Bhavan's Tripura Vidyamandir
1st Terminal Examination: (2025-2026)

Class:- 11 **Subject:- Physics**
Time:- 3 Hours Total :- 70 Marks
Name of the student: Roll: Sec:

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. All the sections are compulsory.

(3) Section A contains twelve MCQ & four Assertion-reason question 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-based questions of 4 marks each, section E contains three long questions of five marks each.

(4) There is no overall choice. However, an internal choice has been provided in section B, C, D. You have to attempt only one of the choices in such questions.

(5) Use of calculators is not allowed.

SECTION-A [1X16=16]

Each of the following carries 1 mark:

1. The kinetic energy of a rolling body is:
   a) Only translational b) Only rotational
   c) Translational + rotational d) Translational – rotational
2. If the mass of the Earth decreases to half and its radius remains the same, the escape velocity will:
   (a) Decrease by factor (b) Decrease by factor
   (c) Increase by factor (d) Remain unchanged
3. A projectile is launched with speed at angle . If the maximum height equals the horizontal range, is:-
   a) 60° b) 45° c) 75° d) 30°
4. The dimensional formula of impulse is-
   a) [M L T^{-2}] b) [M L T^{-1}] c) [$M L^2 T^{-1}$] d) [$M^2 L T^{-1}$] .
5. When a body is dropped from a tower, then there is an increase in its-
   a) Mass b) Velocity c) Acceleration d) Potential energy
6. The torque on a body is given by $\tau = 3t^2$ (in N m). If the initial angular velocity is zero, the angular displacement in 2 s is:-
   a) 4 rad b) 6 rad c) 8 rad d) 12 rad
7. What are the dimensions of $\frac{A}{B}$ in the relation $F = A\sqrt{x} + Bt^2$, where F is force, x is distance and t is time?
   a) [$M L^2 T^{-2}$] b) [$L^{-1/2} T^2$] c) [$L^{-1/2} T^{-1}$] d) [$L T^{-2}$]
8. The Potential energy of a long spring where stretched by 2 cm is U. If the spring is stretched by 8 cm the Potential energy stored is –
   a) U/4 b) 4U c) 8 U d) 16 U
9. How much work must be done by a force on 50 kg body in order to accelerate it from rest to 20m/s in 10s ?
   a) 10^3 J b) 10^4 J c) 2 x 10^3 J d) 4 x10^4 J
10. The equation for displacement of a particle is
    $x = A\sin(\omega t + \Phi) + Bt^2$ .The SI unit of B is:
    a) m/s b) m/s^2 c) m/s^3 d) m^2/s^2
11. 300 J of work is done is sliding a 2 kg block up on inclined plane of height 10 m, the work done against friction is –
    a) 200J b) 100J c) Zero d) 1000J
12. Which of the following parameters of a particle executing uniform circular motion remains constant?
    a) speed b) angular velocity c) radial acceleration d) all of these

Question number (13-16) these consist of two statements-Assertion (A) and Reason(R). Answer the question selecting the appropriate option given below:

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true and R is not the correct explanation of A.
(c) A is true but R is false
(d) A is false but R is true

13. **Assertion(A):** A body becomes weightless at the centre of earth.
Reason(R): As the distance form centre of earth decreases, acceleration due to gravity increases.
14. **Assertion(A):** Two particles of different mass, projected with same velocity at same angles. The maximum height attained by both the particle will be same.
Reason(R): The maximum height of projectile is independent of particle mass.
15. **Assertion(A):** Work done by the force of friction in moving a body around a closed loop is zero.
Reason(R): Work done does not depend upon the nature of force.
16. **Assertion(A):** A man rowing a boat upstream is at rest with respect to the bank. He is doing no external work.
Reason(R): Work done by constant force, W = F s cosθ.

SECTION-B [2X5=10]

17. Three masses 3kg, 4kg and 5 kg are located at the corners of an equilateral triangle of side 1 m. Locate the centre of mass of the system.
18. The equation of state of the gas is expressed as $(P+ a/v^2)(V-b)= nRT$. Where, P = pressure, V = volume, T = temperature and n, a, b, R are constants. Find out the dimensions of a/b.
19. The displacement of a body is given to be proportional to the cube of time elapsed. What is the nature of the acceleration of the body?
20. A jet plane starts from rest with an acceleration of 3 ms-2 and makes a run for 35 s before taking off. What is the minimum length of the runway and what is the velocity of the jet at take off?
21. State vector parallelogram law of vector addition.

Or,

State vector triangular law of vector addition.

SECTION-C [3X7=21]

22. Show that elastic force of a spring is a conservative force. Hence show that the potential energy is $\frac{1}{2}kx^2$
23. If the linear momentum of a body increased by 30%. What will be the percentage increase in kinetic energy of the body?

Or,

A bullet of 10g is fired with a velocity of 850 m/s. After passing through a mud wall 1m thick, its velocity decreased to 90 m/s. Find the resistive force offered by the mud wall.

24. A ball moving with a momentum of 5 kg m/s strikes against a wall at an angle of 30° and is reflected at the same angle. Calculate the change in momentum.
25. Prove the relation $\vec{\tau} = \frac{d\vec{L}}{dT}$ (where symbol has their usual Meaning).
26. Find the percentage decrease in weight of a body, when taken 16 km below the surface of the earth. Take radius of the earth as 6400 km
27. State and prove the work-energy theorem for a variable force.
28. A pump on the ground floor of a building can pump up water to fill a tank of volume 30 m^3 in 15 min. If the tank is 40 m above the ground and efficiency of pump is 30%, how much electric power is consumed by the pump?

SECTION-D [4X2=8]

Case Study:

29. ***Read the following paragraph and answer the questions*.**

Moment of inertia of a body about a given axis is the rotational inertia of the body about that axis. It is represented by $I= MK^2$, where M is mass of body and K is radius of gyration of the body about that axis. It is a scalar quantity, which is measured in kgm^2. When a body rotates about a given axis, and the axis of rotation also moves, then total K.E. of body =K.E. of translation + K.E. of rotation $E = 1/2\ mv^2 + 1/2\ I\omega^2$

With the help of above comprehension, choose the most appropriate alternative for each of the following questions:

i) Moment of inertia of a body depends on

(1) Mass of body (2) size and shape of body

(3) axis of rotation of body (4) all the above

(a) (1) and (2) (b) (1) and (3) (c) (2) and (3) (d) (4)

ii) A circular disc and a circular ring of same mass and same diameter have ____about a given axis.

(a) same moment of inertia (b) unequal moments of inertia

(c) cannot say (d) sometimes equal sometimes not

iii) A 40 kg flywheel in the form of a uniform circular disc of diameter 1m is making 120 rpm. Its moment of inertia about a transverse axis through its centre is-

(a) $40kgm^2$ (b) $5kgm^2$ (c) $10kgm^2$ (d) $20kgm^2$

iv)The dimensional formula of torque is same as that of-

(a) Angular momentum (b) Work (c) Momentum (d) Force

30. Here are many types of spring. Important among these are helical and spiral spring as shown in figure.

Usually, we assume that the springs are massless. Therefore, work done is stored in the spring in the form of elastic potential energy of the spring. Thus, potential energy of a spring is the energy associated with the state of compression or expansion of an elastic spring.

(i) The ratio of spring constants of two springs is 2 : 3. What is the ratio of their potential energy, if they are stretched by the same force?

(a) 2:3 (b) 3:4 (c) 4:9 (d) 9:4

(ii) The potential energy of a body is increases in which of the following cases?

(a) If work is done by conservative force (b) If work is done against conservative force

(c) If work is done by non-conservative force (d) If work is done against non- conservative force

(iii) The potential energy, i.e., U (x) can be assumed zero when

(a) x =0 (b) gravitational force is constant

(c) infinite distance from the gravitational source (d) All of the above

(iv)The potential energy of a spring increases by 15 J when stretched by 3 cm. If it is stretched by 4 cm, the increase in potential energy is-

(a) 27 J (b) 30 J (c) 33 J (d) 36 J

SECTION-E **[5X3=15]**

31) i) Define conservative force. Explain qualitatively that how is the gravitational force a conservative force.

ii) In a ballistics demonstration, a police officer fires a bullet mass 50 g with speed 200 ms^{-1} on soft plywood of thickness 2.00cm. The bullet emerges only with 10% of its initial kinetic energy. What is the emergent speed of the bullet? **[1+2+2]**

Or,

a) Two blocks of mass 2 kg and 5 kg are connected by an ideal string passing over a pulley. The block of mass 2 kg is free to slide on a surface inclined at an angle of 30^0 with the horizontal whereas 5 kg block hangs freely. Find the acceleration of the system and the tension in the string.

b) The motion of a particle of mass m is described by $y= ut + \frac{1}{2} gt^2$. Find the force acting on the particle. **[3+2]**

32) i) Define Orbital velocity and escape velocity.

ii) Derive an expression for the escape velocity of a body mass m, for our earth surface. **[1+1+3]**

Or,

Define Zero vector? The position of a particle is given by $\vec{r} = 3t\,\hat{\imath} + 2t^2\,\hat{\jmath} + 5\hat{k}$. Where t is in seconds and the coefficients have the proper units for r to be in metres.

(a) Find v(t) and a(t) of the particle.

(b) Find the magnitude and direction of v(t) at t =3s. **[1+4]**

33. i) Explain (prove) why pulling is easier than pushing with a neat sketch on a rough horizontal plane.

ii) A bullet of mass 0.04kg moving with a speed of 90 m/s enters a heavy wooden block and is stopped after a distance of 60 cm. What is the average force exerted by the block on the bullet? **[3+2]**

Or,

i) A car moving along a straight highway with speed of 126 kmh^{-1} is brought to a stop within a distance of 200 m. What is the retardation of the car (assumed uniform), and how long does it take for the car to stop?

ii) A ball A is thrown vertically upwards with a speed of 25 m/s from the ground. Another ball B is thrown vertically downward from a height of 50 m with the same speed and along the line of motion of a ball A. at what point the two balls collide? Take g = 9.8 m/s2 **[3+2]**