INDIAN SCHOOL SALALAH

FIRST TERM EXAMINATION – SEPTEMBER 2024

PHYSICS (042)

Class: XI **Date: 24/09/24**

Time: 3hrs. **Maximum Marks: 70**

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 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.

(6) Use of calculators is not allowed.

SECTION A

1. If force (F), acceleration (A) and time (T) are chosen as the fundamental physical quantities. Find the dimensions of energy.

   a. $[F][A^{-1}][T]$ b. $[F][A][T]$

   c. $[F][A][T^2]$ d. $[F][A][T^{-1}]$ **1**

2. The density of material in the CGS system of units is $4g/cm^3$. In a system of units in which unit of length is 10cm and unit of mass is 100g, the value of density of material will be:

   a. 0.4 b. 40

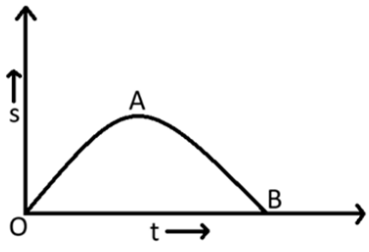
   c. 400 c. 0.04 **1**

3. A car moving with a velocity of 10m/s can be stopped by the application of a constant force F in a distance of 20m. if the velocity of the car is 30m/s, it can be stopped by this force in:

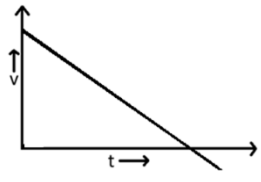
a. 100m b. 120m

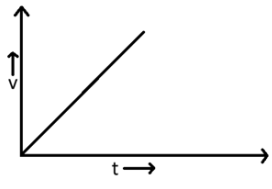
c. 180m d. 160m **1**

4. Velocity-time graph corresponding to displacement-time graph shown in adjoining figure is

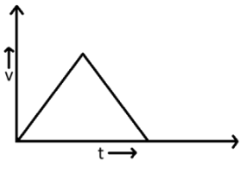


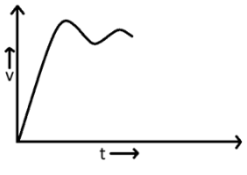
a. b.





c. d.





1

5. Kinetic energy of a body projected at an angle of 30^0 is E. The energy at the topmost point of the journey is:

a. E b. 3E/4

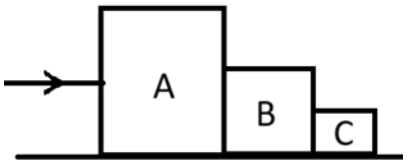
c. E/2 d. E/4 **1**

6. A particle moves in a circle of radius 5cm with a constant speed and time period 0.2π s. The acceleration of the particle is:

a. $15m/s^2$ b. $25m/s^2$

c. $36m/s^2$ d. $5m/s^2$ **1**

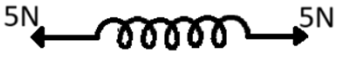
7. Three blocks A, B and C of masses 4kg, 2kg and 1 kg respectively, are in contact on a frictionless surface as shown. If a force of 14N is applied on the 4kg block then the contact force between A and B is:



a. 6N b. 8N

c. 18N d. 2N **1**

8. The tension in the spring is:



a. 5N b. 2.5N

c. 10N d. zero **1**

9. 300J of work is done in sliding a 2kg block up an inclined plane of height 10m. Taking g = 10m/s^2, work done against friction is:

a. 100J b. zero

c. 1000J d. 200J **1**

10. One coolie takes 1 minute to raise a suitcase through a height of 2m but the second coolie takes 30s to raise the same suitcase to the same height. The powers of two coolies are in the ratio of:

a. 1:2 b. 1:3

c. 2:1 d. 3:1 **1**

11. Water drops fall from the roof on a building 20m high at regular intervals. If the first drop strikes the floor when the sixth drop begins to fall, the heights of the second and the fourth drops from the ground at that instant are:

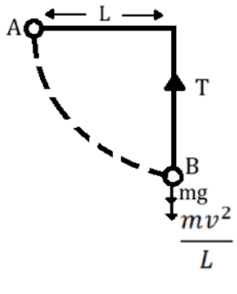
a. 12.8m and 3.2m

b. 12.8m and 7.2m

c. 19.2m and 0.8m

d. 7.2m and 16.8m **1**

12. The mass of the bob of a simple pendulum of length L is m. If the bob is left from its horizontal position then the speed of the bob and the tension in the thread in the lowest position of the bob will be respectively



a. $\sqrt{2gl}$ and $3mg$

b. $3mg$ and $\sqrt{2gl}$

c. $2mg$ and $\sqrt{2gl}$

d.$2gl$ and $3mg$

1

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 the 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.

e) If Assertion is false but Reason is true

13. **Assertion:** A circular railway track of radius r is banked at an angle θ so that a train moving with speed v can safely go round the track. Then, $\tan\theta = rg/v^2$.

Reason: The formula is dimensionally correct. **1**

14. **Assertion:** A body X is thrown vertically upwards with an initial velocity 45m/s. Another body Y is also thrown vertically upward with a velocity 27m/s. During the last ½ sec of motion of each body, speed of each reduces by the same value.

Reason: Both bodies are moving with the same acceleration. **1**

15. **Assertion:** In a collision between two bodies, each body exerts an equal and opposite force on the other at an instant of time during the collision.

Reason: The total energy of the system is conserved. **1**

16. **Assertion:** Velocity of heavy body and velocity of light body are different when they reaches the bottom of a smooth inclined plane from a height H.

Reason: Weight of heavy body is not equal to that of light body **1**

SECTION B

17.Explain why

a. Passengers are thrown forward from their seats when a speeding bus stops suddenly.

b. It is easier to pull a lawn mower than to push it. **2**

18. A particle is projected from the ground with a velocity of 30m/s. After 2sec, it just crosses a wall 10m high. Calculate the angle of projection of the particle. **2**

19. A) An object of mass 5kg falls from rest through a vertical distance of 20m and achieves a velocity of 10m/s. How much work is done by the resistance of the air on the object? **2**

OR

B) A particle of mass 4m which is at rest explodes into three fragments. Two of fragments, each of mass M, are found to move with a speed v each in mutually perpendicular directions. Calculate the total energy released in the process.

20. The length breadth and thickness of a rectangular sheet of metal are 4.234 m, 1.005 m, and 2.01cm respectively. Calculate the volume of the sheet to correct significant figures. **2**

21. Write two uses of dimensions. Convert one joule into erg. **2**

SECTION C

22. Assuming that the mass M of the largest stone that can be moved by flowing river depends on the velocity of water V density of water p and the acceleration due to gravity g. Show that m varies with sixth power of the velocity. **3**

23. Derive an equation for the distance covered by a uniformly accelerated body in the nth second of its motion. A body travels half its total path in the last second of its fall from rest. Calculate the time of its fall. **3**

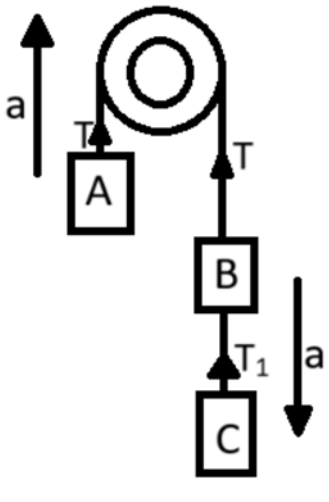
24. A particle starts from the origin at t = 0 s with a velocity of 10 **j** m/s and moves in the x-y plane with a constant acceleration of $(8.0\mathbf{i} + 2.0\mathbf{j})\ ms^{-2}$

a) At what time is the x-coordinate of the particle 16 m? What is the y-coordinate of the particle at that time?

b) What is the speed of the particle at the time? **3**

25. Derive Newton's first law and third law from the second law. **3**

26. A) Three blocks A, B and C, each of mass 2kg, are hanging on a string passing over a fixed frictionless pulley as shown in the figure. What is the tension T_1 in the string connecting blocks B and C ($g = 10 m/s^2$) **3**



OR

B) Define the term coefficient of limiting friction between two surfaces. A body of mass 10 kg is

placed on an inclined surface of angle 30^0. If the coefficient of limiting friction is $1/\sqrt{3}$ find the

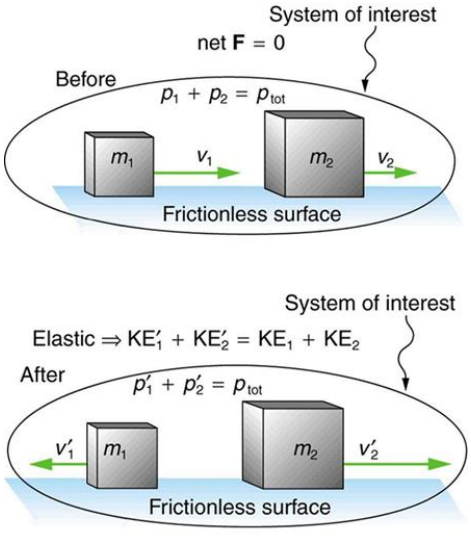
force required to just push the body up the inclined plane. Force is being exerted parallel to the inclined surface

27. Write the properties of conservative force. Show that spring force is a conservative force. **3**

28. Explain the law of conservation of linear momentum of the centre of mass with the help of an example. Write the position vector of the centre of mass of two particles of equal mass. If one of the particles is heavier than the other how the centre of mass will shift? **3**

SECTION D

29. Collision means two objects coming into contact with each other for a very short period. In other words, collision is a reciprocate interaction between two masses for a very short interval wherein the momentum and energy of the colliding masses changes. While playing caroms you might have noticed the effect of a striker on coins when they both collide. **4**



i) In an elastic collision in one dimension if a body A collides against another body B of equal mass at rest, the body A will

a) move with the same velocity, but in the opposite direction.

b) move with twice its initial velocity.

c) move with the same velocity in the same direction.

d) come to rest.

ii) Which physical quantity is conserved during both elastic and inelastic collisions?

a) kinetic energy

b) potential energy

c) momentum

d) velocity

iii) A large mass M moving with velocity v makes an elastic head-on collision with a small mass m at rest. What will be the expression for energy lost by M?

a) $3mv^2$ b) $mv^2/2$ c) $2mv^2$ d) mv^2

iv) A body of mass m moving with a constant velocity v hits another body of the same mass at rest and sticks to it. The velocity of the combined object after the collision is

a) 0 b) 2v c) V d) v/2

OR

iv) The ratio of masses of two balls is 2:1 and before collision the ratio of their velocities is 1:2 in mutually opposite direction. After collision each ball, moves in an opposite direction to its initial direction. If the ratio of velocity of separation to velocity of approach is 5/6, the ratio of speed of each ball before and after collision would be

a) (5/6) times

b) Equal

c) Not related

d) Double for the first ball and half for the second ball

30. Free-fall, in mechanics, state of a body that moves freely in any manner in the presence of gravity. The planets, for example, are in free fall in the gravitational field of the Sun. An astronaut orbiting Earth in a spacecraft experiences a condition of weightlessness because both the spacecraft and the astronauts are in free fall. An object in the technical sense of the term "free fall" may not necessarily be falling down in the usual sense of the term. An object moving upwards might not normally be considered to be falling, but if it is subject to only the force of gravity, it is said to be in free fall. The Moon is thus in free fall around the Earth, though its orbital speed keeps it in a very far orbit from the Earth's surface. **4**

i) What is the acceleration of a freely falling body?

a) less than $9.8m/s^2$

b) more than $9.8m/s^2$

c) depends on the mass of the body

d) $9.8m/s^2$

ii) Under which consideration the acceleration developed in an object is taken to be constant?

a) Height through which the object falls is greater than earth’s radius

b) Height through which the object falls is smaller than earth’s radius

c) The mass of the object is negligible

d) Both a and b

iii) Which of the following equations of motion is correct for free fall?

a) $v = 9.8t$ b) $h = 9.8t$ c) $v = \sqrt{(19.6h)}$ d) Both A and C

iv) The velocity-time graph of a freely falling body is

a) a straight line with positive slope to the time axis

b) a straight line with negative slope to the time axis

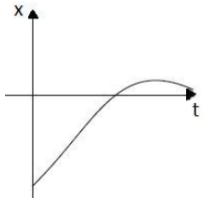
c) a straight line parallel to the time axis

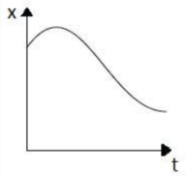
d) a straight line parallel to the acceleration axis

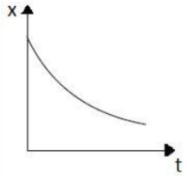
OR

iv) Among the four graphs, there is only one graph of which average velocity over the time interval (0, T) can vanish for a suitably chosen T. Which one is it?

a. b. c.





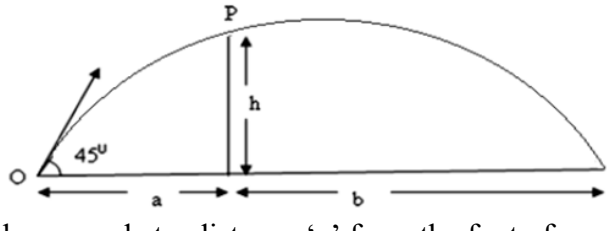


d. None of the above

SECTION E

31 A) a) Derive the expressions for maximum height, maximum horizontal range and time of flight of a projectile fired at an angle with horizontal.

b)



From a point on the ground at a distance 'a' from the foot of a pole of height 'h', a ball is thrown, at an angle of 45^0, which just touches the top of the pole and strikes the ground at a distance 'b', on the other side of it. Find the height of the pole as, **h = ab / (a + b)** **5**

OR

B) a) Define centripetal acceleration. Derive an expression for centripetal acceleration.

b) A body of mass 10kg revolves in a circle of diameter 0.4m making 1000 revolutions per minute. Calculate the linear velocity and centripetal acceleration.

32 A) Derive an expression for maximum speed that a car can take in a banked road.

A circular racetrack of radius 300 m is banked at an angle of 15^0. If the coefficient of friction between the wheels of a race car and the road is 0.2. (tan15 =0.26). What is the optimum speed of the race car to avoid wear and tear on its tire. **5**

OR

B) a) A cricketer pulls his hands backward while catching a ball. Give a reason.

b) Why does a horse pull a cart harder during the first few steps of its motion?

c) Sudden motion of a blanket removes the dust particles from the blanket. Why?

d) A batsman deflects a ball by an angle 45^0 without changing its initial speed which is equal to 54km/h. What is the impulse imparted to the ball? Mass of the ball is 0.15kg.

33 A) What is a rigid body? Define the centre of mass of a rigid body. Is centre of mass of a rigid body always inside the body? Justify. Derive expression for position vector of centre of mass of a two particle system. **5**

OR

B) Write the difference between translatory motion and rotational motion of a rigid body.

Derive an expression for the centre of mass of a uniform bar.

Find the centre of mass of a system of three particles at the vertices of an equilateral triangle.

The masses of the particle are 100g, 150g and 200g respectively. Each side of the equilateral triangle is 0.5m

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