WEEKLY TEST MEDICAL PLUS -01 TEST - 09 RAJPUR
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.

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.

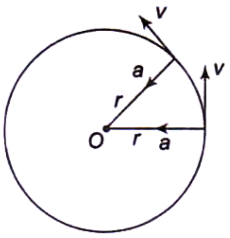
To cross the bridge without leaving the ground, at the highest point of the bridge,

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

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

$\therefore \quad T_1 = T_2$

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

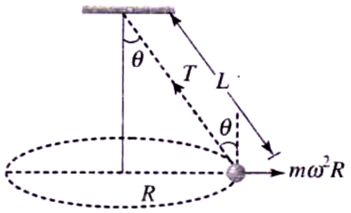
$\therefore \quad \dfrac{L_1}{L_2} = \dfrac{\cos\theta_2}{\cos\theta_1} = \dfrac{\cos 45°}{\cos 30°}$

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

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

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.

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

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

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

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

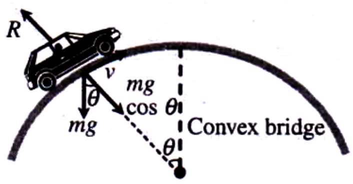
28.

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

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

29.

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

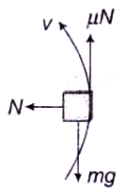


when θ decreases $\cos\theta$ increases i.e., R increases.

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 $= \frac{1}{2} \times 10 \times 11 = 55\,m/s$

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 $vdv \propto x\, dx$

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.

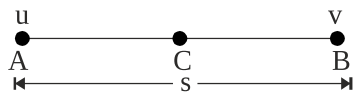
39. $s = kt^{1/2}$

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

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

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

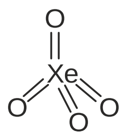
$\therefore$ $v = \frac{dx}{dt} = \frac{1}{\beta + 2\alpha x}$; $\frac{dv}{dt} = \frac{-2\alpha}{(\beta + 2\alpha x)^2} = 2\alpha v^3$

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.

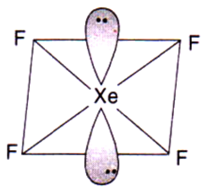
Now, $s = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2} \times 2 \times (3)^2 = 9m$

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]

46.
47. $CH_2{=}CH{-}CH_2{-}C{\equiv}CH$ has 10σ-bonds are 3π-bonds
48. 34 electrons
49. Four atoms directly related with $C{\equiv}C$ are linearly arrnaged
50. XeF has 8 electrons in valence shell. In XeF_2, XeF_4 and XeF_6, two sigma bonds, four sigma bonds and six sigma bonds are respectively formed. Hence, in XeF_2 3 pairs of electrons are left, in XeF_4 2 pairs of electron are left and in XeF_6 only 1 pair of electron is left.
51. In BH_3, B-atom forms 3σ-bonds has sp^2-hybridization. In B_2H_6, each B-atom is joined with 4H atoms and is sp^3-hybridization
52. $\underset{\text{Al is } sp^2}{AlH_3} \xrightarrow{H^-} \underset{\text{Al is } sp^3}{AlH_4^-}$
53. Each f C^1 and C^2 are forming two sigma bonds. Hence, both are sp-hybridised.
54.
55.  XeO_4 has 4σ- and 4π-bonds.
56.
57.
58.
59. Acetylene molecule, $H - {}^{\sigma}C \underset{\sigma 1\sigma + 2\pi\sigma}{\equiv} C - H$ has 3σ and two π-bonds.

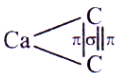
60. XeF_4 has two lone pairs of electrons on central Xe atom.



61 . $AlCl_3$ nad BF_3 have incomplete octets while XeF_4 and $XeOF_2$ have extended octets. Only SCl_2 has completely octet $(Cl - \ddot{\underset{..}{S}} - Cl)$

62.

63.



, **one sigma** and **two pi** bonds.

64.

Phosphorus ($1s^2 2s^2 2p^6 3s^2 3p^6 \boxed{3d}$) can expand electronic configuration because of availability of $3d$-subshell in valence shell.

Nitrogen ($1s^2 2s^2 2p^3$) has no d-subshell in valence shell for expansion of electronic configuration.

65.

81.

82.

83. $3d^3 5s^2$

Block-d

Period-5

Group-number electrons +(n –1) d electrons = 2 + 3 = 5 or (VB)

84. Magic no ($2n^2$) : 2, 8, 8, 18, 18, 32, 50, 50, 72, 72

Period 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

$\therefore$ element 2 + 8 + 18 + 18 + 32 + 32 + 50 + 50 + 72 = 290

85. van der Waals Radii > Covalent radii

86. size of Al $\simeq$ Ga due to poor shielding effect of d-orbitals

Zr $\simeq$ Hf $\rightarrow$ Due to lanthanide concentration

$Fe^{3+} < Fe^{2+} < Fe^{+} \rightarrow +\text{veON} \downarrow \text{size} \uparrow$

87. Heat needed to be supplied per mole

330 + 580 + 1820 + 2740 = 5470 kJ

No. of moles of Al taken $= \dfrac{13.5}{27} = 0.5$ mol

$\Rightarrow$ Heat required = 0.5 × 5470 kJ = 2735 kJ

88. Orbitals bearing lower value of n will be more closer the nucleus and thus electron will experience greater attraction from nucleus and so its removal will be difficult, not easier.

89. (1) Be has completely filled stable valence shell configuration, i.e., $2s^2$ while in Be^+ because of positive charge, the removal of electron requires much higher energy. So, ionisation energy of Be^+ is greater than Be.

(2) Across the period, atomic size decreases and nuclear charge increases and thus valence shell electron(s) is/are tightly held by nucleus. So, ionisation energy of C is greatr than Be.

90. The difference of IP_4 and IP_5 is maximum

Valency	=	4
Group	=	IVA or 14th
Family	=	Carbon family