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CUMMULATIVE EXAM./HALF YEARLY EXAM. 2023-24

CLASS – XI

SUBJECT – PHYSICS (THEORY) Set -1

MARKING SCHEME

SECTION – A: OBJECTIVE TYPE QUESTIONS (16 Ques. ×01 Mark each = 16 Marks)		
1	d	**1**
2	b	**1**
3	a	**1**
4	c	**1**
5	a	**1**
6	a	**1**
7	b	**1**
8	b	**1**
9	a	**1**
10	b	**1**
11	d	**1**
12	c	**1**
13	a	**1**
14	c	**1**
15	c	**1**
16	a	**1**
SECTION – B: SHORT ANSWER TYPE-I (05 Ques. ×02 Marks each = 10 Marks)		
17	Here, mass, m=4.237 g Volume, V=2.5 cm^3 We know the formula, Density, ρ=Volume/Mass =2.5cm/34.237g=1.6948g cm^{-3} we get, ρ=1.7g cm^{-3} **OR** Given that The speed of light in a vacuum is unity And we want to find the distance between the Sun and the Earth We know that Distance = speed×time	 ½ 1 ½ ½

	Speed is unity = 1 unit /s Time = 8minute and 20 s=8×60+20s = 500 s Puting the values we get, Distance between Sun and Earth =1×500=500units	 **1** **½**
18	Let $\vec{a} = 2i + 3j + k$ $\lvert\vec{a}\rvert = \sqrt{2^2+3^2+1^2} = \sqrt{4+9+1} = \sqrt{14}$ $\therefore \hat{a} = \frac{\vec{a}}{\lvert\vec{a}\rvert} = \frac{2i+3j+k}{\sqrt{14}}$ $\therefore \hat{a} = \frac{2}{\sqrt{14}} i + \frac{3}{\sqrt{14}} j + \frac{1}{\sqrt{14}} k$	**1** **1**
19	Initial momentum to the ball A = 0.05(6) = 0.3 kg m/s As the speed is reversed on collision, final momentum of ball A = 0.05(-6) = -0.3 kg m/s Impulse imparted to ball A = change in momentum of ball A = final momentum – initial momentum = -0.3 -0.3 = -0.6 kg m/s. Similarly impulse imparted on ball B is also same as -0.6kgm/s.	**½** **½** **½** **½**
20	Statement and proof	**1+1**
21	Correct derivation for position vector of centre of mass of two particles system.	**2**
	SECTION – C: SHORT ANSWER TYPE-II **(07 Ques. ×03 Marks each = 21 Marks)**	
22	Relation, $F = a\sqrt{x} + bt^2$ By rules of dimensions : Dimensions of = Dimensions of $a\sqrt{x}$ $a = \frac{F}{\sqrt{x}} = \frac{[MLT^{-2}]}{[L^{1/2}]}$ $a = [ML \times L^{-1/2}T^{-2}]$ $a = [ML^{1/2}T^{-2}]$ dimensions of $b = \frac{F}{t^2} = \frac{[MLT^{-2}]}{[T^2]} = [MLT^{-4}]$ $\therefore$ dimensions of $a/b = \frac{[ML^{1/2}T^{-2}]}{[MLT^{-4}]} = [L^{-1/2}T^2]$	**1** **1** **1**
23	Horizontal range, $R=u^2 \sin 2\Theta /g$ and max. height, $H=u^2 \sin^2 \Theta /2g$ Case. 1 when $\Theta = \alpha$;$R_1 =u^2 \sin 2\alpha /g$ and $H_1 =u^2 \sin^2 \alpha /2g$ Case2. When $\Theta = (90-\alpha)$; $R_2=u^2\sin2(90-\alpha)/g = u^2 \sin 2\alpha/g$. and $H_2=u^2 \sin^2 (90-\alpha)/g=u^2 \cos^2\alpha/g$. Therefore , $H_1/H_2=\sin^2\alpha/\cos^2\alpha=\tan^2\alpha$ and $R_1/R_2=$**1**	**½** **½** **½** **½** **½** **½**
24	Graph Derivation of equations	**1** **2**

25	**a)** In order to pull a cart, a horse pushes the ground backward with some force. The ground in turn exerts an equal and opposite reaction force upon the feet of the horse. This reaction force causes the horse to move forward. An empty space is devoid of any such reaction force. Therefore, a horse cannot pull a cart and run in empty space. b) According to Newton's second law of motion, we have the equation of motion: $$F = ma = m\frac{\Delta v}{\Delta t} \qquad ...(i)$$ Where, F = Stopping force experienced by the cricketer as he catches the ball m = Mass of the ball Δt = Time of impact of the ball with the hand It can be inferred from equation (i) that the impact force is inversely proportional to the impact time, i.e., the force experienced by the cricketer decreases if the time of impact increases and vice versa. **Alternative answer of c)** While taking a catch, a cricketer moves his hand backward so as to increase the time of impact (Δt). This is turn results in the decrease in the stopping force, thereby preventing the hands of the cricketer from getting hurt.	**1 ½** **1 ½**
26	Correct relation Statement and explanation with an example	**½** **2 ½**
27	Definition Derivation of $K = \frac{1}{2} I \omega^2$	**1** **2**
28	Correct derivation **OR** Using $g = \frac{4}{3}\pi G R \rho$ $\quad g_1/g_2 = 1:1$ Graph	**3** **2** **1**

SECTION – D: CASE STUDY BASED

(02 Ques. ×04 Marks each = 08 Marks)

29	i). c ii). d iii). b iv). d **OR** b	**1** **1** **1** **1**
30	i). d ii). b iii). Correct definition	**1** **1** **1**

	iv). The second law of motion is quantitative expression of force and it states that the rate of change of momentum of an object is proportional to the applied unbalanced force in the direction of force. Mathematically, F = ma, the unit of force is **kg-m/s^2** or Newton. **OR** Statement of Law of inertia (first law of motion)	1

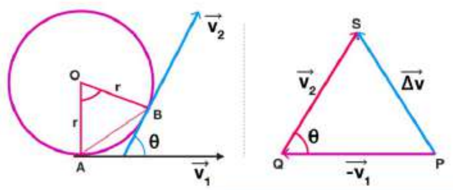
SECTION – E: LONG ANSWER TYPE

(03 Ques. ×05 Marks each = 15 Marks)

31 Definition of centripetal acceleration

The force of a moving object can be written as — **1**

F = ma........(1)



From the diagram given above, we can say that, — **1**

$$\frac{\Delta v}{AB} = \frac{v}{r}$$

AB = arc **AB = vΔ t** — **1**

$$\overrightarrow{PQ} + \overrightarrow{QS} = \overrightarrow{PS} \qquad \frac{\Delta v}{v\Delta t} = \frac{v}{r}$$

$$-v_1 + v_2 = \Delta v \qquad \frac{\Delta v}{\Delta t} = \frac{v^2}{r}$$

$$\Delta v = v_2 - v_1 \qquad a = \frac{v^2}{r}$$

The triangle PQS and AOB are similar. Therefore,

Centripetal acceleration has a constant magnitude since both v and r are constant, but since the direction of v keeps on changing at each instant in a circular motion, hence centripetal acceleration's direction also keeps on changing at each instant, always pointing towards the centre. — **1**

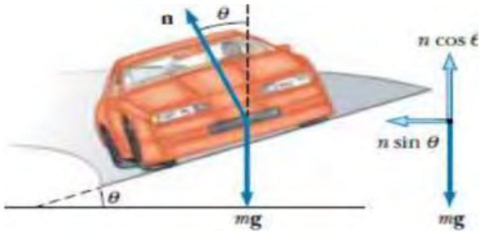
OR

Meaning of banking of road or definition of banking of road

Need of banking of road:

In case of horizontal road necessary centripetal force mv^2/r is provided by static frictional force. When heavy vehicles move with high speed on a sharp turn (small radius) then all the factors contribute to huge centripetal force which if provided by the static frictional force may result in the fatal accident. — **1**

To prevent this roads are banked by lifting their outer edge. Due to this, normal reaction of road on the vehicle gets tilted inwards such that it's vertical component balances the weight of the body and the horizontal component provides the necessary centripetal force.



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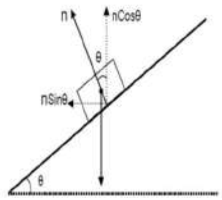

Motion of a car on a banked road

We can reduce the contribution of friction to the circular motion of the car if the road is banked (Fig. 5.14(b)). Since there is no acceleration along the vertical direction, the net force along this direction must be zero. Hence,

$N\cos\theta = mg + f\sin\theta$ (5.19a)

The centripetal force is provided by the horizontal components of N and f.

$N\sin\theta + f\cos\theta = \frac{mv^2}{R}$ (5.19b)

But $f \le \mu_s N$

Thus to obtain v_{max} we put

$f = \mu_s N$.

Then Eqs. (5.19a) and (5.19b) become

$N\cos\theta = mg + \mu_s N\sin\theta$ (5.20a) **1**

$N\sin\theta + \mu_s N\cos\theta = mv^2/R$ (5.20b)

From Eq. (5.20a), we obtain

$N = \frac{mg}{\cos\theta - \mu_s \sin\theta}$ **1**

Substituting value of N in Eq. (5.20b), we get

$\frac{mg\ \sin\ \ {}_s\cos}{\cos\ -\ {}_s\sin} = \frac{mv^2_{max}}{R}$

or $v_{max} = \left(Rg\frac{\mu_s + \tan\theta}{1-\mu_s\tan\theta}\right)^{\frac{1}{2}}$ (5.21)

Comparing this with Eq. (5.18) we see that maximum possible speed of a car on a banked road is greater than that on a flat road. **1**

For $\mu_s = 0$ in Eq. (5.21),

$v_o = (Rg\ \tan\theta)^{1/2}$ (5.22)

At this speed, frictional force is not needed at all to provide the necessary centripetal force. Driving at this speed on a banked road will cause little wear and tear of the tyres. The same equation also tells you that for $v < v_o$, frictional force will be up the slope and that a car can be

32 Definition of elastic collision in one dimension. **1**

Correct Derivation for velocities of the two bodies after such a collision.

or $v_1 = \left(\frac{m_1 - m_2}{m_1 + m_2}\right)u_1 + \left(\frac{2m_2}{m_1 + m_2}\right)u_2$..............(8) **2**

Similarly ,by substituting equation (6) in (2) or substituting equation (8) in (7) ,we get the final velocity of m_2 as

$v_2 = \left(\frac{2m_1}{m_1 + m_2}\right)u_1 + \left(\frac{m_2 - m_1}{m_1 + m_2}\right)u_2$..........(9) **2**

OR

1

	Definition Conservative Derivation with diagram Graph	½ **2 ½** **1**
33	**Escape Speed** . **Expression for escape velocity :-** **Explanation and reason** **OR** (a) Orbital velocity Expression for orbital velocity (b) solution and correct answer	**1** **3** **1** **1** **2** **1**

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