TOPIC WISE MULTIPLE CHOICE QUESTIONS

3.5 EQUATIONS OF UNIFORMLY ACCELERATED MOTION

(1) Equations of motion hold only when there is

(a) linear motion with constant velocity **(b)** linear motion with variable acceleration
(c) linear motion with uniform acceleration **(d)** none of these

(2) The distance covered by a body in time "t" starting from rest is LHR-2018 (G-I)

(a) at^2 **(b)** $2at^2$
(c) $\frac{1}{2}at^2$ **(d)** $\frac{1}{2}a^2t$

(3) Velocity of an object dropped from a building at any instant 't' is given by: FSD-2017

(a) $\frac{1}{2}gt^2$ **(b)** $v_it+\frac{1}{2}gt^2$
(c) at **(d)** gt

(4) Distance travelled by free falling object in first second is: RWP-2019 (G-I)

(a) 4.9m **(b)** 9.8m
(c) 19.6m **(d)** 10m

(5) A mass of 1 kg is freely falling. The force of gravity is SWL-2017

(a) 1 N **(b)** 9.8 N
(c) **0.5 N** (d) **zero**

(6) If an object is dropped from the height h then its velocity is given by

(a) gt **(b)** $1/2gt^2$
(c) $v_it + 1/2\ gt^2$ **(d)** none of these

(7) Acceleration due to gravity near the surface of the earth is

(a) $0ms^{-2}$ **(b)** $9.8ms^{-2}$
(c) $1.6\ m/s^2$ **(d)** $11.2\ m/s^2$

(8) Distance covered by a free falling body during 2^{nd} second of its motion is

(a) 4.9m **(b)** 9.8m
(c) 14.7m **(d)** 19.6m

(9) A paratrooper moves downward with

(a) zero acceleration **(b)** negative acceleration
(c) positive acceleration **(d)** none of these

(10) If an object is moving with constant velocity of $20ms^{-1}$ towards north then its acceleration will be

(a) $5\ ms^{-2}$ **(b)** $10ms^{-2}$
(c) $9ms^{-2}$ **(d)** $0ms^{-2}$

(11) As we go at a greater height from the surface of earth, the value of g

(a) increases **(b)** decreases
(c) remain same **(d)** none of these

(12) Which one is the correct relation

(a) $a = \frac{v_f - v_i}{2t}$ **(b)** $a = \frac{v_f^2 + v_i^2}{2S}$
(c) $a = \frac{2(s - v_i t)}{t^2}$ **(d)** $a = \frac{(s + v_i t)}{2t^2}$

3.7 MOMENTUM AND IMPULSE

(13) The system on which no external force acts is called
(a) isolated system **(b)** open system
(c) non-inertial system **(d)** thermal system

(14) Impulse can be defined as (RWP 2014)
(a) $\vec{I} = \vec{F} \times \vec{d}$ **(b)** $\vec{I} = \vec{F} \times t$
(c) $\vec{I} = \vec{F} \times \vec{V}$ **(d)** $\vec{I} = \frac{\vec{F}}{t}$

(15) Impulse has same unit as that of: (DGK 2012, 13)FSD 2019 (G-I)
(a) force **(b)** energy
(c) mass **(d)** linear momentum

(16) A force of 10 N acts on a body of mass 5 kg for one second, the change in its momentum will be MTN-2018 (G-II)
(a) 10 kg ms^{-1} **(b)** 50 kg ms^{-1}
(c) **2 kg ms^{-1}** (d) **20 kg ms^{-1}**

(17) The product of force and time is called
(a) Impulse **(b)** momentum
(c) acceleration **(d)** torque

(18) A force of 10N act on a body of mass 10kg for 5 sec. The change in momentum of the body is
(a) 10 Ns **(b)** 100 Ns
(c) 50 Ns **(d)** 150 Ns

(19) Force acting on a body is equal to
(a) rate of change of momentum **(b)** change of momentum
(c) momentum **(d)** both a & b

(20) Dimension of momentum is
(a) [MLT] **(b)** [MLT^2]
(c) [ML^{-1}T] **(d)** [MLT^{-1}]

(21) The unit of impulse is
(a) Nm **(b)** Ns
(c) Ns^{-1} **(d)** N

(22) Direction of impulse is same as that of
(a) change in momentum **(b)** velocity
(c) change in acceleration **(d)** no direction

(23) SI unit of momentum is same as that of
(a) impulse **(b)** velocity
(c) force **(d)** acceleration

(24) Which bullet of same momentum is more effective in knocking a bear down
(a) rubber bullet **(b)** lead bullet
(c) both are equally effective **(d)** none of these

(25) If the force of 250N acts on an object for 2 seconds, than change in momentum will be
(a) 50Ns **(b)** 450Ns
(c) 500Ns **(d)** 125Ns

(26) In the absence of an unbalanced force, the momentum of an isolated system always
(a) increase **(b)** decreases
(c) conserved **(d)** none of these

(27) Does a moving object has impulse?
(a) may or may not be **(b)** yes always
(c) never **(d)** none of these

(28) The force which might be enough to fracture the naked skull is
(a) 50N **(b)** 10N
(c) 15N **(d)** 5N

(29) The relation $I = \overline{F} \times \Delta t$ shows
(a) momentum **(b)** power
(c) impulse **(d)** work

(30) The rate of change in momentum is called
(a) force **(b)** torque
(c) distance **(d)** time

(31) When the retarding time is increased during the impact than the average force
(a) increases **(b)** decreases
(c) zero **(d)** no change

(32) The motor cycle's safety helmet prevents the serious injury due to padding because it
(a) extends the time of impact **(b)** increases impulsive force
(c) decreases the impulsive force **(d)** both a and c

(33) A tennis ball hits with the wall for collision time of 0.2 sec, if the impulse reduces to 10Ns then the impulsive force will be
(a) 10N **(b)** 100N
(c) 5N **(d)** 50N

3.8 ELASTIC AND INELASTIC COLLISION

(34) The collision in which linear momentum as well as K.E is conserved is called
(a) nearly elastic collision **(b)** perfectly elastic collision
(c) non elastic collision **(d)** none of these

(35) In an inelastic collision
(a) momentum is conserved **(b)** energy is conserved
(c) both a & b **(d)** none

(36) In case of elastic collision
(a) magnitude of relative velocity of approach equal to the magnitude of relative velocity of separation
(b) magnitude of relative velocity of approach is doubled of the magnitude of relative velocity of separation
(c) magnitude of relative velocity of approach greater to magnitude of relative velocity of separation
(d) magnitude of relative velocity of approach very less to the magnitude of relative velocity of separation

(37) For two colliding balls which condition is applicable for one dimensional elastic collision
(a) they should be non-rotating (b) they should be smooth
(c) both a and b (d) none of these

(38) When two objects undergoes an inelastic collision then
(a) objects comes to rest after collision
(b) momentum of the objects changes
(c) momentum does not change
(d) the law of conservation of energy is violated

3.9 FORCE DUE TO WATER FLOW

(39) When water strikes a wall the force exerted by water on the wall is
(a) $\vec{F} = m\vec{v}$ (b) $\vec{F} = \frac{m\vec{v}}{t}$
(c) $\vec{F} = \frac{mt}{\vec{v}}$ (d) $\vec{F} = \frac{m}{\vec{v}}$

(40) Suppose a water flows out from a pipe at 3kgs^{-1} and its velocity changes from 5ms^{-1} to zero on striking the wall, then force of water will be
(a) 15N (b) 20N
(c) 5kgms^{-1} (d) 15kgms^{-1}

3.10 MOMENTUM AND EXPLOSIVE FORCES

(41) When the bullet is fired from the rifle, it follows the principle of
(a) conservation of energy (b) conservation of force
(c) conservation of mass (d) conservation of momentum

3.11 ROCKET PROPULSION

(42) When a rocket moves upward its acceleration
(a) constant (b) decrease
(c) increases continuously (d) become zero

(43) __________ mass of rocket is in the form of fuel **SWL-2017,DGK-2016 (G-I)**
(a) 60% (b) 70%
(c) 80% (d) 90%

(44) A mass of fuel consumed by a typical rocket to overcome earth's gravity is
(a) 10000 kgs^{-1} (b) 1000kgs^{-1}
(c) 100kgs^{-1} (d) 10kgs^{-1}

(45) A typical rocket ejects the burnt gases at speeds of over **MTN-2016 (G-I)**
(a) 400ms^{-1} (b) 4000ms^{-1}
(c) 40ms^{-1} (d) 40000ms^{-1}

(46) The rocket carries its fuel in the form of
(a) solid only (b) liquid only
(c) solid and liquid (d) gases and solid

(47) The acceleration of rocket is expressed as
(a) $\vec{a} = \frac{m\vec{v}}{M}$ (b) $\vec{a} = \frac{mt}{M}$
(c) $\vec{a} = \frac{M}{m\vec{v}}$ (d) $\vec{a} = \frac{m\vec{v}^2}{M}$

(48) **Rocket ejects the burnt gasses at a speed of over (consuming fuel at rate of 10000 kg/s)** **LHR-2019 (G-II)**

(a) 4000 m/s **(b)** 400 m/s
(c) 4000 cm/s **(d)** 400 cm/s

3.12 PROJECTILE MOTION

(49) **A fighter plane drops a bomb when it is at the top of enemies target. Bomb misses the target due to**

(a) horizontal component of velocity **(b)** action of gravity
(c) vertical component of velocity **(d)** bad weather

(50) **Motion of a projectile is** **LHR 2015(G-I)**

(a) one dimensional **(b)** two dimensional
(c) three dimensional **(d)** four dimensional

(51) **Total time of flight of projectile is given as** **(GRW 2014)**

(a) $\frac{v_i \sin\theta}{g}$ **(b)** $\frac{2v_i \sin\theta}{g}$
(c) $\frac{v_i \sin\theta}{2g}$ **(d)** $\frac{2v_i \sin^2\theta}{g}$

(52) **Which shows correct relation between H and T of projectile?** **LHR-2018 (G-II)**

(a) $H = \frac{2T^2}{8}$ **(b)** $H = \frac{gT^2}{8}$
(c) $H = \frac{8g}{T^2}$ **(d)** $H = \frac{8}{gT^2}$

(53) **The horizontal range of a projectile at 30° with horizontal is same at an angle:** **(SWL 2015)LHR-2017 (G-I)**

(a) 40° **(b)** 45°
(c) 90° **(d)** 60°

(54) **The horizontal component of velocity of projectile:** **(RWP 2012),LHR-2017 (G-I)**

(a) increases **(b)** decreases
(c) increases or decreases **(d)** remains constant

(55) **Ranges of projectile are equal for pair of angles;** **(MTN 2015)MIRPUR (AJK) 2015**

(a) 45°, 50° **(b)** 45°, 60°
(c) 40°, 50° (d) 40°, 55°

(56) **The range of projectile is same for** **(SGD 2015)**

(a) 0, 45 **(b)** 35, 55
(c) 15,60 **(d)** 30,75

(57) **The angle for which the maximum height and horizontal range of a projectile equal to each other is** **(BWP 2014)**

(a) 30° **(b)** 45°
(c) 60° **(d)** 76°

(58) **The velocity of projectile at maximum height is** **DGK-2016 (G-II)**

(a) $v_i \cos\theta$ **(b)** zero
(c) $v_i \sin\theta$ **(d)** none of these

(59) If the initial velocity of a projectile becomes doubled, the time of flight will be come: **MTN-2018 (G-I)**

(a) double **(b)** same
(c) 3 times **(d)** 4 times

(60) In projectile motion, acceleration has zero value along

(a) Vertical direction **(b)** horizontal direction
(c) Both a and b **(d)** none of these

(61) In projectile motion the acceleration in vertical direction is

(a) 9.8 m/s^2 **(b)** zero
(c) Variable **(d)** none of these

(62) In projectile motion horizontal velocity

(a) Reduces to zero **(b)** remains constant
(c) Zero **(d)** all of these

(63) Projectile moves with constant

(a) horizontal velocity **(b)** vertical velocity
(c) acceleration due to gravity **(d)** both a and c

(64) Which of them is not a projectile motion?

(a) football kicked off by a player **(b)** an object dropped from an aero plane
(c) a missile launched from a launching pad **(d)** none of these

(65) At maximum height of projectile motion, the angle between velocity and acceleration is

(a) 45^o **(b)** 90^o
(c) 180^o **(d)** 76^o

(66) At the highest point during projectile motion

(a) acceleration is zero **(b)** velocity is zero
(c) vertical component of velocity is zero **(d)** none of these

(67) Which parameter changes during projectile motion?

(a) vertical velocity **(b)** acceleration
(c) horizontal velocity **(d)** both a and b'

(68) A body is projected at angle 'θ' with horizontal by velocity v_i, the vertical component of its velocity at any time t is

(a) $v_i \sin 2\theta + gt$ **(b)** $v_i \cos \theta$
(c) $v_i \cos \theta - gt$ **(d)** $v_i \sin \theta - gt$

(69) The horizontal velocity at the point of hitting is given

(a) $v_i \sin \theta$ **(b)** $v_i \cos \theta$
(c) $v_i \cos \theta\ t$ **(d)** $v_i \cos \theta / t$

(70) Height of projectile is calculated by H = **MTN-2016 (G-I)**

(a) $\frac{v_i^2 \sin^2 \theta}{2g}$ **(b)** $\frac{v_i^2 \sin 2\theta}{g}$
(c) $\frac{v_i^2 \sin^2 \theta}{g}$ **(d)** $\frac{v_i^2 \sin \theta}{2g}$

(71) Time taken by a projectile to reach maximum height is t =

(a) $\frac{v_i \sin \theta}{2g}$ **(b)** $\frac{v_i \sin 2\theta}{g}$
(c) $\frac{v_i \sin \theta}{g}$ **(d)** none

(72) For range to have maximum value, the function sin2 θ should have value

(a) 90 **(b)** 1
(c) 45 **(d)** 0

(73) Range of projectile is maximum when θ =

(a) 45^o **(b)** 90^o
(c) 60^o **(d)** 30^o

(74) Maximum range of projectile is given by

(a) $\frac{2v_i^2}{g}$ **(b)** $\frac{v_i^2}{g}$
(c) $\frac{v_i^2}{2g}$ **(d)** $\frac{v_i^2 \sin 2\theta}{g}$

(75) When a projectile is fired at angle θ, then the relation between height "H" and range "R" is

(a) H = R **(b)** H = $\frac{R}{2}$
(c) H = $\frac{R}{4}\tan\theta$ **(d)** H = 4R

(76) A ballistic flight is the motion under

(a) Inertia **(b)** Gravity
(c) Both a and b **(d)** Aerodynamic forces

(77) Ballistic trajectory is the path followed by projectile

(a) Powered and unguided **(b)** Un-powered and unguided
(c) Un-powered and guided **(d)** Powered and guided

(78) Two projectile are projected at angle of 20^0 and 70^0 with same velocity which one have longer range

(a) Which is fired at 20^0 **(b)** Which is fired at 70^0
(c) Both have same range **(d)** none of these

(79) One ball is allowed to drop freely and the other is projected horizontally at the same time which ball will reach the ground earlier

(a) First ball **(b)** Second ball
(c) Both will reach at the same time **(d)** none of these

(80) A ball is allowed to fall freely from certain height. It covers a distance in first second equal to: MTN 2015 (G-II)

(a) 2g **(b)** g
(c) $\frac{g}{2}$ **(d)** g^2

(81) The angle of projection for which the maximum height and the horizontal range of a projectile are equal to (GRW 2013)

(a) 45^o **(b)** $\tan^{-1}\left(\frac{1}{4}\right)$
(c) $\tan^{-1}(4)$ **(d)** none of these

(82) For which pair ranges of projectile are same. (GRW 2015)

(a) 45^o, 50^o **(b)** 60^o, 40^o
(c) 30^o,60^o **(d)** none of these

ANSWER KEYS

(Topic Wise Multiple Choice Questions)

1	c	16	a	31	b	46	d	61	a	76	c
2	c	17	a	32	d	47	a	62	b	77	b
3	d	18	c	33	d	48	a	63	c	78	c
4	a	19	a	34	b	49	a	64	d	79	c
5	b	20	d	35	a	50	b	65	b	80	c
6	a	21	b	36	a	51	b	66	c	81	c
7	b	22	a	37	c	52	b	67	a	82	c
8	a	23	a	38	c	53	d	68	d		
9	c	24	b	39	b	54	d	69	b		
10	d	25	c	40	a	55	c	70	a		
11	b	26	c	41	d	56	b	71	c		
12	c	27	a	42	c	57	d	72	b		
13	a	28	d	43	c	58	a	73	a		
14	b	29	c	44	a	59	a	74	b		
15	d	30	a	45	b	60	b	75	c		

SHORT QUESTIONS

(From Textbook Exercise)

3.9. Define impulse and show that how it is related to linear momentum?

SGD-15(G-I), BWP-15(G-I), GRW-15 (G-I), SWL-16, MTN-16 (G-I) & (G-II), DGK-16 (G-I) & (G-II), SGD-16 (G-I), RWP-16 (G-I), LHR-16 (G-II), FSD-17, LHR-17 (G-II), LHR-19 (G-II), GRW-19 (G-I)

When the force acts on a body for a very short interval of time then the product of average force and time for which the force acts is called impulse

$$\vec{I} = \vec{F} \times \Delta t$$

As $\quad \vec{F} \times t = m\vec{v}_f - m\vec{v}_i$

$$\vec{I} = \Delta \vec{P}$$

Hence Impulse is equal to change in linear momentum.

3.10. State the law of conservation of linear momentum, pointing out the importance of isolated system. Explain, why under certain conditions, the law is useful even though the system is not completely isolated? ***GRW-14(G-I), SGD-15(G-II)***

Ans: Importance:

For an isolated system, total change in linear momentum due to mutually interacting forces is zero.

Statement:

It states that, the total linear momentum of an isolated system remains constant.

Law is also useful in a situation when mutually interacting forces are much greater than external force because in this situation external force is negligible.

Example

Firing of a bullet from gun.

3.11. Explain the difference between elastic and inelastic collisions. Explain how would a bouncing ball behave in each case? Give plausible reasons for the fact that K.E is not conserved in most cases?

BWP-15(G-I), MTN-15(G-I)&(G-II), SGD-16 (G-II)

Ans:

Elastic Collision	Inelastic Collision
In ideal case, when no K.E is lost, the collision is said to be perfectly elastic.	A collision in which the K.E of the system is not conserved is called inelastic collision.

Suppose we drop a ball from a certain height. If it has elastic collision on striking the floor, it will come at the original height but in case of inelastic collision, ball will lose some part of kinetic energy and will not bounce back at the same height.

In most of the cases, some part of kinetic energy is lost as heat and sound energies.

3.12. Explain what is meant by projectile motion. Derive expressions for (a) the time of flight (b) the range of projectile Show that range of projectile is maximum when projectile is thrown at an angle of 45° with the horizontal.

SGD-15(G-II), MTN-15(G-I), BWP-15(G-I), RWP-15(G-I), FSD-15(G-I), LHR-15(G-I)&(G-II), MIRPUR (AJK) 15, SGD-16 (G-I), SWL-17, LHR-17 (G-II), BWP-19 (G-II)

Ans: See the book

3.13. At what point or points in its path does a projectile have its minimum speed, its maximum speed?
SGD-15(G-II), SWL-16, MTN-16 (G-II), DGK-16 (G-II), SGD-16 (G-I)&(G-II), LHR-16 (G-II), BWP-17 (G-I) & (G-II), DGK-18 (G-I), FSD-18, FSD-19, BWP-19 (G-I)

Ans: (i) The projectile has minimum speed at maximum height because at this point the vertical component of the velocity is zero. i.e. $v = v_x$ only

(ii) It has maximum speed at the point of projection and point of landing, because at these points vertical component of velocity has maximum value. i.e. $v = \sqrt{v_x^2 + v_y^2}$

TOPIC WISE SHORT QUESTIONS

3.3 REVIEW OF EQUATIONS OF UNIFORMLY ACCELERATED MOTION

(7) Does the man can jump high on the surface of Moon?

Ans: Let a man makes high jump with initial velocity v_i and at highest point its final velocity v_f becomes zero, also a = - g. Then height attained by him is given as.

$$V_f^2 - V_i^2 = 2as$$

$$0^2 - V_i^2 = -2gh$$

$$h = \frac{V_i^2}{2g}$$

Since at the surface of moon, the value of g is low, thus he will attain more height.

(8) Calculate the distance covered by a free-falling body during first second of its motion. SGD-2018 (G-I)

Ans:

$$S_{nth} = \frac{1}{2}g(2n-1)$$

$$S_{1st} = \frac{1}{2}(10)(2(1)-1)$$

$$S_{1st} = 5m$$

Newton's Third Law of Motion:

When two bodies interact the action is always equal and opposite to reaction.

"To every action force there is an equal and opposite reaction force."

It means that action always acts on one body and reaction on the other body. That is why action and reaction never balanced each other.

If two bodies A and B collide, the action of body A on B is force $\vec{F}_{BA}$ and reaction of B on A is force $\vec{F}_{AB}$. Then according to Newton's third law of motion we can write

$$\vec{F}_{BA} = -\vec{F}_{AB}$$

(9) Define inertial non inertial frame of references DGK-2016 (G-II)

Ans: Frame Of Reference:

To locate a point in plane or space we require a coordinate system.

Frame of reference is a coordinate system used to measure some observation about an event on body such as velocity and acceleration etc.

There are two kinds of frames of reference.

Inertial frame:

Those frames of reference which are either at rest or moving with uniform relative velocity are called inertial frames.

* Newton's Law of inertia holds in these frames

* They have no acceleration.

Non inertial frame:

Those frames which are not moving with uniform relative velocities are called non inertial frames.

* Newton's law of inertia does not hold in these frames.

* They have acceleration.

3.7 MOMENTUM AND IMPULSE

(10) As the unit of momentum is kg ms^{-1}. Show that its unit is also Ns.

Ans: Unit of momentum $= kg\frac{m}{s}$

Multiplying and dividing by s $= kg\frac{\text{m}}{\text{s}}\times\frac{s}{s}$

$$=\text{kg}\frac{\text{m}}{\text{s}^2}\times s$$

As, $\text{kg}\ \frac{m}{s^2} = N$

$$= \text{Ns}$$

(11) Prove that change of momentum is the impulse?

Ans: By Newton's 2nd law

$$\vec{F} = m\vec{a}$$

$$\vec{F} = \frac{m\overrightarrow{v_f} - m\overrightarrow{v_i}}{\Delta t}$$

$$\vec{F}\ x\ \Delta t = m\overrightarrow{v_f} - m\overrightarrow{v_i}$$

$$\vec{I} = \Delta\vec{P}$$

(12) Find the Dimensional formulas for i) Impulse ii) Momentum

Ans: **(i)** Dimension of Impulse

$$\vec{I} = \vec{F}\times t$$

$$[I]=[F][T]$$

$$[I]=[M][a][T]$$

$$=[M]\left[LT^{-2}\right][T]=\left[MLT^{-1}\right]$$

(ii) Dimension of momentum

$$P = mv$$

$$[P]=[m][V]$$

$$=[M]\left[LT^{-1}\right]$$

$$=\left[MLT^{-1}\right]$$

(13) Which will be more effective in knocking a bear down, rubber bullet or lead bullet?

Ans: Since the rubber is soft as compared to lead bullet, it will not enter the skin of Bear so retarding time for rubber bullet is large as compared to lead bullet. Therefore the average impulsive force due to lead bullet is more effective to knock the bear down.

(14) What is the effect on the speed of a fighter plane chasing another when it opens fire? What happens to the speed of pursued plane when it returns the fire?

Ans: When the fighter plane chasing another plane opens fire then due to reacting force of firing its velocity decreases, while the speed of the pursued plane when it fire backward, velocity increases due to the reacting force.

(15) How the helmet prevent the serious injury.

Ans: The motorcycle's safety helmet is padded so as to extend the time of any collision and hence average force reduces. So it prevents serious injury.

(16) Show that $\vec{F} = \frac{\Delta \vec{P}}{\Delta t}$ **LHR-2013**

Ans: $\vec{F} = m\vec{a}$

$$\vec{F} = \frac{m\overrightarrow{v_f} - m\overrightarrow{v_i}}{\Delta t}$$

$$\vec{F} = \frac{m\overrightarrow{v_f} - m\overrightarrow{v_i}}{\Delta t}$$

$$\vec{F} = \frac{\Delta \vec{P}}{\Delta t}$$

(17) A 20 g ball hits the wall of a squash court with a constant force of 50 N. If the time of impact of the force is 0.5 sec., find the impulse? LHR-2017 (G-I)

Ans: $I = F \times \Delta t$

$I = 50 \times 0.5$

$I = 25 N\,\text{sec}$

(18) What is the effect on the speed of a fighter plane chasing another when it opens the fire? DGK-2016 (G-II)

Ans: The speed of chasing plane will decrease when it opens the fire due to newton's 3^{rd} law , there will be a reaction force on the plane.

(19) State law of conservation of momentum. What is its limitation? SWL-2019

Ans: It states "In the absence of an external force, the total linear momentum of an isolated system remains conserved.

OR

Total linear momentum of an isolated system remains constant

Limitation: it is applicable for the isolated system only .

(20) Calculate the linear momentum of a ball of mass 100 gm. Which moves with 5m/s along a straight line.

Ans: P = m v

$P = (100 \times 10^{-3})(5)$

P = 0.5 N Sec

(21) A rubber ball and lead ball of same size are moving with same velocity. Which ball have greater momentum and why? **LHR-2019 (G-II)**

Ans: As we know that P = m v

According to given statement velocity of the lead and rubber ball is same so momentum will be directly proportional to the mass

$$P \propto m$$

As mass of the lead ball islarger as compare to the rubber ball so lead ball will have greater momentum.

3.8 ELASTIC AND INELASTIC COLLISION

(22) In what type of collision the total energy and momentum are conserved.

Ans: In every type of collision both momentum and total energy are always remain conserved because both are fundamental laws.

(23) What is the benefit to use the seat belt during drive the car?

Ans: The seat belt may increase the collision time during impact so the impulsive forces decrease.

(24) Find the value of v'_1 and v'_2 after elastic collision of light body with massive body at rest. **RWP-2014**

Ans : Velocity of the lighter body after collision

$$v_1' = \left(\frac{m_1 - m_2}{m_1 + m_2}\right)v_1 + \frac{2m_2 v_2}{m_1 + m_2}$$

$$v_1' = \left(\frac{0 - m_2}{0 + m_2}\right)v_1 + \frac{2m_2(0)}{m_1 + m_2}$$

$$v_1' = -v_1$$

Velocity of the heavy body after collision

$$v_2' = \frac{2m_1}{m_1 + m_2}v_1 + \frac{m_2 + m_1}{m_1 + m_2}v_2$$

$$v_2' = \frac{2(0)}{0 + m_2}v_1 + \frac{m_2 + 0}{0 + m_2}(0)$$

$$v_2' = 0$$

3.9 FORCE DUE TO WATER FLOW

(25) What are the factors upon which force due to water flow depend? **GRW-2014**

Ans: Force due to water flow is calculated as

$$F = \frac{m}{t}v$$

So it is clear that force due to water flow depend upon

- Mass of water striking per second
- Velocity of striking water

(26) A 1500kg car has its velocity reduced from 20ms^{-1} to 15ms^{-1} in 3sec. How large was the average retarding force. **LHR-2019 (G-I)**

Ans: As, $\vec{F} = m\vec{a}$

$$\vec{F} = \frac{m\vec{v_f} - m\vec{v_i}}{\Delta t}$$

$$\vec{F} = \frac{m(\vec{v_f} - \vec{v_i})}{\Delta t}$$

$$\vec{F} = \frac{1500(15-20)}{3}$$

$$\vec{F} = -2500\,N$$

3.10 MOMENTUM AND EXPLOSIVE FORCES

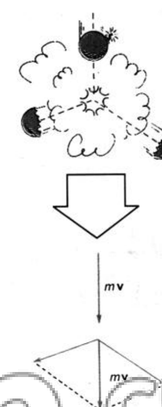
(27) How would you find, the momentum of an explosive force? Explain with an example. **LHR-2016 (G-I)**

Ans: Within an isolated system if an explosion takes place, the law of conservation of momentum holds. e.g.

When a shell explodes in mid-air, its fragments fly off in different directions but sum of linear momentum of all its fragments equals to the initial momentum of shell before explosion as shown in figure.

(28) A bullet in fired from a refile. Derive the relation for velocity of refile. **LHR-2019 (G-II)**

Ans: **Recoil of gun:**



Consider a bullet of mass m is fired from a gun of mass M with a velocity $\vec{v}$.

The gun experiences a recoil. It moves in opposite direction with velocity $\vec{v'}$. Velocity $\vec{v'}$ of recoil can be calculated by applying law of conservation of momentum.

Total momentum of the system before firing = 0

After Firing:

Momentum of bullet = $m\vec{v}$

Momentum of gun = $M\vec{v}'$

Total momentum of system after firing = $M\vec{v}' + m\vec{v}$

According to law of conservation of momentum, initial momentum before collision and final momentum after collision must be same.

$$\therefore \quad M\vec{v} + m\vec{v} = 0$$

$$M\vec{v'} = -m\vec{v}$$

$$\vec{v'} = -\frac{m\vec{v}}{M}$$

Negative sign indicates that direction of motion of gun is in opposite direction with respect to the direction of motion of bullet.

3.11 ROCKET PROPULSION

(29) What is the principle of rocket propulsion?

Ans: The propulsion of rocket is based on the law of conservation of momentum and third law of motion.

The rocket engine expels gases by burning fuel in downward direction. With the passage of time, the momentum of gases increases due to increase of their mass. Hence to keep the total momentum constant, the momentum of rocket increases in the upward direction by third law of motion.

Rocket increases its momentum by increasing its velocity.

3.12 PROJECTILE MOTION

(30) Describe the two uses of Ballistic missiles.

Ans: **i)** The Ballistic missiles are useful only for short ranges.

ii) The shooting of a missile on a selected distant spot is a major element of warfare

(31) What is the relation for maximum range of projectile?

Ans: The projectile gain maximum range when it is projected at angle of 45^0 So,

$$R = \frac{Vi^2 Sin 2\theta}{g}$$

$$= \frac{vi^2 \sin 90^o}{g}$$

$$R_{max} = \frac{Vi^2}{g} \qquad \because \sin 90^0 = 1$$

(32) What is the horizontal acceleration of the projectile?

Ans: As the horizontal component of velocity for projectile motion remain constant throughout the motion. So the horizontal acceleration is zero. Because in the horizontal direction, there is no force on the projectile.

(33) What is the time taken by projectile to reach maximum height?

Ans: As $T = \frac{2Vi \sin\theta}{g}$

Above relation is for time of flight for whole path of projectile. But the time required to reach the maximum height of projectile is given by.

Time to reach maximum height = $\frac{\text{Time of flight}}{2}$

$$t = \frac{vi \sin\theta}{g}$$

(34) What kinds of missiles are used for long and short ranges?

Ans: **(i)** For short ranges ballistic (un-powered and un-guided) missiles are used.

(ii) For long ranges guided and powered missiles are used.

(35) What is difference between ballistic missile, Ballistic trajectory and Ballistic flight?

Ans: **Ballistic Missile:**

The un-powered and un-guided missiles are called ballistic missile

Ballistic Trajectory

The path followed by the ballistic missiles is called ballistic trajectory.

Ballistic Flight:

A ballistic flight is that in which a projectile is given an initial push and is then allowed to move freely due to inertia and under the action of gravity.

(36) If a ball (B_1) is projected at angle of 20^0 then by what angle another ball (B_2) should be projected to gain same range as ball (B_1).

Ans: To gain the same range of Ball (B_2) as the ball (B_1), it should be projected at angle of 70^0 (neglecting air friction).

In other words if the sum of projected angles of two objects are 90^0 then the ranges will have the same values.

(37) Show that the relation for the range of projectile is same for both angles of projection of 60^0 and 30^0.

Ans: $R_{30^o} = \frac{V_i^2 \sin 2\theta}{g} \quad \because \theta = 30^0$

$R_{30^o} = \frac{V_i^2 sin60^0}{g}$

$sin60^0 = 0.866$

$R_{30^o} = \frac{V_i^2 (0.866)}{g}$ ______ (1)

$R_{60^o} = \frac{V_i^2 \sin 2(60)}{g}$

$R_{60^o} = \frac{V_i^2 \sin 120^0}{g} \qquad \because \sin 120^0 = 0.866$

$R_{60^o} = \frac{V_i^2 (0.866)}{g}$ ______ (2)

From (1) and (2) it is clear

$R_{30^o} = R_{60^o}$

(38) If angle of projection of projectile is 90°, find its range. **SWL-2019**

Ans: $R = \frac{V_i^2 \sin 2\theta}{g}$

$R = \frac{V_i^2 \sin 2(90^0)}{g}$

$R = 0$

(39) The horizontal range of projectile is four times of its maximum height. What is angle of projection? **FSD-2019 (G-I)**

Ans: $R = \frac{V_i^2 \sin 2\theta}{g}$ ....(1)

$H = \frac{v_i^2 \sin^2 \theta}{2g}$ ....(2)

by dividing eq(1) and eq(2) we get

$R \tan\theta = 4H$

$4H \tan\theta = 4H \qquad \because R = 4H$

$\tan\theta = 1$

$\theta = 45^0$

(40) Which quantity remains same at all points on the trajectory of a projectile: either velocity or acceleration? Explain. **GRW-2019 (G-I)**

Ans: Acceleration of the projectile remains constant throughout the trajectory while velocity of projectile continuously changing , it will be maximum at projection point and point of landing and it will be minimum at highest point of the trajectory

(41) Show that range R and maximum range R_{max} are related as: $\frac{R}{R_{max}} = \sin 2\theta$

LHR-2018 (G-II)

Ans: $R = \frac{V_i^2 \sin 2\theta}{g}$ ....(1)

$R_{max} = \frac{V_i^2 \sin 2(45^0)}{g} = \frac{V_i^2}{g}$

puttin eq (1) $R = R_{max} \sin 2\theta$

$\frac{R}{R_{max}} = \sin 2\theta$