Bhavan's Tripura Vidyamandir

1st Terminal Examination (2024-2025)

Class:-11 **Subject:-Physics**

Time:-3 Hours Total :- 70 Marks

Name of the student : Roll: Section:

General instructions:

- There are 33 questions in all. All questions are compulsory
- This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.
- 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.
- 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.
- Use of calculators is not allowed.

SECTION-A [1X16=16]

Each of the following carries 1 mark:

1. If $|\vec{A} + \vec{B}| = |\vec{A}| + |\vec{B}|$, then the angle between $\vec{A}$ *and* $\vec{B}$ will be
   a) 90^0 b) 120^0 c) 0^0 d) 60^0

2. If '*s*' represents distance and 'S' represent displacement, then $\frac{|S|}{s}$ is-
   a) >1 b) <1 c) =1 d) ≤ 1

3. A particle starts its motion from rest under the action of a constant force. If the distance covered in first 10 sec is S_1 and that covered in the first 20 sec is S_2 ,then-
   a) $S_2 = 3S_1$ b) $S_2 = 4S_1$ c) $S_2 = S_1$ d) None of the above

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 masses of two planets are in the ratio 1:2, their radii are in the ratio 1:2. The acceleration due to gravity on the planets are in the ratio-
   a) 1:2 b) 2:1 c) 3:5 d) 5:3

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 masses of two planets are in the ratio 1 : 2. Their radii are in the ratio 1 : 2. The acceleration due to gravity on the planets are in the ratio.
   a) 1 : 2 b) 2 : 1 c) 3 : 5 d) 5 : 3
11. A body is projected from earth's Surface to become its satellite. Its time period of revolution will not depends upon.
   a) Mass of earth b) Its own mass
   b) gravitational constant d) Radius of earth
12. 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

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):** In projectile motion, the angle between the instantaneous velocity and acceleration at the highest point is 180°.

    Reason(R): At the highest point, velocity of projectile will be in horizontal direction only.

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):** Impulsive force is large and acts for a short time.

    Reason(R): Finite change in momentum should be produced by the 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. Find the value of 'a' for which the vector $\vec{A} = 3\,\hat{\imath} + 3\,\hat{\jmath} + 9\,\hat{k}$ and $\vec{B} = \hat{\imath} + a\,\hat{\jmath} + 3\,\hat{k}$ are parallel.
18. If the error in measuring the radius of a sphere is 2%. What would be the error in the measurement of volume of the sphere?
19. What is Reaction time? Find its expression.
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 Kepler's laws of planetary motion
    a) Law of Area (Second Law) b) Law of periods (Third Law)

OR

The value of g (acceleration due to gravity) is not constant. Derive an expression of 'g' at altitude h.

SECTION-C [3X7=21]

22. A ball whose kinetic energy is E, is projected at an angle of 45^0 to the horizontal. What will be the kinetic energy of the ball at the highest point of the flight?
23. If the linear momentum of a body increased by 20%. What will be the percentage increase in kinetic energy of the body?

OR

A bullet of 10g is fired with a velocity of 800 m/s. After passing through a mud wall 1m thick, its velocity decreased to 100 m/s. Find the resistive force offered by the mud wall.

24. Using the method of calculus, Prove that, $x = x_0 + v_0t + \frac{1}{2}gt^2$ (where symbol has their usual Meaning)
25. Prove the relation $\vec{\tau} = \frac{d\vec{L}}{dT}$ (where symbol has their usual Meaning).
26. How much below the surface of the earth does the acceleration due to gravity become 70% of its value at the surface of earth? (Take R= 6400 km)
27. State and prove the work-energy theorem for a variable force.
28. Show that are given gun will shoot three times as high when elevated at an angle of 60° when fired at an angle of 30 degree but will carry the same distance on a horizontal plane.

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 40kg 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) 40kgm2 (b) 5kgm2 (c) 10kgm2 (d) 20kgm2

iv) Kinetic energy of rotation of flywheel in the above case is-

(a) 20J (b) 2J (c) 400J (d) 80J

OR

The dimensional formula of torque is same as that of-

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

30) Depending on the location, an object at the surface of Earth falls with an acceleration between 9.76 and 9.83 m/s^2(32.0 and 32.3 ft/s2). Earth is not exactly spherical. It is similar to a "squashed" sphere, with the radius at the equator slightly larger than the radius at the poles. This has the effect of slightly increasing gravitational acceleration at the poles (since we are close to the centre of Earth and the gravitational force depends on distance) and slightly decreasing it at the equator. Also, because of centripetal acceleration, the acceleration due to gravity is slightly less at the equator than at the poles. Changes in the density of rock under the ground or the presence of mountains nearby can affect gravitational acceleration slightly.

The acceleration of an object changes with altitude. The change in gravitational acceleration with distance from the centre of Earth follows an inverse-square law. This means that gravitational acceleration is inversely proportional to the square of the distance from the centre of Earth. As the distance is doubled, the gravitational acceleration decreases by a factor of 4. As the distance is tripled, the gravitational acceleration decreases by a factor of 9, and so on. The extent of the variation of g with height differs from that of the variation of g with depth, but it's to note that the value of g falls both with increasing height & with increasing depth, with respect to the earth's surface. This also means the value of g is maximum on the surface of the earth itself.

i) The value of 'g' is inversely proportional to the square of the Earth's-

a) diameter b) radius
c) weight d) area

ii) If R is the radius of the earth, the height at which the weight of body becomes ¼ its weight on the surface of earth is

a) 2R b) R/2 c) R d) R/4

iii) A body weighs 200 N on the surface of earth. How much will it weigh half way down to the centre of earth?

a) 100 N b) 150 N c) 200 N d) 250 N

iv) For a planet having mass equal to mass of the earth but radius is one fourth of radius of the earth. The escape velocity of this planet will be

a) 11.2 km/s b) 22.4 km/s c) 5.6 km/s d) 44.8 km/s

OR

Which of the following statements is true-

(a) g is less at the earth's surface than at a height above it or a depth below it

(b) g is same at all places on the surface of the earth

(c) g has its maximum value at the equator

(d) g is greater at the poles than at the equator

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

(i) Show that the total mechanical energy of a freely falling body remain constant.

(ii) Plot a graph of K.E and P.E of the above case. **[4+1]**

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? Find the magnitude and direction of the resultant of two vectors A and B in Terms of their magnitudes and angle θ between them. **[1+4]**

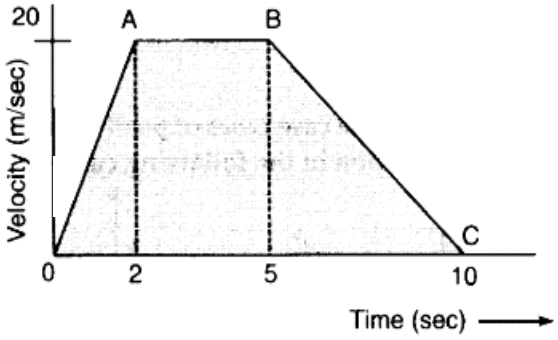
33. i) Four particles of mass 1kg, 2kg ,3kg and 4kg are placed at the four vertices A, B , C and D of square of side 1m. Find the position of centre of mass of the particle.

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) The velocity-time graph of an object moving along a straight line is as shown :



Calculate distance covered by object between:

(i) t = 0 to t = 5 sec.

(ii) t = 0 to t = 10 sec.

[3+2]