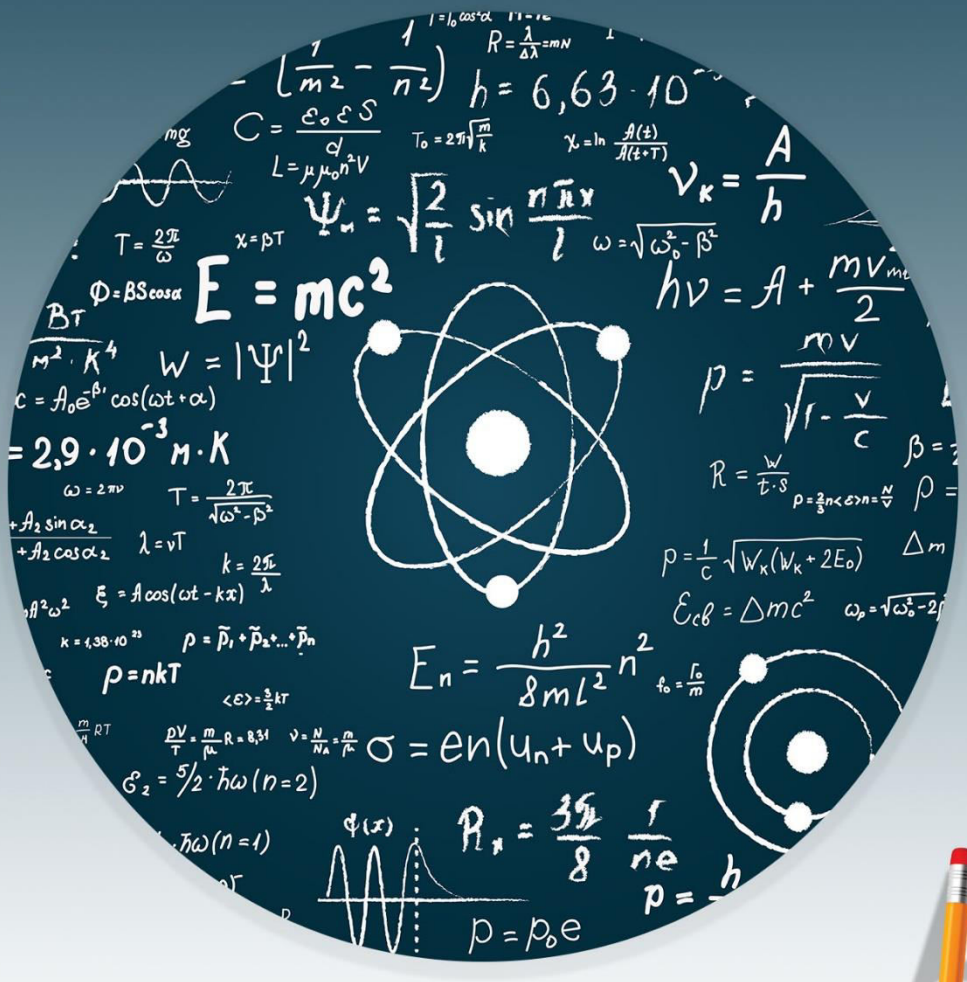
PHYSICS



WORKSHEET-14

STEP

A PROJECT BY PUNJAB GROUP

Worksheet-14

Topics:- Work, Kinetic & Potential Energy, Inter Conversion of K.E & P.E, Power, Angular Displacement, Angular Velocity, Centripetal Force & Geostationary Orbits, Radian

USE THIS SPACE FOR SCRATCH WORK

Q.1 When a person lifts a body from ground work done by the lifting force is?

A) Positive C) Negative

B) Zero D) Half of positive maximum

Q.2 When a person lifts a body from ground work done by force of gravity is?

A) Positive C) Half of negative maximum

B) Negative D) Zero

Q.3 A force of $3\hat{i}+4\hat{j}$ N displaces the body through $4\hat{i}+3\hat{j}$ m the work done will be:

A) 12 J C) 28 J

B) 24 J D) – 12 J

Q.4 The following four particles have same K.E, then which of them has maximum momentum:

A) Proton C) Positron

B) Electron D) α-particle

Q.5 The power of a pump which can pump 100 kg of water to a height of 100 m in 5 sec is:

A) 20 kW C) 40 kW

B) 200 kW D) 4 kW

Q.6 1 MWh is equal to:

A) 3.6 kJ C) 3.6 MJ

B) 3.6 J D) 3.6 GJ

Q.7 Work done is equal to:

A) Change in K.E C) Change in elastic P.E

B) Change in P.E D) All of these

Q.8 Which of the following is unit of P.E:

A) eV C) joule

B) calorie D) All of these

Q.9 Slope of energy time graph is equal to:

A) Acceleration C) Power

B) Momentum D) Work

Q.10 Moving body may not have:

A) K.E C) P.E

B) Momentum D) All of these

Q.11 The base units of power are:

A) kg m s^{-1} C) kg m^2 s^{-3}

B) kg m s^{-2} D) kg m^2 s^3

Q.12 Which of the following work is greater?

A) +100 J C) +200 J

B) -500 J D) -1000 J

Q.13 For which angle work is said to be positive maximum?

A) 0° C) 90°

B) 180° D) 60°

Q.14 For which angle work is said to be negative maximum?

A) 0° C) 90°

B) 180° D) 60°

Q.15 For which angle work is said to be maximum?

A) 0° C) Both "A" and "B"

B) 180° D) 60°

Q.16 A force of 20 N acts on a body through a distance of 10 m. What must be the angle between force and displacement such that work comes out to be 100 J?

A) 90° C) 30°

B) 0° D) 60°

Q.17 For what angle between $\vec{F}$ and $\vec{d}$ work reduces to half of its maximum value?

A) 60° C) 45°

B) 30° D) 90°

Q.18 A loaded and an unloaded cart are moving with same kinetic energies such that same retarding force acts on them and they finally stop after covering "S_1" and "S_2" distances respectively, which of the following is true?

A) $S_1=S_2$ C) $S_1>S_2$

B) $S_1<S_2$ D) None of these

Q.19 When gravitational field does negative work then P.E of body.

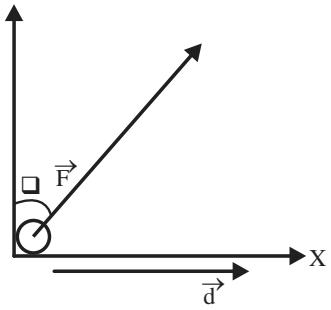
A) May increase C) Must increase

B) May decrease D) Must decrease

USE THIS SPACE FOR SCRATCH WORK

USE THIS SPACE FOR SCRATCH WORK

Q.20 Consider the figure in which a force $\vec{F}$ acts on a body through displacement $\vec{d}$:



For which value of "θ" work is said to be maximum?

A) 0° C) Both "A" & "B"

B) 180° D) 90°

Q.21 Considering figure of Q.20 what will be the mathematical formula for the calculation of work?

A) $W = Fd\cos\theta$ C) $W = Fd\tan\theta$

B) $W = Fd\sin\theta$ D) None of these

Q.22 A force of 2 N acts on body for 1 m distance, the maximum work done is:

A) 2 units C) 5 units

B) 3 units D) 6 units

Q.23 A mass is lifted to a height in 10 sec. Now if the same mass is lifted to the same height in 20 sec then work done in two cases are in the ratio:

A) 1:2 C) 1:1

B) 2:1 D) 4:1

Q.24 A body is released from a height of 5 m. If friction is ignored then its velocity just before striking the ground will be ($g = 10\ m\ s^{-2}$):

A) $5\ m\ s^{-1}$ C) $15\ m\ s^{-1}$

B) $10\ m\ s^{-1}$ D) $20\ m\ s^{-1}$

Q.25 The direction of angular displacement is:

A) Along axis of rotation

B) In the plane of rotation

C) Perpendicular to plane of rotation

D) Both A and C

Q.26 The angular velocity of spin motion of earth is:

A) $\frac{\pi}{12}$ rev min^{-1} C) $\frac{\pi}{4}$ rev min^{-1}

B) $\frac{\pi}{6}$ rad h^{-1} D) $\frac{\pi}{12}$ rad h^{-1}

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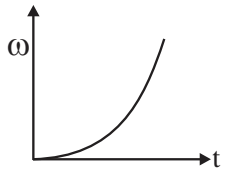
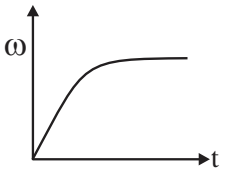
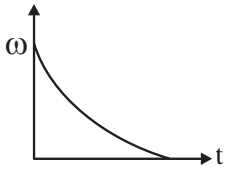
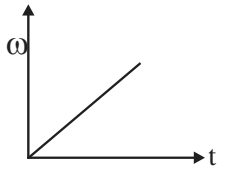
Q.27 The angular velocity time graph which corresponds to constant angular acceleration is:

A) 

C) 

B) 

D) 

Q.28 The ratio of units of angular acceleration to angular velocity gives units of:

A) Time C) Frequency

B) Length D) Mass

Q.29 An electric fan rotating at 3 rev s^{-1} is switched off. It comes to rest in 18 s. What will be the deceleration produced?

A) 0.5 rev s^{-2} C) 0.2 rev s^{-2}

B) 0.25 rev s^{-2} D) 0.16 rev s^{-2}

Q.30 If the radius of a circle is doubled keeping same angular velocity, then centripetal force becomes:

A) Double C) Half

B) Remains same D) Reduces by four times

Q.31 Time period of the orbital motion of a geostationary satellite is:

A) 5060 sec C) 24 hour

B) 84 min D) Any of these

Q.32 Which one is not true about communication satellites?

A) They use microwaves to communicate

B) Minimum three correctly positioned satellites are required for global coverage.

C) Their orbital speed is greater than orbital speed of low flying satellites

D) None of these

Q.33 An object is moving with a velocity of 15 m s^{-1} such that a constant force acts on it of 3 N. What must be the power developed in this case?

A) 5 W C) 30 W

B) 15 W D) 45 W

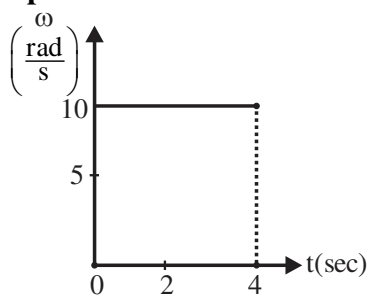
Q.34 The angular displacement covered by hour hand of a clock while moving from 12 O′clock to 3 O′clock is:

A) 90° C) 135°

B) 75° D) 45°

USE THIS SPACE FOR SCRATCH WORK

Q.35 The angular displacement covered by a body in the following graph is:



A) 40 rev C) 20 rev

B) 30 rad D) 40 rad

Q.36 Which statement is incorrect about two points "A" & "B" present on a spinning body having unequal distances from axis of rotation?

A) Both points have same angular acceleration

B) Both points have different velocity

C) Both points have same axis of rotation

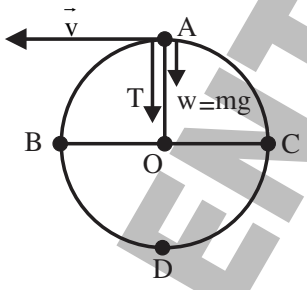
D) Both points have same acceleration

Q.37 If $\vec{r} = 4\hat{i}$ and $\vec{\omega} = 4\hat{k}$ then $\vec{v}$ is:

A) $16\hat{k}$ C) $16\hat{i}$

B) $16\hat{j}$ D) $-16\hat{k}$

Q.38 A ball tied to the end of a string, is swung in a vertical circle of radius "r" under the action of gravity as shown in figure. What will be tension in string at "A"?



A) Zero C) Equal to weight

B) Equal to centripetal force D) None of these

Q.39 The angular displacement covered by earth while orbiting around sun in a time equal to half of one year is:

A) $\frac{\pi}{2}$ *rad* C) $\frac{3\pi}{2}$ *rad*

B) π *rad* D) 2π *rad*

Q.40 The orbital speed of a geostationary satellite is:

A) 7.9 km s^{-1} C) 11.1 km s^{-1}

B) 3.1 km s^{-1} D) 5.9 km s^{-1}

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

SOLUTIONS

Unit – 3 (WS-14)

Q.1 Answer is "A"

Solution:- As $\vec{F}$ & $\vec{d}$ are parallel so $W = +ve$

Q.2 Answer is "B"

Solution:- $\vec{F}$ & $\vec{d}$ are anti-parallel so $W = -ve$

Q.3 Answer is "B"

Solution:- Simply use relation; $W = \vec{F}.\vec{d}$

$W = F_x d_x + F_y d_y + F_z d_z$

Q.4 Answer is "D"

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

As E = same so $p \propto \sqrt{m}$

Q.5 Answer is "A"

Solution:- $P = \frac{W}{t} = \frac{mgh}{t}$

Q.6 Answer is "D"

Solution:- Mega watt hour is related with joule as:

$1\text{MWh} = 1\times10^6 \times 3600 \text{ W s}$

$= 3.6\times10^9 \text{ J}$

$1\text{MWh} = 3.6 \text{ GJ}$

Q.7 Answer is "D"

Solution:- According to work-energy principle

"Work done on a body is equal to change in its K.E or change in its P.E or change in both energies."

i.e $W = \Delta K.E$ or $\Delta P.E$ or both

Q.8 Answer is "D"

Solution:- The different units of energy and their relation with SI-unit is as following:

- 1 kWh = 3.6 MJ
- 1 eV = 1.6×10^{-19} J
- 1 calorie = 4.18 J
- 1 erg = 10^{-7} J

Q.9 Answer is "C"

Solution:-

Slope = $\frac{\Delta y}{\Delta x} = \frac{\Delta Energy}{\Delta time} = Power$

Q.10 Answer is "C"

Solution:- It may be moving on plane surface, so its P.E with reference to that plane surface will be zero.

Q.11 Answer is "C"

Solution:- The base units of power are:

$P = \frac{\Delta W}{\Delta t} = \frac{J}{s} = \frac{N\ m}{s} = \frac{kg\ m s^{-2}\ m}{s}$

$P = kg\ m^2\ s^{-3}$

Q.12 Answer is "D"

Solution:- Whenever greater or smaller work is to be decided, compare all given options without their signs, the negative or positive signs just indicate the angle between the force & displacement, i.e

- W=+ve , if $\theta<90°$
- W=-ve , if $\theta>90°$
- W=0=minimum , if $\theta=90°$

Q.13 Answer is "A"

Solution:- When force and displacement are parallel, then;

W=Fdcosθ

θ=0° ; cos0°=+1=positive maximum

$W = +Fd$ = positive maximum

Q.14 Answer is "B"

Solution:- When force and displacement are antiparallel, then;

$W = Fd\cos\theta$

$\theta = 180°; \cos 180° = -1$ = negative maximum

$W = -Fd$ = negative maximum

Q.15 Answer is "C"

Solution:- Work done is positive maximum when $\vec{F}$ and $\vec{d}$ are parallel and it is negative maximum when $\vec{F}$ and $\vec{d}$ are anti-parallel. Physically both +ve maximum work and –ve maximum work are equal, -ve work does not mean work is less than zero.

Q.16 Answer is "D"

Solution:- Use relation; $W = Fd\cos\theta$

Q.17 Answer is "A"

Solution:-

$$W = \frac{W_{max}}{2} = \frac{Fd}{2}$$

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

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

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

$$\theta = 60°$$

Q.18 Answer is "A"

Solution:

According to Work-Energy Principle

$\Delta K.E = W_{friction}$

$\Delta K.E = Fd\cos\theta$

Stopping distance = d

Since both cars have same K.E, so their stopping distances are also equal.

Q.19 Answer is "C"

Solution:- When gravity does –ve work "h" increases hence P.E increases

Q.20 Answer is "D"

Solution:- Making θ = 90°, $\vec{F}$ becomes parallel to the $\vec{d}$

Q.21 Answer is "B"

Solution:- Here angle between $\vec{F}$ & $\vec{d}$ is 90°-θ which makes

$W = Fd\cos(90° - \theta) = Fd\sin\theta$

Q.22 Answer is "A"

Solution:- Simply use relation;

W = maximum = Fd

Q.23 Answer is "C"

Solution:- Work done does not depend upon time.

Q.24 Answer is "B"

Solution:- Use relation $v = \sqrt{2gh}$

Q.25 Answer is "D"

Solution:- All angular quantities have same direction most of the time & is along axis of rotation.

Q.26 Answer is "D"

Solution:- $\omega = \frac{\theta}{t} = \frac{2\pi}{24}$ rad h^{-1}

Q.27 Answer is "D"

Solution:- Slope of ω-t graph=α

Q.28 Answer is "C"

Solution:- $\frac{\alpha}{\omega} = \frac{rad\ s^{-2}}{rad\ s^{-1}} = s^{-1}\ or\ Hz$

Q.29 Answer is "D"

Solution:- Use relation; $\alpha = \frac{\omega_f - \omega_i}{t}$ take

$\omega_f = 0\ rad\ s^{-1}$

Q.30 Answer is "A"

Solution:- Use relation $F_c = mr\omega^2$

Q.31 Answer is "C"

Solution:- The time period of a geostationary satellite is 24 hour which is exactly same as the time period of spin motion of earth.

Q.32 Answer is "C"

Solution:- Communication satellites are usually geostationary satellites for which orbital speed is 3.1 km s^{-1} while the orbital speed of low flying satellites is 7.9 km s^{-1} which is greater than communication satellites.

Q.33 Answer is "D"

Solution:- The power developed in terms of force & velocity is:

$P = \vec{F}.\vec{v} = Fv\cos\theta$

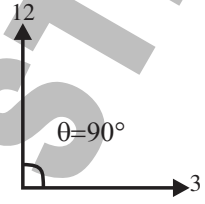
Here: $F = 3\ N, v = 15\ m\ s^{-1}, \theta = 0°$

$P = 3 \times 15\cos 0°$

$P = 45\ W$

Q.34 Answer is "A"

Solution:- When hour hand moves from 12 O'clock to 3 O'clock, it covers an angle of 90°.



Q.35 Answer is "D"

Solution:- Magnitude of angular displacement = Area of ω-t graph

$\theta = \omega t$

$\theta = (10)(4) = 40$ rad

Q.36 Answer is "D"

Solution:- All the point on a spinning rigid body have;

i. Same angular parameters

ii. Different linear parameters

Q.37 Answer is "C"

Solution:-

$\vec{v} = \vec{\omega} \times \vec{r} = \left(4\hat{k}\right) \times \left(4\hat{i}\right)$

$\vec{v} = 16\left(\hat{k} \times \hat{i}\right)\left(\therefore \hat{k} \times \hat{i} = \hat{j}\right)$

$\vec{v} = 16\hat{j}$

Q.38 Answer is "A"

Solution:- At the highest point of vertical circle

$T + w = \frac{mv^2}{r}$

$T = \frac{mv^2}{r} - w$

$T = m\left(\frac{v^2}{r} - g\right)$

$\therefore$ At highest point $g = \frac{v^2}{r}$,

so, tension=T=0

Q.39 Answer is "B"

Solution:- In one year (complete revolution) the earth covers an angular displacement = 2π

In half year (half revolution) the earth covers an angular displacement

$= \frac{2\pi}{2} = \pi\ rad$

Q.40 Answer is "B"

Solution:- Orbital speed for geostationary satellite is 3.1 km s^{-1}.

STEP

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