rest to a speed of 20 m/s in 10 seconds. What is the average net force acting on the car?<br>(A) 2000 N<br>(B) 200 N<br>(C) 20000 N<br>(D) 2 N | 1 |
| 11. | A weight lifter lifts a weight off the ground and holds it up<br>(A) Work is done in lifting as well as holding the weight.<br>(B) No work is done in both lifting and holding the weight.<br>(C) Work is done in lifting the weight, but no work is required to hold it up.<br>(D) No work is done in lifting the weight, but work is required to be done in holding it up. | 1 |
| 12. | A bullet is fired from a rifle. If the rifle recoils, the kinetic energy of the rifle is<br>(A) Greater than that of a bullet.<br>(B) Less than that of a bullet.<br>(C) Equal to that of a bullet.<br>(D) None of the above. | 1 |

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| | **For Questions 13 to 16, two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the options given below.**<br>(A) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.<br>(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.<br>(C) Assertion is true but Reason is false.<br>(D) Both Assertion and Reason are false. | |
| 13. | **Assertion (A):** A body can have acceleration even when its velocity is zero.<br>**Reason (R):** Acceleration depends only on the change in speed, not on the velocity. | 1 |
| 14. | **Assertion (A):** The horizontal range of a projectile is the same for angles of projection $\theta$ and $(90 - \theta)$ for a given initial speed.<br>**Reason (R):** The horizontal range of a projectile is directly proportional to $(\sin 2\theta)$ | 1 |

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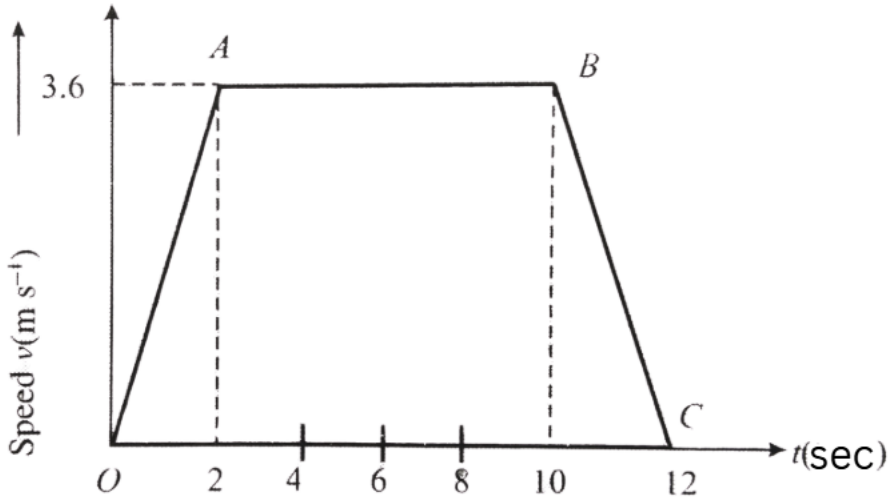
| 15. | **Assertion (A):** It is easier to pull a lawnmower than to push it.<br>**Reason (R):** Pulling reduces the normal reaction and hence the frictional force, while pushing increases the normal reaction and friction. | 1 |
| 16. | **Assertion (A):** The work done by a centripetal force in uniform circular motion is always zero.<br>**Reason(R):** In uniform circular motion, the centripetal force is always perpendicular to the instantaneous displacement of the particle. | 1 |
| | **SECTION B** | |
| 17. | Find the dimensions of 'ab' in the relation, $F = a\sqrt{x} + bt^2$ where 'F' is force, 'x' is distance and 't' is time. | 2 |
| 18. | (a) State the parallelogram law of vector addition.<br>(b) Find the magnitude and direction of the vector $\hat{\imath} + \hat{\jmath}$ | 2 |
| 19. | (a) Draw the variation of potential energy and kinetic energy of a block attached to a spring obeying Hooke's law.<br>(b) Define spring constant and write its S.I. unit. | 2 |
| 20(I) | A lift is going up. The total mass of the lift and the passengers is 1500 kg. The variation of the speed of the lift is given by the graph shown below:<br>  <br><br>(a) What will be the tension in the rope at t = 1 s?<br>(b) What will be the tension in the rope at t = 6 s? | 2 |
| | **OR** | |
| 20(II) | A woman pushes a box of mass 20 kg on a horizontal surface with a horizontal force of F. The coefficients of static and kinetic friction are $\mu_s = 0.6$ and $\mu_k = 0.5$.<br>(i) What must F be so that she can make the box start to slide?<br>(ii) If she maintains the same force once the block starts to slide, what will be its acceleration? | |

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| 21(I) | Prove the work-energy theorem for a constant force.<br>**OR**<br>Derive an expression for the elastic potential energy. | 2 |
| 21(II) | | |

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| | **SECTION C** | |
| 22. | A wave is set up in a stretched string by plucking it. The velocity 'v' of the wave depends upon tension 'F' in the string, its length 'l' and its mass 'm'. Derive an expression for the velocity of the wave using dimensional analysis. | 3 |
| 23. | Show that the path of a projectile is a parabola. | 3 |
| 24. | Two vectors are represented by $\vec{A}$ and $\vec{B}$ with Θ being the angle between them. Derive an expression for the magnitude and resultant of these two vectors using the law of vector addition. | 3 |
| 25. | State Newton's second law of motion and hence derive F = ma, where all the terms have their usual meanings. | 3 |
| 26. | Why is it easier to pull than push a body? Explain with the help of a neat diagram and write the necessary expressions to justify your answer. | 3 |

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| 27(I) | A body is dropped from rest at a height of 150 m, and simultaneously, another body is dropped from rest from a point 100 m above the ground. What is the difference between their heights after they have fallen for 3 seconds? Take g = 10 $ms^{-2}$.<br>**OR** | 3 |
| 27(II) | A bottle is dropped from a balloon and reaches the ground in 20 seconds. Determine the height of the balloon if<br>(a) it was at rest in the air.<br>(b) It was ascending with a speed of 50 $ms^{-1}$, when the bottle was dropped. | |
| 28. | State the law of conservation of mechanical energy and prove it in the case of a freely falling body. | 3 |
| | **SECTION - D** | |
| 29 | In a tall building, there is an elevator designed to carry a total load of up to 1800 kilograms, including passengers. One day, it moves upward at a steady speed of 2 $ms^{-1}$. However, the elevator faces a challenge: a frictional force of 4000 N opposes its motion, coming from the cables and machinery inside the shaft.<br>To keep the elevator moving smoothly at this constant speed, the motor must work hard to overcome both the weight of the elevator and the passengers pulling it down and the friction force pushing against it. | 1 Mark each |

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| | (I) The total downward force on the elevator due to its weight and the frictional force is<br>(A) 18000 N<br>(B) 22000 N<br>(C) 2200 N<br>(D) 1800 N<br><br>(II) The minimum power that must be delivered by the motor to the elevator to maintain this constant upward speed is<br>(A) 22000 W<br>(B) 44000 W<br>(C) 4400 W<br>(D) 2200 W<br><br>(III) In this elevator system, which statement is TRUE?<br>(A) Friction helps the elevator move up.<br>(B) The motor force equals the elevator's weight.<br>(C) The cable tension exceeds the elevator's weight.<br>(D) Power is independent of velocity.<br><br>(IV) What happens to the power required if the frictional force doubles while the speed remains constant?<br>(A) Power required halves.<br>(B) Power required doubles.<br>(C) Power required stays the same.<br>(D) Power output is zero. | |

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| 30. | When two teams, Team A and Team B, play tug-of-war, they pull on opposite ends of a rope. Suppose Team A pulls on the rope with a force $F_{AB}$ (force exerted on the rope by Team A), and Team B pulls with a force $F_{BR}$ (force exerted on the rope by Team B). According to Newton's Third Law of Motion, the rope also exerts forces back on the teams. Specifically, the rope pulls Team A with a force equal in magnitude but opposite in direction to $F_{AB}$. This means the force on Team A by the rope is $F_{RA}=-F_{AB}$.<br>Here's how the forces work between Team A and the rope:<br>• Team A pulls the rope forward with force $F_{AB}$.<br>• The rope pulls back on Team A with force $F_{RA}$, equal in magnitude but opposite in direction.<br>• This mutual interaction is an example of action-reaction pairs from Newton's Third Law. | |

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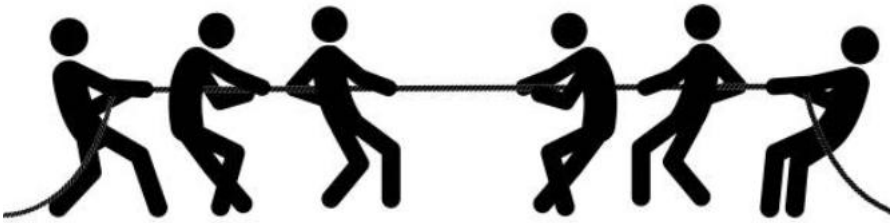
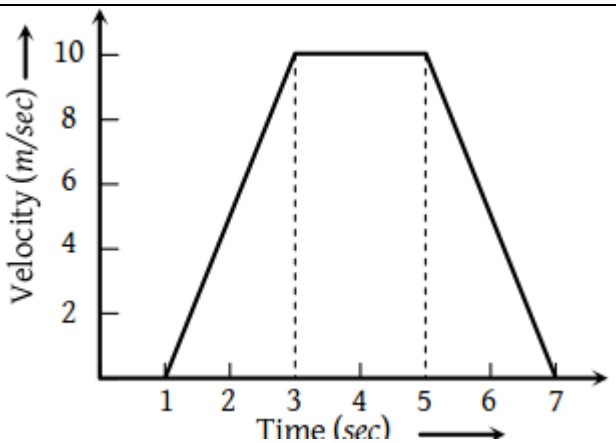
| |  <br> | |
| | (I) Team A pulls the rope with a force of 750 N to the east. Team B pulls with a force of 600 N to the west. The rope has a mass of 2 kg. Calculate the acceleration of the rope and give its direction. | 2 |
| | (II) In tug-of-war, one team eventually wins by pulling the other team across a line. If Newton's Third Law states that forces come in equal and opposite pairs, how is it possible for one team to win? | 1 |
| | (III) Explain any other example involving Newton's third law of motion. | 1 |
| | **SECTION E** | |
| 31(I) | (A) Using the v-t graph, derive $v^2 - u^2 = 2as$, where all the terms have their usual meanings.<br>(B) Two cars started simultaneously towards each other from towns A and B, which are 480 km apart. It took the first car, travelling from A to B, 8 hours to cover the distance and the second car, travelling from B to A, took 12 hours. Determine when the cars meet after starting and at what distance from town A. Assume that both cars travel at constant speed.<br>**OR** | 3+2 |
| 31(II) | (A) Using v-t graph, derive $s=ut+1/2\ at^2$, where all the terms have their usual meanings.<br>(B) The velocity–time graph is shown in the figure below. | 3+2 |




The distance covered by the body in the last two seconds of its motion is what fraction of the total distance covered in all seven seconds?

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| 32(I) | (A) Deduce the expression for the time of flight and horizontal range of a projectile, in terms of initial velocity and angle of projection.<br><br>(B) From the top of a building 19.6 m high, a ball is projected horizontally. After how long does it strike the ground? If the line joining the point of projection to the point where it hits the ground makes an angle of 45° with the horizontal, what is the initial velocity of the ball? | 3+2 |
| | **OR** | |
| 32(II) | (A) Define centripetal acceleration and hence derive an expression for the centripetal acceleration of a body moving in a circular path of radius 'r' with uniform speed 'v'.<br>(B) A stone tied to a string of length 1.2 m is whirled in a horizontal circle. If the centripetal acceleration is 25 m/s², find the linear and angular speed of the stone. | 3+2 |
| 33(I) | (A) Derive an expression for the maximum velocity of a car moving on a level circular road having a coefficient of friction μ.<br>(B) A car takes a circular turn of radius 20 m at a speed of 54 km/h. What is the least coefficient of friction between tyres and road that can prevent slipping?<br>(C) Give any two methods of increasing friction. | 2+2+1 |
| | **OR** | |
| 33(II) | (A) Derive an expression for the maximum velocity of a car moving on a banked circular road having a coefficient of friction μ.<br>(B) A banked road has a radius of curvature of 80 m and a banking angle of 60°. What is the safe speed for negotiating this turn without friction? (g = 9.8 m/s²) | 3+2 |