"Education for Knowledge, Science and Culture"
-Shikshanmaharshi Dr. Bapuji Salunkhe

Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College (Empowered Autonomous), Kolhapur.

Department of Physics

B.Sc.-I Internal Evaluation Examination, Oct-2023

Day and Date: Wednesday, 08-10-2023 **Mechanics-I** ***Time:*** *10.00 a.m.*

QI. Select the correct alternatives ***Marks(10)***

1. The time rate of change of linear momentum is …….. *(2)*

b) linear acceleration b) force

c) angular acceleration d) torque

2. If the total force acting on the particle or system of particles is zero, then .....of the particle or system is conserved

c) linear momentum b) energy

c) angular momentum d) torque

QII. Answer the following questions **(8)**

3. State and prove the law of conservation of energy for system of particles.
4. A gun of mass 16 kg when fired recoils with velocity 200 cm/s. If the muzzle velocity acquired by the bullet is 600 m/s, find the mass of the bullet.

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Vivekanand College (Empowered Autonomous), Kolhapur.

Department of Physics

B.Sc.-I Internal Evaluation Examination, Oct-2023

Day and Date: Wednesday, 08-10-2023 **Mechanics-II** ***Time:*** *11.00* a.m.

QI. Select the correct alternatives ***Marks(10)***

1. The planetary orbits around the sun are---------- **(1)**

   a) circular b) elliptical

   c) parabolic d) hyperbolic

2. The period of satellite does not depend on---------- (1)

   a) Radius of earth b) mass of the earth

   c) height of satellite d) mass of the satellite

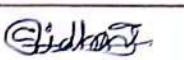
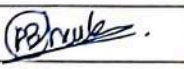
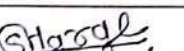
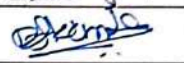
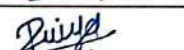
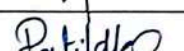
QII. Answer the following questions

1. What is meant by central force field ? **(4)**
2. State Newtons law of gravitation and explain nature of gravitational force **(4)**

Vivekanand College, Kolhapur (Empowered Autonomous)
Department of Physics
Internal Examination 2023-24
B.Sc. I Physics (SEM I)

Mechanics I and II Major/Minor/OE **Date :- 20/10/2023**

Sr. No.	Roll No	Name of the Student	Signature	Marks
1	7201	AGRAWAL PREM MILIND		
2	7202	CHOUGALE PRADNESH PRAKASH		
3	7203	DIVADE VIJAY DIPAK		
4	7204	GHARAL VINAYAK RAMDAS		
5	7205	KAMBLE TANMAY MAHENDRA		
6	7206	NEBAPURKAR JOHSWA SAMUAL		
7	7207	PATIL SANGRAM SATISH		
8	7208	SUTAR AVADHUT SHAHAJI		
9	7209	THOMBARE AMRUTA DHANAJI		
10	7210	UTTURE SHUBHAM UMESH		
11	7211	RAUT RUSHIKESH SARJERAO		
12	7212	SAYYAD NIHAL RIYAJ		
13	7213	BHOSALE KARAN ANIL		
14	7214	DHABALE SUMIT JOTIBA		
15	7215	HAVALE PRATIK ANIL		
16	7216	KADAM NISHANT SAMBHAJI		
17	7217	KADAM PRATIKSHA PRATAP		
18	7218	KANKEKAR TRUPTI HANMANT		
19	7219	KHABALE PRASAD DEEPAK		

20	7220	PATIL RIYA PRAMOD		
21	7221	TAPLE GOURAV GURUDAS		
22	7226	BANDUKE SIDDHANT SACHIN		
23	7227	BHAJANAWALE SAMIKSHA RAJU		
24	7228	CHOUGALE ARPITA BALAVANT		
25	7229	CHOUGALE SAHIL DEEPAK		
26	7230	HARGE SANCHIT GURUPRASAD		
27	7231	KAMBLE DIPALI SATAPPA		
28	7232	KHADE RIYA BALKRISHNA		
29	7233	MAYEKAR PRACHI PUNDLIK		
30	7234	PATIL ARIHANT KIRAN		
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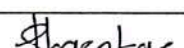
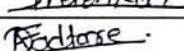
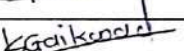
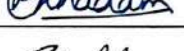
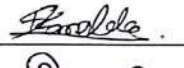
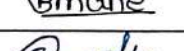
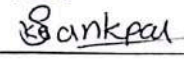
32	7236	BHARANKAR SUMITA SANDIP		
33	7237	FADTARE DIVYA ANANDA		
34	7238	GAIKWAD SAKSHI BAJIRAV		
35	7239	GORADE VISHAL KARYAPPA		
36	7240	KADAM PARIMAL CHANDRASHEKHAR		
37	7241	KAMBLE SHRIRANG BAGHWAN		
38	7242	MANE KRUSHNA BALAVANT		
39	7243	MAYEKAR SAIRAJ SHAKTI		
40	7244	PATIL DIVYANI UTTAM		
41	7245	PATIL SHITAL SHIVAJI		
42	7246	PATIL SHREYA PRAVIN		
43	7247	POL SHRAVANI RAJESH		
44	7248	SANKPAL KAJAL BALIRAM		
45	7249	THORAT INDRAJEET GANAPATRAO		

46	7250	ATHANE SHREYA DEE[AK		
47	7251	DESAI SARTHAK SAGAR		
48	7252	KALEKAR HARSH VINAYAK		
49	7253	KAMBLE PRAJWAL KIRAN		
50	7254	KAMBLE SMITAL VILAS		
51	7255	KATTI PRATHAMESH MAHESH		
52	7256	KAZI MAHAMANDKAIF MAKSUD		
53	7257	KHOPKAR PRATAMESH BABASO		
54	7258	MAHTO SURAJKUMAR SUBHASH		
55	7259	MANE DINESH DATTATRAY		
56	7260	NIGADE RUPESH MOHAN		
57	7261	PAWAR SHREYAS SUBHASH		
58	7262	SHINDE RUSHIKESH VINAYAK		
59	7263	WADKAR PRATHMESH ARUN		

02+08 = (10/10)

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06808

Shri Swami Vivekanand Shikshan Sanstha Kolhapur's

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor

Suppliment No. : 1 + 1 = 2
Roll No. : 7234
Class : BSc I.

Date : 20-10-23
Subject : Physics M.-I
Test / Tutorial No. : Internal Exam.
Div. : A.

Q. 1.

1. a] 40 N

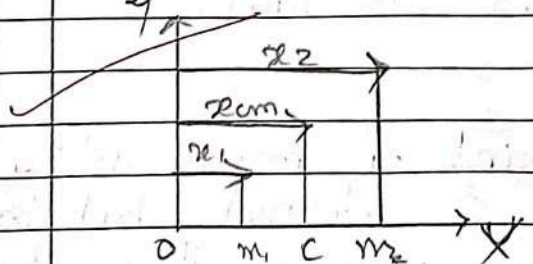
02 2. d] Torque.

Q. 2.

2. Center of Mass

The center of mass is a point where whole mass of body is suppose tobe concentrate.

Significance:



Consider, a system having n no. of partical with mass $m_1, m_2, \ldots m_n$.

If the no. of particles enter or levave to the system therefore mass of system is constan

$$M\bar{x}_{com} = m_1x_1 + m_2x_2 + \ldots + m_nx_n$$

diff. above eqn w.r.t. time.

$$M\frac{d\bar{x}_{com}}{dt} = m_1\frac{dx_1}{dt} + \frac{m_2dx_2}{dt} + \ldots + \frac{m_ndx_n}{dt}$$

but, $\frac{dx_{com}}{dt} = dV_{com}$ = Velocity of center of mass

$$M\bar{V}_{com} = m_1V_1 + m_2V_2 + \ldots + m_nV_n$$

again diff. w.r.t. time

$$M\frac{d\bar{V}_{com}}{dt} = \frac{m_1dV_1}{dt} + \frac{m_2dV_2}{dt} + \ldots + \frac{m_ndV_n}{dt}$$

but, $\frac{d\bar{V}_{com}}{dt} = \bar{a}_{com}$

2 1/2

$$M\bar{a}_{com} = m_1a_1 + m_2a_2 + \ldots m_na_n.$$

According to newton's 2nd law

$$F = ma$$

There are two kind of forces acting on particle. Internal & external but interne force are equal & opposite then their co their exist only external force.

$$\bar{F}_{ext} = F_1 + F_2 \ldots + F_n$$

The mass of system of particle moves if the mass of particle where concentrate to the center of mass.

Center of mass

$$(m_1+m_2)\, x_{cm} = m_1v_1 + m_2v_2$$

$$x_{cm} = \frac{m_1v_1 + m_2v_2}{m_1+m_2}$$

Q.1. | 13 | Linear Momentum.

Consider, a system having n no. particle with mass $m_1, m_2, \ldots m_n$ & velocity $V_1, V_2 \ldots V_n$

Assume that, no. of particles leave or enter to system them mass in const.

There are two force acts Internal & exter Internal are equal & opposite therefore th are cancle. only exist external force.

~~For, If conservative force act on system then~~
If force act on system is vector sum of External force act on system.

$$\bar{F}ext = \bar{F}_1 + \bar{F}_2 + \ldots \bar{F}_n$$

Let, $P_1, P_2, \ldots P_n$ are linear momentum

Then total momentum is

$$\bar{P} = \bar{P}_1 + \bar{P}_2 + \ldots P_n$$

$$P = mv$$

$$MV = m_1V_1 + m_2V_2 \ldots + m_nV_n$$

According to newton's 2nd law

$$\bar{F}ext = m\bar{a}$$

$$= m \cdot \frac{dv}{dt}$$

$$= \frac{dP}{dt}$$

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Suppliment No. : 2
Roll No. : 7234
Class : BSc. I

Subject : Physics. M-I
Test / Tutorial No. : Internal Exam.
Div. : A

If net external force act on system is zero then $F=0$ & $\frac{dP}{dt}=0$

$P=$ constant.

The particle of ~~conservation~~ moment of particle is remain constant if external force act on system is zero(0).

02

Q.12. Angular momentum

Consider a system having n no. of particles with AM $l_1, l_2, \ldots l_n$

The total AM of system is vector sum of AM of indivisival particles.

$$L = l_1 + l_2 + \ldots + l_n$$

The total AM make change on account of torque acting on system. Then torque acting on system can arise due to internal as well as external force but internal are equal & opposite the force they are cancle only external force act on system.

The τ is contribute to change in total AM

$$\tau = \frac{dL}{dt}$$

τ = total external τ act on system

$$\tau = \tau_1 + \tau_2 + \ldots \tau_n$$

The rate rate of AM of particle in the system remain constant if the external torque act on system is zero,

$\tau = 0$ then $\frac{dl}{dt} = 0$ $\quad l = \text{constant}$

then AM is conserved.

2. i) Center of mass

Let, ~~x_{cm}~~ to x_1 & x_2 are seperate atadistace of m_1 & m_2 from origin 'o'.
Let, c be the point at distance x_{cm} which is equal to ~~m~~ $M = m_1 + m_2$ where whole mass is conserved.

then,

$$(m_1 + m_2)\, x_{cm} = m_1 v_1 + m_2 v_2$$

$$x_{cm} = \frac{m_1 v_1 + m_2 v_2}{m_1 + m_2}$$

x_{cm} is the position of center of mass which mean x_1 & x_2
There are n particle along the line then position of center of mass is

$$x_{cm} = \frac{m_1 v_1 + m_2 v_2 + \cdots + m_n v_n}{m_1 + m_2 + \cdots + m_n}$$

$\Sigma = M$ total mass of cental of mass.

There are n laying on 3 dimentional space then position of ce... mas... w.r.t. origin given by Co-... Ce.47

$$x_{cm} = \frac{\sum m_i x_i}{M}$$

$$y_{cm} = \frac{\sum m_i y_i}{M}$$

$$z_{cm} = \frac{\sum m_i z_i}{M}$$

This 3 expt. combined in single expt.

$$\bar{r}_{cm} = x_{cm}\hat{i} + y_{cm}\hat{j} + z_{cm}\hat{k}$$

$$\bar{r}_{cm} = \frac{\sum m_i \bar{r}_i}{M}$$

The no. of particles are very large which distribute uniformly.

The co-ordinates of center of mass obtain by replacing sumation by integration

$$\bar{r}_{cm} = \frac{\int \bar{r} \cdot dm}{dm}$$

$$\bar{r}_{cm} = \frac{\int \bar{r} \cdot dm}{M}$$

where, dm is infinitesimely small mass element.

∴ where whole mass is divided

02+8 (10/10)

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06787

Shri Swami Vivekanand Shikshan Sanstha Kolhapur's

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Name :- Divyani Uttam Patil.

Suppliment No. : 01

Roll No. : 7244

Class : BSc. I

Signature of Supervisor	

Subject : Physics (Mechanics - I)

Test / Tutorial No. :

Div. : A

Q.1 1. a) 40 N

Solution :-

Given :- $m = 10\ kg$

$v_1 = 4\ m/s$

$v_2 = 24\ m/s$

$t = 5\ sec.$

To find :- the force acting on the body (F)

Formula :- $F = ma$

Calculation :- From formula,

$$F = m\left(\frac{v_2 - v_1}{t}\right)$$

$$= 10 \times \frac{24-4}{5}$$

$$= 10 \times \frac{20}{5}$$

$$\therefore F = 40\ N$$

01

∴ Ans :- the force acting on the body is 40 N.

VIVEKANAND COLLEGE KOLHAPUR ESTD JUNE 1964

2) d) torque

Solution:-

The time rate of change of angular momentum is torque.

$\therefore \frac{d\bar{l}}{dt} = \bar{\tau}$

6)

.2 1. An expressions for law of conservation of linear and angular momenta for system of particles as follows:-

1) For linear momenta of system of particles

Statement :- The rate of change of linear momenta is conserved or constant when an external force act on the system of particle is constant (or zero).

i.e. The rate of change of vector sum of linear momenta is constant when net external force is zero.

Consider, the system of 'n' particles having masses, $m_1, m_2, \ldots, m_n$ and moving with velocities $v_1, v_2, \ldots, v_n$. Suppose, no particle enter and leave the system. There are two forces act on system of particle.
i.e. internal as well as external force.
But internal force is equal and opposite to each therefore, it gets cancelled. Only external force acts on it.

$\therefore$ The total vector sum of forces is given by

$F_{ext} = F_1 + F_2 + \ldots\ldots + F_n$

Let, $P_1, P_2, \ldots P_n$ be the linear momenta of system.

of particles where $p = Mv$.

The total linear momenta is given by,

$P = \bar{P}_1 + \bar{P}_2 + \ldots + \bar{P}_n$

$Mv = m_1\bar{v}_1 + m_2\bar{v}_2 + \ldots + m_n\bar{v}_n$ ..(2)

According to Newton's 2nd law,

$\bar{F}_{ext} = m\bar{a}$

$= m\frac{d\bar{v}}{dt}$

$= \frac{d}{dt}(m\bar{v})$

$\therefore \bar{F}_{ext} = \frac{d\bar{P}}{dt}$ ..(3)

If the rate of change of linear momenta is conserved when net force acting on particle of system is zero.

$\therefore$ If $\bar{F}_{ext} = 0$ then $\frac{d\bar{P}}{dt} = 0$

2) For Angular momenta of system of particles.

Statement :-

The rate of change of vector sum of angular momenta is consvered when net torque is actin on it is zero.

Consider, a system of 'n' particles, having forces as external and internal. But internal forces get vanished. Only external force act on it. Suppose, the total torque act on a system of particle is given as,

$$\bar{\tau} = \bar{\tau}_1 + \bar{\tau}_2 + \bar{\tau}_3 + \ldots + \bar{\tau}_n$$

As no particle enter or leave the system.

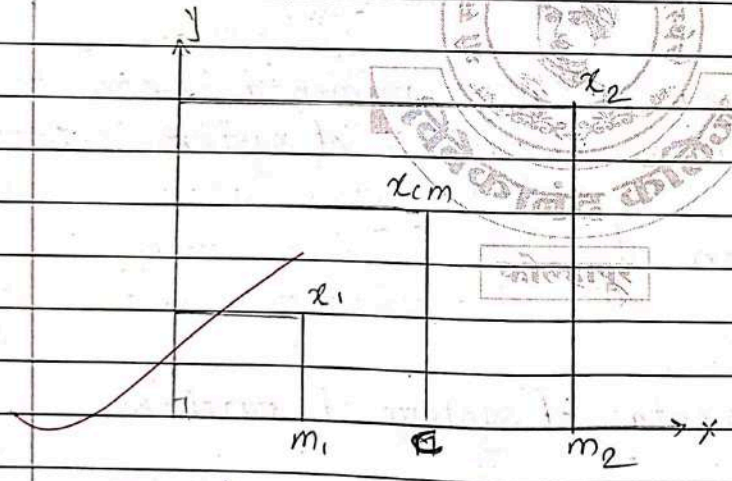
$$\therefore \bar{\tau} = \frac{d\bar{l}}{dt}$$

If $\bar{\tau} = 0$ then $\frac{d\bar{l}}{dt} = 0$

i.e. The net angular momenta of system of particle is conserved when net torque acting on it is zero

04

2. Centre of Mass



Consider a plane, having masses m_1 and m_2 with distance x_1 and x_2. C be the point of mean of x_1 and x_2 where whole mass, $M = m_1 + m_2$ is concentrated.

Centre of mass is said to be whole mass of body is supposed to be concentrated.

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VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)
SUPPLIMENT
Signature of Supervisor
Suppliment No. : 02
Roll No. : 7244
Class : B Sc. I
Subject : Mechanics I
Test / Tutorial No. :
Div. : A

Equating the momenta is given by,

$$(m_1+m_2)x_{cm} = m_1x_1 + m_2x_2$$

$$\therefore x_{cm} = \frac{m_1x_1 + m_2x_2}{m_1+m_2}$$

For n^{th} particle centre of mass is given by

$$x_{cm} = \frac{m_1x_1 + m_2x_2 + \ldots + m_nx_n}{m_1+m_2+\ldots+m_n}$$

When system in 3 plane axis (x, y, z) then

$$x_{cm} = \frac{\sum m_i x_i}{M_i}, \quad y_{cm} = \frac{\sum m_i y_i}{m_i}, \quad z_{cm} = \frac{\sum m_i z_i}{m_i}$$

Combined this expression in one equation as,

$$\bar{r} = x_{cm}\hat{i} + y_{cm}\hat{j} + z_{cm}\hat{k}$$

For ith particle,

$$\bar{r}_{cm} = \frac{\int r\,dm}{\int dm}$$

$$= \frac{\int r\,dm}{M}$$

where, dm is infinitesimally mass.

Physical significance :-

Consider a system of n^{th} particles having masses $m_1, m_2, \ldots m_n$ and moving with velocities, $v_1, v_2, \ldots v_n$.

∴ The total mass of system is M.

$$\therefore M\bar{r}_{cm} = m_1\bar{r}_1 + m_2\bar{r}_2 + \ldots + m_n\bar{r}_n \quad \ldots(1)$$

Diff. above eqⁿ with respect to time.

$$M\frac{d\bar{r}_{cm}}{dt} = m_1\frac{d\bar{r}_1}{dt} + m_2\frac{d\bar{r}_2}{dt} + \ldots + m_n\frac{d\bar{r}_n}{dt}$$

$$M\frac{d\bar{r}_{cm}}{dt} = M\bar{v}_{cm}$$

$$\therefore M\bar{v}_{cm} = m_1\bar{v}_1 + m_2\bar{v}_2 + \ldots + m_n\bar{v}_n \quad \ldots(2)$$

Again diff. w.r. to time.

$$M\frac{d\bar{v}_{cm}}{dt} = m_1\frac{d\bar{v}_1}{dt} + m_2\frac{d\bar{v}_2}{dt} + \ldots + m_n\frac{d\bar{v}_n}{dt}$$

$$M\bar{a} = m_1a_1 + m_2a_2 + \ldots + m_na_n$$

According to Newton's 2nd law

$F = ma$

∴ As internal force get vanished and only external force act on it.

As no particle enter or leave the system.

As only external force is acts on it.

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– शिक्षणमहर्षी डॉ. बापूजी साळुंखे

34487

Shri Swami Vivekanand Shikshan Sanstha Kolhapur's

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

SUPPLIMENT

Signature of Supervisor	I - 06/10 . II - 8/10
Suppliment No. :	Subject : Mechanics-I & Mechanic II
Roll No. : 7209	Test / Tutorial No. :
Class : B.Sc. fy	Div. : A

Q I Select the correct alternatives

1. The time rate of change of angular momentum is
b) force

2. The linear momentum of the particle or system is conserved, if the total b) torque acting on the particle or system of particle is zero.

Q II. Answer the following questions

1. ~~The principle~~ state and prove the law of conservation of linear momentum for system of particles.

→ The linear momentum of a particle is defined as the product of the mass of the particle times the velocity of that particle. Conservation of momentum of a particle is a property exhibited by any particle where the total amount

of momentum never changes linear momentum of a particle is a vector quantity and is denoted by $\vec{p}$

The conservation of linear momentum formula mathematically expresses that the momentum of the system remains constant when the net external force is zero.

Initial momentum = final momentum

$p_i = p_f$

linear momentum formula

linear momentum is mathematically expressed that

$\vec{P} = m\vec{v}$

$\vec{P}$ is the linear momentum.

$\vec{v}$ is the linear velocity

m is the mass of body.

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2. Given :- (M_1) = mass of the gun = 20 kg

(v_1) = Recoils with velocity = 400 cm/s = 40×10^1 m/s

(v_2) = Muzzle velocity = 800 m/s

(m_2) = Mass of the Bullet = ?

Soln :- As per the law of conservation.

$$m_1 v_1 = m_2 v_2$$

$$\frac{m_1 v_1}{v_2} = m_2$$

$$m_2 = \frac{m_1 v_1}{v_2}$$

$$= \frac{20 \times 40 \times 10^1}{800}$$

$$= \frac{80 \times 10^1}{80}$$

$$= 1 \times 10^1$$

m_2 = 10 gram

Ans :- The mass of Bullet is 10 gram.

Mechanics - II

Select the correct alternatives:

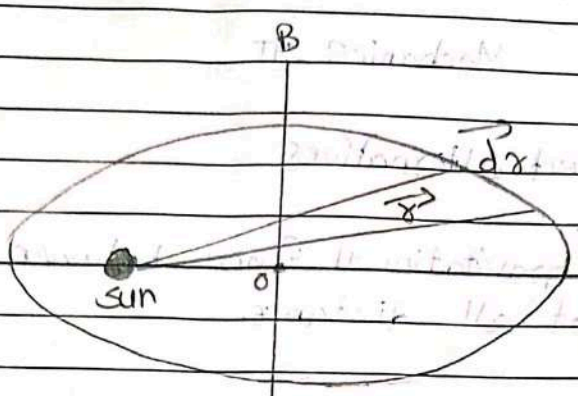
What is the gravitational force between two objects?
c) attractive at all distance.

The value of 'g'
~~c) attractive at all distances~~
b) Decreases as we go to the centre of the earth.

Answer the following questions:

1) What is meant by central force field?
* A force is said to be a central force if it is always directed towards and away from fixed point 'O' and its magnitude only depends on distance from that fixed point. The particle is said to move in central force field of force acting on partical ~~satisfied~~ satisfied properties of central force field. the fixed point is reffered as the centre of force.

~~The value of g~~
~~d. is more at equator and less at poles~~



Keplar's law

There are three Keplar's laws of planetry motion are below :-

1) laws of eliptical orbitals
2) laws of areas
3) laws of periods.

1) laws of eliptical orbitals :- All the planets are move in elliptical orbits of situated one of the foci with the sun of the ellipse. This is known as Laws of elliptical orbits.

2) Laws of areas :- The radius vector from the sun to planet sweeps equal areas in equal time that is the areal velocity of the planet is constant. This is known as laws of areas.

3) Laws of periods :-

Laws of periods is also know as harmonic laws.

॥ ज्ञान, विज्ञान आणि सुसंस्कार यांसाठी शिक्षण प्रसार ॥
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34481

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SUPPLIMENT

Smital Vilas Kamble

Suppliment No. :

Roll No. : 7254

Class : BSC F.Y.

Signature of Supervisor : I - 09/10 II - 05/10

Subject : Mechanics - I

Test / Tutorial No. :

Div. : A

Q I Select the correct alternatives:

(1) The time rate of change of angular momentum is

→ angular acceleration

(2) ~~The linear momentum of the~~

→ linear momentum

S.II

(2)

→ By the law of conservation of momentum, initial momentum = Find momentum.

$\therefore p_1 = p_2$

$\therefore m_1 v_1 = m_2 v_2$

Here,

$m_1 = 20gm$, $V_2 = 200\ ms^{-1}$, $m_2 = 20kg = 20,000gm$

$\therefore V_2 = \frac{m_1 v_1}{m_2}$

$\therefore \frac{20 \times 200}{20000}$

$\therefore v_2 = 0.2\ m/s$

$\therefore$ f_2

MECHANICS-II

Q I

(1)

→ a] attractive ~~all~~ at all distance

(2)

→ b] Decreases as we go to the centre of the earth poles.

Q II

(1)

→ Central force is the force that is radially pointing and the magnitude is dependent on the distance from the source. ~~Exp~~ Example of central force are gravitational force, electrostic force and spring force.

(2)

→ ① The path of the planets about the sum is elliptical is shape, with the centre of the sum being located at one focus.

② An imaginary line drawn from the centre of the sun to the centre of the centre of the planet will sweep out equal area in the equal intervals of time.

③ The ratio of the square of the periods of any two planets is equal to the ratio of the cubes of their average distances the sun

03

66/10

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SUPPLIMENT

Signature of Supervisor

Suppliment No. : 1
Roll No. : 7229
Class : I (OE)

Subject : Physics Mecanics - II
Test / Tutorial No. : 1
Div. : A

Q.1

3] The Pkabedary orbits around the sun are.----

→ b] elliptical

4] The period of satellite does not depend on.----

→ d] mass of the satellite

0/2

Q.2

3] → The central for is the force acting on a object that fouses along the line between the object and the origin. ~~relies only~~ The magnitude of the central force relies only on the distance between the centre

The mathematical equation
$F = f(r)\hat{r}$

0/4

4] → ~~State newton's law of gravitation~~

4] → Statement :- every particle of matter attracts every other particle of matter attracts every other particle of matter with a force that is directly proportional to the product of their masses and inversally proportional to the square of the distance between them

$$\vec{F}_{21} = k \frac{m_1 - m_2}{r^2} (-\hat{r}_{21})$$

$\hat{r}_{21}$ → unit vector from m_1 to m_2

$\vec{F}_{21}$ → force is directed from m_2 to m_1

The gravitational force is attractive in nature The force of attraction that tries to pull two masses together in the universe is termed the gravitational force of attraction.