WEEKLY TEST MEDICAL PLUS -01 TEST - 09 Balliwala SOLUTION Date 14-07-2019

[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.

$$\text{Acceleration} = \omega^2 r = (2\pi f)^2 r = 4\pi^2 f^2 r$$
$$= 4\pi^2 \times 1 \times (2\times 10^4) = 8\times 10^5 \text{m/s}^2.$$

4.

Displacement, velocity and acceleration change continuously with respect to time because of change in direction.

5.

The required retardation is given by:

$$a = \frac{v^2}{2x} = \frac{20\times 20}{2\times 20} = 10 \text{ m s}^{-2}$$

The centripetal acceleration required to describe a circle of radius 20 m is,

$$\frac{v^2}{R} = \frac{20\times 20}{20} = 20 \text{ m s}^{-2}$$

Thus, it is better to apply the brakes.

6.

In circular motion, centripetal force acting on the body is always perpendicular to the velocity vector or displacement vector. Hence, work done $(= \vec{F}\cdot\vec{d})$ is always zero whatever may be the displacement along the circular path.

7.

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,

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

8.

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.

9.

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

10.

Acceleration of a point at the tip of the blade

$$= \text{centripetal acceleration} = \omega^2 R = (2\pi f)^2 R$$

$$= \left(2 \times \frac{22}{7} \times \frac{1200}{60}\right)^2 \times \frac{30}{100} = 4740 \text{ m/sec}^2$$

11.

Centripetal force required for negotiating the curve $= \frac{Mv^2}{R}$.

When velocity is doubled, centripetal force required is quadrupled, *i.e.*, tendency to overturn is also quadrupled.

12.

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

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

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

13.

Centripetal force = force of friction

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

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

14.

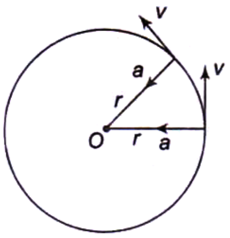
To cross the bridge without leaving the ground, at the highest point of the bridge,

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

15.

16.

In a uniform circular motion, the acceleration is directed towards the centre while velocity is acting tangentially.



17.

$r = 25 \times 10^{-2}$ m, f=2 /sec

$\omega = 2\pi f = 4\pi$ rad/sec

Acceleration = $\omega^2 r = (4\pi)^2 \times 25 \times 10^{-2}$

$= 16 \times 25 \times 10^{-2}\pi^2$ m/s^2

$= 4\pi^2$ m/s^2

18.

Tangential acceleration, $a_t = r\alpha = 4$ m/s^2.

Radial acceleration

$$a_t = \omega^2 r = \frac{v^2}{r} = \frac{60 \times 60}{1200} = 3 \text{ m/s}^2$$

Hence, resultant acceleration of the car

$$a = \sqrt{a_t^2 + a_r^2} = \sqrt{4^2 + 3^2} = 5 \text{ m/s}^2$$

19.

For a particle performing uniform circular motion, magnitude of the acceleration remains constant.

20.

Here, $v = 27 \text{ km h}^{-1} = 27 \times \frac{5}{18} \text{ms}^{-1}$

$v = \frac{15}{2} = 7.5 \text{ ms}^{-1}$

$r = 80$ m

Centripetal acceleration, $a_c = \frac{v^2}{r}$

$$a_c = \frac{(7.5 \text{ ms}^{-1})^2}{80 \text{ m}} = 0.7 \text{ ms}^{-2}$$

Tangential acceleration, $at = 0.5$ m s^{-2}

Magnitude of the net acceleration is

$$a = \sqrt{(a_c)^2 + (a_t)^2} = \sqrt{(0.7)^2 + (0.5)^2} = 0.86 \text{ ms}^{-2}$$

21.

The change in velocity when the particle completes half revolution is given by

$$\Delta v = 5 \text{ m/s} - (-5 \text{ m/s}) = 10 \text{ m/s}$$

Time taken to complete half revolution

$$t = \frac{\pi r}{v} = \frac{\pi \times 5}{5} = \pi \text{ sec}$$

Average acceleration $= \dfrac{\Delta v}{t} = \dfrac{10}{\pi} \text{m/s}^2$

22.

Since $T = 2\pi\sqrt{\dfrac{L\cos\theta}{g}}$

$\therefore \quad T_1 = T_2$

$\Rightarrow \quad L_1 \cos\theta_1 = L_2 \cos\theta_2$

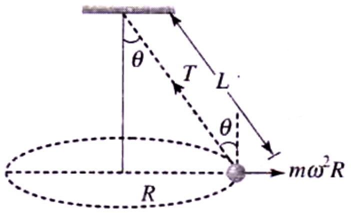
$\therefore \quad \dfrac{L_1}{L_2} = \dfrac{\cos\theta_2}{\cos\theta_1} = \dfrac{\cos 45°}{\cos 30°}$

$\dfrac{L_1}{L_2} = \dfrac{\sqrt{2}}{\sqrt{3}}$

23.

$T \sin\theta = M\omega^2 R$

$T \sin\theta = M\omega^2 L \sin\theta$



From (i) and (ii)

$$T\ M\omega^2 L = M4\pi^2 n^2 L = M4\pi^2\left(\frac{2}{\pi}\right)^2 L = 16\ ML$$

24.

$\tan\theta = \dfrac{v^2}{rg}$. Here $\dfrac{v^2}{r} =$ constant

or $\quad \dfrac{v_1^2}{r_1} = \dfrac{v_2^2}{r_2}$ or $r_2 = r_1 \times \dfrac{v_2^2}{v_1^2}$

or $\quad r_2 = 50 \times \dfrac{(2v_1)^2}{v_1^2} = 50 \times 4 = 200$ m

25.

$F = \mu(mg)$

Centripetal force $F = mv^2/r$

$\therefore \quad \mu mg = (mv^2/r)$ or $r = v^2/\mu g$

or $\quad r = \dfrac{(12)^2}{0.4 \times 10} = 36\ m$

26.

When string breaks, only tangential component of acceleration will survive. Hence, path followed is tangential to circular path.

27.

$F = m\omega_1^2 r_2 \Rightarrow F = m\omega_2^2 r_2$

$\frac{\omega_1^2 r_1}{\omega_2^2 r_2} = 1 \Rightarrow r_2 = \frac{\omega_1^2 r_1}{\omega_2^2}$

$\omega_1 = \omega \Rightarrow \omega_2 = 2\omega$

$r_2 = \frac{\omega \times 4}{4\omega} = 1\text{ cm}$

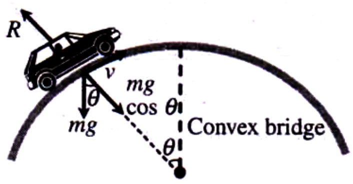
28.

Tension, $T = \frac{mv^2}{r} + mg\cos\theta$

For, $\theta = 30°$, $T_1 = \frac{mv^2}{r} + mg\cos 30°$

29.

$R = mg\cos\theta - \frac{mv^2}{r}$

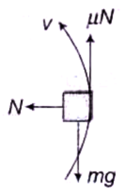


when θ decreases $\cos\theta$ increases i.e., R increases.

30.

$\mu N = mg$

$\mu\frac{mv^2}{r} = mg \Rightarrow v = \sqrt{\frac{gr}{\mu}} = \sqrt{\frac{10\times 2}{0.2}} = 10\text{ m/s}$



31. Time given, t = 140 sec.
Time taken to complete on round = 40 sec
Hence, athlete will complete three and a half rounds in the given time and his displacement will be 2R.

32. The area under the acceleration-time graph gives change in velocity. Since, particle starts with u = 0, therefore change in velocity = $v_f - v_i = v_{max} - 0$ = area, under a–t graph $= \frac{1}{2}\times 10\times 11 = 55\text{m/s}$

33. $x = at^2 - bt^3$

velocity $= \frac{dx}{dt} = 2at - 3bt^2$

and acceleration $= \frac{d}{dt}\left(\frac{dx}{dt}\right) = 2a - 6bt$

acc. will be zero if $t = \frac{2a}{6b} = \frac{a}{3b}$

34.

35.

36. According to quetion :

$$\frac{dv}{dt} \propto x$$

or $\frac{dv}{dx}.\frac{dx}{dt} \propto x$

or $\frac{dv}{dx}.v \propto x$

or $v dv \propto x\, dx$

or $v^2 \propto x^2$

As KE is proportional to v^2, hence loss of KE is proportional to x^2.

37. $t_1 = \frac{x/2}{3} = \frac{x}{6}$

$x = 4.5t_2$, $x_2 = 7.5t_2$

Also $x_1 + x_2 = \frac{x}{2} = (4.5 + 7.5)t_2$

That is $t_2 = \frac{x}{24}$

$$t = t_1 + 2t_2 = \frac{x}{6} + \frac{2x}{24} = \frac{x}{4}$$

$$v = \frac{x}{t} = 4 m/s$$

38. Velocity is equal the slope of displacement-time graph $\left(\because \frac{dy}{dx} = \frac{dx}{dt}\right)$ which is negative at the point E.

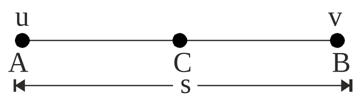
39. $s = kt^{1/2}$

$$\frac{d^2s}{dt^2} = -\frac{1}{4}kt^{-3/2}$$

As t increases, the retardation decreases.

40.

41.



Let s be the distance between AB and a be constant acceleration of a particle. Then,

$v^2 - u^2 = 2as$

or $as = \frac{v^2 - u^2}{2}$ ......(i)

Let v_C be velocity of a particle at mid-point C.

$\therefore$ $v_C^2 - u^2 = 2a\left(\frac{s}{2}\right)$

$v_C^2 = u^2 + as = u^2 = \frac{v^2 - u^2}{2}$ [Using eqn. (i)]

$$v_C = \sqrt{\frac{u^2 + v^2}{2}}$$

42. The displacement $x = at + bt^2 - ct^3$
velocity $= a + 2bt - 3ct^2$
acceleration $= 2b - 3c.2t$

i.e., acceleration is zero at time $t = \frac{2b}{6c} = \frac{b}{3c}$

$\therefore$ $\text{Velocity}\left(\text{at } t = \frac{b}{3c}\right) = a + 2b\frac{b}{3c} - 3c\frac{b^2}{9c^2}$

$= a + \frac{2b^2}{3c} - \frac{b^2}{3c} = a + \frac{b^2}{3c}$

43. $t = \alpha x^2 + \beta x = x(\beta x + \beta)$

$I = 2\alpha\frac{dx}{dt}.x + \beta\frac{dx}{dt}$

$\therefore$ $v = \frac{dx}{dt} = \frac{1}{\beta + 2\alpha x}$; $\quad \frac{dv}{dt} = \frac{-2\alpha}{(\beta + 2\alpha x)^2} = 2\alpha v^3$

44. Given that; $v = kt = 2t$. As the electron starts from rest, hence acceleration is 2 m/s^2 as is obvious from the given equation.

Now, $s = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2} \times 2 \times (3)^2 = 9m$

45. From $v^2 = u^2 - 2as$, we have $0 = u^2 - 2(10)(20)$
or $u = 20$ m/s
Also, $v = u - at$ or $0 = 20 - 10t$ or $t = 2s$
So, the ball returns to the hand of the juggler after 4s. To maintain proper distance, the balls must be thrown upat an interval of $\frac{4}{4}$ or 1 sec.

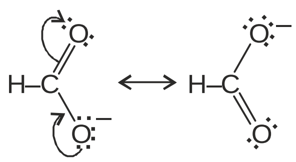
[CHEMISTRY]

69. L.E. is directly proportional to charge and inversely proportional to size.

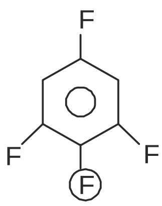
70. $E = \frac{hc}{\lambda} = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{\lambda}$

$E(\text{given}) = \frac{242 \times 10^3}{6.02 \times 10^{23}}$ J per molecule of Cl–Cl bond

$\frac{6.6 \times 10^{-34} \times 3 \times 10^8}{\lambda} = \frac{242 \times 10^3}{6.02 \times 10^{23}} \Rightarrow \lambda = 494$ nm

71. 

72.

73. In choices (a), (c), and (d) net $\mu = 0$.
In choice (b), the setting of three C–F dipoles is similar to choice (a) has $\mu = 0$ and then only C—(F) one is left  with $\mu = x$.

74. Isoelectronic species are isostructural also.

ClO_3^- and SO_3^{2-} have 66 electrons each.

XeO_3 and $IO_3^{\ominus}$ have 102 electrons each.

XeF_2 have $IF_2^{\ominus}$ have 72 electrons each.

76. (b) If the two elements have similar electronegativities,the bond between them will be covalent, while a large difference in electronegativities leads to an ionic bond.

77. (a) From electronic configuration valencies of X and Y are + 2 and –1 respectively so formula of compound is XY_2.

78. (b) Ionic compounds can't pass electricity in solid state because they don't have mobile ion in solid state.

79. (c) Structure of KCN is $[K^+(C^- \equiv \ddot{N})]$.

80. (b) Sugar is an organic compound which is covalently bonded so in water it remains as free molecules.

81. (d) BF_3 does not have octet, it has only six electrons so it is electron deficient compound.

82. (b) $NaCl$ is a ionic compound because it consists of more elelctronegativity difference compare to HCl.

83. (a) NH_4Cl has a coordinate bond besides covalent and ionic bonds $\left[\begin{array}{c} H \\ | \\ H - N \rightarrow H \\ | \\ H \end{array}\right]^+ Cl^-$

84. (b) $^-O - \overset{\overset{O^-}{|}}{C} = O$ has covalent bonds only.

85. (b) Due to symmetry dipole moment of p-dichloro benzene is zero.

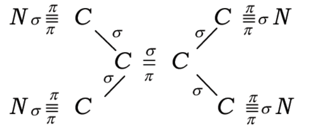
86. (d) CCl_4 has zero dipole moment because of symmetric tetrahedral structure. CH_3Cl has slightly higher dipole moment which is equal to 1.86D. Now CH_3Cl has less electronegativity then CH_2Cl_2. But CH_2Cl_2 has greater dipole moment than $CHCl_3$.

87. (a) More the difference in electronegativity of atoms. Bond between them will be more polar.

88. (d) $C - F$ bond has the most polar character due to difference of their electronegativity.

89. (a) H_2S has angular geometry and have some value of dipole moment.

90. (a)



9π and 9σ bonds.