Class: XI

2024-2025

ANNUAL EXAMINATION (THEORY)

MS

SUBJECT: PHYSICS (042)

Set-B1/B2

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

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 12 MCQ of 1 mark each AND 4 assertion reason type questions, 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 type questions of 5 marks each.

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

(5). Use of calculators is not allowed.

(6) This question paper contains 11 pages.

(7) tan 37^0 = 3/4

SECTION-A

1. The pair of physical quantities does not have the same dimensional formula are

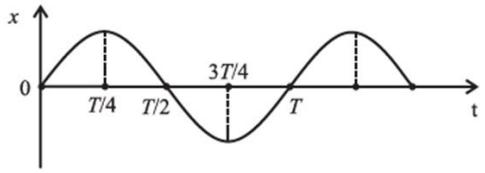
(a) Stress and Pressure

(b) Stress and Modulus of rigidity

(c) Surface tension and Torque

(d) Force and Tension

2. For the given graph of SHM, which statement is true (if position 'x' is taken along y-axis and time 't' is taken along x-axis).



(a) velocity – time graph start from origin towards +y direction.

(b) velocity – time graph start from origin towards -y direction.

(c) acceleration – time graph start from origin towards +y direction.

(d) acceleration – time graph start from origin towards -y direction.

3. The escape velocity for a body of mass 1Kg, projected vertically upwards from the surface of earth is 11.2 km/s. If the body of mass 100Kg is projected at an angle of 30^0 with the vertical, the escape velocity will be?
(a) increased
(b) decreased
(c) does not change
(d) Such big body cannot be thrown

4. The horizontal and vertical components of the velocity of a projectile starting from origin are 10 m/s and 20 m/s, respectively. The horizontal range of the projectile will be [g = 10 m/s^2]
(a) 5 m
(b) 10 m
(c) 20 m
(d) 40 m

5. Given: **C** = **A** × **B** and **D** = **B** × **A**. What is the angle between **C** and **D (A,B,C,D are vectors)**?
(a) zero (b) 60^0
(c) 90^0 **(d) 180^0**

6. A spherical liquid drop of radius R is divided into eight equal droplets. If surface tension is T, then work done in the process will be……

(a) $2\pi R^2T$ (b) $3\pi R^2T$ **(c) $4\pi R^2T$** (d) $2\pi RT^2$

7. The moment of inertia of an object does not depend upon:

(a) mass of object

(b) mass distribution

(c) angular velocity

(d) axis of rotation

8. A tuning fork produces waves in air. If the temperature of the air increases, then which of the following will change
(a) amplitude (b) frequency **(c) wavelength** (d) time-period

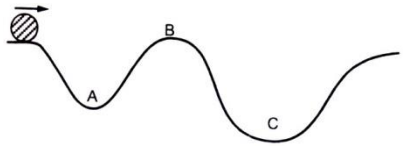
9. The ratio of Moment of inertia about an axis passing through the centre and perpendicular to its plane of a disc and that of a ring of same mass and of same radius is……..

(a) 1:1
(b) 1:2
(c) 2:1
(d) 4:1

10. The vector $\vec{P} = a\hat{i} + a\hat{j} + 3\hat{k}$ and $\vec{Q} = a\hat{i} - 2\hat{j} - \hat{k}$ are perpendicular to each other. The positive value of a is:

(a) 3 (b) 4
(c) 9 (d) 13

11. A body moves along an uneven horizontal road surface with constant speed at all points. The normal reaction of the road on the body is



(a) minimum at A (b) **minimum at B**
(c) minimum at C (d) the same at A, B and C

12. The respective number of significant figures for the numbers 23.023, 0.0003 and 21×10^{-3} are

(A) 5, 1, 2 (B) 5, 1, 5
(C) 5, 5, 2 (D) 4, 4, 2

ASSERTION REASON TYPE QUESTION

(a) If both Assertion and Reason are True and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are True but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is True but Reason is False.
(d) If both the Assertion and Reason are False

13. **ASSERTION-** The viscosity of liquid increases rapidly with rise of temperature.

REASON- Viscosity of a liquid is the property of liquid by virtue of which it supports the relative motion amongst different liquids layers.

Ans- (D)

14. **ASSERTION-** For velocity **v** = 0, acceleration **a** is always zero.

REASON- For acceleration **a** = 0 , velocity **v** is always zero.

Ans- D

15. **ASSERTION-** The centre of mass of a uniform ring is at its geometrical centre.

REASON- The centre of mass of all bodies (uniform distribution of mass) lies at the geometrical centre of the body only.

Ans- **(A)**

16. **ASSERTION:** During thunder storm temporary roofs fly off.
REASON: During thunder storm above the roof pressure increases which causes flying off roofs. (C)

SECTION-B

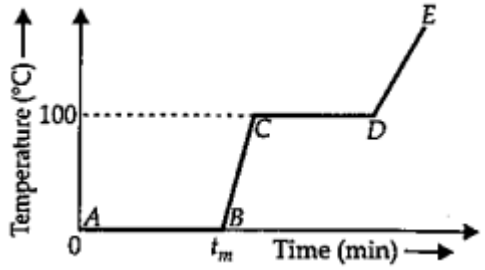
17. State Pascals law. Draw Schematic diagram of Hydraulic lift. (1+1)

OR

17. What is the pressure on a swimmer 10 m below the surface of a lake? Given that Atmospheric pressure = 1×10^5 Pa, g=10m/s^2 and density of water is 1000 kg m^{-3}

Ans- 2 atm pressure

18. (a) Give the statement of second law of thermodynamics (any one).
(b) Plot the temperature versus time graph showing the changes in the state of ice on heating.



19. If mass 'm' velocity 'v' and radius 'r' considered to be fundamental quantities, find the expression for force by using dimensional analysis.

In other set F=mv/t

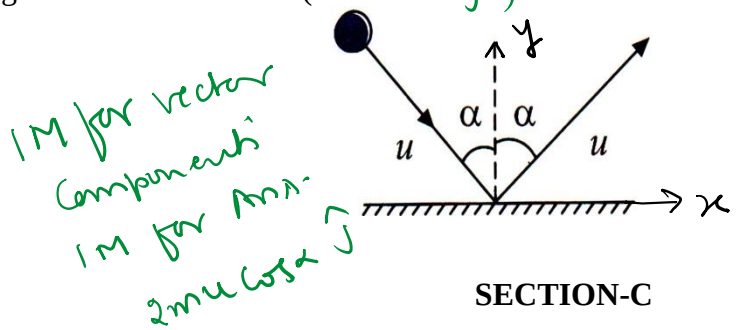
20. Show that the rate of change of angular momentum of a point mass is equal to the torque acting on the mass.

Ans-

Proof for $\vec{\tau} = \frac{d\vec{L}}{dt}$ By using $\vec{\tau} = \vec{r} \times \vec{F}$

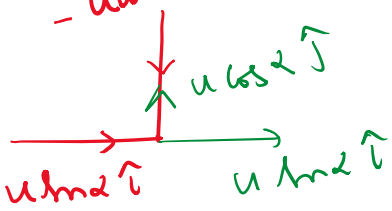
$\frac{1}{2}$ m of only expression is written

21. A ball of mass 'm' moving with speed 'u' collides with the floor at an angle 'α' with the vertical. If it rebounds at the same angle 'α' and with the same speed, Calculate the change in magnitude of momentum. (2mu cosα $\hat{j}$)



1M for vector components
1M for Ans.
2mu Cosα $\hat{j}$

Ans $-u\cos\alpha\hat{j}$



SECTION-C

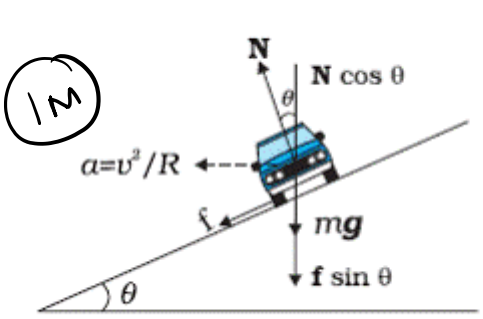
22. A pebble of mass 0.05 kg is thrown vertically upwards. Give the direction and magnitude of the net force on the pebble, (a) during its upward motion, (b) during its downward motion, (c) at the highest point where it is momentarily at rest.

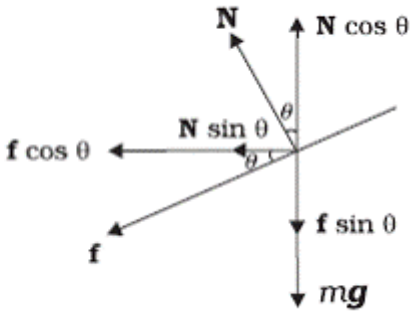
Ans- in all cases direction is downwards and equal to .05g = .5N (1M for each part)

In other set consider mass of .05g

23. Find the expression for the maximum safe speed of a vehicle taking turn on a rough banked road of radius 'r'.

Ans-





$\frac{mv^2}{r}$

$N\cos\theta - \mu N\sin\theta = mg \Rightarrow N(\cos\theta - \mu\sin\theta) = mg$ 1M

$\mu N\cos\theta + N\sin\theta = mv^2/r \Rightarrow N(\mu\cos\theta + \sin\theta) = \frac{mv^2}{r}$

$v = \sqrt{\frac{\mu\cos\theta + \sin\theta}{\cos\theta - \mu\sin\theta}(rg)}$ 1M

24. Write True or False for the following

(a) When Potential energy is minimum, nature of equilibrium is stable.(T)

(b) When Potential energy is maximum, nature of equilibrium is stable.(F)

(c) When Potential energy is constant , nature of equilibrium is neutral.(T)

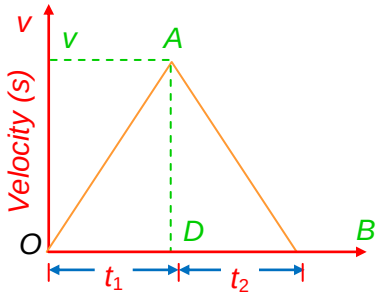
25. A car accelerates from rest at constant rate α for some time after which it decelerates at a constant rate β to come to rest. If the total time elapsed is t seconds, calculate

(a) the maximum velocity reached

(b) the total distance travelled.

ANS-

The situation as shown in figure



Let the car accelerate for time t_1 and decelerate for time t_2, so that total time $t_1 + t_2 = t$ Let v be the maximum velocity reached

(a) For accelerated motion,

$v = 0 + \alpha t_1$

or, $v = \alpha t_1$

For decelerated motion, $0 = v + (-\beta)t_2$

or $v = \beta t_2$

$\therefore \quad \alpha t_1 = \beta t_2$

or $\dfrac{t_2}{t_1} = \dfrac{\alpha}{\beta}$

Adding 1 to both sides

$$\frac{t_2 + t_1}{t_1} = \frac{\alpha + \beta}{\beta}$$

or $$\frac{t}{t_1} = \frac{\alpha + \beta}{\beta}$$

or $$t_1 = \frac{\beta t}{\alpha + \beta}$$

Hence, $v = \alpha t_1 = \alpha\left(\dfrac{\beta t}{\alpha + \beta}\right) = \left(\dfrac{\boldsymbol{\alpha\beta t}}{\boldsymbol{\alpha + \beta}}\right)$ (2M)

(b) Total distance traveled = Area of ΔOAB

or, $S = \dfrac{AD \times OB}{2}$

$$= \frac{v \times t}{2}$$

$$= \frac{(\alpha\beta)t}{\alpha + \beta} \cdot \frac{t}{2}$$

$$= \frac{\boldsymbol{1}}{\boldsymbol{2}}\left(\frac{\boldsymbol{\alpha\beta}}{\boldsymbol{\alpha + \beta}}\right)\boldsymbol{t^2}$$ (1M)

26. Find the expression for the orbital velocity of a satellite of mass ‘m’ launched in horizontal direction from height ‘h’ above from the surface of earth of mass ‘M’ and radius ‘R’. hence find expression for total energy of this satellite.

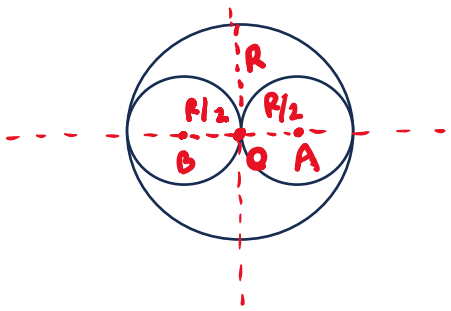
Ans- use $\frac{mv_0^2}{(R+h)} = G\frac{Mm}{(R+h)^2}$ (1M)

$\Rightarrow v_0 = \sqrt{\frac{GM}{R+h}}$

$KE = \frac{1}{2}\frac{GMm}{(R+h)}$ (1M) $\quad TE = -\frac{1}{2}\frac{GMm}{(R+h)}$ (1M)

$PE = -\frac{GMm}{(R+h)}$

27. From a disc of radius R (uniform distribution of mass); a small disc 'B of radius R/2 is cut and it is put at the place 'A' on the bigger disc as shown in figure. Calculate the new position of COM. Consider 'O' as origin.



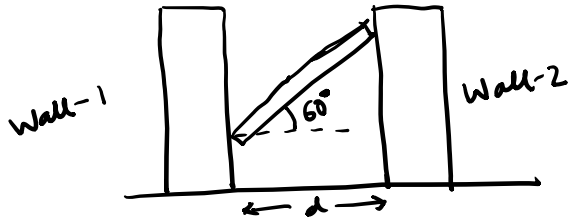
Ans- $Y_{COM} = 0$ ($\frac{1}{2}$M)

$X_{COM} = \frac{A_1x_1 - A_2x_2 + A_3x_3}{A_1 - A_2 + A_3} = \frac{\pi R^2(0) - \pi\left(\frac{R}{2}\right)^2\left(-\frac{R}{2}\right) + \pi\left(\frac{R}{2}\right)^2\left(+\frac{R}{2}\right)}{\pi R^2 - \pi\left(\frac{R}{2}\right)^2 + \pi\left(\frac{R}{2}\right)^2}$ (1$\frac{1}{2}$M)

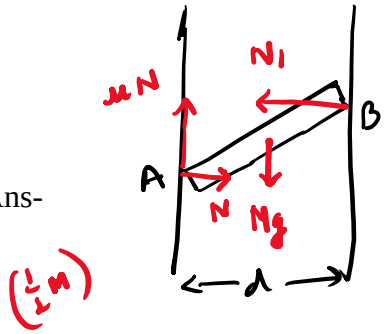
($\frac{1}{2}$M)

OR $= \frac{+2\pi\frac{R^3}{8}}{\pi R^2} = +\frac{R}{4}$ ($\frac{1}{2}$M)

27. A rod of mass M having uniform distribution of mass, is just in the state of rest. If wall (W1) is rough and wall (W2) is smooth, find the coefficient of friction between the wall(W1) and the rod. The rod is inclined as shown in figure.



Ans-



$N = N_1$ — (1) (½ M)

$\mu N = Mg$ — (2) (½ M)

Balancing torque about A

$Mg\left(\frac{d}{2}\right) = N_1 d \tan 60$ — (3) (½ M)

on solving $\mu = 2\sqrt{3}$ (1 M)

28. Show that Cp – Cv =R. where Cp is the molar specific heat capacity at constant pressure ,Cv is the molar specific heat capacity at constant volume.

Ans- proof required

SECTION-D

29. Wave motion is a disturbance by which linear momentum and energy can be transferred without actual transfer of material. The equation of a wave is given by **$y = 4x10^{-3}$ sin (2x+60t) m,** where x is in metre, t is in second.

(i). The given equation of wave is travelling along

(a) +x axis **(b) -x axis** (c) +y axis (d) -y axis

(ii). The amplitude of the wave is

(a) **$4x10^{-3}$ m** (b) $4x10^{-3}$ cm (c) $4x10^{-3}$ km (d) $4x10^{-3}$ mm

(iii). The wave length of the wave is

(a) **π m** (b) π cm (c) 2π m (d) π/2 m

OR

(iii). The Time period of the wave is

(a) π sec (b) π/10 sec (c) 2π sec **(d) π/30 sec**

(iv). The wave velocity is

(a) π m/s (b) 10 m/s (c) 2π m/s **(d) 30 m/s**

30. A light rod of length 600 cm is suspended from the ceiling horizontally by means of two vertical wires of equal length tied to its ends. One of the wires is made of steel and is of cross-section 0.1 sq.cm and the other is made of brass and is of cross-section 0.2 sq.cm.

(i). The unit of stress is same as that of….

(a) Tension **(b) Pressure** (c) Force (d) Density

(ii). If weight 'w' is suspended at a point on the length of the rod, for translatory equilibrium

(a) 'w' is more than sum of tensions in wires

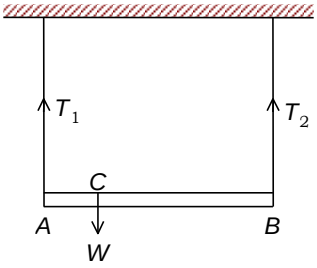
(b) 'w' should be equal and opposite to sum of tensions in wires

(c) 'w' is less than sum of tensions in wires

(d) No relation can be obtained of w with tensions

OR

(ii). If weight 'w' is suspended at a point on the length of the rod as shown, for rotational equilibrium



(a) T_1 (AC) > T_2 (BC)

(b) T_1 (AC) = T_2 (BC)

(c) T_2 (AC) > T_1 (BC)

(d) No relation can be obtained among tensions and length

(iii). Find AC in metre to produce equal stress in both wires.
(a) 1 (b) 2 (c) 3 **(d) 4**

(iv). Find AC in metre to produce equal strain in both wires so that rod remains horizontal. Given Y of steel = 20×10^{10} Nm^{-2}, Y of brass = 10×10^{10} Nm^{-2}

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

SECTION-E

31. What is elastic collision? Find the expression for the separating velocities of the two objects of masses m_1, m_2 moving in same direction with velocities u_1,u_2 respectively($u_1 > u_2$) and collide elastically in one dimension. (m_2 is ahead of m_1)

Ans- def-1M

Proof to calculate separating velocities (2+2) with diagram

OR

31. What is inelastic collision? Two bodies of masses m_1, m_2 moving with velocities u_1, u_2 respectively in the same direction such that ($u_1 > u_2$) and collide perfect inelastically in one dimension, Find the loss of kinetic energy of the system.

Ans- def 1(M) , proof to calculate loss of KE (4M)

32. (a) Give two points to differentiate transverse and longitudinal wave.

Ans- 1M for each difference

(b) Find the equation of the resultant wave obtained by the superposition of the following three waves. (3)

$Y_1 = A \sin(kx-wt)$

$Y_2 = A/2 \sin(kx-wt+\pi/2)$

$Y_3 = A/3 \sin (kx-wt+\pi)$

Ans- resultant amplitude = 5A/6 (1M)

Phase angle $\Phi = 37$ (1M)

Equation $Y= 5A/6 \sin (kx-wt+\Phi)$ (1M)

OR

32.(a) Find the expression for the time period of a simple pendulum of length 'l' (R >>> l)for small oscillations . R is the radius of earth.

Ans- proof 2M with a proper diagram

(b) Find the minimum time taken by a particle performing SHM having time period 'T' and amplitude 'A' to go from (i) x = A/2 to x = 0 (ii) x = A/2 to x =A
Ans-

33.(a) State Bernoulli's theorem, by using this find the expression for ‘speed of efflux’ of water.

(3)

(b) A fully loaded Boeing aircraft has a mass of 3.3×10^5 kg. Its total wing area is 500 m^2. It is in level flight with a speed of 960 km/h. Estimate the pressure difference between the lower and upper surfaces of the wings. (2)

Ans- 6.5×10^3 Nm^{-2}

OR

33. (a) What is capillarity action? Deduce an expression for rise in the water level in the capillary tube when dipped in water. If tube is of insufficient length, does the water overflow?

(3)

(b) Draw a graph showing variation of net force (on y-axis) on spherical body with velocity (on x-axis) when falling in a viscous liquid (consider downward direction as +ve direction). What does the slope of this graph, intercept on Y-axis represents. (2)

1M for Graph.