SAFE HANDS & IIT-ian's PACE

BPT # 04 (NEET) SOLUTIONS

1. (b)
Sol. By comparing the given equation with standard equation $y = a\sin(\omega t + \phi)$

$\omega = 100\pi$ so $T = \frac{2\pi}{\omega} = \frac{2\pi}{100\pi} = 0.02$ sec

2. (c)
Sol. $x = a\sin(\omega t - \alpha)$

and $y = b\cos(\omega t - \alpha) = b\sin(\omega t - \alpha + \pi/2)$

Now the phase difference = $(\omega t - \alpha + \frac{\pi}{2}) - (\omega t - \alpha)$

$= \pi/2 = 90^o$

3. (c)
Sol. $v = \omega\sqrt{a^2 - y^2} = 2\sqrt{(60)^2 - (20)^2}$ = 113 mm/sec

4. (a)
Sol. By comparing with standard equation $y = a\sin(\omega t + \phi)$ we get $a = 0.30;\ \omega = 220$

$\therefore\ 2\pi n = 220 \Rightarrow n = 35Hz$

so $v_{max} = a\omega = 0.3 \times 220 = 66 m/s$

5. (c)
Sol. $v = \omega\sqrt{a^2 - y^2} \Rightarrow \frac{a\omega}{2} = \omega\sqrt{a^2 - y^2} \Rightarrow$

$\frac{a^2}{4} = a^2 - y^2$

$\Rightarrow y = \frac{\sqrt{3}A}{2}$ [As $v = \frac{v_{max}}{2} = \frac{a\omega}{2}$

6. (c)
Sol. $v_{max} = a\omega = a\frac{2\pi}{T} = 2\frac{2\pi}{2} \Rightarrow v_{max} = 2\pi$

7. (a)
Sol. $\frac{\Delta T}{T} = \frac{1}{2}\alpha\Delta\theta = \frac{1}{2} \times 12 \times 10^{-6} \times (40 - 20)$;

$\Delta T = 12 \times 10^{-5} \times 86400$ sec / day = 10.3 sec/day.

8. (b)
Sol. $T = 2\pi\sqrt{l/g}$ hence $T \propto \sqrt{l}$

Percentage increment in $T = \frac{1}{2}$(percentage increment in l)
= 0.5%.

9. (a)
Sol. Because the S.H.M. starts from extreme position so
$y = a\cos\omega t$ form of S.H.M. should be used.

$\frac{A}{2} = A\cos\frac{2\pi}{T}t \Rightarrow \cos\frac{\pi}{3} = \cos\frac{2\pi}{T}t \Rightarrow t = T/6$

10. (c)
Sol. $v_{max} = a\omega = 100\ cm/\sec$ and $a = 10\ cm$ so $\omega = 10\ rad/\sec$.

$\therefore\ v = \omega\sqrt{a^2 - y^2} \Rightarrow 50 = 10\sqrt{10^2 - y^2} \Rightarrow$
$y = 5\sqrt{3}$

11. (b)
Sol. $\frac{x}{a}$ = sin ωt.......(i)
$\frac{y}{b}$ = cos ωt ....(2)
square & add (1) and (2)
$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ which shows ellipse.

12. (c)
Sol. ke $\frac{1}{2}m\omega^2\left(x_0^2 - x^2\right)$
$= \frac{1}{2}m\omega^2\left(x_0^2 - x_0^2\sin^2\omega\right)$
$= \frac{1}{2}m\omega^2 x_0^2\left(\frac{1+\cos^2\omega}{2}\right)$
Note the frequency is 2ω or 2f

13. (d)
Sol. x = $x_0\sin(\omega t + \phi)$ = x_0 sin ωt + cosϕ + $x_0$cos ωt sin ϕ = 3 cos ωt+ 4 sin ωt
Comparing we get x_0 cos ϕ = 4.......(1)
and x_0 sin ϕ = 3 ....(2)
dividing (2) by (1)
tan ϕ = 3/4 or ϕ= 37^0.
Squaring and adding (1) and (2) we get
x_0 = 5.

14. (c)
Sol. The motion will be SHM only if acceleration

(or $\frac{d^2y}{dt^2}$ α - y)

This is true for (C)

15. (a)
Sol. $F = -\frac{dU}{dx}$ For $U(x) = \frac{k}{2}(x-a)^2$ $\frac{dU}{dx} = k(x-a)$
$\Rightarrow$ F = -k(x – a)
This is the condition for SHM about point x =+ a
Other functions do not satisfy this condition.
Hence Answer is (A)

16. (c)

Sol. Time to complete $\frac{1}{4}$th of the oscillations of $\frac{T}{4}$ s.

Time to complete $\frac{1}{8}$th vibration means when the vibrating particle reaches from the extreme position to the half the amplitude

$\Rightarrow$ y = $\frac{A}{2}$ = A sin$\left(\omega t + \frac{\pi}{2}\right)$ = A cosωt $\Rightarrow$ t = $\frac{T}{6}$ s

$\therefore$ Total time required $\frac{T}{4} + \frac{T}{6} = \frac{5T}{12}$

17. (c)

Sol. y = a (sinωt + cosωt)

$= A\sqrt{2}\left\{\frac{1}{\sqrt{2}}\sin\omega t + \frac{1}{\sqrt{2}}\cos\omega t\right\}$

$= a\sqrt{2}\sin\left(\omega t + \frac{\pi}{4}\right)$

$\therefore$ The motion is S.H.M. in nature and has an amplitude a$\sqrt{2}$.

18. (c)

Sol. K.E. = $\frac{1}{2}m\omega^2(A^2 - y^2)$

P.E. = $\frac{1}{2}m\omega^2 y^2$

$\because$ K.E. = P.E.

$\therefore \frac{m\omega^2}{2}(A^2 - y^2) = \frac{m\omega^2 y^2}{2}$

$\therefore$ 2y^2 = A^2 or y = A/$\sqrt{2}$

19. (c)

Sol. K.E. $= \frac{m\omega^2}{2}(A^2 - y^2)$

$= \frac{m\omega^2}{2}[A^2 - (A\sin(\omega t + \phi))^2]$

$= \frac{m\omega^2}{2}[A^2 - A^2\sin^2(\omega t + \phi)]$

$= \frac{m\omega^2 A^2}{2}[\cos^2(\omega t + \phi)]$

$= \frac{m\omega^2 A^2}{4}[1 + \cos(2\omega t + 2\phi)]$

$\therefore$ Frequency $= \frac{2\omega}{2\pi}$ = 2n

20. (d)

Sol. For small amplitude the time period is independent of the amplitude therefore there will be no change in its time period.

21. (c)

Sol. y_2 = 5 [sin (3πt) + $\sqrt{3}$ cos (3πt)]

= 5 × 2 [$\frac{1}{2}$ sin (3πt) + $\frac{\sqrt{3}}{2}$ cos (3π t)]

= 10 [sin (3π t + $\frac{\pi}{3}$)]

A_2 = 10 and A_1 = 10

A_1/A_2 = 1 $\Rightarrow$ $A_1 : A_2$ = 1 : 1

22. (a)

Sol. Since the satellite is orbiting under the action of earth's gravitational force, inside a satellite an object experiences weightlessness.

$\Rightarrow$ Effective acceleration due to gravity is zero.

$\Rightarrow$ The period of simple pendulum = T = 2π $\sqrt{\frac{\ell}{g}}$.

when g = 0 $\Rightarrow$ T = ∞.

23. (a)

Sol. T = $2\pi\sqrt{\frac{\ell}{g}}$ = 2 sec.

Now, L = 4ℓ

$\therefore$ T' = $2\pi\sqrt{\frac{4\ell}{g}}$ = 4 sec.

24. (b)

Sol. y = 10 sin (6t + π/3)

At t = 0,

y = 10 sin $\frac{\pi}{3} = \frac{10\sqrt{3}}{2}$ m. = 5$\sqrt{3}$ m

v = $\frac{dy}{dt} = 10 \times 6\cos(6t + \frac{\pi}{3})$ = 60 cos (6t + $\frac{\pi}{3}$)

At t = 0

v = 60 cos $\frac{\pi}{3}$ = $\frac{60}{2}$ = 30 m/s

25. (a)
Sol. 0.5g = kx
or, $k = \frac{0.5\times10}{0.2}$ = 25 N/m
$T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{0.25}{25}} = \frac{\pi}{5}$ sec.

26. (b)
Sol. $K_{av} = \frac{1}{T}\int_{6}^{T}\frac{1}{2}m\omega^2A^2\cos^2(\omega t + \phi)$

27. (d)
Sol. At the end of one complete vibration, the particle returns to the initial position.

28. (b)
Sol. Comparing with $y = 2\pi\sqrt{\frac{\ell}{g}}$;
$T' = 2\pi\sqrt{\frac{1}{\sqrt{g^2+a^2}}}$
clearly, T' < T

29. (b)
Sol. The time period is independent with its amplitude so again T = 5 sec

30. (d)
Sol. $v = \omega\sqrt{a^2-x^2}\ \frac{2\pi}{T}\sqrt{a^2-x^2} = \frac{2\times3}{3}\sqrt{25-16}$
= 6 cm/s

31. (a)
Sol. Comparing with acceleration + $\omega^2x = 0$
$\omega^2 = 4\pi^2$ or $\omega = 2\pi$
or $2\pi\nu = 2\pi$ or $\nu = 1$ Hz

32. (a)
Sol. When the spring is fully compressed or fully extended is when the Hook's law forces are the greatest, and this indicates that the acceleration is the greatest. F = ma.

33. (a)
Sol. Time period does not depend on mass
$T \propto \sqrt{\ell}$ …. (i), $T' \propto \sqrt{9\ell}$ ….(ii) or $T' = 3$ T.

34. (a)
Sol. Here, $y_1 = 10\sin\frac{\pi}{4}(12t+1)$

Or $y_1 = 10\sin(3\pi t + \frac{\pi}{4})$ ……. (i)

And $y_2 = 5(\sin 3\pi t + \sqrt{3}\cos 3\pi t)$

Or $= 10(\sin 3\pi t \times \frac{1}{2} + \cos 3\pi t \times \frac{\sqrt{3}}{2})$

$\Rightarrow y_2 = 10\sin(3\pi t + \frac{\pi}{3})$

Comparing equation (i) and (ii) with standard equation for SHM we get

$A_1 = 10$ and $A_2 = 10$ $\therefore \frac{A_1}{A_2} = \frac{10}{10} = \frac{1}{1}$

35. (d)
Sol. The distance travelled by the particle in one time period is 4A.

36. (d)
Sol. The phase of a particle executing SHM is defined as the state of a particle as regards to its position and direction of motion at any instant of time in the given curve phase is same whent t = 1 s and t = 5 s. also phase is same when t = 2s and t= 6 s.

37. (d)
Sol. In SHM, the acceleration of the particle is directed
towards the mean position.

38. (a)
Sol. In SHM, Acceleration,
$a = \frac{d^2x}{dt^2} = -\omega^2x$

39. (d)
Sol. The circular motion of a particle with constant speed is periodic but not simple harmonic motion as it not to and fro about a fixed point.

40. (d)
Sol. In SHM, acceleration a is related to displacement x by the relation $a = -\omega^2x$ which is for option (d).

41. (a)
Sol. In SHM, acceleration, $a = -\omega^2x$
$\therefore$ The graph between a and x is straight line.

42. (c)

Sol. The given equation of SHM is

$$x = 3\sin\left(2\pi t + \frac{\pi}{4}\right)$$

Compare the given equation with standard equation of SHM

$$x = A\sin(\omega t + \phi)$$

We get

$$A = 3\,m, \omega = 2\pi\,s^{-1}$$

$\therefore$ Maximum speed $v_{max} = A\omega = 3m \times 2\pi s^{-1}$

$$= 6\pi\,m\,s^{-1}$$

43. (b)

Sol. In SHM, the total energy is

$$E = \frac{1}{2}m\omega^2 A^2$$

Where the symbols have their usual meanings

$$E \propto A^2$$

44. (c)

Sol. Given

$x = a\cos\omega t$ …… (i)

$y = a\sin\omega t$ ……. (ii)

Squaring and adding (i) and (ii) we get

$$x^2 + y^2 = a^2\cos^2\omega t + a^2\sin^2\omega t = a^2$$

It is equation of circle thus trajectory of motion will be circle

45. (d)

Sol. Given : $x = a\sin\omega t + b\cos\omega t$ … (i)

Let $a = A\cos\phi$ … (ii)

And $b = A\sin\phi$ ….. (iii)

Squaring and adding (ii) and (iii) we get

$$a^2 + b^2 = A^2\cos^2\phi + A^2\sin^2\phi = A^2$$

Eq. (i) can be written as

$$x = A\cos\phi\sin\omega t + A\sin\phi\cos\omega t = A\sin(\omega t + \phi)$$

it is equation of SHM with amplitude $A = \sqrt{a^2 + b^2}$

46. (c)
Sol. $\Delta E_V = E_P - E_R$.

47. (d)
Sol. Heat is always flow from the higher to lower temperature.

48. (b)
Sol. Solid $\longrightarrow$ Gas, ΔS is maximum.

49. (d)
Sol. $+ve\ \Delta H$ and $-ve\ \Delta S$ both oppose the reaction.

50. (c)
Sol. Because solid $\rightarrow$ solid, ΔS is same and ΔH is –ve.

51. (a)
Sol. For exothermic reactions $H_p < H_R$.
For endothermic reactions $H_p > H_R$.

52. (b)
Sol. 78g of benzene on combustion produces heat = – 3264.6 kJ
$\therefore 39g$ will produce $= \frac{-3264.6}{2} = -1632.3\,kJ$.

53. (d)
Sol. Aim: $2C + H_{2(g)} \rightarrow C_2H_{2(g)}$.
eq. (ii) + eq. (iii) $\rightarrow$ eq. (iv) – eq. (i)
find the required result.

54. (c)
Sol. Enthalpy of formation of HCl.

55. (a)
Sol. CH_4 is the best fuel because its calorific value $= \frac{-212.8}{16} = -13.3\,kcal/g$ is higher among the other gases.

56. (d)
Sol. $\frac{1}{2}H_2 + \frac{1}{2}Cl_2 \rightarrow HCl,\ \Delta H = -90\ KJ$

$\therefore \Delta H = \frac{1}{2}E_{H-H} + \frac{1}{2}E_{Cl-Cl}$

or $-90 = \frac{1}{2} \times 430 + \frac{1}{2} \times 240 - E_{HCl}$

$\therefore E_{H-Cl} = 425\ kJ\ mol^{-1}$.

57. (b)
Sol. For spontaneous change $\Delta G = -ve$.

58. (a)
Sol. $\Delta G = 0$ for equilibrium.

59. (b)
Sol. $\Delta G = -2.303\ RT \log K'$, Here $R = 2\,cal,\ T = 300\,K$

$K' = \frac{10 \times 15}{3 \times 5} = 10$; $\Delta G = -2.303 \times 2 \times 300 \times \log_{10} 10$

$= -2.303 \times 2 \times 300 \times 1 = -1381.8\,cal$

60. (c)
Sol. An isolated system neither shows exchange of heat nor matter with surroundings.

61. (a)
Sol. $w = -2.303\,nRT \log \frac{P_1}{P_2}$

$= 2.303 \times 1 \times 2 \times 300 \log \frac{2}{10} = 965.84$

At constant temperature $\Delta E = 0$
$\Delta E = q + w$; $q = -w = -965.84\,cal$

62. (b)
Sol. $C_{(g)} + 4H(g) \rightarrow CH_4(g);\ \Delta H = -166kJ$
Bond energy for C – H $= -\frac{166}{4} = -41.5\ kJ/mole$

63. (a)
Sol. Subtracting equation (ii) from equation (i), we get
$C(s) + O_2(g) = CO_2(g) + 97$ kcal
$CO_2(g) + C(s) = 2CO(g) - 39$ kcal

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or, $-CO_2(g) + O_2(g) = CO_2(g) - 2CO(g) + 136$ kcal
or, $2CO(g) + O_2 = 2CO_2(g) + 136$ kcal
or, $CO(g) + 1/2\ O_2(g) = CO_2(g) + 68$ kcal
Required value = 68 kcal

64. (b)
Sol. As we know,
$\Delta H = \Delta E + \Delta nRT$
Where Δn = Gaseous product moles – gaseous reactant moles
For the reaction,
$CO(g) + 1/2O_2(g) \longrightarrow CO_2(g)$
$\Delta n = 1-(1+1/2) = -1/2$
$\therefore \Delta H = \Delta E - 1/2\ RT$
$\therefore \Delta H < \Delta E$

65. (d)
Sol. O_3 (g) is the allotropic form of oxygen and energy of O_3 (g) is higher.

66. (a)
Sol. ΔH represents heat of reaction.

67. (c)
Sol. Entropy is extensive property & others are intensive properties.

68. (a)
Sol. We know that $\Delta E = Q + W = 600 + (-300) = 300$ J
W = – 300, because the work done by the system.

69. (c)
Sol. Some solids dissolves exothermically as LiCl
(ΔH = –ve) and other dissolved endothermically as KCl
(ΔH = +ve). solvent-solvent interaction and solute-solute interaction are endothermic while solvent-solute interaction is exothermic. The sum of the three interaction determines whether ΔH_{sol} is endothermic or exothermic.

70. (c)
Sol. Volume is not an intensive property.

71. (a)
Sol. First law of thermodynamics is represented mathematically as $\Delta E = q + W$, where ΔE is change in internal energy, q is heat absorbed and W is work does.

72. (b)
Sol. Since the system is insulated, heat is not allowed to enter or leave the system.
Thus, $q = 0, \Delta E = q + W \Rightarrow \Delta E = W$

73. (a)
Sol. $\Delta H = \Delta E + \Delta n_g RT$

$$\Delta n_g = 1 - \frac{3}{2} = -\frac{1}{2} \quad \text{or} \quad -0.5$$

Hence $\Delta H = \Delta E - 0.5RT$

74. (d)
Sol. This is the statement of Hess's law of heat summation.

75. (d)
Sol. Heat cannot flow a cold body to a hot body.

76. (b)
Sol. $\Delta S_{system} = \Delta S_{total} - \Delta S_{surrounding}$

77. (b)
Sol. Reactants have less energy then products

78. (c)
Sol. Thermodynamics is not concerned about how and at what rate chemical reactions are carried out, but is based on initial and final states of a system undergoing the change.

79. (d)
Sol. The pressure (P), volume (V), temperature (T), amount (n) etc. are the state variables or state functions.

80. (d)
Sol. There is no change in volume from $A \rightarrow B$.

81. (c)
Sol. $X \xrightarrow{\Delta H_1} Y$

$X \xrightarrow{\Delta H_1} P \xrightarrow{\Delta H_2} Q \xrightarrow{\Delta H_3} Y$

$\Delta H = \Delta H_1 + \Delta H_2 + \Delta H_3$

82. (d)
Sol. $S + 3/2O_2 \rightarrow SO_3 + 2x\,\text{kcal}$ …(i)

$SO_2 + 1/2O_2 \rightarrow SO_3 + y\,\text{kcal}$ …(ii)

Now, subtract eq. (ii) from (i), we get,

$S + O_2 \rightarrow SO_2 + 2x - y\,\text{kcal}$

$\therefore$ Heat of formation of SO_2 in equal to 2x – y kcal.

83. (b)
Sol. For an exothermic reaction, $\Delta H_R > \Delta H_P$

84. (a)
Sol. Average of two bond dissociation energies:

$$\frac{497.8 + 428.5}{2} = 463.15\,\text{kJ mol}^{-1}$$

85. (d)

Sol. Enthalpy of decomposition of HCl will be

$\frac{44}{2} = 22 \text{kcal/mol}$

86. (c)

Sol. $\Delta H^o{}_{soln} = \Delta H^o{}_{lattice} + \Delta H^o{}_{hyd}$

87. (a)

Sol. $N_2 + 3H_2 \rightarrow 2NH_3$

$\Delta H = \Delta H(N \equiv N) + 3 \times \Delta H(H-H) - 2 \times 3\Delta H(N-H)$

$= 945.36 + 3 \times 435.0 - 6 \times 389.0 = -83.64 \text{kJ}$

Heat of formation of $NH_3 = \frac{-83.64}{2} = -41.82$ kJ/mol

88. (a)

Sol. $\Delta G = \Delta H - T\Delta S,$

At equilibrium, $\Delta G = 0, \Delta H = T\Delta S$

30000 = T ×100

T = 300 K or 27 °C

89. (c)

Sol. X + 3Y $\rightleftharpoons$ 2Z

$\Delta S = 2 \times 50 - (60 + 3 \times 40) = -80 \text{kJ}$

$\Delta G = \Delta H - T\Delta S$ when $\Delta G = 0$

$T = \frac{\Delta H}{\Delta S} = -40 \times \frac{1000}{-80} = 500\text{K}$

90. (c)

Sol. In eqn (i), no bond is being broken while in eqn (ii), 2H –H bonds are broken. So, in eqn (ii) some of the energy is used up to break up to break the bonds. Thus, x > y.

Biology Answer key:

Q.No.	Ans.	Q.No.	Ans.	Q.No.	Ans.	Q.No.	Ans.	Q.No.	Ans.
91	C	109	C	127	B	145	B	163	D
92	B	110	B	128	A	146	B	164	B
93	B	111	C	129	B	147	D	165	B
94	C	112	D	130	B	148	A	166	A
95	A	113	A	131	B	149	A	167	C
96	A	114	C	132	D	150	B	168	B
97	B	115	B	133	A	151	B	169	D
98	B	116	D	134	C	152	D	170	C
99	B	117	D	135	A	153	C	171	B
100	C	118	D	136	B	154	B	172	C
101	A	119	A	137	B	155	B	173	D
102	B	120	C	138	B	156	C	174	B
103	C	121	A	139	C	157	D	175	D
104	C	122	C	140	A	158	A	176	D
105	B	123	B	141	D	159	A	177	A
106	A	124	B	142	C	160	D	178	D
107	B	125	C	143	D	161	D	179	C
108	A	126	A	144	A	162	B	180	C