TEST NO.4

1. **A body moves a distance of 10 m along a straight line under the action of a force of 5 N and work done is 25J. The angle which the force makes with the direction of motion will be:**

(A) 60° (B) 90°
(C) 30° (D) 0°

Explanatory Answer: (A)

Work = F d cos θ

$25 = 5 \times 10 \cos\theta$ *i.e.*, $\cos\theta = \frac{1}{2}$ $\theta = 60^\circ$

2. **Work done in lowering the bucket into the well is:**

(A) Zero (B) Positive
(C) Negative (D) None of these

Explanatory Answer: (C)

We are applying the force in the upward direction so that it may not fall freely. But

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the displacement is in the downward direction. So angle between $\vec{F}$ and $\vec{d}$ is 180° and

Work $= F\,d\cos 180°$
$= -Fd$

3. A 100 Kg car is moving at a speed of 10 m/sec and comes to rest after covering a distance of 50 m. The amount of work done against friction is:

(A) $+5 \times 10^1$ J (B) $+5 \times 10^2$ J
(C) $+5 \times 10^3$ J (D) $+5 \times 10^4$ J

Explanatory Answer: (C)

$m = 100$ kg, $v_i = 10$ m/sec $v_f = 0$, $d = 50$ m
Use loss of KE = work done

$\frac{1}{2} m (v_f^2 - v_i^2)$ = work done

4. Which force is not a conservative force?

(A) Frictional force (B) Gravitational force
(C) Electric force (D) Elastic spring force

Explanatory Answer: (A)

You can verify your answer "For your Information" on page 82 of the Textbook.

5. The work done by a force keeping an object in circular motion with constant speed is:

(A) Zero J (B) 1 J
(C) 0.1 J (D) 0.01 J

Explanatory Answer: (A)

When a body is revolving in a circle, centripetal force acts on it which is always toward centre. Since the displacement of the body is along the tangent, hence angle between $\vec{F}$ and $\vec{d}$ is 90°, which means that work = F d cos 90° = zero

6. A body of weight 1 N has a kinetic energy of 1 Joule when its speed is:

(A) 1.46 m sec^{-1} (B) 2.44 m sec^{-1}
(C) 3.42 m sec^{-1} (D) 4.43 m sec^{-1}

Explanatory Answer: (D)

Weight = 1 N ; $m = \frac{W}{g} = \frac{1}{9.8}$ kg

K.E. $= \frac{1}{2} mv^2$

$1\text{ J} = \frac{1}{2}\left(\frac{1}{9.8}\text{ kg}\right)v^2$

$v^2 = 19.6$ *i.e.*, $v = 4.43$ m sec^{-1}

7. Kinetic energy of a body of mass 2 kg is 8 joules. Kinetic energy of a body of mass 4 kg moving with same velocity as that of first body, will be:

(A) 2 J (B) 4J
(C) 16J (D) 64J

Explanatory Answer: (C)

If mass is doubled, then according to K.E. = $\frac{1}{2} mv^2$, K.E. will also be doubled.

8. When two protons are brought closer potential energy of both of them:

(A) Increases (B) Decreases
(C) Remains same (D) None of these

Explanatory Answer: (A)

Protons are positively charged particles and repel each other. When they are brought closer, work has to be done upon them which is stored as potential energy.

9. A rubber ball falling from a height of 5 m rebounds from a hard floor and loses 30% of its energy in the impact. The height of the rebound is:

(A) 4 m (B) 3.5 m
(C) 3 m (D) 5 m

Explanatory Answer: (B)

30% of 5 m is 1.5 metres.
This is the loss. Hence answer = 5 – 1.5 = 3.5 m

10. A bullet of mass 100 grams is fired with a velocity of 10 m sec^{-1} from a gun of mass 1 kg. The ratio of KE of bullet to that of gun is:

(A) 100 : 1 (B) 10 : 1
(C) 1 : 10 (D) 1 : 100

Explanatory Answer: (B)

From law of conservation of momentum,

$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$
$0 + 0 = 0.1 \times 10 + 1 \times v_2'$
$v_2' = -1$ m sec^{-1}

Hence K.E. of bullet $= \frac{1}{2} m_1v_1' = \frac{1}{2} \times 0.1 \times 100 = 5$ J

K.E. of gun $= \frac{1}{2} m_2v_2' = \frac{1}{2} \times 1 \times (-1)^2 = 0.5$ J

Their ratio is 5 : 0.5
or 10 : 1 Ans.

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11. A bomb of mass 9 kg explodes into two pieces of mass 3 kg and 6 kg. The velocity of 3 kg mass is 16 m sec^{-1}. The KE of 6 kg mass will be:

(A) 96 (B) 112
(C) 180 (D) 192

Explanatory Answer: (D)

Law of conservation of momentum is

$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$

$mv = m_1v_1' + m_2v_2'$

$9 \times 0 = 3 \times 16 + 6\, v_i'$

$v_2' = -8$ m sec^{-1}

K.E. of 6 Kg mass $= \frac{1}{2} m_2v_2' = \frac{1}{2} \times 6 \times (-8)^2$

$= 192$ J

12. Escape velocity from surface of Moon as compared to that from Earth surface is:

(A) Greater (B) Smaller
(C) Equal (D) None of these

Explanatory Answer: (B)

We know that $V_{esc} = \sqrt{2gR}$

Since values of g and R for Moon are less as compared to that for Earth, hence the answer.

13. If the velocity of the rocket to escape out of Earth's gravitational pull is 11×10^3 m sec^{-1}, then its value for cricket ball will be:

(A) 11×10^3 m sec^{-1} (B) 1100 m sec^{-1}
(C) 11×10^{-3} m sec^{-1} (D) All of these

Explanatory Answer: (A)

Since escape velocity is independent of mass of the object, hence value of escape velocity for rocket or cricket ball with be the same.

14. A particle of mass m has momentum p. Its kinetic energy will be:

(A) $\frac{1}{2}$ mp (B) $\frac{1}{2} mp^2$
(C) $2\frac{p^2}{m}$ (D) $\frac{1}{2}\frac{p^2}{m}$

Explanatory Answer: (B)

K.E. $= \frac{1}{2} mv^2 = \frac{1}{2}\frac{m^2v^2}{m} = \frac{1}{2}\frac{p^2}{m}$

15. When 4 J work is done on a body of mass 2 kg, then velocity of the body will become:

(A) 1 m sec^{-1} (B) 2 m sec^{-1}
(C) 2.5 m sec^{-1} (D) None of these

Explanatory Answer: (B)

We can use Work $= \frac{1}{2} mv^2$

4 J $= \frac{1}{2} \times 2v^2$

$v^2 = 4$ or $v = 2$ m sec^{-1}

16. A brick of mass 2 kg is dropped from a rest position at certain height. Find the height if the brick strikes the ground with a velocity of 19.6 m/sec:

(A) 39.6 m (B) 29.6 m
(C) 19.6 m (D) 9.6 m

Explanatory Answer: (C)

$m = 2$ kg, $v_i = 0$, $h = ?$, $v_f = 19.6$ m/sec

Use $v_f = \sqrt{2gh}$

$v_f^2 = 2gh$ or $h = \frac{v_f^2}{2g}$

17. Given that density of water = 1 gm/cm^3. Then mass of 100 m^3 of water comes out to be:

(A) 1×10^4 Kg (B) 1×10^5 kg
(C) 1×10^6 Kg (D) None of these

Explanatory Answer: (B)

density $= 1\frac{gm}{cm^3} = \frac{10^{-3}\text{ kg}}{10^{-6}\text{ m}^3} = 10^3$ kg-m^3

volume $= 100$ m^3

density $= \frac{\text{mass}}{\text{volume}}$ or mass $=$ density $\times$ volume

18. Due to some frictional forces, velocity of a body reduces from 10 m/sec to 6 m/sec. The percentage loss in his K.E. comes out to be:

(A) 17.7% (B) 64%
(C) 52% (D) None of these

Explanatory Answer: (B)

$v_i = 10$ m/sec, $v_f = 6$ m/sec

$$\% \text{ loss of K.E.} = \frac{\frac{1}{2} mv_i^2 - \frac{1}{2} mv_f^2}{\frac{1}{2} mv_i^2}$$

19. A body moving with a velocity of 5 m/sec possesses kinetic energy of 625 J while in motion. Mass of the body is:

(A) 50 grams (B) 500 grams
(C) 5 kg (D) 50 kg

Explanatory Answer: (D)

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v = 5 m/sec, K.E = 625 J, m = ?

$K.E. = \frac{1}{2}mv^2$

$m = \frac{2(K.E.)}{v_2}$

20. Toy car A of mass 20 kg has a speed of 4 m/sec and toy car B of mass 10 kg has a speed of 8 m/sec. The K.E. of car A is:

(A) Half that of car B (B) Equal to that of car B

(C) Twice that of car B (D) Four times that of car B

Explanatory Answer: (A)

Toy car A m = 20 kg v = 4 m/sec K.E. = $\frac{1}{2}mV^2$

$= \frac{1}{2}$

$\times 20 \times 16 = 160$ J

Toy car B m = 10 Kg,

v = 8 m/sec K.E. $= \frac{1}{2} \times 10 \times 64 = 320$ J

TEST NO.5

1. A point on the rim of a wheel moves 0.2 m when the wheel turns through an angle of 14.3 degrees. The radius of the wheel is:

(A) 0.05 m (B) 0.08 cm

(C) 0.8 m (D) 0.008 m

Explanatory Answer: (C)

Given s = 0.2 m, $\theta = 14.3^\circ = \frac{14.3}{57.3}$ rad. = 0.25 rad.

r = ?, use $s = r\theta$

2. One radian is equal to:

(A) 30.3° (B) 45.3°

(C) 50.3° (D) 57.3°

Explanatory Answer: (D)

Since 2π radian $= 360^\circ$,

Hence 1 radian $= \frac{360^\circ}{2\pi}$

$= \frac{360^\circ}{2 \times 3.14} = 57.3^\circ$

3. Centripetal force performs:

(A) Maximum work (B) Negative work

(C) Positive work (D) None of these

Explanatory Answer: (D)

Since the centripetal force is directed towards centre and displacement is along the tangent, so work done by centripetal force is $Fd \cos 90^\circ$ = zero.

4. A stone tied to the end of a 20 cm long string is whirled in a horizontal circle. If centripetal acceleration is 9.8 m/sec^2, then its angular velocity in rad/sec is:

(A) $\frac{22}{7}$ (B) 7

(C) 14 (D) 21

Explanatory Answer: (B)

$a_c = 9.8$ m/sec^2

w = ? (in rad/sec)

r = 20 cm = 0.2 m

$a = r\omega^2$ or $\omega = \sqrt{\frac{a}{r}} = \sqrt{\frac{9.8}{0.2}} = 7$ rad/sec

5. Which one is the correct formula:

(A) $a_c = v^2\omega$ (B) $a_c = \frac{\omega^2}{r}$

(C) $a_c = v\omega^2$ (D) $a_c = \omega^2 r$

Explanatory Answer: (D)

$a_c = \frac{v^2}{r} = \frac{r^2\omega^2}{r} = r\omega^2$

6. The rear wheels of an automobile ar rotating with an angular velocity of 1 rev/sec which is reduced to 38 rad/sec in seconds when brakes are applied. It angular acceleration is:

(A) 5 rad/sec^2 (B) −10 rev/sec^2

(C) −10 rad/sec^2 (D) −5 rev/sec^2

Explanatory Answer: (C)

$\omega_i = 14$ rev/sec

$= 14 \times 2\pi$ rad/sec

$= 88$ rad/sec

$\omega_f = 38$ rad/sec

Use $\alpha = \frac{\omega_f - \omega_i}{t}$

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7. **A rotating wheel accelerates up to the value of 0.75 rev/sec^2 after 2 seconds of its start. Its angular velocity becomes :**

(A) 9.42 rad/sec (B) 2.6 rev/sec
(C) 1.5 rev/sec (D) Both A and C

Explanatory Answer: (D)

$\alpha = 0.75$ rev/sec^2, $w_i = 0$, $t = 2$ sec, $w_f = ?$

Use $\alpha = \frac{\omega_f - \omega_i}{t} = \frac{\omega_f}{t}$ or $\omega_f = \alpha t$

8. **A body moving along the circumference of a circle of radius R completes one revolution. The radius of the covered path to the angle subtended at the centre is:**

(A) Radius of the circle (B) Twice the radius
(C) thrice the radius (D) None of these

Explanatory Answer: (A)

Path covered in one revolution = $2\pi R$

Angle subtended in one revolution = 2π radians

$\text{Ratio} = \frac{2\pi R}{2\pi} = R$

9. **A wheel, 2 m in diameter, makes 15 rev/min, the linear speed of point on its rim (in m/sec) is:**

(A) 2π (B) π
(C) $\frac{\pi}{2}$ (D) 10π

Explanatory Answer: (C)

Radius $r = 1$m

$\omega = 15$ rev min^{-1} $= 15$ rev $(60$ sec$)^{-1}$

$= \frac{15}{60}$ rev sec^{-1}

$= 0.25 \times 2\pi$ rad sec^{-1}

$v = r\omega = 1 \times 0.25 \times 2\pi = \frac{\pi}{2}$ (m sec^{-1})

10. **Angular speed for the daily rotation of Earth in radian per hour is:**

(A) π (B) 4π
(C) $\frac{\pi}{12}$ (D) None of these

Explanatory Answer: (C)

Since Earth completes one rotation (around its own axis) in 24 hours, hence Time period = 24 hours.

$\omega = \frac{2\pi}{T} = \frac{2\pi}{24} = \frac{\pi}{12}$ rad hr^{-1}

11. **A body can have constant velocity when it follows:**

(A) A circular path (B) A rectilinear path
(C) Trajectory of a projectile (D) None of these

Explanatory Answer: (B)

Constant velocity means that both of its magnitude and direction remains constant. This can happen only when the body is moving in a straight line. In a circular motion, magnitude of velocity may be kept constant but its direction changes continuously.

12. **When a body moves in a circle, the angle between its linear velocity 'v' and angular velocity 'ω' is always:**

(A) 0° (B) 45°
(C) 90° (D) 180°

Explanatory Answer: (C)

If the body is revolving in a circle (XY plane), then according to right hand rule, angular velocity will be directed along Z-axis. Since Z-axis is perpendicular to XY plane, hence the answer.

13. **In racing car moving around a circular track, the centripetal force is provided by:**

(A) Banking of roads (B) Friction between wheels and road
(C) None of these (D) Both A and B

Explanatory Answer: (D)

Banked tracks are needed for turns. That are taken so quickly that friction alone between wheels of the vehicle and the road cannot provide energy for centripetal force.

14. **When a body is whirled in a vertical circle at the end of a string, tension is maximum:**

(A) At the top (B) At the bottom
(C) At the centre (D) None of these

Explanatory Answer: (B)

For the bottom point of a vertical circle, w

can write

$T - mg = ma$

$T = ma + mg$ (i)

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15. **A disc rolls down a hill and its speed at the bottom is found to be 11.4 m/sec. Height of the hill is then nearly:**

(A) 10 m (B) 12 m
(C) 13 m (D) 15 m

Explanatory Answer: (A)

$v = 11.4$ m/sec, $h = ?$

Use $v = \sqrt{\frac{4gh}{3}}$ *i.e.,* $v^2 = \frac{4gh}{3}$

$h = \frac{3v^2}{4g}$

16. **Which of the following represent unit of $\vec{L}$?**

(A) Kg-m^2/sec (B) Kg-m^{-1} sec^2
(C) Kg-m/sec^2 (D) Kg-m/sec

Explanatory Answer: (A)

$\vec{L} = \vec{r} \times \vec{p} = \vec{r} \times m\vec{v}$

$= \text{meter} \times \text{kg} \times \frac{\text{meter}}{\text{sec}} = \text{kg-m}^2/\text{sec}$

17. **The unit of $\vec{L}$ in SI system is:**

(A) J/sec (B) J-sec
(C) N-sec (D) N/sec

Explanatory Answer: (B)

$\vec{L} = \text{kg}\,\frac{m^2}{\text{sec}} = \text{kg}\,\frac{m}{\text{sec}} \times m = \text{kg}\left(\frac{m}{\text{sec}^2} \times \text{sec}\right) \times m$

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

$= N \times m \times \text{sec}$

$= J \times \text{second}$

18. **A particle of mass 200 gms is moving along a circle of radius 500 cm with a speed of 30 m/sec. Its angular momentum about the centre of circle in SI unit is given by:**

(A) 3×10^4 (B) 3×10^3
(C) 3×10^2 (D) 3×10^1

Explanatory Answer: (D)

$m = 200$ grams $= 0.2$ kg
$r = 500$ cm $= 5$m
$v_o = 3$ m/sec
Use $L = mv_o r$

19. **If the orbital speed of Earth around the Sun is given as 30 Km/sec, radius of circular path as 1.5×10^{11} m, and 6×10^{24} kg as mass of Earth, then angular momentum of Earth in SI unit is given as:**

(A) 2.7×10^{40} (B) 7.2×10^{40}
(C) 2.7×10^{37} (D) 7.2×10^{37}

Explanatory Answer: (A)

$v_o = 30$ km/sec $= 3 \times 10^4$ m/sec
$r = 1.5 \times 10^{11}$ m
$m = 6 \times 10^{24}$ kg
Use $L = mv_o r$

20. **Earth moves around the Sun and travels a distance of 9.42×10^8 km in 3.16×10^7 seconds. Orbital speed of Earth comes out to be:**

(A) 3 m/sec (B) 3×10^4 m/sec
(C) 3×10^6 m/sec (D) None of these

Explanatory Answer: (B)

$s = 2\pi r = 9.42 \times 10^8$ km $= 9.42 \times 10^{11}$ m
$t = 3.16 \times 10^7$ sec

$v_o = \frac{s}{t} = \frac{2\pi r}{t} = \frac{9.42 \times 10^{11}}{3.16 \times 10^7} = 3 \times 10^4$ m/sec

21. **The time of 30 vibrations of a simple pendulum is recorded as 54.6 seconds by a stop-watch whose least count is 0.1 second. The time period in seconds will be quoted as:**

(A) 1.82 ± 0.006 (B) 0.54 ± 0.003
(C) 1.82 ± 0.003 (D) 0.54 ± 0.006

Explanatory Answer: (C)

The uncertainty in the time period of a vibrating body is found by $= \frac{\text{least count of a timing device}}{\text{number of vibrations}}$

$= \frac{0.1}{30} = 0.0031$

and time period $T = \frac{54.6}{30} = 1.82$ seconds.

22. **Suppose water comes out of a pipe at the rate of 3 kg per second and its velocity changes from 5 m/sec to zero on striking the wall perpendicularly. The force exerted on the wall is:**

(A) 15 N (B) 8 N
(C) –2 N (D) 1.66 N

Explanatory Answer: (A)

$\frac{m}{t} = 3\,\frac{\text{kg}}{\text{sec}}$, $v_f - v_i = 5 - 0 = 5$ m/sec

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

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23. **A vector of magnitude 5 N is added to a vector of magnitude 8 N while the orientations are changeable. Range of their possible sum will vary from:**

(A) Zero to 3 N (B) 1 N to 13 N
(C) 13 N to 3 N (D) None of these

Explanatory Answer: (C)

If both the vectors are parallel, they will give resultant equal to 13 N and if they are anti-parallel, the resultant will be of magnitude 3 N.

24. **One – eighth of the initial mass of a certain radioactive isotope remain undecayed after one hour. Which of the following is the half life of isotope in minutes?**

(A) 8min (B) 20min
(C) 30min (D) 45min

Explanatory Answer: (B)

$$\frac{1}{8}=\left(\frac{1}{2}\right)^{3} \Rightarrow n=3$$

$$T_{\frac{1}{2}}=\frac{t}{n}$$

$$T_{\frac{1}{2}}=\frac{60\,\text{min}}{3}$$

$$T_{\frac{1}{2}}=20\,\text{min}$$

25. **Light from a source is incident on two photocells of work function 3ev and 1.5ev respectively. The energy of incident light is 4.5ev. Which of the following is the ratio of the velocities of photoelectron ejected from two photocells:**

(A) $\left(\frac{V_1}{V_2}\right)_{max}=\frac{1}{\sqrt{2}}$ (B) $\left(\frac{V_1}{V_2}\right)_{max}=\frac{1}{2}$

(C) $\left(\frac{V_1}{V_2}\right)_{max}=\frac{1}{3}$ (D) $\left(\frac{V_1}{V_2}\right)_{max}=\frac{1}{\sqrt{3}}$

Explanatory Answer: (A)

$$\frac{\frac{1}{2}mv^2{}_1}{\frac{1}{3}mv^2{}_2}=\frac{4.5-3}{4.5-1.5}=\frac{1.5}{3}$$

$$\frac{v^2{}_1}{v^2{}_2}=\frac{1}{2}$$

$$=\frac{1}{\sqrt{2}}$$

26. **The radius of curvature of the path of charged particle in a uniform magnetic field is directly proportional to the:**

(A) Charge an particle (B) momentum of particle
(C) Energy of particle (D) intensity of magnetic field

Explanatory Answer: (B)

$$evB=\frac{mv^2}{r}$$

$$eB=\frac{mv}{r}$$

$$r=\frac{mv}{eB}$$

$$r=\frac{p}{eB}$$

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TEST NO.6

1. **A body passing through a viscous medium is affected by:**

(A) One force only (B) Two forces
(C) Four forces (D) None of these

Explanatory Answer: (B)

Two forces are:
(i) Weight of the body downward.
(ii) Dry force upward.

2. **N s m^{-2} is unit of:**

(A) Drag force (B) Pressure
(C) Surface tension (D) Coefficient of viscosity

Explanatory Answer: (D)

See explanation in the answer to Q. No. 8.

3. **A body moving through a viscous medium eventually comes to rest because**

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of:

(A) Force of gravity (B) Force of friction
(C) Its weight (D) Both A and C

Explanatory Answer (B)

This force of friction is actually drag force.

4. Glycerin has viscosity _____ the viscosity of water.

(A) More than (B) Equal to
(C) Less than (D) None of these

Explanatory Answer (A)

See explanation in the answer to Q. No. 11.

5. Unit of viscosity is:

(A) $Kg\ m^{-1}\ sec^{-1}$ (B) $N\ s\ m^{-2}$
(C) $J\ s\ m^{-3}$ (D) All of these

Explanatory Answer (D)

(i) Stoke's law is $F = 6\pi\eta\ r\ v$

so $\eta = \frac{F}{6\pi\ r\ v}$

$= \frac{kg\text{-}m\ sec^{-2}}{m\text{-}m\ sec^{-1}} = kg\text{-}m^{-1}\ sec^{-1}$

(ii) $kg\ m^{-1}\ sec^{-1} = kg\ m\ sec^{-2}\ (m^{-2}\ sec)$
$= N\ s\ m^{-2}$

(iii) $N\ s\ m^{-2} = N\text{-}m(s\ m^{-3}) = J\ s\ m^{-3}$

6. Density of a fluid is defined as:

(A) Its volume to mass ratio (B) Product of volume and mass
(C) Its mass of volume ratio (D) None of these

Explanatory Answer (D)

Viscosities of

(i) Air $= 0.019 \times 10^{-3}$ (SJ Unit)
(ii) Water $= 0.810 \times 10^{-3}$ (SJ Unit)
(iii) Plasma $= 1.6 \times 10^{-3}$ (SJ Unit)
(iv) Glycerin $= 6.29 \times 10^{-3}$ (SJ Unit)

Compare these and you will get your answer.

7. Two copper balls of 1 cm and 2 cm in diameter are simultaneously dropped in the same viscous medium. The terminal velocity of bigger ball is:

(A) Not affected due to its size (B) Twice that of small size ball
(C) Four times that of small size ball (D) $\frac{1}{4}$th of that of small size ball

Explanatory Answer (C)

$v_T = \frac{2\rho g r^2}{9\eta}$

i.e., $v_T \propto r^2$ (for fixed ρ) hence the answer.

8. At high speeds, fluid friction _____ and fuel consumption _____.

(A) Increases, decreases (B) Increases, increases
(C) Decreases, increases (D) None of these

Explanatory Answer (B)

Since at high speed, air resistance increases, so more fuel is consumed.

9. The unit of viscosity in SI system is:

(A) $kg^{-1}\ m\ sec^{-1}$ (B) $kg\ m^{-1}\ sec^{-1}$
(C) $kg^{-1}\ m^{-1}\ sec$ (D) None of these

Explanatory Answer (B)

$F = 6\pi\eta\ r\ v$ or

$\eta = \frac{F}{6\pi\ r\ v} = \frac{\text{newton}}{\text{meter} \times \frac{\text{meter}}{\text{sec}}}$

$= \frac{kg\text{-}m\text{-}sec^{-2}}{m^2\ sec^{-1}}$

$= kg\text{-}m\ sec^{-2}\ m^{-2}\ sec^{1}$

$= kg\text{-}m^{-1}\ sec^{-1}$

10. The dimensions of viscosity are:

(A) $M^2L^{-1}T^{-2}$ (B) $M^{-1}L^{1}T^{-1}$
(C) $M^{-1}L^{-1}T$ (D) $ML^{-1}T^{-1}$

Explanatory Answer (D)

Dimensions can be made from the units

i.e., $kg\text{-}m^{-1}\ sec^{-1} = [ML^{-1}T^{-1}]$

11. A drop-like particle has a density of 10^3 kg/m^3. It falls through a fluid of $\eta = 10^{-3}$ (SI units) with a terminal velocity of 2.2×10^{-6} m/sec. The radius of the particle will be:

(A) 10^{-3} m (B) 10^{-4} m
(C) 10^{-5} m (D) 10^{-6} m

Explanatory Answer (D)

$\rho = 10^3\ kg/m^3$, $\eta = 10^{-3}$ (SI unit), $v_t = 2.2 \times 10^{-6}$ m/sec

radius = ?

$V_t = \frac{2\rho g r^2}{9\eta}$ or

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$$r = \sqrt{\frac{9\,\eta\, v_t}{2\,\rho\, g}}$$

$$r = \sqrt{\frac{9 \times 10^{-3} \times 2.2 \times 10^{-6}}{2 \times 10^{3} \times 9.8}}$$

$$= \sqrt{10^{-3} \times 10^{-6} \times 10^{-3}}$$
$$= \sqrt{10^{-12}}$$
$$= 10^{-6}\ m$$

12. The drag force acting on a spherical droplet of radius 10^{-5} m moving with a velocity of 1 cm/sec in a fluid of viscosity 5.31×10^{-7} (SI units) comes out to be:

(A) 10^{-16} N (B) 10^{-14} N
(C) 10^{-12} N (D) 10^{-10} N

Explanatory Answer: (C)

F = ?, r = 10^{-5} m,
v = 1 cm/sec = 10^{-2} m/sec
$\eta = 5.31 \times 10^{-7}$ (SI units)
$F = 6\pi\eta\, r\, v$
$= 6 \times 3.14 \times 5.31 \times 10^{-7} \times 10^{-5} \times 10^{-2}$
$= 100 \times 10^{-7-5-2} = 10^{-12}$ N

13. Given that ρ (for water) = 10^3 kg/m^3
η (for air) = 2×10^{-5} (SI units)
radius of droplet = 10^{-5} meters
then terminal velocity of droplet comes out to be nearly:

(A) 1 cm/sec (B) 10 cm/sec
(C) 100 cm/sec (D) None of these

Explanatory Answer: (A)

Apply $v_t = \frac{2\,\rho\, g\, r^2}{9\eta}$

$v_t = 10^{-2}$ m/sec = 1 cm /sec

14. Density of water and density of air have been found respectively as:

(A) 1 gm-cm^{-3}, 1.29 kg-m^{-3} (B) 1000 kg-m^{-3}, 1290 gm-m^{-3}
(C) 1000 kg-m^{-3}, 1.29 kg-m^{-3} (D) Only B and C

Explanatory Answer: (C)

density of water = 1000 kg-m^{-3} = 1 gm-cm^{-3}
density of air = 1.29 kg-m^{-3} = 1290 gm-m^{-3}

15. The equation of continuity is defined as $A_1v_1 = A_2v_2$. Unit of A_1v_1 is:

(A) Cubic meter (B) Cubic meter per second
(C) Square meter per second (D) None of these

Explanatory Answer: (B)

A_1 is area and v is velocity, so
$A_1v_1 = m^2 \times m\ sec^{-1} = m^3\ sec^{-1}$

16. IF A, v, t denote area of a pipe, velocity of the fluid and time of flow, then rate of flow will be:

(A) $\frac{Av}{t}$ (B) Avt
(C) Av (D) $\frac{vt}{A}$

Explanatory Answer: (C)

See answer to Q. 39 for explanation.

17. As the water falls from a tap, the speed of water _____ and so its cross-sectional area _____.

(A) Increases, decreases (B) Decreases, increases
(C) Increases, increases (D) None of these

Explanatory Answer: (A)

Speed of falling body (in this case, water) increases and according to $A_1v_1 = A_2v_2$, the cross-sectional area of water decreases.

18. The pipe near the low end of a large water storage tank develops a small leak and a stream of water shoots from it. The top of water in the tank is 15 m above the point of leak. The water will rush from the hole at a speed of:

(A) 37 m sec^{-1} (B) 7 m sec^{-1}
(C) 27 m sec^{-1} (D) 17 m sec^{-1}

Explanatory Answer: (D)

This problem relates to Torricelli's theorem
i.e., $v = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 15} = 17$ m sec^{-1}

19. The term $\frac{1}{2}\rho v^2$ in Bernoulli's theorem h unit of:

(A) Work (B) Force
(C) Volume (D) Pressure

Explanatory Answer: (D)

Since Bernoulli's equation is

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unit of:

(A) Work (B) Force

(C) Volume (D) Pressure

Explanatory Answer: (D)

Since Bernoulli's equation is

$P + \frac{1}{2}\rho v^2 + \rho g h = \text{constant}$,

Since quantities of same dimensions only can be added, hence unit of $\frac{1}{2}\rho v^2$ and $\rho g h$ are same as pressure.

$\frac{1}{2}\rho v^2 = \text{kg-m}^{-3}\ (\text{m}^2\ \text{sec}^{-2}) = \text{kg m sec}^{-2}\ \text{m}^{-2} = \text{N-m}^{-2}$

pressure unit

$\rho gh = (\text{kg-m}^{-3})(\text{m sec}^{-2})(\text{m}) = (\text{kg m sec}^{-2})(\text{m}^{-2})$

$= \text{N-m}^{-2}$

= pressure unit

20. If velocity of efflux is 100 m sec^{-1} and area of the hole is 0.06 cm^2, how much volume of water will flow out of the hole in one second?

(A) 6×10^{-4} m^3 (B) 6.0 m^3

(C) 600 m^3 (D) 6.0 cm^3

Explanatory Answer: (A)

$v = 100$ m sec^{-1}, $A = 0.06$ cm^2 $= 6 \times 10^{-2} \times 10^{-4}$ m^2

$= 6 \times 10^{-6}$ m^2

Volume per second = rate of flow = Av

$= 6 \times 10^{-6} \times 10^2$ m^3 sec^{-1}

$= 6 \times 10^{-4}$

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