

**WEEKLY TEST OYJ TEST - 29 R & B**  
**SOLUTION Date 24-11-2019**

**[PHYSICS]**

1. (d) Velocity is the time derivative of displacement.

Writing the given equation of a point performing SHM

$$x = a \sin\left(\omega t + \frac{\pi}{6}\right) \quad \dots(i)$$

Differentiating Eq. (i), w.r.t. time, we obtain

$$v = \frac{dx}{dt} = a \omega \cos\left(\omega t + \frac{\pi}{6}\right)$$

It is given that  $v = \frac{a\omega}{2}$ , so that

$$\frac{a\omega}{2} = a \omega \cos\left(\omega t + \frac{\pi}{6}\right)$$

or  $\frac{1}{2} = \cos\left(\omega t + \frac{\pi}{6}\right)$

or  $\cos \frac{\pi}{3} = \cos\left(\omega t + \frac{\pi}{6}\right)$

or  $\omega t + \frac{\pi}{6} = \frac{\pi}{3} \Rightarrow \omega t = \frac{\pi}{6}$

or  $t = \frac{\pi}{6\omega} = \frac{\pi \times T}{6 \times 2\pi} = \frac{T}{12}$

Thus, at  $T/12$  velocity of the point will be equal to half of its maximum velocity.

2. (b) Acceleration  $\propto -$  (displacement).

$$A \propto -y$$

$$A = -\omega^2 y$$

$$A = -\frac{k}{m} y$$

$$A = -ky$$

Here,  $y = x + a$

$$\therefore \text{acceleration} = -k(x + a)$$

3. (c) For a particle executing SHM  
 acceleration  $a \propto -\omega^2$  displacement ( $x$ ) ... (i)  
 Given  $x = a \sin^2 \omega t$  ... (ii)  
 Differentiating the above equation, we get

$$\frac{dx}{dt} = 2a\omega(\sin \omega t)(\cos \omega t)$$

Again differentiating, we get

$$\begin{aligned} \frac{d^2x}{dt^2} &= a = 2a\omega^2 [\cos^2 \omega t - \sin^2 \omega t] \\ &= 2a\omega^2 \cos 2\omega t \end{aligned}$$

The given equation does not satisfy the condition for SHM [Eq. (i)]. Therefore, motion is not simple harmonic.

4. (d) The given velocity-position graph depicts that the motion of the particle is SHM.  
 In SHM, at  $t = 0$ ,  $v = 0$  and  $x = x_{\max}$ .  
 So, option (d) is correct.
5. (b) Equation of SHM is given by  
 $x = A \sin(\omega t + \delta)$   
 $(\omega t + \delta)$  is called phase.

when  $x = \frac{A}{2}$ , then

$$\sin(\omega t + \delta) = \frac{1}{2} \Rightarrow \omega t + \delta = \frac{\pi}{6}$$

$$\text{or } \phi_1 = \frac{\pi}{6}$$

For second particle,  $\phi_2 = \pi - \frac{\pi}{6} = \frac{5\pi}{6}$

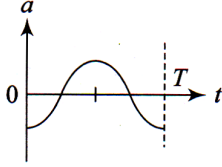
$$\begin{aligned} \therefore \phi &= \phi_2 - \phi_1 \\ &= \frac{4\pi}{6} = \frac{2\pi}{3} \end{aligned}$$

6. (b) We now that  $v_{\max} = a\omega$  and  $v = n\lambda$   
 $\therefore \frac{v_{\max}}{v} = \frac{a\omega}{n\lambda} = \frac{a(2\pi n)}{n\pi} = \frac{2\pi a}{\lambda}$   
 $= \frac{2\pi a}{2\pi/k} = ka = \frac{\pi}{2} \times 3 = \frac{3\pi}{2}$

7. (c) Displacement,  $x = A \cos(\omega t)$  (given)

$$\text{Velocity, } v = \frac{dx}{dt} = -A\omega \sin(\omega t)$$

$$\text{Acceleration, } a = \frac{dv}{dt} = -A\omega^2 \cos(\omega t)$$



Hence graph (c) correctly depicts the variation of  $a$  with  $t$ .

8. (d) As springs are connected in series, effective force constant

$$\frac{1}{k} = \frac{1}{k_1} + \frac{1}{k_2} \Rightarrow k = \frac{k_1 k_2}{k_1 + k_2}$$

Hence, frequency of oscillation is

$$n = \frac{1}{2\pi} \sqrt{\frac{k}{m}} = \frac{1}{2\pi} \sqrt{\frac{k_1 k_2}{(k_1 + k_2)m}}$$

9. (c)  $n = \frac{1}{2\pi} \sqrt{\frac{K_{\text{effective}}}{m}}$

Springs are connected in parallel

$$K_{\text{eff}} = K_1 + K_2 = K + 2K = 3K$$

$$\Rightarrow n = \frac{1}{2\pi} \sqrt{\frac{(K + 2K)}{m}} = \frac{1}{2\pi} \sqrt{\frac{3K}{m}}$$

10. (a) As springs are connected in series, effective force constant

$$\frac{1}{k_{\text{eff}}} = \frac{1}{k} + \frac{1}{k} = \frac{2}{k} \Rightarrow k_{\text{eff}} = \frac{k}{2}$$

Hence, frequency of oscillation is

$$n = \frac{1}{2\pi} \sqrt{\frac{k_{\text{eff}}}{m}} = \frac{1}{2\pi} \sqrt{\frac{k}{2M}}$$

11.  $K = \frac{1}{2} m\omega^2 (A^2 - y^2)$ ,  $U = \frac{1}{2} m\omega^2 y^2$

$$K = U \quad \text{or} \quad \frac{1}{2} m\omega^2 (A^2 - y^2) = \frac{1}{2} m\omega^2 y^2$$

$$\text{i.e., } 2y^2 = A^2 \quad \text{or} \quad y = \frac{A}{\sqrt{2}}$$



12. D

13. According to theory section,

$$f = \frac{1}{2\pi} \sqrt{\frac{BA^2}{MV_0}}$$

$$\therefore T = 2\pi \sqrt{\frac{MV_0}{BA^2}} = 2\pi \sqrt{\frac{M(hA)}{BA^2}} = 2\pi \sqrt{\frac{Mh}{BA}}$$

As  $B = P$ 

$$\text{Hence, } T = 2\pi \sqrt{\frac{Mh}{PA}}$$

14. B

15. B

16. C

17. Time taken by the pendulum to move from  $A$  to  $O$  and from  $O$  to

$$A = \frac{T}{2}$$

Time period of oscillation  $\propto \sqrt{L}$ .

$$\therefore \frac{T_1}{T} = \sqrt{\frac{L/4}{L}} = \frac{1}{2} \text{ or } T_1 = \frac{T}{2}$$

Time taken to complete half the oscillation =  $\frac{T}{4}$ .

Total time period of oscillation

$$= \frac{T}{2} + \frac{T}{4} = \frac{3T}{4}$$

18. B

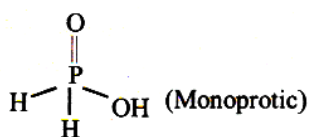
19. A

20. A

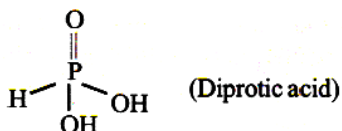
**[CHEMISTRY]**

21.

(b) Phosphinic acid as shown in structure below has one P—OH bond thus it is monobasic or monoprotic

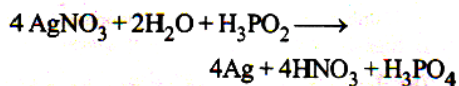


Phosphonic acid as shown in structure has two P—OH bonds thus it is dibasic or diprotic



22.

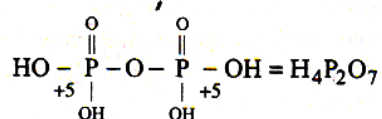
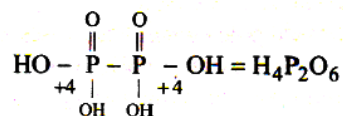
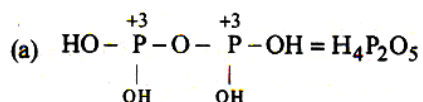
- (a) The acids which contain P-H bond have strong reducing properties. Thus  $\text{H}_3\text{PO}_2$  acid is good reducing agent as it contains two P-H bonds and reduces, for example,  $\text{AgNO}_3$  to metallic silver.



23.

(c) Compound	Oxidation number of nitrogen
$\text{N}_2\text{H}_4$	= -2
$\text{NH}_3$	= -3
$\text{N}_3\text{H}$	= -1/3
$\text{NH}_2\text{OH}$	= -1

24.



25.

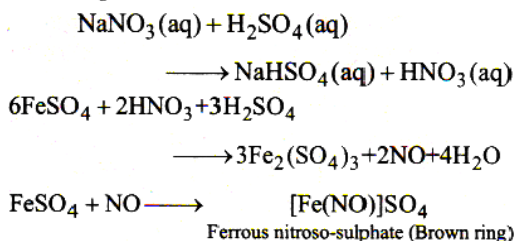
- (c) Nitrogen form  $\text{N}_2$  (i.e.  $\text{N} \equiv \text{N}$ ) but phosphorus form  $\text{P}_4$ , because in  $\text{P}_2$ ,  $p_\pi - p_\pi$  bonding is present which is a weaker bonding.

26.

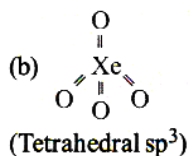
- (a) Order of dipole moment decreases as  $\text{NH}_3 > \text{PH}_3 > \text{AsH}_3 > \text{SbH}_3$   
(Based upon electronegativity)

27.

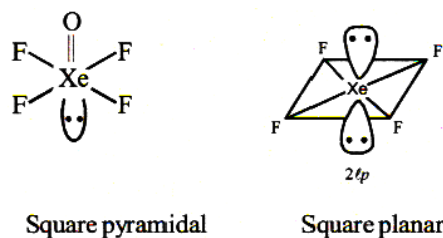
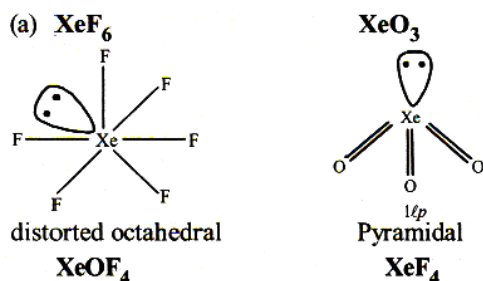
- (b) Brown ring test is done for the confirmation of  $\text{NO}_3^-$  ions.



28.



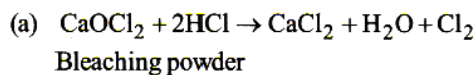
29.



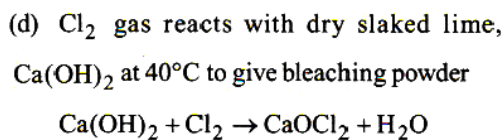
30.

(d) On account of highly stable  $ns^2np^6$  configuration in the valence shell. These elements have no tendency either to lose gain or share electrons with atoms of other elements i.e., their combining capacity or valency is zero. Further all the orbitals in the atoms of these elements are doubly occupied i.e electrons are not available for sharing.

31.



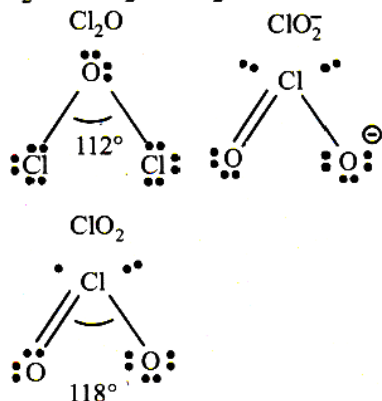
32.



33.

(c) The correct order of increasing bond angle

is  $\text{Cl}_2\text{O} < \text{ClO}_2^- < \text{ClO}_2$



\* In  $\text{ClO}_2^-$  there are 2 lone pairs of electrons present on the central chlorine atom. Therefore

the bond angle in  $\text{ClO}_2^-$  is less than  $118^\circ$  which is the bond angle in  $\text{ClO}_2$  which has less number of electrons on chlorine.

34.

(b) If acidic nature is high,  $K_a$  is high and  $\text{p}K_a$  is low

	$\text{H}_2\text{O}$	$\text{H}_2\text{S}$
$K_a$	$1.8 \times 10^{-6}$	$1.3 \times 10^{-7}$
	$\text{H}_2\text{Se}$	$\text{H}_2\text{Te}$
$K_a$	$1.3 \times 10^{-4}$	$2.3 \times 10^{-3}$

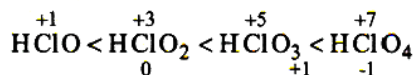
since  $\text{p}K_a = -\log K_a$

Hence the order of  $\text{p}K_a$  will be

$\text{H}_2\text{O} > \text{H}_2\text{S} > \text{H}_2\text{Se} > \text{H}_2\text{Te}$

35.

(b) As oxidation number of central atom in oxy-acid increases strength increases. Hence the correct order of acidic strength is



36.

(c) Bond dissociation energy of fluorine is less because of its small size and repulsion between electrons of two atoms. So option (c) is wrong order. The correct order is

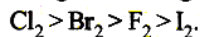
$[\text{Cl}_2 > \text{Br}_2 > \text{F}_2 > \text{I}_2]$

37.

(b and c)

(a) The oxidising power of halogen follow the order  $F_2 > Cl_2 > Br_2 > I_2$ .(b) The correct order of electron gain enthalpy of halogens is  $Cl_2 > F_2 > Br_2 > I_2$ . The low value of  $F_2$  than  $Cl_2$  is due to its small size.

(c) The correct order of bond dissociation energies of halogens is



It is the correct order of electronegativity values of halogens.



38.

(c)  $MI > MBr > MCl > MF$ . As the size of the anion decreases covalency decreases.

39.

(c) The bond energy of  $F_2 < Cl_2$  due to more repulsion in between non-bonding electrons(2p) of  $F_2$  in comparison to non-bonding pair (3p) repulsion in  $Cl_2$ , the bond energy of  $F_2 < Cl_2$ .**Bond energy ( $kJ mol^{-1}$ ):**

F – F	Cl – Cl	Br – Br	I – I
158.8	242.6	192.8	151.1

40.

(b) Bond dissociation enthalpy decreases as

the bond distance increases from  $F_2$  to  $I_2$ . This is due to increase in the size of the atom, on moving from F to I.F – F bond dissociation enthalpy is smaller than Cl – Cl and even smaller than Br – Br. This is because F atom is very small and hence the three lone pairs of electrons on each F atom repel the bond pair holding the F-atoms in  $F_2$  molecules.

The increasing order of bond dissociation enthalpy is

