WEEKLY TEST TYJ TEST - 21 B
SOLUTION Date 15-09-2019

[PHYSICS]

1.

Because the body is revolving in a circle with constant speed, hence acceleration acting on it is exactly perpendicular to direction of its motion, *i.e.*, the body possesses normal acceleration.

2.

Because the particle moving in a circle describes equal angles in equal times, hence both ω and *r* are constant. Thus, magnitude of velocity vector remains constant but the direction changes from point to point.

3.

Angular speed of the particle, *i.e.*, rate of change of angular displacement of the particle remains constant.

4.

As, $T_1 = T_2$

Hence, $\frac{2\pi r_1}{v_1} = \frac{2\pi r_2}{v_2}$ or $\frac{v_1}{v_2} = \frac{r_1}{r_2}$

$$\frac{F_1}{F_2} = \frac{mv_1^2}{r_1} \times \frac{r_2}{mv_2^2} = \left(\frac{v_1}{v_2}\right)^2 \times \frac{r_2}{r_1} = \left(\frac{r_1}{r_2}\right)^2 \times \frac{r_2}{r_1} = \frac{r_1}{r_2}$$

5.

Since, water does not fall down, therefore, the velocity of revolution should be just sufficient to

provide centripetal acceleration at the top of vertical circle. So,

$$v = \sqrt{gr} = \sqrt{10 \times 1.6} = 4 \text{ m/s}$$

6.

Because the particle is moving in a circle with uniform speed, hence kinetic energy $\left(= \frac{1}{2} mv^2\right)$ will remain constant. Acceleration, velocity and displacement will change from point to point due to change in direction.

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$$v = \sqrt{5gr} = \sqrt{5 \times 9.8 \times 4} = \sqrt{196} = 14 \text{ m/s.}$$

8.

Velocity at the top is $\sqrt{gr}$ and that at the bottom is $\sqrt{5gr}$. Hence, required difference in kinetic energy

$$= \frac{1}{2} M[5gr - gr] = 2Mgr$$

$$= 2 \times 10 \times 1 \times 1 = 20 \text{ J}.$$

9.

Centripetal force = force of friction

$$\frac{Mv^2}{r} = \mu \times \text{reactional force}$$

or $\frac{Mv^2}{r} = \mu Mg$ or $v = \sqrt{\mu rg}$.

10.

To cross the bridge without leaving the ground, at the highest point of the bridge,

$$\frac{Mv^2}{R} = Mg \quad \text{or} \quad v = \sqrt{Rg}.$$

11.

Length of the path,

$$314 = \frac{2\pi r}{4} \quad \text{or} \quad r = 200 \text{ m}$$

$$\therefore \quad F = \frac{mv^2}{r} = \frac{1500 \times (20)^2}{200} = 3000 \text{ N}.$$

12.

Given that masses and time periods of two bodies are same,

$$F = m\omega^2 R = m\left(\frac{2\pi}{T}\right)^2 R$$

As m and T are same for two bodies, hence

$$\frac{F_1}{F_2} = \frac{R_1}{R_2}.$$

13.

$$v_{\text{max.}} = \sqrt{\mu rg} = \sqrt{0.3 \times 10 \times 300}$$

$$= 30 \text{ m/sec} = 30 \times \frac{18}{5} = 108 \text{ km/hr}$$

14.

$$v = 4.9 \text{ m/sec}, r = 4 \text{ m}, \mu = \frac{v^2}{rg} = \frac{(4.9)^2}{4 \times 9.8} = 0.61.$$

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[CHEMISTR]

16. As it absorbs heat, $q = +208$ J

$$w_{rev} = -2.303 nRT \log_{10}\left(\frac{V_2}{V_1}\right)$$

$$w_{rev} = -2.303 \times (0.04) \times 8.314 \times 310 \ \log_{10}\left(\frac{375}{50}\right)$$

$\therefore \ w_{rev} = -207.76 \approx -208$ J

17. For isothermal reversible expansion of an ideal gas volume V_1 to V_2 the work done is given as :

18. $$W = -2.303 nRT \log\frac{V_2}{V_1}$$

$$= -2.303 \times 1 \times 8.314 \times 300 \times \log\frac{20}{10}$$

$= -2.303 \times 8.314 \times 300 \times 0.3010 = -1729$ joules

Work done = – 1729 joules

19. Volume depends on the mass of the system.

20.

21. As internal energy is a function of temperature, therefore $\Delta U = 0$

22.

23. For an adiabatic process neither heat enters or leaves the system

$\therefore \quad q = 0$.

24. ΔE and ΔH both are zero in case of cyclic process. [Also, for isothermal free or reversible expansion of ideal gas, ΔE and ΔH both are zero].

25.

26. In case of thermodynamic equilibrium $\Delta V, \Delta P, \Delta T$ and Δn all have to be zero.

27.

28. $W_{\text{expansion}} = -P\Delta V$

$$= -(1\times 10^5 \text{Nm}^{-2})[(1\times 10^{-2} - 1\times 10^{-3})\text{m}^3]$$

$$= -10^5 \times (10\times 10^{-3} - 1\times 10^{-3})\text{Nm}$$

$$= -10^5 \times 9\times 10^{-3}\text{J} = -9\times 10^2 \text{J} = \mathbf{-900\ J}$$

29. $q = \mathbf{+200\ J}$

$W = -P\Delta V = -1\times(20-10) = -10$ atm L

$= -10\times 101.3$ J $= \mathbf{-1013\ J}$

$\Delta E = q + W = (200 - 1013)$ J $= \mathbf{-813\ J}$

30. $\frac{V_2}{V_1} = \frac{1}{10}$

W (on the system) $= -2.303 nRT \log\frac{V_2}{V_1} = -2.303\times 1\times 2\times 500 \log\frac{1}{10}$ cal

$$= +\frac{2.303\times 2\times 500}{1000}\text{ kcal} = \mathbf{+2.303\ kcal}$$