Shaan Chawla
XI - B

TERM-I EXAMINATION

Class 11 - Physics

Time Allowed: 3 hours **Maximum Marks: 70**

General Instructions:

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(1) There are 39 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 Case study based questions 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. Given that the displacement of an oscillating particle is given by y = A sin(Bx + Ct + D). The dimensional formula for (ABCD) is: **[1]**

   a) $[M^0L^{-1}T^{-1}]$ b) $[M^0L^0T^0]$

   c) $[M^0L^{-1}T^0]$ d) $[M^0L^0T^{-1}]$

2. What will be the ratio of the distances moved by a freely falling body from rest in 4th and 5th seconds of journey? **[1]**

   a) 1 : 1 b) 16 : 25

   c) 7 : 9 d) 4 : 5

3. A projectile is given an initial velocity of $\hat{i} + 2\hat{j}$. The cartesian equation of its path is (Take g = 10 ms^{-2}) **[1]**

   a) $y = 2x - 5x^2$ b) $y = 2x + 15x^2$

   c) $y = 2x - 25x^2$ d) $y = x - 5x^2$

4. Two billiard balls each of mass 0.05 kg moving in opposite directions with speed 6 ms^{-1} collide and rebound at **[1]**

the same speed. What is the impulse imparted to each ball due to the other?

a) 0.4 kg ms^{-1} b) 0.6 kg ms^{-1}

c) 0.3 kg ms^{-1} d) 0.5 kg ms^{-1}

5. A body of mass 10 kg lies on a rough horizontal surface. When a horizontal force of F Newtons acts on it, it gets an acceleration of 5 m/s^2 and when the horizontal force is doubled, it gets an acceleration of 18 m/s^2. The coefficient of friction between the body and the horizontal surface (assume $g = 10\ m/s^2$) is [1]

a) 0.4 b) 0.8

c) 0.2 d) 0.6

6. A spring of force constant 800 Nm^{-1} has an extension of 5 cm. The work done in extending it from 5 cm to 15 cm is [1]

a) 32 J b) 24 J

c) 8 J d) 16 J

7. The force on a particle as the function of displacement x (in x-direction) is given by $F = 10 + 0.5x$ The work done corresponding to displacement of particle from $x = 0$ to $x = 2$ unit is [1]

a) 29 J b) 21 J

c) 25 J d) 18 J

8. An iron chain lies on a rough horizontal table. It starts sliding when one-fourth of its length hangs over the edge of the table. The coefficient of static friction between the chain and surface of the table is [1]

a) $\frac{1}{2}$ b) $\frac{1}{4}$

c) $\frac{1}{3}$ d) $\frac{1}{5}$

9. If the linear momentum is increased by 50%, then kinetic energy will increase by [1]

a) 125% b) 25%

c) 50% d) 100%

10. A body is moving along a circular path. How much work is done by the centripetal force? [1]

a) Zero b) -2 J

c) 3 J d) -1 J

11. One circular ring and one circular disc both are having the same mass and radius. The ratio of their moments of inertia about the axis passing through their centres and perpendicular to their planes will be [1]

a) 1 : 2 b) 2 : 1

c) 1 : 1 d) 4 : 1

12. The separation between C and O atoms in CO is 1.2 A. The distance of carbon atom from the centre of mass is [1]

a) 0.7 Å b) 0.5 Å

c) 0.3 Å d) 0.9 Å

13. **Assertion:** Two balls of different masses are thrown vertically upward with the same speed. They will pass through their point of projection in the downward direction at the same speed. [1]

Reason: The maximum height and downward velocity attained at the point of projection are independent of the mass of the ball.

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 the reason is not the correct explanation of assertion.

c) If the assertion is true but the reason is false.

d) If both assertion and reason are false.

14. **Assertion (A):** When a stationary bus starts suddenly, our feet being in touch with the floor of the bus also start moving with the bus. [1]

Reason (R): There is friction between the feet and the floor of the bus.

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

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

15. **Assertion:** Graph between potential energy of a spring versus the extension or compression of the spring is a straight line. [1]

Reason: Potential energy of a stretched or compressed spring is proportional to square of extension or compression.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

16. **Assertion:** It is more difficult to open the door by applying the force near the hinge. [1]

Reason: Torque is maximum at hinge.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

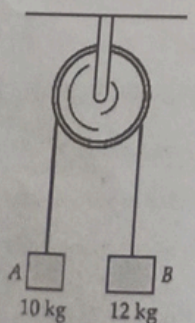
c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

Section B

17. Find the dimensions of $\frac{a}{b}$ in the equation: $F = a\sqrt{x} + bt^2$, where F is force, x is distance and t is time. [2]

18. In the given pulley block system as shown in fig, the system starts from rest. What is the speed and distance moved by each mass at t = 3s? [2]



19. A body of mass 0.5 kg travels in a straight line with velocity $v = ax^{3/2}$, where $a = 5m^{-\frac{1}{2}}s^{-1}$. What is the work [2]

done by the net force during its displacement from x=0 to x=2m?

OR

It is well known that a raindrop falls under the influence of the downward gravitational force and the opposing resistive force. The latter is known to be proportional to the speed of the drop but is otherwise undetermined. Consider a drop of mass 1.00 g falling from a height 1.00 km. It hits the ground with a speed of 50.0 ms^{-1}.

a. What is the work done by the gravitational force?

b. What is the work done by the unknown resistive force?

20. Prove that the rate of change of total angular momentum of a system of particles about a reference point is equal to the total torque acting on the system. [2]

21. A 40 kg flywheel in the form of a uniform circular disc of 1 m radius is making 120 rpm. Calculate the angular momentum. [2]

Section C

22. Derive by the method of dimensions, an expression for the volume of a liquid flowing out per second through a narrow pipe. Assume that the rate of flow of liquid depends on: [3]

i. the coefficient of viscosity η of the liquid

ii. the radius r of the pipe and

iii. the pressure gradient $\left(\frac{p}{l}\right)$ along the pipe.

Take $K = \frac{\pi}{8}$

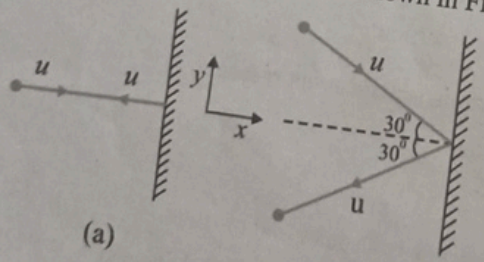
23. From the top of a multi-storeyed building, 39.2 m tall, a boy projects a stone vertically upwards with an initial velocity of 9.8 ms^{-1} such that it finally drops to the ground, [3]

i. When will the stone reach the ground?

ii. When will it pass through the point of projection?

iii. What will be its velocity before striking the ground? Take g = 9.8 ms^{-2}.

24. Two identical billiard balls strike a rigid wall with the same speed but at different angles, and get reflected without any change in speed, as shown in Fig. What is [3]

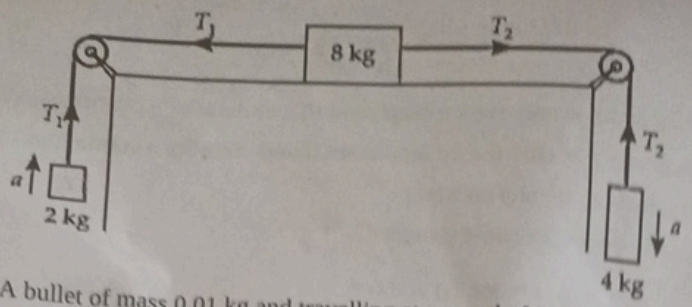


(a) (b)

a. the direction of the force on the wall due to each ball?

b. the ratio of the magnitudes of impulses imparted to the balls by the wall?

25. In figure, find the acceleration of the system and the tensions T_1 and T_2 in the strings. Assume that the table and the pulleys are frictionless and the strings are massless. Take g = 9.8 ms^{-2}. [3]



26. A bullet of mass 0.01 kg and travelling at a speed of 500 ms^{-1} strikes a block of mass 2 kg which is suspended by a string of length 5 m. The geometrical centre of the block is found to rise a vertical distance of 0.1 m. What is the speed of the bullet after it emerges from the block? Take g = 9.8 ms^{-2}. [3]

27. An object of mass 0.4 kg moving with velocity of 4 m/s collides with another object of mass 0.6 kg moving in same direction with a velocity of 2 m/s . If the collision is perfectly inelastic, what is the loss of KE due to impact? [3]

OR

State and prove work-kinetic energy theorem for a variable force.

28. Two point masses of 2 kg and 10 kg are connected by a weightless rod of length 1.2 m. Calculate the M.I. of the system about an axis passing through the centre of mass and perpendicular to the system. [3]

Section D

Question No. 29 to 32 are based on the given text. Read the text carefully and answer the questions: [4]

While treating the topic of projectile motion, it is assumed that the air resistance has no effect on the motion of the projectile.

Friction, force due to viscosity, air resistance are all dissipative forces. In the presence of any of such force opposing motion, any object will lose some part of its initial energy and consequently, momentum too. Thus, a projectile that traverses a parabolic path will certainly show deviation from its idealised trajectory in the presence of air resistance. It will not hit the ground with the same speed with which was projected from it.

In the absence of air resistance, the x-component of the velocity remains constant and it is only the y-component that undergoes a continuous change. However, in the presence of air resistance, both of these will get affected. That means that the range will be less than the value calculated from equation

$$R = \frac{u^2 \sin 2\theta_0}{g}$$

Maximum height attained will also be less than the value predicted by the equation

$$H_{max} = \frac{(u \sin \theta_0)^2}{2g}$$

In order to avoid air resistance, we will have to perform the experiment in vacuum or under low pressure.

29. In presence of air resistance, a projectile

a) Both Loses its energy and momentum
b) Loses its energy
c) Loses its momentum
d) Loses its acceleration

30. In the absence of air resistance,

i. the x-component of the velocity remains constant and it is only the y-component that undergoes a continuous change
ii. the y-component of the velocity remains constant and it is only the x-component that undergoes a continuous change
iii. the x-component and y-component of the velocity both remain constant
iv. the x-component and y-component of the velocity both vary continuously

a) Option (iv)
b) Option (i)

c) Option (ii)

d) Option (iii)

31. In presence of air resistance,

i. the x-component of the velocity remains constant and it is only the y-component that undergoes a continuous change

ii. the y-component of the velocity remains constant and it is only the x-component that undergoes a continuous change

iii. the x-component and y-component of the velocity both remain constant

iv. the x-component and y-component of the velocity both vary continuously

a) Only Option (iii)

b) Option (i) and (ii)

c) Only Option iv

d) Option (iv) and (ii)

32. Following chart shows the acceleration due to gravity of different planets.

Planet	Acceleration due to gravity, g
Mercury	3.59
Venus	8.87
Earth	9.81
Mars	3.77
Jupiter	25.95
Saturn	11.08

Which one of the following statement is correct?

i. Range and maximum height of a projectile with same initial velocity and angle of projection will be same in each planet.

ii. Range and maximum height of a projectile with same initial velocity and angle of projection will be maximum at Jupiter.

iii. Range and maximum height of a projectile with same initial velocity and angle of projection will be minimum at Mercury.

iv. Range and maximum height of a projectile with same initial velocity and angle of projection will be minimum at Jupiter.

a) Option (iii)

b) Option (ii)

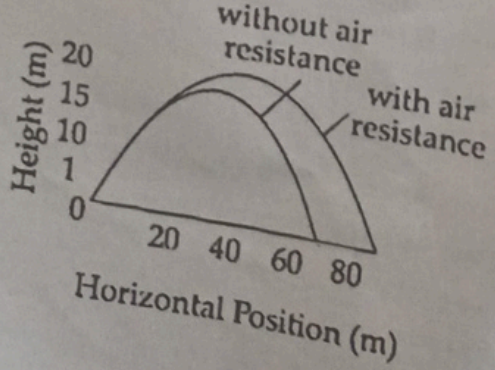
c) Option (i)

d) Option (iv)

OR

Which of the following diagram correctly depicts the path of a projectile in presence and absence of air resistance?

a)



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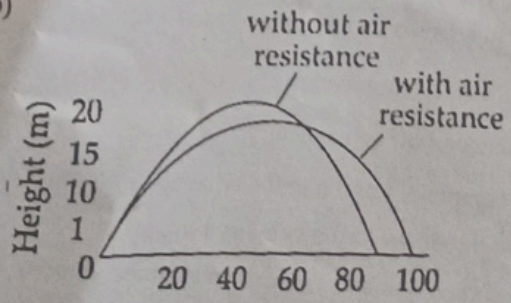
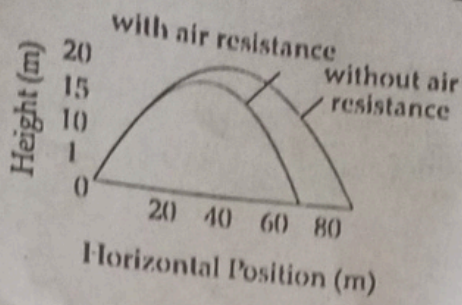
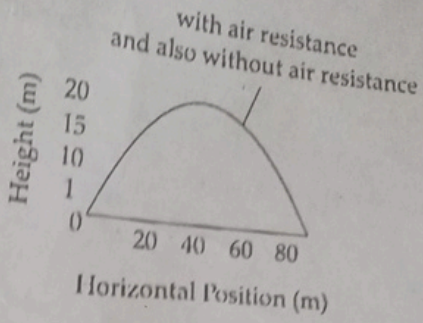


c)

d)

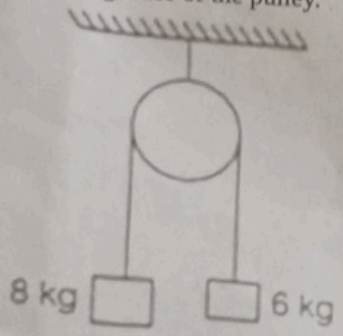




Question No. 33 to 36 are based on the given text. Read the text carefully and answer the questions: [4]

When bodies are in contact, there are mutual contact forces satisfying the third law of motion. The component of contact force normal to the surfaces in contact is called normal reaction. The component parallel to the surfaces in contact is called friction.

In the figure, 8 kg and 6kg are hanging stationary from a rough pulley and are about to move. They are stationary due to the roughness of the pulley.



33. Which force is acting between pulley and rope?

a) Tension force
b) Gravitational force
c) Buoyant force
d) Frictional force

34. The normal reaction acting on the system is:

a) 2 g
b) 8 g
c) 14 g
d) 6 g

35. The tension is more on side having mass of:

a) 8 kg
b) Same on both
c) 6 kg
d) Nothing can be said

36. Coefficient of friction of the pulley is:

a) $\frac{1}{6}$
b) $\frac{1}{7}$
c) $\frac{1}{4}$
d) $\frac{1}{5}$

OR

The force of friction acting on the rope is:

a) 40 N
b) 20 N
c) 30 N
d) 50 N

Section E

37. (a) Derive second equation of motion using graphical method.

(b)A hundred metre sprinter increases her speed from rest uniformly at the rate of 1 ms^{-2} upto three quarters of the total run and covers the last quater with uniform speed. How much time does she take to cover the first half and the second half of the run? [5]

OR

(a) Derive third equation of motion by graphical method.

(b)Two particles move along x - axis. The position of particle 1 is given by $x = 6.00t^2 + 3.00t + 2.00$ (in metre and in seconds); acceleration of particle 2 is given by a = - 8.00 t(in m/s^2 and seconds) and at t = 0, its velocity is 20 m/s. When the velocities of the particles match, find their velocities.

38. (a) Prove that the path followed by a projectile when projected at an angle from ground is a parabola.

(b)A particle starts from the origin at t = 0 s with a velocity of $10.0\hat{j}\,m/s$ and moves in the x-y plane with a constant acceleration of $(8.0\hat{i} + 2.0\hat{j})ms^{-2}$. [5]

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?

OR

(a) Two vectors P and Q are inclined at an angle θ. Derive a formula for resultant of these vectors using triangle law.

(b) $\hat{i}$ and $\hat{j}$ are unit vectors along x and y-axes respectively. What is the magnitude and direction of vectors $\hat{i} + \hat{j}$ and $\hat{i} - \hat{j}$? What are the components of a vector $A = 2\hat{\mathbf{i}} + 3\hat{\mathbf{j}}$ along the direction $\hat{i} + \hat{j}$ and $\hat{i} - \hat{j}$?

39. a. What do you mean by centripetal force?

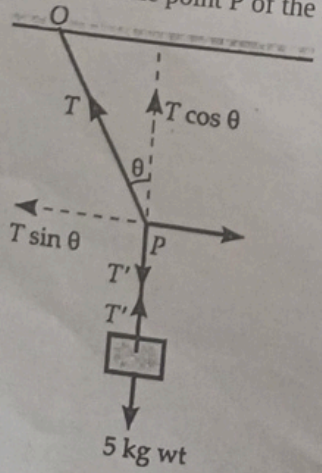
b. Draw a diagram showing the motion of a car on a rough horizontal road. Show various forces acting, on this car in the diagram. Hence derive an expression for maximum speed of the car. [5]

c. Determine the maximum acceleration of the train in which a box lying on its floor will remain stationary. Given that coefficient of friction between the box and the train's floor is 0.15. Take g = 10 ms^{-2}.

OR

(a) Show that Newton's second law of motion is the real law of motion.

(b)A mass of 5 kg is suspended by a rope of length 2 m from a ceiling. A force of 50 N in the horizontal direction is applied at the point P of the rope, as shown in figure.



i. What is the angle the rope makes with the vertical in equilibrium? Take g = 10ms^{-2}. Neglect the mass of the rope.

ii. What is the tension in the rope?