WEEKLY TEST TYJ-02 TEST 34 RAJPUR ROAD
SOLUTION Date 05-01-2020

[PHYSICS]

1. **(a)** It is given that energy remains the same.

Hence, $E_A = E_B$

Energy $\propto a^2n^2 \Rightarrow \frac{a_B}{a_A} = \frac{n_A}{n_B}$ $\quad$ ($\because$ energy is same)

$\therefore \quad \left(\frac{a_A}{a_B}\right)^2 = \left(\frac{n_B}{n_A}\right)^2$

Given, $n_A = n,\ n_B = \frac{n}{8}$

$\therefore \quad \frac{a_A}{a_B} = \frac{n/8}{n} = \frac{1}{8} \quad \Rightarrow a_B = 8a_A = 8a$

2. **(d)** The frequency of note emitted by the wire,

$$n = \frac{1}{2l}\sqrt{\frac{T}{m}}$$

m = mass m per unit length of wire and T = tension,
and l = length of wire.

$$\frac{n_1}{n_2} = \sqrt{\frac{T_1}{T_2}}$$

Given, $T_1 = 10$ N, $n_1 = n$, and $n_2 = 2n$

$$\Rightarrow \quad \frac{n}{2n} = \sqrt{\frac{10}{T_2}} \quad \Rightarrow \quad T_2 = 10 \times 4 = 40 \text{ N}$$

3. **(c)** Phase difference $= \frac{2\pi}{\lambda} \times$ path difference

Path difference $\Delta = \frac{\lambda}{2\pi} \times \phi = \frac{\lambda}{2\pi} \times \frac{\pi}{3} = \frac{\lambda}{6}$

4. **(a)** The apparent change in the frequency of the source due to relative motion between source and observer is known as Doppler's effect. The perceived frequency (n') when listener is static and source is moving away is given by

$$n' = n\left(\frac{v}{v+v_s}\right)$$

where n is frequency of source, v is velocity of sound and v_s is velocity of source.

Putting $v = 330$ m/s, $v_s = 30$ m/s, $n = 800$ Hz.

$$n' = 800 \times \left(\frac{330}{330+30}\right)$$

$$n' = 733.3 \text{ Hz}$$

In the limit when speed of source and observer is much lesser than that of sound v_1, the change in frequency becomes independent of the fact whether the source is moved or the detector.

5. **(b)** The velocity of sound is given by $v = \sqrt{\frac{\gamma P}{\rho}}$

where P is pressure, ρ is density and γ is adiabatic constant.

$$\Rightarrow \quad \frac{v_1}{v_2} = \sqrt{\frac{\rho_2}{\rho_1}} = \sqrt{\frac{4}{1}} = 2:1$$

6. **(b)** Compare with $y = a \sin(\omega t - kx)$

We have $k = \frac{2\pi}{\lambda} = 62.4 \quad \Rightarrow \quad \lambda = \frac{2\pi}{62.4} = 0.1$

7. **(b)** The frequency produced in a string of length l, mass per unit length m, and tension T is

$$n = \frac{1}{2l}\sqrt{\frac{T}{m}}$$

Given $l_1 = 50$ cm, $n_1 = 800$ Hz

and $n_2 = 1000$ Hz

$$n_1 l_1 = n_2 l_2$$

$$\Rightarrow \quad 800 \times 50 = 1000 \times l_2$$

$$\Rightarrow \quad l_2 = 40 \text{ cm}$$

8. **(d)** Points B and F are in same phase as they are λ distance apart.

9. **(c)** Water waves are transverse as well as longitudinal in nature.

10. **(d)** Fundamental frequency of open organ pipe $=\dfrac{v}{2l}$

Frequency of third harmonic of closed pipe $=\dfrac{3v}{4l}$

$$\therefore \quad \frac{3v}{4l}=100+\frac{v}{2l}$$

$$\Rightarrow \quad \frac{3v}{4l}-\frac{2v}{4l}=\frac{v}{4l}=100 \Rightarrow \frac{v}{2l}=200\text{ Hz}$$

11. **(a)** $dB=10\log_{10}\left[\dfrac{I}{I_0}\right]$,

where $I_0 = 10^{-12}$ wm^{-2}

Since $40=10\log_{10}\left[\dfrac{I_1}{I_0}\right] \Rightarrow \dfrac{I_1}{I_0}=10^4$

Also, $20=10\log_{10}\left[\dfrac{I_2}{I_0}\right] \Rightarrow \dfrac{I_2}{I_1}=10^2$

$$\Rightarrow \quad \frac{I_2}{I_1}=10^{-2}=\frac{r_1^2}{r_2^2}$$

$$\Rightarrow \quad r_2^2=100r_1^2 \quad \Rightarrow r_2=10\text{ m}$$

12. **(b)** Given $\dfrac{I_1}{I_2}=\dfrac{4}{1}$

We know $I \propto a^2$

$$\therefore \quad \frac{a_1^2}{a_2^2}=\frac{I_1}{I_2}=\frac{4}{1} \quad \text{or} \quad \frac{a_1}{a_2}=\frac{2}{1}$$

$$\therefore \quad \frac{I_{max}}{I_{min}}=\frac{(a_1+a_2)^2}{(a_1-a_2)^2}=\left(\frac{2+1}{2-1}\right)^2$$

$$=\left(\frac{3}{1}\right)^2=\frac{9}{1}$$

Therefore, difference of loudness is given by

$$L_1-L_2=10\log\frac{I_{max}}{I_{min}}=10\log(9)$$

$$=10\log 3^2=20\log 3.$$

13. **(a)** When the source is coming to the stationary observer,

$$n' = \left(\frac{v}{v - v_s}\right)n \quad \text{or} \quad 1000 = \left(\frac{350}{350 - 50}\right)n$$

or $n = (1000 \times 300/350)$ Hz

When the source is moving away from the stationary observer.

$$n'' = \left(\frac{v}{v + v_s}\right)n$$

$$= \left(\frac{350}{350 + 50}\right)\left(\frac{1000 \times 300}{350}\right)$$

$$= 750 \text{ Hz}$$

14. **(c)** Fundamental frequency of closed pipe

$$n = \frac{v}{4l} = 220 \text{ Hz} \Rightarrow v = 220 \times 4l$$

If 1/4 of the pipe is filled with water then remaining length of air column is $\frac{3l}{4}$

Now fundamental frequency $= \dfrac{v}{4\left(\dfrac{3l}{4}\right)} = \dfrac{v}{3l}$ and

First overtone = 3 × fundamental frequency

$$= \frac{3v}{3l} = \frac{v}{l} = \frac{220 \times 4l}{l} = 880 \text{ Hz}$$

15. **(c)** $f \, \alpha \sqrt{T}$

$$f = \frac{1}{2l}\sqrt{\frac{T}{\mu}} \Rightarrow \frac{\Delta f}{f} = \frac{1}{2}\frac{\Delta T}{T}$$

$$\Rightarrow \quad \Delta f = \frac{202}{2} \times \frac{1}{101} = 1$$

16. **(d)** $\dfrac{v_1}{v_2} = \dfrac{28}{27}$

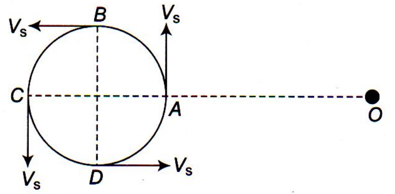
$$v_1 - v_2 = 3 \text{ or } \frac{28}{27}v_2 - v_2 = 3$$

$$v_2 = 27 \times 3 \text{ Hz} = 81 \text{ Hz}$$

or $v_1 = v_2 + 3 = (81 + 3)\text{Hz}$

or $v_1 = 84$ Hz

17. **(d)** Frequency heard by the observed will be maximum when the source is in the position D. In this case, source will be approaching towards the stationary observer, almost along the line of sight (as observer is stationed at a larger distance).



Similarly, frequency heard by the observer will be minimum when the source reaches at the position B. Now, the source will be moving away from the observer.

$$n_{\min.} = \frac{v}{v+v_s} \times n = \frac{330}{330+1.5\times 20} \times 440$$

$$= \frac{330\times 440}{360} = 403.3 \text{ Hz}$$

18. (d) When pulse is reflected from a rigid support, the pulse is inverted both lengthwise and sidewise

19. (c) Here $A = 0.05m$, $\frac{5\lambda}{2} = 0.025 \Rightarrow \lambda = 0.1m$

Now standard equation of wave

$$y = A\sin\frac{2\pi}{\lambda}(vt - x) \Rightarrow y = 0.05\sin 2\pi(33t - 10x)$$

20. (d) Intensity $\propto a^2\omega^2$

here $\frac{a_A}{a_B} = \frac{2}{1}$ and $\frac{\omega_A}{\omega_B} = \frac{1}{2} \Rightarrow \frac{I_A}{I_B} = \left(\frac{2}{1}\right)^2 \times \left(\frac{1}{2}\right)^2 = \frac{1}{1}$

[CHEMISTRY]

21. (a) $\underset{1s^1}{H} + e^- \rightarrow \underset{1s^2 \text{ or } [He]^2}{H^-}$

$\underset{[He]^2 2s^2 2p^5}{F} + e^- \rightarrow \underset{[He]^2 2s^2 2p^6 \text{ or } [Ne]^{10}}{F^-}$

22. (a) Hydrogen from bonds in +1 and –1 oxidation state.

23. (b) Hydrogen forms maximum number of compounds in chemistry comparison than carbon.

24. (c) $Zn + H_2O \rightarrow ZnO + H_2$

$Zn + 2NaOH \rightarrow Na_2ZnO_2 + H_2$

$Zn + 2HCl \rightarrow ZnCl_2 + H_2$

$Zn + 2H_2SO_4 \rightarrow ZnSO_4 + SO_2 + 2H_2O$.

25. (b)

26. (b)

27. (c)

28. (b) $Ca(HCO_3)_2 + Ca(OH)_2 \rightarrow \underset{\text{ppt.}}{2CaCO_3} \downarrow + 4H_2O$

29. (c) D_2O in which $D = {}_1H^2$

30. (b) HCO_3^- is main reason of temporary hardness of water.

31. (b) By boiling temporary hardness of water can be removed.

$Ca(HCO_3)_2 \xrightarrow{\text{Boil}} \underset{\text{(insoluble)}}{CaCO_3} + H_2O + CO_2$

32. (c) $\underset{\text{Zeolite}}{Na_2Al_2Si_2O_8} .xH_2O + Ca^{+2} \rightarrow$

$CaAl_2Si_2O_8.xH_2O + 2Na^+$

33. (b) Water has high dielectric constant *i.e.*, 82, high liquid range and can dissolve maximum number of compounds. That is why it is used as universal solvent.

34. (a) Heavy water *i.e.*, D_2O slows down the speed of neutrons in nuclear reactors..

35. (a) Chlorides and sulphates of *Mg* and *Ca* produces permanent hardness and bicarbonates of *Mg* and *Ca* produces temporary hardness.

36. (d) Permanent hardness cannot be removed by boiling of water but temporary hardness can be removed.

37. (d) Water containing Ca^{+2}, Mg^{+2} and $H^+ (> 10^{-7} m)$ is a hard water.

$H^+(aq) + CH_3COONa(aq) \rightleftharpoons CH_3COOH(s) + Na^+(aq)$

38. (c) D_2O actually has higher freezing point (3.8°C) than water H_2O (0°C).

39. (b) $\underset{0}{Cl_2} + H_2O_2 \rightarrow \underset{-1}{2HCl} + O_2$

In this reaction H_2O_2 works as reducing agent

40. (d) $[H_2O_2 \rightarrow H_2O + \frac{1}{2}O_2] \times 2$

$\underset{68\,g}{2H_2O_2} \rightarrow 2H_2O + O_2$ 22.4 *litre* at N.T.P.

$\because$ 22.4 *litre* O_2 at N.T.P. obtained by 68 *gm* of H_2O_2

$\therefore$ 10 *litre* O_2 at N.T.P. obtained by $\frac{68}{22.4} \times 10 = 30.35\, gm / litre$

$\therefore$ 1000 *ml* O_2 at N.T.P. obtained by = 30.35 *gm*

$\therefore$ 100 *ml* O_2 at N.T.P. obtained by $= \frac{30.35}{1000} \times 100 = 3.035\%$

[MATHEMATICS]

41. (d) $a=4$, vertex $=(0,0)$, focus $=(0,-4)$.

42. (c) Vertex $=(2,0) \Rightarrow$ focus is $(2+2,0)=(4,0)$.

43. (d) It is a fundamental concept.

44. (c) Since the axis of parabola is y-axis

$\therefore$ Equation of parabola $x^2=4ay$

Since it passes through (6, – 3)

$\therefore 36=-12a \Rightarrow a=-3$

$\therefore$ Equation of parabola is $x^2=-12y$.

45. (d) Given parabola can be written as $(y+1)^2=-(x-1)$.

Hence vertex is (1, –1), which lies in IV quadrant.

46. (a) $\Delta=(1)(1)(2)+2\left(\frac{3}{2}\right)(0)(-1)-(1)(0)^2-(1)\left(\frac{3}{2}\right)^2-2(-1)^2$

$=2-\frac{9}{4}-2<0$ and $h^2-ab=1-1=0$.

i.e., $h^2=ab \Rightarrow$ a parabola.

47. (b) Let any point on it be (x, y), then from definition of parabola, we get $\frac{\sqrt{(x+8)^2+(y+2)^2}}{\left|\frac{2x-y-9}{\sqrt{5}}\right|}=1$

Squaring and after simplification, we get $x^2+4y^2+4xy+116x+2y+259=0$.

48. (a) Equation will be of the form $y^2=4A(x-a)$, where $A=(a'-a)$ or $y^2=4(a'-a)(x-a)$.

49. (b) Eliminating t, we get

$16x^2=4y \Rightarrow x^2=\frac{1}{4}y$, which is a parabola.

50. (a) $\Delta \neq 0, h^2=ab$ *i.e.*, parabola.

51. (a) Since $9y^2-16x-12y-57=0$

$\Rightarrow \left(y-\frac{2}{3}\right)^2=\frac{16}{9}\left(x+\frac{61}{16}\right)$

Put $y-\frac{2}{3}=Y$ and $x+\frac{61}{16}=X \Rightarrow Y^2=4\left(\frac{4}{9}\right)X$

Axis of this parabola is $Y=0 \Rightarrow y-\frac{2}{3}=0 \Rightarrow$

$3y=2$.

52. (c) $y^2-4y+4=5x+5 \Rightarrow (y-2)^2=5(x+1)$

Obviously, latus rectum is 5.

53. (c) $4y^2+2x-20y+17=0$

$2\left(y-\frac{5}{2}\right)^2=-(x-4) \Rightarrow 4a=\frac{1}{2}$.

54. (d) Equation of parabola is $x^2-4x-8y+12=0$

$\Rightarrow x^2-4x+4=8y-8$

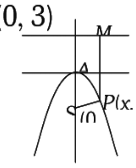
$\Rightarrow (x-2)^2=8(y-1) \Rightarrow X^2=8Y$

Comparing with $X^2=4aY$, we get $a=2$

$\therefore$ Directrix is $Y=-a \Rightarrow y-1=-2 \Rightarrow y=-1$.

55. (a) Here vertex $\equiv$ (0, 6) and focus $\equiv$ (0, 3) then $Z\equiv(0,9)$ *i.e.*, $y=9$

$\therefore$ Equation of parabola, $SP=PM$



$\Rightarrow \sqrt{(x-0)^2+(y-3)^2}=|y-9|$

$\Rightarrow x^2+y^2-6y+9=y^2-18y+81$

or $x^2+12y=72$.

56. (d) Point (1, 0) $\Rightarrow \left(\frac{dy}{dx}\right)_{(1,0)}=2-1=1$

Hence the tangent is $y-0=x-1$.

57. (c) $y=-\frac{l}{m}x-\frac{n}{m}$

Condition for above line to be tangent to $y^2=4ax$ is $-\frac{n}{m}=\frac{am}{-l}$ or $nl=am^2$.

58. (a) Any point on $y^2=4ax$ is $(at^2, 2at)$, then tangent is $2aty=2a(x+t^2) \Rightarrow yt=x+at^2$.

59. (a) From condition for tangent to a parabola,

$1=\frac{1}{m} \Rightarrow m=1$.

60. (a) Tangent to parabola is, $y=mx+\frac{a}{m}$ .....(i)

A line perpendicular to tangent and passing from focus $(a,0)$ is, $y=-\frac{x}{m}+\frac{a}{m}$ .....(ii)

Solving both lines (i) and (ii) $\Rightarrow x=0$.