Indian School Al Wadi Al Kabir

Assessment I (2024-2025)

Class: XI | Sub: Physics (042) | Max. Marks: 70

Date: 22/09/2024 | Set - I | Time: 3 hours

General Instructions:

i. There are 33 questions in all. All questions are compulsory.
ii. This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
iii. All the sections are compulsory.
iv. **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.
v. There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.
vi. Use of calculators is not allowed.

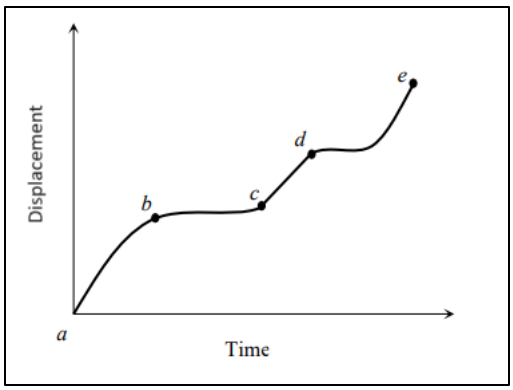
[SECTION – A] **(16x1=16 marks)**

1. The physical quantity with the dimensional formula $[ML^2T^{-3}]$ is
(a) Kinetic energy.
(b) Power.
(c) Acceleration.
(d) Force.

2. Given $Force = \frac{\alpha}{density+\beta^3}$. What are dimensions of α, β?
(a) $[ML^{-2}T^{-2}]$, $[ML^{-1/3}]$
(b) $[M^2L^4T^{-2}]$, $[M^{1/3}L^{-1}]$
(c) $[M^2L^{-2}T^{-2}]$, $[M^{1/3}\ L^{-1}]$
(d) $[M^2L^{-2}T^{-2}]$, $[ML^{-3}]$

3. Which of the following is a dimensional constant?
(a) Coefficient of friction
(b) Refractive index
(c) Speed of light in vacuum
(d) None of the above

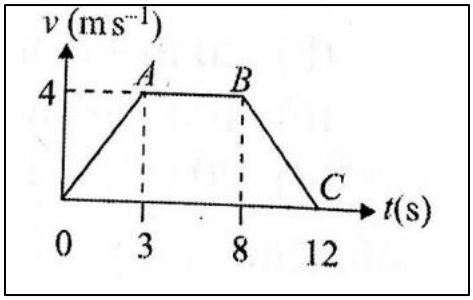
4. The displacement versus time graph for a body moving in a straight line is shown in figure. Which of the following regions represents the motion when no force is acting on the body?



(a) ab
(b) bc
(c) cd
(d) de

5. The velocity of a particle at an instant is 10 m/s. After 5 s, the velocity of the particle is 20 m/s. Find the velocity at 3 seconds before the instant when velocity of a particle is 10m/s.
(a) 8 m/s
(b) 4 m/s
(c) 6 m/s
(d) 7 m/s

6. From the velocity–time graph, given in figure of a particle moving in a straight line, one can conclude that



(a) Its average velocity during the 12 s interval is 24/7 m s^{-1}.
(b) Its velocity for the first 3 s is uniform and is equal to 4 m s^{-1}.
(c) The body has a constant acceleration between t = 3 s and t = 8 s.
(d) The body has a uniform retardation from t = 8 s to t = 12 s.

7. If range is double the maximum height of a projectile, then θ is
(a) $\tan^{-1} 1$
(b) $\tan^{-1}$ ¼
(c) $\tan^{-1}$ ½
(d) $\tan^{-1} 2$

8. In uniform circular motion, if the radius of the circle is doubled, keeping the speed constant, the centripetal acceleration:

(a) becomes half.
(b) becomes double.
(c) remains the same.
(d) becomes four times.

9. An object will continue moving uniformly when, the resultant force
(a) on it is increasing continuously.
(b) is at right angles to its rotation.
(c) on it is zero.
(d) on it begins to decrease.

10. A body whose momentum is constant must have constant
(a) velocity.
(b) force.
(c) acceleration.
(d) All of the above.

11. What happens to the elastic potential energy if the displacement 'x' is doubled, keeping the spring constant 'k' the same?
(a) The elastic potential energy doubles.
(b) The elastic potential energy halves.
(c) The elastic potential energy becomes four times greater.
(d) The elastic potential energy remains the same.

12. The minimum velocity (in m s^{-1}) with which a car driver must traverse a flat curve of radius 150 m and coefficient of friction 0.6 to avoid skidding is
(a) 60
(b) 30
(c) 15
(d) 25

For Questions 13 to 16, two statements are given–one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.
(a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.
(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) If Assertion is true but Reason is false.
(d) If both Assertion and Reason are false.

13. **Assertion(A):** A cloth covers a table. Some dishes are kept on it. The cloth can be pulled out without dislodging the dishes from the table.
Reason(R): For every action there is equal and opposite reaction.
14. **Assertion(A):** The average speed of a particle can never be less than the magnitude of its average velocity.
Reason(R): Average speed is the total distance travelled divided by the total time, while average velocity is the total displacement divided by the total time.
15. **Assertion(A):** Work done in moving a body over a closed loop is zero for every force in nature.
Reason(R): Work done does not depend on nature of force.
16. **Assertion(A):** The unit vector of a given vector has the same direction as the original vector.
Reason(R): A unit vector is a vector with magnitude 1 and is used to represent direction.

[SECTION – B] **(05x2=10 marks)**

17. Find the dimensions of 'ab' in the relation $P = \frac{b-x^3}{at}$ where 'P' is power, 'x' is distance and 't' is time.

18. A ball of mass m is thrown vertically up. Another ball of mass 2m is thrown at angle of Θ with the vertical. Both of them remain in the air for same period of time. What is the ratio of the heights attained by the two balls?

19. State work – energy theorem for a constant force and hence prove the same.

20. Explain the following:
    (a) Why does skidding take place generally on a rainy day along a curved path?
    (b) Why is it difficult to put a cycle into motion than to maintain its motion?

21. Two masses 1 g and 9 g are moving with equal kinetic energies. Find the ratio of the magnitudes of their respective linear momenta.

OR

A machine gun fires 60 bullets per minute with a velocity of 700 ms^{-1}. If each bullet has a mass of 50 g, find the power developed by the gun.

[SECTION – C] **(07x3=21 marks)**

22. Orbital velocity 'v' of a satellite may depend on its mass 'm', distance 'r' from the centre of earth and acceleration due to gravity 'g'. Using dimensional analysis, obtain an expression for orbital velocity.

23. A stone is thrown vertically upwards. When stone is at a height half of its maximum height, its speed is 10 m/s. Find the maximum height attained by the stone.

24. Define centripetal acceleration and hence derive an expression for the centripetal acceleration of a body moving in circular path of radius 'r' with uniform speed 'v'.

25. State parallelogram law of vector addition. Show that the magnitude of the resultant of two vectors $\vec{A}$ & $\vec{B}$ inclined at angle Θ is $R = \sqrt{A^2 + B^2 + 2ABcos\theta}$

26. State Newton's second law of motion and hence derive F=ma.

OR

Deduce Newton's first law of motion from Newton's second law of motion and hence define 1 N.

27. A neutron having a mass of 1.67×10^{-27} kg and moving at 10^8 ms^{-1} collides with a deuteron at rest and sticks to it. If the mass of the deuteron is 3.34×10^{-27} kg, find the speed of the combination.

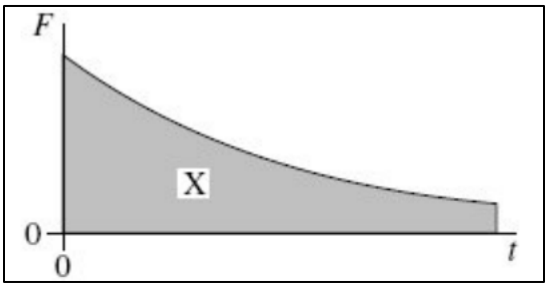
28. State and prove the principle of conservation of mechanical energy for a body freely falling under gravity.

[SECTION D] **(02x4=08 marks)**

29. **Case Study Based Question:**
    Imagine a car driving along a highway at a constant speed. The road is smooth, and there are no obstacles ahead, so the driver maintains a steady pace without accelerating or decelerating. According to Newton's First Law of Motion, this car will continue moving in a straight line at a constant speed as long as no external force

acts on it. This is known as uniform motion, and in this case, since the car's speed is constant, its acceleration is zero. Suddenly, a pedestrian unexpectedly crosses the road, and the driver needs to react quickly to avoid a collision. The driver immediately applies the brakes, which introduces an external force that acts on the car. The car's deceleration depends on the magnitude of the braking force and the mass of the car. A larger braking force will result in greater deceleration, and heavier the car, more force will be required to slow it down.

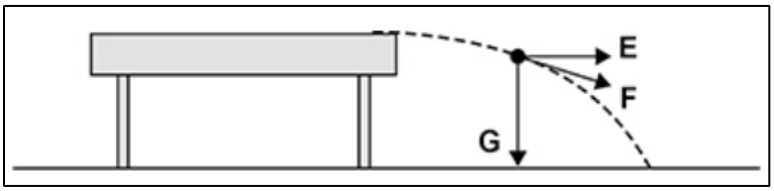
i. The graph shows the variation with time, t, of the force, F, acting on a body. What physical quantity does the area X represent?



(a) The displacement of the body.
(b) The acceleration of the body.
(c) The change in momentum of the body.
(d) The change in kinetic energy of the body.

ii. Which one of the following is the possible unit of rate of change of momentum?
(a) kg m/s
(b) Ns
(c) N/s
(d) kg m/s^2

iii. A coin is projected horizontally from the top of a desk. The diagram shows the coin at one point in its path. The air resistance is negligible.



The arrows E, F and G represent different directions. Which row gives the direction of the acceleration and the direction of the momentum of the coin at this point?

	acceleration	momentum
A	F	F
B	F	E
C	G	F
D	G	E

(a) A
(b) B
(c) C
(d) D

iv. When forces F_1, F_2, F_3 are acting on a particle of mass m such that F_2 and F_3 are mutually perpendicular and the particle remains stationary. If the force F_1 is now removed, then the acceleration of the particle is

(a) F_1/m
(b) F_2/m
(c) $(F_2 - F_3)/m$
(d) F_3/m

OR

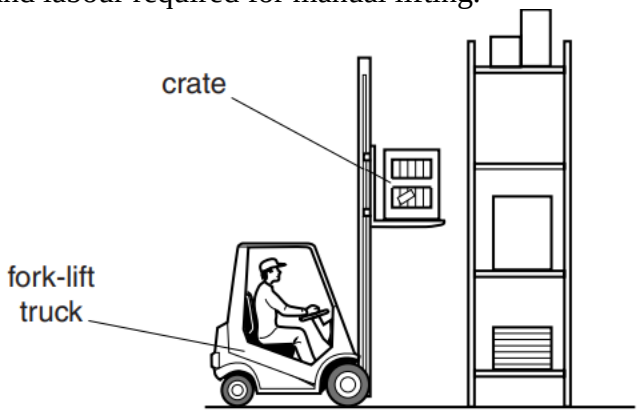
A body of mass 2 kg moves with an acceleration of 3 m/s. The change in momentum in one second is

(a) 6 kg m/s
(b) Zero
(c) 2/3 kg m/s
(d) 3/2 kg m/s

30. **Case Study Based Question:**

A forklift is used in a warehouse to move heavy objects with ease and efficiency. In this case, a forklift truck is lifting a crate onto a high shelf. The process involves understanding forces, the center of gravity, and safety protocols to ensure successful lifting and storage of the crate without accidents.

Forklifts are essential tools for optimising space in warehouses. By utilising high shelves, warehouses can store more products vertically without occupying extra floor space. This maximises storage capacity and allows for better organization of inventory. The use of forklifts helps move large or heavy loads efficiently, reducing the time and labour required for manual lifting.



The above figure shows a fork-lift truck lifting a crate on to a high shelf in a warehouse.

The fork-lift truck lifts a crate of weight 640 N through a vertical distance of 3.5 m in 4.0 s.

i. What is the useful work done in lifting the crate?

(a) 2240 J
(b) 224 J
(c) 22.4 J
(d) 240 J

ii. Which of the following situations involves the least power?

(a) Doing 500 J of work in 5 second.
(b) Doing 400 J of work in 2 second.
(c) Doing 200 J of work in 10 second.
(d) Doing 100 J of work in 1 second.

iii. What happens to the power if the same amount of work is done in half the time?

(a) Power is doubled.
(b) Power is halved.
(c) Power remains the same.
(d) Power is reduced by a quarter.

iv. Which of the following is equal with newton-metre?

(a) Joule
(b) Horse Power
(c) Watt
(d) Pascal

OR

What is the smallest unit of power?

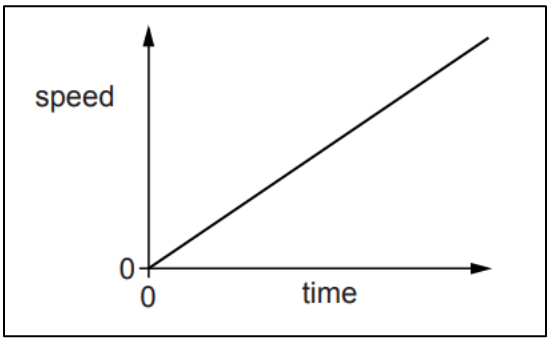
(a) Watt
(b) Kilowatt
(c) Horse power
(d) Milliwatt

[SECTION E] **(03×5=15)**

31. I. (a) Using v-t graph, derive $v^2 - u^2 = 2as$, where all the terms have their usual meanings.

(b) A bus travels at a constant speed. It stops for a short time and then travels at a higher constant speed. Draw a distance-time graph for this bus journey.

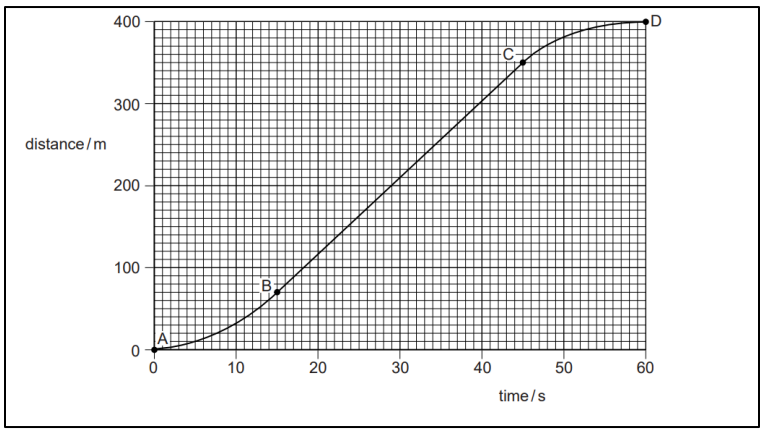
(c) Below is the speed – time graph for an object moving in a straight line. Describe the motion of the object shown by the graph.



OR

II. (a) Using v-t graph, derive $s=ut+1/2\ at^2$, where all the terms have their usual meanings.

(b) A girl rides her bicycle along a straight level road. Fig. shows a graph of her distance moved against time.



Describe her motion
(i) from A to B
(ii) from B to C

32. I. (a) Show that the path of a projectile is parabolic.
(b) A bullet 'P' is fired from a gun when the angle of elevation of the gun is 30°. Another bullet 'Q' is fired from the gun when the angle of elevation is 60°. The vertical height attained in the second case is 'x' times the vertical height attained in the first case. What is the value of 'x'?

OR

II. (a) Deduce the expression for time of flight and horizontal range of a projectile, in terms of initial velocity and angle of projection.
(b) Two stones are projected at an angle of 60° and 45° and the total heights reached are the same. Find the ratio of their initial velocities.

33. I. (a) Derive an expression for maximum velocity of a car moving on a banked circular road having coefficient of friction μ.
(b) Why is static friction called a self-adjusting force?

OR

II. (a) Derive an expression for maximum velocity of a car moving on a level circular road having coefficient of friction μ.
(b) Why is it easier to pull a lawn roller than to push it? Explain with necessary diagrams.