PHYSOL-3 EXAMINATION SERIES

Exam-2 CHAPTERS 4,5,6 & 7

SUNDAY 08-05-2022 @ 7.00pm

Answerkey

Answer any 3 questions from 1 to 5. Each carries 1 score

1	zero.	**1**
2	90^o	**1**
3	Moment of inertia.	**1**
4	(d) three	**1**
5	Inertia of Motion	**1**

Answer any 5 questions from 6 to 13. Each carries 2 score

<table>
<tr><td>6</td><td>tan θ= $\frac{4H}{R}$
Here R = 4H So $\theta=45^0$</td><td>2</td></tr>
<tr><td>7</td><td>given 2usinθ /g= 5
usinθ= 25

Now. $H = u^2 Sin^2\theta / 2g$
$= 25^2/2\times10$
= 31.25 m</td><td>2</td></tr>
<tr><td>8</td><td>By Newton’s second law,
$\vec{F}=k\frac{d\vec{P}}{dt}$
But $\vec{P}=m\vec{v}$
Therefore
$\vec{F}=k\frac{d(m\vec{v})}{dt}$
$\vec{F}=km\frac{d\vec{v}}{dt}$
$\vec{F}=km\vec{a}$
But k=1 Therefore $\vec{F}=m\vec{a}$</td><td>2</td></tr>
<tr><td>9</td><td>
<table>
<tr><th>Sl.No</th><th>A</th><th>B</th></tr>
<tr><td>1</td><td>Newton’s First law</td><td>Law of inertia</td></tr>
<tr><td>2</td><td>Conservation of Linear momentum</td><td>Momentum before collision = Momentum after collision</td></tr>
<tr><td>3</td><td>Newton’s third law</td><td>Action <-> Reaction</td></tr>
<tr><td>4</td><td>Impulse</td><td>Change in momentum.</td></tr>
</table>
</td><td>2</td></tr>
<tr><td>10</td><td>(a) $W=(3\hat{i}+4\hat{j}-5\hat{k})\quad(5\hat{i}+4\hat{j}+3\hat{k})$ = 15 + 16-15 = 16joule</td><td>1</td></tr>
</table>

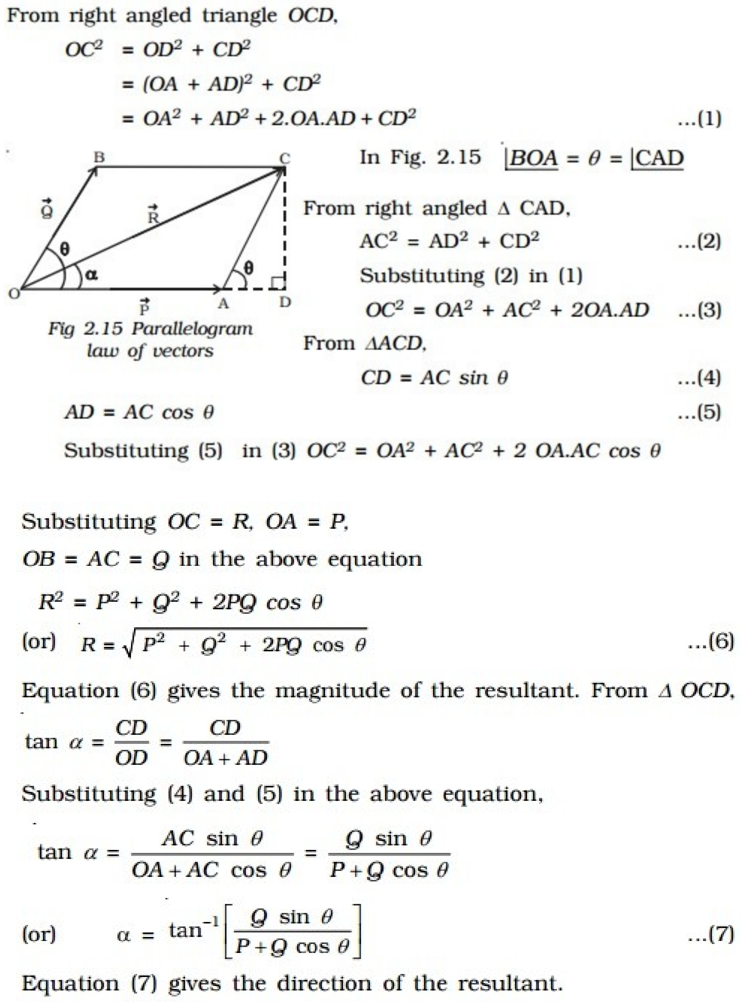
	(b) 1.displacement is zero 2. force and displacement are perpendicular to each other	**1**
11	Consider a spring of spring constant K let the spring be stretched by a force f through a small distance dx Work Done dw = f dx = kxdx The work done in increasing the length of the spring by an amount x can be calculated by integrating the above equation between the limit X = 0 to x ∫ dw= ∫ kx dx W=k ∫ x dx= $kx^2/2$ W= ½ kx^2 – 0 W = ½ kx^2	**2**
12	Parallel axes theorem statement $I'=I_c+MR^2$	**2**
13	Angular momentum $\vec{L}=\vec{r}\times\vec{P}$ P=m×v $\frac{d\vec{L}}{dt}=\frac{d}{dt}(\vec{r}\times\vec{P})=\vec{r}\times\frac{d\vec{P}}{dt}+\frac{d\vec{r}}{dt}\times\vec{P}$ Where $\frac{d\vec{r}}{dt}\times\vec{P}=\vec{v}\,x\,m\,x\,\vec{v}=0$ $\frac{d\vec{L}}{dt}=\vec{r}\times\vec{F}$ =τ (Torque)	**2**

Answer any 3 questions from 14 to 17. Each carries 3 score

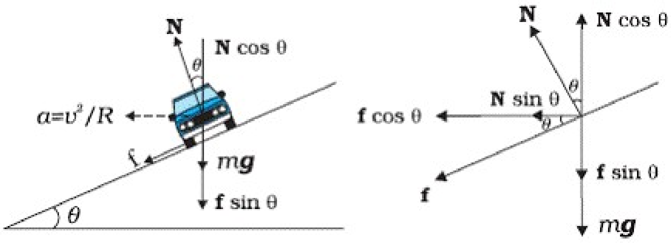
14	a)Parallelogram law of vector addition.	**1**
	b) **Expression for Maximum height(H):** We have $V^2=u^2+2as$ Taking the vertical components; $V_y^2=u_y^2+2a_ys_y$ Here Vy=0, u_y=usinθ , a_y=-g and S_y =H Therefore $0=(u\sin\theta)^2-2gH$ $2gH=u^2\sin^2\theta$ Maximum Height , $H=\frac{u^2\sin^2\theta}{2g}$	**2**
15	F= m(v-u)/t $F=\frac{m(v-u)}{t}$ $F=\frac{0.05(20--20)}{0.1}$ $F=\frac{0.05(40)}{0.1}$ F=20N	3
16	$Power=\frac{Work}{time}$	

	$Power=\frac{mgh}{t}$ mass=volume×density $Power=\frac{volume*density*g*h}{t}$ g=10 $Power=\frac{40*1000*10*5}{30*60}=1111.11W=P=1.11KW$	3
17	a) Statement $I_z=I_x+I_y$ b) $I_x=I_y=I_d$ $I_z=2I_d$ $I_d=\frac{I_z}{2}$ $I_d=\frac{\frac{MR^2}{2}}{2}$ $I_d=\frac{MR^2}{4}$	1 2

Answer any 2 questions from 18 to 20. Each carries 4 score

18	 From right angled triangle OCD, $OC^2 = OD^2 + CD^2$ $= (OA + AD)^2 + CD^2$ $= OA^2 + AD^2 + 2.OA.AD + CD^2$ ...(1) In Fig. 2.15 $\underline{\lvert BOA} = \theta = \underline{\lvert CAD}$ From right angled Δ CAD, $AC^2 = AD^2 + CD^2$ ...(2) Substituting (2) in (1) $OC^2 = OA^2 + AC^2 + 2OA.AD$ ...(3) From ΔACD, $CD = AC \sin\theta$ ...(4) $AD = AC \cos\theta$ ...(5) Substituting (5) in (3) $OC^2 = OA^2 + AC^2 + 2\ OA.AC \cos\theta$ Fig 2.15 Parallelogram law of vectors Substituting $OC = R$, $OA = P$, $OB = AC = Q$ in the above equation $R^2 = P^2 + Q^2 + 2PQ \cos\theta$ (or) $R = \sqrt{P^2 + Q^2 + 2PQ\cos\theta}$ ...(6) Equation (6) gives the magnitude of the resultant. From Δ OCD, $\tan\alpha = \frac{CD}{OD} = \frac{CD}{OA+AD}$ Substituting (4) and (5) in the above equation, $\tan\alpha = \frac{AC\ \sin\theta}{OA+AC\ \cos\theta} = \frac{Q\ \sin\theta}{P+Q\cos\theta}$ (or) $\alpha = \tan^{-1}\left[\frac{Q\ \sin\theta}{P+Q\cos\theta}\right]$ ...(7) Equation (7) gives the direction of the resultant.	4
19	(a) The process of raising the outer edge than the inner edge for a curved road is called Banking of road. The angle through which the outer edge is raised is called **angle of banking**.	1

(b) 1



(c)
Let
R--> radius of circular path θ--> angle of banking μ_S -->Coefficient of friction.

From the diagram

$$N\cos\theta = mg + f\sin\theta$$
$$N\cos\theta = mg + \mu_S N\sin\theta$$
$$N\cos\theta - \mu_S N\sin\theta = mg$$
$$N(\cos\theta - \mu_S\sin\theta) = mg$$

Therefore $$N = \frac{mg}{\cos\theta - \mu_S\sin\theta}$$ ------------------(1)

Similarly $$\frac{mv^2}{R} = N\sin\theta + f\cos\theta$$
$$\frac{mv^2}{R} = N\sin\theta + \mu_S N\cos\theta$$
$$\frac{mv^2}{R} = N(\sin\theta + \mu_S\cos\theta)$$ ----------------(2) 2

Substituting (1) in (2)

$$\frac{mv^2}{R} = \frac{mg}{\cos\theta - \mu_S\sin\theta}(\sin\theta + \mu_S\cos\theta)$$
$$\frac{v^2}{R} = \frac{g(\sin\theta + \mu_S\cos\theta)}{(\cos\theta - \mu_S\sin\theta)}$$
$$v^2 = \frac{Rg(\sin\theta + \mu_S\cos\theta)}{(\cos\theta - \mu_S\sin\theta)}$$

Therefore $$v = \sqrt{\frac{Rg(\sin\theta + \mu_S\cos\theta)}{(\cos\theta - \mu_S\sin\theta)}}$$

Dividing by cos θ,

$$v = \sqrt{\frac{Rg(\tan\theta + \mu_S)}{(1 - \mu_S\tan\theta)}}$$

This is the safe velocity (maximum possible speed) for a vehicle on a banked road.

20 a) Work -Energy theorem states that “Work done is equal to change in Kinetic energy”. 1

b)**At the point ‘A’:-**

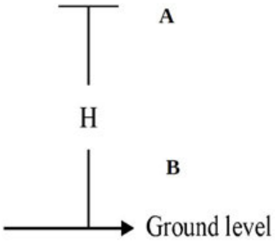
Kinetic Energy, KE =0 (because velocity u=0)
Potential Energy, PE =mgH

At the point ‘B’:-

Kinetic energy , KE = $\frac{1}{2}mv^2$ 2

But $v^2 = 2gH$ (because u=0, a=g)

Therefore , KE =mgH and PE = 0This shows that the



	potential energy of a body is completely converted in to kinetic energy during its free fall under the gravity. c) negative. Or a) Angular momentum. b) We know that when external torque is zero, Angular momentum remains constant. $I\omega$= a constant. When planets are at near region of sun their r will be small. So I will be small. ($I=MR^2$). So their ω will be large. When planets are at far regions, r is large, so I is large, then ω will be small. So planets are slow at far regions.	1