PHYSICS
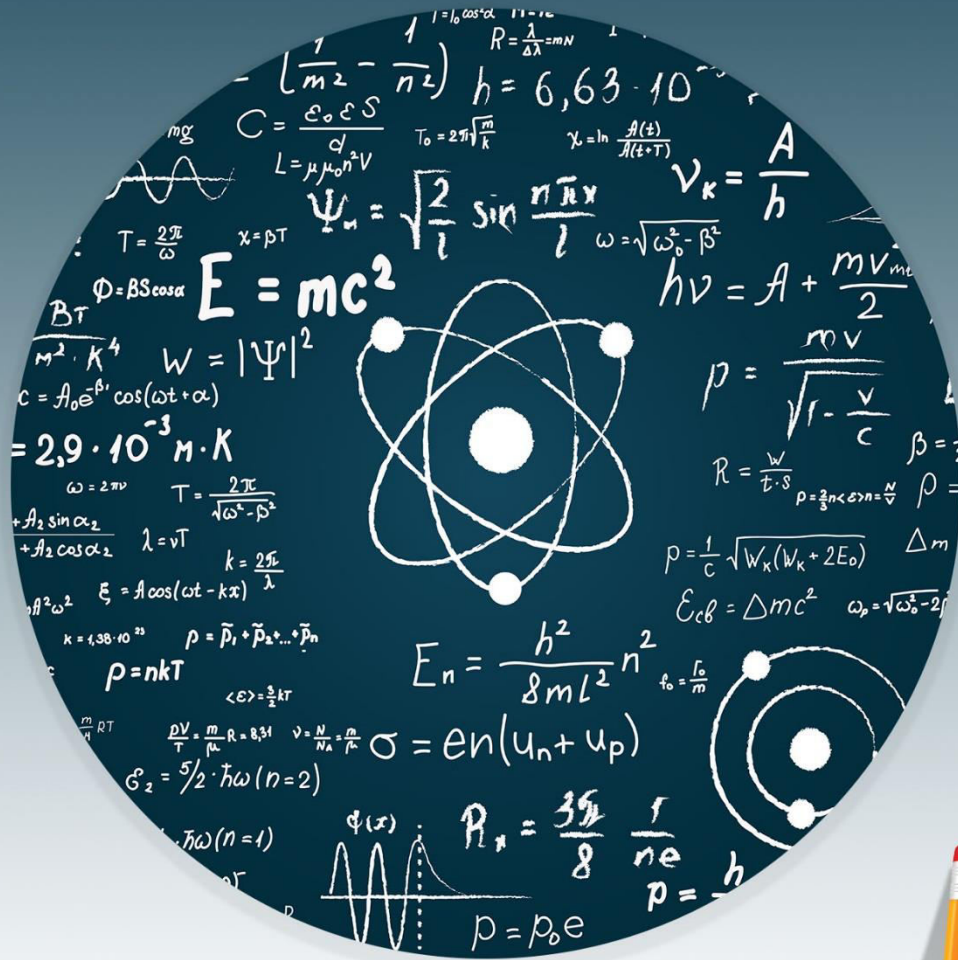
WORKSHEET-13

Worksheet-13

Topics:- Linear Momentum, Law of Conservation of Linear Momentum, Collision, Elastic Collision in one dimension, Projectile motion, Characteristics of Projectile motion

Q.1 **Time rate of change of momentum is equal to:**

A) Force   C) Velocity

B) Impulse   D) Force constant

Q.2 **If momentum is increased by 20% then K.E. increases by:**

A) 44%   C) 66%

B) 55%   D) 77%

Q.3 **If R is the maximum horizontal distance of projectile then the greatest height attained by projectile in this condition is:**

A) R   C) 2R

B) $\dfrac{R}{2}$ D) $\dfrac{R}{4}$

Q.4 **During projectile motion if H = R then angle of projection with horizontal is**

A) $\text{Tan}^{-1}(4)$ C) $\text{Tan}^{-1}\left(\dfrac{1}{4}\right)$

B) $\text{Tan}^{-1}\left(\sqrt{4}\right)$ D) $\text{Tan}^{-1}\left(\dfrac{1}{\sqrt{4}}\right)$

Q.5 **Range of projectile is R when angle of projection is 60°, then the value of other angle of projection for same range is:**

A) 40°   C) 50°

B) 30°   D) 20°

Q.6 **A person can throw a stone to maximum range of 100 m. The greatest height with same conditions to which he can make the stone to rise is:**

A) 50 m   C) 100 m

B) 150 m   D) 25 m

Q.7 **During projectile motion the quantities that remain constant are:**

A) Acceleration, v_x C) Force, velocity

B) Acceleration, K.E   D) Acceleration, Momentum

Q.8 The path of projectile is:

A) Hyperbola   C) Parabola

B) Straight line   D) Ellipse

Q.9 Motion of projectile is _____ dimensional.

A) One   C) Two

B) Three   D) Four

Q.10 Four projectiles are launched at angles 20°, 30°, 40° and 50° respectively. Which of these projectiles will have maximum range?

A) Projectile launched at 20°

B) Projectile launched at 50°

C) Projectile launched at 30°

D) Both projectiles launched at 40° and 50°

Q.11 Which component of the velocity of projectile remains constant throughout the motion?

A) v_x C) a_x

B) v_y D) a_y

Q.12 Which of the following factors in a projectile motion remains same?

A) v_x C) a_x

B) a_y D) All of these

Q.13 At which angle when a projectile is launched R=H?

A) 45°   C) 76°

B) 30°   D) 60°

Q.14 At which angle when a projectile is launched $H = \dfrac{R}{4}$?

A) 45°   C) 76°

B) 30°   D) 60°

Q.15 The angle between velocity of projectile and acceleration at the highest point becomes:

A) 90°   C) 0°

B) 180°   D) 76°

Q.16 A person moving in a car at a constant velocity throws an apple vertically upwards. If we ignore air friction and suppose car to move with same velocity then according to an observer standing outside.

A) Apple will follow a parabolic path and will fall again in car

B) Apple will follow a parabolic path but will fall behind car

C) Apple will follow a linear path and will fall again in car

D) Apple will follow a parabolic path but will fall before car

Q.17 Two balls are thrown at angles of θ and (90°-θ) with the horizontal with same speed. Ratio of their time of flights is:

A) $\tan^2\theta:1$ C) $\tan\theta:1$

B) $1:\tan\theta$ D) 1:1

Q.18 A bomber drops its bomb when it is vertically above the target, it misses the target due to (falls ahead):

A) Air resistance

B) Horizontal component of velocity

C) Vertical component of velocity

D) Gravity

Q.19 The maximum height of projectile has the largest value for which of the following angles of projection?

A) 0°   C) 30°

B) 60°   D) 75°

Q.20 A body drops a coin from the window of a moving train. The path of coin according to a stationary observer inside the train will be:

A) Vertical straight line   C) Parabolic

B) Elliptical   D) Circular

Q.21 A ball whose K.E is E, is projected at an angle of 45° with vertical then, its K.E at maximum height is

A) E   C) $\dfrac{E}{2}$

B) $\dfrac{E}{\sqrt{2}}$ D) 2E

Q.22 **In a competition, fielders are required to throw the cricket hard ball as far as possible. Under ideal conditions, the optimum throwing angle is 45°. What should this angle, with respect to ground, be in (i) Strong winds against the direction of throw; and (ii) Strong winds in the direction of throw?**

A) (i) more than 45°, (ii) less than 45°

B) (i) less than 45°, (ii) more than 45°

C) 45° in both cases

D) Depends on throwing speed

Q.23 **A collision in which K.E of system remains constant is called:**
A) Elastic Collision   C) Partially elastic Collision
B) Inelastic Collision   D) Any of these

Q.24 **In the head on elastic collision of a heavy vehicle moving with a velocity of 20 m s^{-1} and a small stone at rest, the stone will fly away with a velocity equal to**
A) 5 m s^{-1} C) 20 m s^{-1}
B) 10 m s^{-1} D) 40 m s^{-1}

Q.25 **A body of mass 3 kg is acted upon by a force which varies as shown in the graph below. The momentum acquired during 6 s is given by (given initial momentum = 0):**

F/N

10

2   4   6   t(s)

0
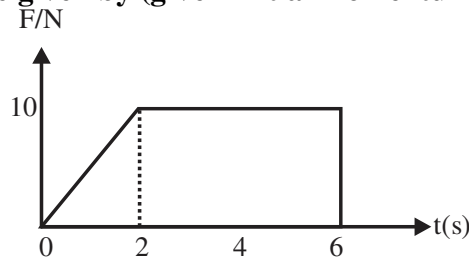
A) Zero   C) 5 N s
B) 30 N s   D) 50 N s

Q.26 **The rate of change of momentum of a freely falling body is:**
A) Equal to weight   C) Is greater than weight
B) Is less than weight   D) All of these

Q.27 **Momentum of an object is defined as:**
A) Quantity of motion in a body   C) Both "A" & "B"
B) Product of mass and velocity   D) None of these

Q.28 **When a large force acts on a body for a short interval of time then the change in momentum?**
A) Is called impulse   C) Both "A" & "B"
B) Is equal to F×Δt   D) Not possible

Q.29 **A bullet is shot from a rifle. As a result, the rifle recoils. The momentum of rifle as compared to that of the bullet is:**

A) Less   C) Equal

B) Greater   D) Cannot be concluded

Q.30 **A body is projected with a certain kinetic energy, has a horizontal range R. The kinetic energy will be minimum at a position of the projectile when its horizontal distance is**

A) R   C) $\dfrac{R}{2}$

B) $\dfrac{3R}{4}$ D) $\dfrac{R}{4}$

Q.31 **A force of 100 N acts on a body of mass 10 kg such that it's velocity changes from v_i to v_f in 20 s then the rate of change of momentum will be equal to:**

A) 100 N   C) Less than 100 N

B) Greater than 100 N   D) Zero

Q.32 **A body is projected with kinetic energy K at an angle of 60^0 with the horizontal. Its kinetic energy at the highest point of its trajectory will be**

A) 2K   C) $\dfrac{K}{2}$

B) K   D) $\dfrac{K}{4}$

Q.33 **The acceleration of a projectile at its highest point is:**

A) Maximum   C) Zero

B) Minimum   D) g

Q.34 **SI unit of impulse is same as of:**

A) Force   C) Momentum

B) Time   D) Torque

Q.35 **When two objects of masses "m_1" and "m_2" makes a collision such that linear momentum of them is said to be conserved then?**

A) $m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$

B) $m \propto \dfrac{1}{v}$

C) No external force acts on bodies

D) All of these

Q.36 **A force of 400 N acts on a body for time interval of 10 ms then the impulse will be:**

A) 2 N s   C) 6 N s

B) 4 N s   D) 8 N s

Q.37 **The speed of projectile at maximum height is half of its initial speed v then its angle of projection is:**

A) 30° C) 45°

B) 60° D) 90°

Q.38 The range of projectile at 30° is R, at the angle of 60° the range will be:

A) R
C) 2R

B) R/2
D) R/4

Q.39 The horizontal component of velocity of a projectile moving with initial velocity of 500 m s^{-1} at an angle of 60° with y-axis is:

A) 500 m s^{-1}
C) 250 m s^{-1}

B) 1000 m s^{-1}
D) $250\sqrt{3}$ m s^{-1}

Q.40 A projectile is launched at point "A" and follows the path ABCDE. Which statement is true for the projectile when it is at the highest point "C" of its path?

A) The horizontal component of projectile's velocity is zero

B) The K.E of projectile is zero

C) The momentum of projectile is zero

D) The horizontal component of projectile's acceleration is zero

ANSWER KEY (Worksheet-13)							
1	A	11	A	21	C	31	A
2	A	12	D	22	C	32	D
3	D	13	C	23	A	33	D
4	A	14	A	24	D	34	C
5	B	15	A	25	D	35	D
6	D	16	A	26	A	36	B
7	A	17	C	27	C	37	B
8	C	18	B	28	C	38	A
9	C	19	D	29	C	39	D
10	D	20	A	30	C	40	D

SOLUTIONS
Unit – 1B (W-13)

Q.1   Answer is "A"

Solution:- $F = \dfrac{\Delta p}{\Delta t}$

Q.2   Answer is "A"

Solution:- Use relation $P = \sqrt{2mE}$

Q.3   Answer is "D"

Solution:- When $\theta = 45°$, $R = max$ then

$H = \dfrac{R}{4}$

Q.4   Answer is "A"

Solution:- For a projectile;

If R=nH then

$\theta = \tan^{-1}\left(\dfrac{4}{n}\right) = \tan^{-1}\left(\dfrac{4}{1}\right) = 76°$

For given question

$R = 1H \Rightarrow \theta = \tan^{-1}\left(\dfrac{4}{1}\right)$

Q.5   Answer is "B"

Solution:- If sum of two angles is 90°, the ranges at those angles are equal if projected with same speed.

Q.6   Answer is "D"

Solution:- The maximum range and height are related as;

$R = \dfrac{v_i^2}{g}\sin 2\theta$; $h = \dfrac{v_i^2 \sin 2\theta}{2g}$

As range is maximum at $\theta = 45°$, so;

$R_{max} = \dfrac{v_i^2}{g}$; $h = \dfrac{v_i^2}{2g}\left(\sin 45°\right)^2$

$R_{max} = \dfrac{v_i^2}{g}$; $h = \dfrac{v_i^2}{4g}$

$h = \dfrac{R_{max}}{4}$

Just remember this formula. This formula says at maximum range height is four times less than maximum range.

Q.7   Answer is "A"

Solution:- As friction is ignored so $v_x = constant$ also $a_x = 0 = constant$

And $a_y = g = constant$

Q.8   Answer is "C"

Solution:- Usually we consider ideal case in which air friction is ignored, so path of projectile is parabola.

Q.9   Answer is "C"

Solution:- Projectile motion is a two dimensional motion under constant acceleration due to gravity.

Q.10   Answer is "D"

Solution:- The range of projectile is maximum at 45°. But among given option 45° is not present, so range among given options will be maximum at that angle which is closest to 45° (no matter whether it is closer with value less than 45° or greater than 45°). As 40° and 50° are equally closest to 45°, so range will be maximum at these angles.

Q.11   Answer is "A"

Solution:- As air friction is ignored in projectile motion, so no force acts along horizontal direction, hence horizontal component of velocity remains constant and horizontal component of acceleration remains zero. i.e

$$v_x = \text{constant} \; ; \quad a_x = \frac{\Delta v_x}{\Delta t} = 0$$

Q.12 Answer is "D"

Solution:- $v_x = \text{constant}$,

$a_x = 0 = \text{constant}, a_y = g = \text{constant}$

Q.13 Answer is "C"

Solution:- For a projectile;

If R=nH then $\theta = \tan^{-1}\left(\dfrac{4}{n}\right)$

For given question

$R = 1H \Rightarrow \theta = \tan^{-1}\left(\dfrac{4}{n}\right) = \tan^{-1}(4) = 76°$

Q.14 Answer is "A"

Solution:- If R = nH

then $\theta = tan^{-1}\left(\dfrac{4}{n}\right)$

Q.15 Answer is "A"

Solution:- At highest point $v_y = 0$ so $v = v_x$ is $\perp'_r$ to a=g

Q.16 Answer is "A"

Solution:- Car will provide it horizontal component and person a vertical so combination makes a parabolic path.

Q.17 Answer is "C"

Solution:-

$$\frac{t_1}{t_2} = \frac{\left(\dfrac{2v_i \sin\theta}{g}\right)}{\left(\dfrac{2v_i \sin(90-\theta)}{g}\right)} = \frac{\sin\theta}{\sin(90-\theta)}$$

$$\frac{t_1}{t_2} = \frac{\sin\theta}{\cos\theta} = \tan\theta$$

Q.18 Answer is "B"

Solution:-

Because of horizontal component of velocity, the bomb undergoes projectile motion rather than vertically downward motion so it misses the target.

Q.19 Answer is "D"

Solution:- Height of projectile is given as;

$$h = \frac{v_i^2 \sin^2\theta}{2g}$$

It is maximum at 90°, among given options 90° is not present, so height will be maximum at that angle which is closer to 90°.

Q.20 Answer is "A"

Solution:- The path will be projectile for an observer standing outside the train, while for an observer within the train the path will be straight line.

Q.21 Answer is "C"

Solution:-

Use relation; $K.E_H = K.E_i \times cos^2\theta$

For $P.E_H = K.E_i \times sin^2\theta$

Q.22 Answer is "C"

Solution:- Range can only be maximum at $\theta = 45°$.

Q.23 Answer is "A"

Solution:- A Collision in which K.E of system remains constant is called elastic collision.

Q.24 Answer is "D"

Solution:- When a massive body collides with a light body then after collision velocity of light body is twice the initial velocity of massive body.

Q.25 Answer is "A"

Solution:-

Area of F-t graph = change in momentum

Area of F-t graph = $\frac{1}{2}(2)(10)+(6-2)(10) = 50$ N s

Q.26 Answer is "A"

Solution:- $F_{applied}$ = Rate of change of

momentum = $\frac{\Delta p}{\Delta t}$

For freely falling body, the only force acting on body is force of gravity (weight).

Q.27 Answer is "C"

Solution:- Definition of momentum

Q.28 Answer is "C"

Solution:- Definition of Impulse

Q.29 Answer is "C"

Solution:- By conservation of momentum, rifle and bullet have equal momentum but in opposite direction.

Q.30 Answer is "C"

Solution:- K.E is minimum at peak point of projectile.

At peak point

$v = \sqrt{v_x^2 + v_y^2} = \sqrt{v_x^2 + 0} = v_x$

$v = v_x = \text{minimum} \neq 0$

Q.31 Answer is "A"

Solution:- Rate of change of momentum = Applied force = 100 N

Q.32 Answer is "D"

Solution:- At highest point

$K.E = K.E_i \cos^2\theta = (K)\cos^2 60° = \frac{K}{4}$

Q.33 Answer is "D"

Solution:- Acceleration of projectile throughout the motion is equal to acceleration due to gravity.

Q.34 Answer is "C"

Solution:- Impulse and momentum have same units.

Q.35 Answer is "D"

Solution:- All are true according to conservation of momentum.

Q.36 Answer is "B"

Solution:-

Impulse = F × Δt

Impulse = $(400)(10×10^{-3})$

Impulse = 4 N s

Q.37 Answer is "B"

Solution:-

$v_x = v_i \cos\theta = \frac{v_i}{2}$

$\cos\theta = \frac{1}{2}$

$\theta = \cos^{-1}\left(\frac{1}{2}\right) = 60°$

Q.38 Answer is "A"

Solution:-

If $\theta_1 + \theta_2 = 90°$, ranges at θ_1 and θ_2 are equal.

Q.39   Answer is "D"

Solution:- $v_x = v_i \cos\theta$

$= (500)\cos 60° = 250 \ m \ s^{-1}$

Q.40   Answer is "D"

Solution:- Horizontal component of acceleration is zero at all points of trajectory as F_x = 0.

STEP

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