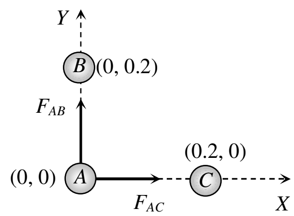
Solution to EDT 05 Gravitation

1. (a)
Sol. Earth and moon both exerts same force on each other.

2. (a)
Sol. Let particle A lies at origin, particle B and C on y and x -axis respectively



$$\overrightarrow{F_{AC}} = \frac{G m_A m_B}{r_{AB}^2}\hat{i} = \frac{6.67\times10^{-11}\times1\times1}{(0.2)^2}\hat{i} = 1.67\times10^{-9}\,\hat{i}\,N$$

Similarly $\overrightarrow{F_{AB}} = 1.67\times10^{-9}\hat{j}\,N$

$\therefore$ Net force on particle A $\vec{F} = \vec{F}_{AC} + \vec{F}_{AB} = 1.67\times10^{-9}(\hat{i}+\hat{j})\,N$

3. (b)
Sol. Acceleration due to gravity $g = \frac{GM}{R^2}$

$$\therefore \frac{g_{moon}}{g_{earth}} = \frac{M_{moon}}{M_{earth}}\cdot\frac{R_{earth}^2}{R_{moon}^2} = \left(\frac{1}{80}\right)\left(\frac{4}{1}\right)^2$$

$$g_{moon} = g_{earth}\times\frac{16}{80} = \frac{g}{5}.$$

.

4. (a)
Sol. $\frac{g'}{g} = \left(\frac{R}{R+h}\right)^2 = \left(\frac{R}{R+2R}\right)^2 = \frac{1}{9}$

$\therefore\ g' = \frac{g}{9}.$

5. (b)
Sol. Acceleration due to gravity at height h is given by

$$g' = g\left(\frac{R}{R+h}\right)^2$$

$$\Rightarrow \frac{g}{100} = g\left(\frac{R}{R+h}\right)^2$$

$$\Rightarrow \frac{R}{R+h} = \frac{1}{10} \quad \Rightarrow h = 9R.$$

6. (d)

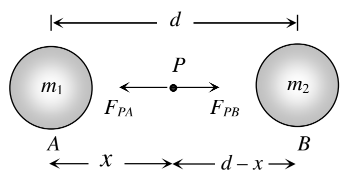
Sol. If P is the point where net gravitational force is zero then $F_{PA} = F_{PB}$

$$\frac{Gm_1 m}{x^2} = \frac{Gm_2 m}{(d-x)^2}$$

By solving $x = \dfrac{\sqrt{m_1}\, d}{\sqrt{m_1} + \sqrt{m_2}}$

For the given problem $d = D$, $m_1 =$ earth, $m_2 =$ moon and $m_1 = 81 m_2$ $\therefore m_2 = \dfrac{m_1}{81}$

So $x = \dfrac{\sqrt{m_1}\, D}{\sqrt{m_1} + \sqrt{m_2}} = \dfrac{\sqrt{m_1}\, D}{\sqrt{m_1} + \sqrt{\dfrac{m_1}{81}}} = \dfrac{D}{1 + \dfrac{1}{9}} = \dfrac{9D}{10}$



7. (b)

Sol. Percentage change in g when the body is raised to height h, $\dfrac{\Delta g}{g} \times 100\,\% = \dfrac{2h \times 100}{R} = 1\%$

Percentage change in g when the body is taken into depth d, $\dfrac{\Delta g}{g} \times 100\% = \dfrac{d}{R} \times 100\% = \dfrac{h}{R} \times 100\%$ [As $d = h$]

$\therefore$ Percentage decrease in weight $= \dfrac{1}{2}\left(\dfrac{2h}{R} \times 100\right) = \dfrac{1}{2}(1\%) = 0.5\%$.

8. (a)

Sol. Effective acceleration due to gravity due to rotation of earth $g' = g - \omega^2 R \cos^2 \lambda$

$\Rightarrow \quad 0 = g - \omega^2 R \cos^2 60^o \Rightarrow \dfrac{\omega^2 R}{4} = g$

$\Rightarrow \omega = \sqrt{\dfrac{4g}{R}} = 2\sqrt{\dfrac{g}{R}} = \dfrac{2}{800} \dfrac{rad}{sec}$

[As $g' = 0$ and $\lambda = 60^o$]

$\Rightarrow \quad \omega = \dfrac{1}{400} = 2.5 \times 10^{-3} \dfrac{rad}{\text{sec}}$.

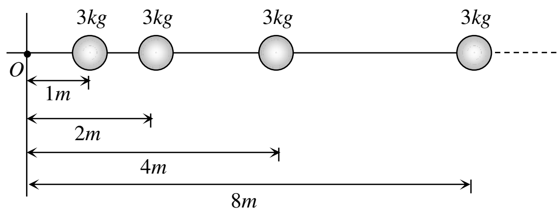
9. (b)

Sol. $I = -\left(\dfrac{\partial V}{\partial x}\hat{i} + \dfrac{\partial V}{\partial y}\hat{j} + \dfrac{\partial V}{\partial z}\hat{k}\right) = -(3\hat{i} + 4\hat{j} + 12\hat{k})$ [As $V = (3x + 4y + 12z)$ (given)]

It is uniform field Hence its value is same every where $|I| = \sqrt{3^2 + 4^2 + 12^2} = 13\, Nkg^{-1}$.

10. (d)

Sol. Intensity at the origin $I = I_1 + I_2 + I_3 + I_4 + ...$



$$= \frac{GM}{r_1^2} + \frac{GM}{r_2^2} + \frac{GM}{r_3^2} + \frac{GM}{r_4^2} + ... \qquad = GM\left[\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{4^2} + \frac{1}{8^2} + ...\right]$$

$$= GM\left[1 + \frac{1}{4} + \frac{1}{16} + \frac{1}{64} + ...\right]$$

$$= GM\left(\frac{1}{1 - \frac{1}{4}}\right)$$

[As sum of G.P. $= \frac{a}{1-r}$]

$$= GM \times \frac{4}{3} \quad = G \times 3 \times \frac{4}{3} = 4G \qquad \text{[As } M = 3kg \text{ given]}$$

11. (d)

Sol. $V = -\int E\,dx \;= -\int \frac{K}{x^3}dx \;= \frac{K}{2x^2}$.

12. (c)

Sol. Gravitational intensity at point P, $I = \frac{GM}{r^2}$ and

gravitational potential $V = -\frac{GM}{r}$

$\therefore \quad V = I \times r \quad = 6\ N/kg \times 8000\ km \quad = 4.8 \times 10^7 \frac{Joule}{kg}$.

13. (a)

Sol. Escape velocity does not depend upon the angle of projection.

14. (a)

Sol. $v_e = \sqrt{\frac{2Gm}{R}} = \sqrt{\frac{8}{3}\pi\rho GR^2}$ $\therefore v_e \propto R$ if ρ = constant. Since the planet having double radius in comparison to earth therefore the escape velocity becomes twice i.e. $22\ km/s$.

15. (c)

Sol. From the law of conservation of energy

Difference in potential energy between ground and maximum height = Kinetic energy at the point of projection

$$\frac{mgh}{1+h/R} = \frac{1}{2}m(kv_e)^2 = \frac{1}{2}mk^2v_e^2 = \frac{1}{2}mk^2(\sqrt{2gR})^2$$

[As $v_e = \sqrt{2gR}$]

By solving height from the surface of earth $h = \frac{Rk^2}{1-k^2}$

So height from the centre of earth $r = R + h = R + \frac{Rk^2}{1-k^2}$

$= \frac{R}{1-k^2}$.

16. (b)

Sol. If $F \propto \frac{1}{R^n}$ then $v \propto \frac{1}{\sqrt{R^{n-1}}}$; here $n = 1$ $\therefore v \propto \frac{1}{\sqrt{R^{1-1}}} \propto R^0$.

17. (d)

Sol. Orbital radius of second satellite is 2% more than first satellite

So from $T \propto (r)^{3/2}$, Percentage increase in time period $= \frac{3}{2}$ (Percentage increase in orbital radius)

$= \frac{3}{2}(2\%) = 3\%$.

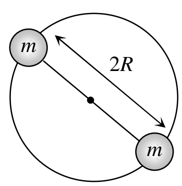
18. (b)

Sol. $T = 2\pi\sqrt{\frac{(R+h)^3}{GM}} = 2\pi\sqrt{\frac{(R+R)^3}{gR^2}} = 2\pi\sqrt{\frac{8R}{g}} = 4\sqrt{2}\pi\sqrt{\frac{R}{g}}$ [As $h = R$ (given)]

19. (c)

Sol. Both the particles moves diametrically opposite position along the circular path of radius R and the gravitational force provides required centripetal force

$\frac{mv^2}{R} = \frac{Gmm}{(2R)^2} \Rightarrow v = \frac{1}{2}\sqrt{\frac{Gm}{R}}$



20. (b)

Sol. Conservation of angular momentum

$L = I\omega = \frac{2}{5}MR^2 \times \frac{2\pi}{T} =$ constant $\therefore T \propto R^2$

[If M remains same]

$\Rightarrow \frac{T_2}{T_1} = \left(\frac{R_2}{R_1}\right)^2 = \left(\frac{R/n}{R}\right)^2 = \frac{1}{n^2} \Rightarrow T_2 = \frac{24}{n^2} hr$

[As $T_1 = 24\, hr$].

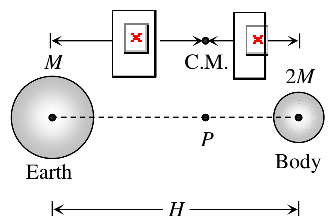
21. (c)

Sol. As the masses of the body and the earth are comparable, they will move towards their centre of mass, which remains stationary.

Hence the body of mass 2m move through distance $\frac{H}{3}$.

and time to reach the earth surface $= \sqrt{\frac{2h}{g}} = \sqrt{\frac{2H/3}{g}}$

$= \sqrt{\frac{2H}{3g}}$



22. (a)

Sol. $T = \frac{2\pi R_2^{3/2}}{\sqrt{GM}}$ or $GM = \frac{4\pi^2 R_2^3}{T^2}$

and $g = \frac{GM}{R_1^2} = \frac{4\pi^2 R_2^3}{R_1^2 T^2}$

23. (b)

Sol. $m\frac{dv}{dt} = \alpha v^2 dt$ or $\frac{dv}{v^2} = \frac{\alpha dt}{m}$

and $v = \sqrt{\frac{GM}{r}}$

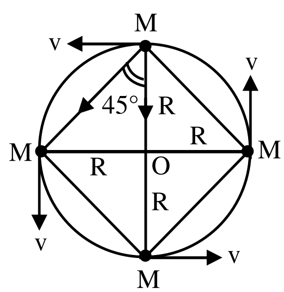
We know $v_i = \sqrt{\frac{GM}{nr}}$ and $v_f = \sqrt{\frac{GM}{R}}$

$\int_{v_i}^{v_f} \frac{dV}{V^2} = \int \frac{\alpha dt}{m}$

or $t = \frac{m}{\alpha}\left[\frac{1}{v_i} - \frac{1}{v_f}\right] = \frac{m}{\alpha\sqrt{GM/R}}\left[\sqrt{n} - 1\right]$

24. (d)

Sol. Gravitational force on each due to other three particles provides the necessary centripetal force.



$\therefore \sqrt{2}\frac{GM^2}{(\sqrt{2}R)^2}\cos 45^0 + \frac{GM^2}{(2R)^2} = \frac{Mv^2}{R}$

Simplifying it, we get

$v = \sqrt{\frac{GM}{R}\left(\frac{2\sqrt{2}+1}{4}\right)}$

25. (d)

Sol. $W_g = \vec{F}_g \cdot \Delta\vec{S} = 10(\hat{i}-\hat{j}).(\hat{i}-3\hat{j})$

$= 10 + 30 = 40$ J

26. (a)

Sol. $m_1v_1 - m_2v_2 = 0$ by conservation of momentum

$\frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 - \frac{Gm_1m_2}{r} = 0$

(by conservation of energy)

Also, $v_{rel.} = v_1 + v_2$

27. (a)

Sol. From Keplar's law VR = constant

so $Vr = V'R \Rightarrow V' = Vr/R$

28. (c)

Sol. According to Kepler's law $T^2 \propto a^3$

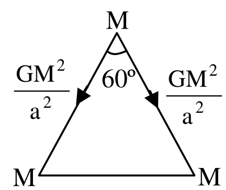
Here a = semi-major axis $= \left(\frac{r_1+r_2}{2}\right)$

$\therefore T^2 \propto \left(\frac{r_1+r_2}{2}\right)^3$

$T \propto \left(\frac{r_1+r_2}{2}\right)^{3/2} \propto (r_1+r_2)^{3/2}$

29. (c)

Sol.

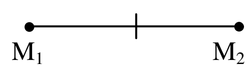


$F = \sqrt{3}\frac{GM^2}{a^2}$

30. (d)

Sol. Total potential energy at mid point is

$\left[-\frac{GM_1m}{d/2} - \frac{GM_2m}{d/2}\right]$



or $-\frac{2G}{d}(M_1 + M_2)m$

If v is required escape velocity, the

$\frac{1}{2}mv^2 = \frac{2G}{d}(M_1 + M_2)m$

$v = 2\sqrt{\frac{G(M_1+M_2)}{d}}$

31. (b)

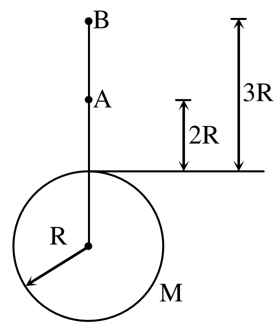
Sol. Actually gravitational force provides the centripetal force so force acting on satellite is F.

32. (a)

Sol. $\frac{v_1}{v_2} = \sqrt{\frac{2g_1R_1}{2g_2R_2}} = \sqrt{K_1K_2}$

33. (c)

Sol.



$U_i = -\frac{GMm}{(2R+R)}$

$U_f = -\frac{GMm}{(R+3R)}$

$W = \Delta U = U_f - U_f$

$= \frac{GMm}{12R} = \frac{GM}{R^2} \times \frac{mR}{12}$

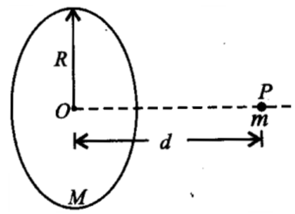
$= mgR/12$

34. (c)

Sol. $\Delta U = \frac{mgh}{1+\frac{h}{R}} = \frac{mg\frac{R}{4}}{1+\frac{R/4}{R}} = \frac{mg\frac{R}{4}}{\frac{5}{4}} = \frac{mgR}{5}$

35. (c)

Sol. The situations is as shown in the figure.



Gravitational force on an object of mass m at point p distance d from centre O lying on the axis of the circular ring of radius R and mass M is given by

$$F=\frac{GMmd}{(R^2+d^2)^{3/2}}$$

When d = r, then

$$F=\frac{GMmR}{(R^2+R^2)^{3/2}}=\frac{GMmR}{(2R^2)^{3/2}}=\frac{GMmR}{2^{3/2}R^3}=\frac{GMm}{2\sqrt{2}R^2}$$

36. (b)

Sol. It will remains the same as the gravitational force is independent of the medium separating the masses.

37. (b)

Sol. Accelerations due to gravity on earth is

$$g=\frac{GM_E}{R_E^2} \qquad \text{..... (i)}$$

As $\rho=\frac{M_E}{\frac{4}{3}\pi R_E^3} \Rightarrow M_E=\rho\frac{4}{3}\pi R_E^3$

Substituting this value in Eq. (i), we get

$$g=\frac{G\left(\rho\frac{4}{3}\pi R_E^3\right)}{R_E^2}=\frac{4}{3}\pi\rho G R_E \text{ or } \rho=\frac{3g}{4\pi G R_E}$$

38. (c)

Sol. Gravitational potential energy at any point at a distance r form the centre of the earth is

$$U=-\frac{GM_Em}{r}$$

Where M_E and m be masses of earth and body respectively.

At the surface of the earth, $r=R_E$

$$\therefore U_1=-\frac{GM_Em}{R_E}$$

At a height h from the surface,

$$r=R_E+h=R_E+nR_E=(1+n)R_E$$

$\therefore U_2 = -\frac{GM_E m}{(n+1)R_E}$

Changes in potential energy is

$\Delta U = U_2 - U_1 = -\frac{GM_E m}{(n+1)R_E} - \left(-\frac{GM_E m}{R_E}\right)$

$= \frac{GM_E m}{R_E}\left(1 - \frac{1}{(n+1)}\right) = \frac{GM_E mn}{(n+1)R_E}$

$= mgR_E \frac{n}{(n+1)} \qquad \left(\because g = \frac{Gm_E}{R_E^2}\right)$

39. (c)

Sol. Gravitations potential on the surface of the shell is V = Gravitational potential due to particle $(V_1)+$ Gravitational potential due to shell itself (V_2)

$= -\frac{Gm}{R} + \left(-\frac{G3m}{R}\right) = -\frac{4Gm}{R}$

40. (d)

Sol. Kinetic energy = $\frac{GM_E m}{2r}$

A –s

Potential energy $= -\frac{GM_E m}{r}$

B – r

Total energy $= -\frac{GM_E m}{2r}$

C – P

Orbital velocity $= \sqrt{\frac{GM_E}{r}}$

D – q

41. (c)

Sol. Let the rocket reaches a height h form the surface of earth.

Total energy at the surface of the earth is

$E_s = \frac{1}{2}mv^2 - \frac{GM_E m}{R_E}$

Where m and M_E are the masses of rocket and earth respectively.

At highest point, the velocity of the rocket becomes zero.

Total energy at the highest point is

$$E_h = -\frac{GM_E m}{(R_E + h)}$$

According to law of conservation of energy,

$$E_s = E_h$$

$$\therefore \frac{1}{2}mv^2 - \frac{GM_E m}{R_E} = -\frac{GM_E m}{R_E + h}$$

$$\frac{1}{2}v^2 = \frac{GM}{R_E} - \frac{GM_E}{R_E + h}$$

$$= \frac{gR_E^2}{R_E} - \frac{gR_E^2}{R_E + h} \qquad \left(\because g = \frac{GM_E}{R_E^2}\right)$$

$$v^2(R_E + h) = 2gR_E h$$

$$v^2 R_E = 2gR_E h - v^2 h$$

$$R_E v^2 = h(2gR_E - v^2)$$

$$h = \frac{R_E v_2}{2gR_E - v^2}$$

42. (c)

Sol. A polar satellite is a low altitude satellite. Hence, options (c) is an incorrect statement. While all the other statement are correct.

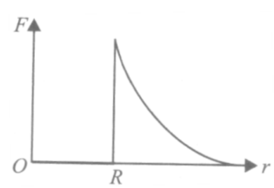
43. (b)

Sol. Gravitational field due to the thin spherical shell. Inside the shell,

F = 0 (For r < R)

On the surface of the shell.

$$F = \frac{GM}{R^2} \text{ (For } r = R)$$



Outside the shell,

$$F = \frac{GM}{r^2} \text{ (For } r > R)$$

The variation of F with distance r from the centre is as shown in the figures.

44. (d)

Sol. Asteroids move in circular orbits like planets under the action of central forces.

45. (d)

Sol. According to the principle of equivalence the gravitational mass of a body is equal to its inertial mass.

46. (d)

Sol. According to the questions, the gravitational force between the planet and the star is

$F = \frac{1}{R^{5/2}} \quad \therefore F = \frac{GMm}{R^{5/2}}$

Where M and m be masses of star and planet respectively.

For motions of a planet in a circular orbit.

$mR\omega^2 = \frac{GMm}{R^{5/2}}$

$mR\left(\frac{2\pi}{T}\right)^2 = \frac{GMm}{R^{5/2}} \quad \left(\because \omega = \frac{2\pi}{T}\right)$

$\frac{4\pi^2}{T^2} = \frac{GM}{R^{7/2}} \Rightarrow T^2 = \frac{4\pi^2}{GM}R^{7/2}$

$T^2 \propto R^{7/2}$ or $T \propto R^{7/4}$

47. (d)

Sol. Accelerations due to gravity at a place of latitude λ due to the rotation of earth is

$g` = g - R_E\omega^2 \cos^2\lambda$

At equator, $\lambda = 0°, \cos 0° = 1$

$\therefore \quad g` = g_e = g - R_E\omega^2$

At poles, $\lambda = 90°, \cos 90° = 0$

$\therefore \quad g` = g_p = g$

$\therefore \quad g_p - g_e = g - (g - R_E\omega_2)$

$= R_E\omega^2$

48. (b)

Sol. Let v be the speed of the body when it escapes the gravitational pull of the earth and u be speed of projection of the body from the earth's surface.

According to law of conservation of mechanical energy.

$\frac{1}{2}mu^2 - \frac{GM_E m}{R_E} = \frac{1}{2}mv^2 - 0$

Where m and M_E be masses of the body and earth respectively and R_E is the radius of the earth.

$v^2 = u^2 - \frac{2GM_E}{R_E}$

$v^2 = u^2 - v_e^2 \quad \left(\because v_e = \sqrt{\frac{2GM_E}{R_E}}\right)$

$v = \sqrt{u^2 - v_e^2} = \sqrt{(3v_e)^2 - v_e^2}$

$= \sqrt{8}v_e = 11.2\sqrt{8}\text{kms}^{-1} = 22.4\sqrt{2}\text{km s}^{-1}$

49. (b)

Sol. Since the speeds of the stars are negligible when they are at a distance r, hence the initial kinetic energy of system is zero. Therefore, the initial total energy of the system is

$$E_i = KE + PE = 0 + \left(-\frac{GMM}{r}\right) = -\frac{GM^2}{r}$$

Where M represent the mass of each star and r is initial separation between them.
When two stars collide their centres will be at a distance twice the radius of a star i.e, 2R.
Let v be the speed with which two stars collide. Then total energy of the system at the instant of their collision is given by

$$E_f = 2\times\left(\frac{1}{2}Mv^2\right) + \left(-\frac{GMM}{2R}\right) = Mv^2 - \frac{GM^2}{2R}$$

According to law of conservations of mechanical energy

$$E_f = E_i$$

$$Mv^2 - \frac{GM^2}{2R} = -\frac{GM^2}{r} \text{ or } v^2 = GM\left(\frac{1}{2R} - \frac{1}{r}\right)$$

$$\text{Or } v = \sqrt{GM\left(\frac{1}{2R} - \frac{1}{r}\right)}$$

50. (c)

Sol. The acceleration due to gravity at a depth d below the surface of earth is

$$g` = g\left(1 - \frac{d}{R}\right) = g\left(\frac{R-d}{R}\right) = g\frac{r}{R} \qquad \text{..... (i)}$$

Where R – d = r = distance of locations form the centre of the earth. When r = 0, g` = 0
From (i) g $\propto$ r till R = r, for which g` = g

For r > R, $g` = \frac{gR^2}{(R+h)^2} = \frac{gR^2}{r^2} \text{ or } g` \propto \frac{1}{r^2}$

Here, R + h = r

Therefore, the variation of g with distance r from centre of earth will be as shown in figure (iv).Thus, options (c) is correct. So answer is not (iV), it is choice (C) remember choice not answer.

CHEMISTRY SOLUTIONS

51. (d)
Sol. In cyclic process, a system in a given state goes through a series of different processes, but in the end returns to its initial state.
52. (c)
Sol. $\Delta E = 0$ for isothermal reversible cycle.
53. (c)
Sol. In isolated system neither exchange of matter nor exchange of energy is possible with surroundings.
54. (c)
Sol. It is the definition of calorific value.
55. (b)
Sol. The functions whose value depends only on the state of a system are known as state functions.
56. (b)
Sol. The intensive property is mass/volume.
57. (c)
Sol. An isolated system neither shows exchange of heat nor matter with surroundings.
58. (d)
Sol. ΔQ is not a state function.
59. (c)
Sol. For adiabatic process $\Delta Q = 0$.
60. (d)
Sol. First low of thermodynamics is also known as Law of conservation of mass and energy.
61. (b)
Sol. $\Delta H = \Delta E + P\Delta V$.
62. (c)
Sol. $\Delta n_g = 1 - \frac{3}{2} = \frac{-1}{2}$, As Δn_g is negative, thus $\Delta H < \Delta E$.
63. (a)
Sol. The enthalpies of all elements in their standard state at $25^o C$ or 298K are zero.
64. (a)
Sol. At constant T and P internal energy of ideal gas remains unaffected.
65. (c)
Sol. $-W = +2.303\, nRT \log \frac{p_1}{p_2}$

$-W = 2.303 \times 1 \times 2 \times 300 \log \frac{10}{1} = 1381.8\, cal.$
66. (c)
Sol. Here $\Delta n = 0$ so, $\Delta E = \Delta H$.
67. (a)
Sol. For this reaction $\Delta n = 0$ than $\Delta E = \Delta H$.

68. (c)

Sol. $\Delta H - \Delta E = \Delta nRT$; $\Delta n = -3$

so, $\Delta H - \Delta E = -3RT$.

69. (c)

Sol. Enthalpy (H) is defined as the sum of internal energy $E + PV$, $H = E + PV$.

70. (d)

Sol. When $\Delta S = +ve$ the change is spontaneous.

71. (d)

Sol. Heat is always flow from the higher to lower temperature.

72. (d)

Sol. $\Delta S^o = 2S^o_{HCl} - (S^o_{H_2} + S^o_{Cl_2})$

$= 2 \times 186.7 - (130.6 + 223.0) = 19.8\ JK^{-1}mol^{-1}$

73. (b)

Sol. For adiabatic expansion $q = 0$ than according to following relation $\Delta S = \frac{q}{T}, \Delta S = 0$.

74. (b)

Sol. Solid $\longrightarrow$ Gas, ΔS is maximum.

75. (d)

Sol. $+ve\ \Delta H$ and $-ve\ \Delta S$ both oppose the reaction.

76. (c)

Sol. $\Delta S_{vap} = \frac{\Delta H_{vap}}{T} = \frac{37.3\ KJ\ mol^{-1}}{373\ K}$

$= 0.1\ kJ\ mol^{-1}\ K^{-1} = 100\ J\ mol^{-1}\ K^{-1}$.

77. (d)

Sol. For isothermal expansion of ideal gas, $\Delta E = 0$.

78. (b)

Sol. $C + O_2 \rightarrow CO_2 + 94.2\ Kcal.$ …..(i)

$H_2 + \frac{1}{2}O_2 \rightarrow H_2O + 68.3\ Kcal.$ ….(ii)

On multiplication of eq. (ii) by 2 and than adding in eq. (i)

$C + 2H_2 + 2O_2 \rightarrow CO_2 + 2H_2O + 230.8\ Kcal$ …(iii)

On subtracting eq. (iii) by following eq.

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O + 210.8\ Kcal.$ we get,

$C + 2H_2 \rightarrow CH_4\ \ \Delta H = 20\ Kcal.$

79. (b)

Sol. $\Delta S = 16\, J\, mole^{-1} K^{-1}$

$$T_{b.p.} = \frac{\Delta H_{\text{vapour}}}{\Delta S_{\text{vapour}}} = \frac{6 \times 1000}{16} = 375\, K$$

80. (a)

Sol. For exothermic reactions $H_p < H_R$.

For endothermic reactions $H_p > H_R$.

81. (b)

Sol. 78g of benzene on combustion produces

heat = – 3264.6 kJ

$\therefore 39\, g$ will produce $= \frac{-3264.6}{2} = -1632.3\, kJ$.

82. (a)

Sol. eq. (i) + eq. (ii) gives the required result.

83. (a)

Sol. Change of liquid to vapour takes energy in the form of heat so it is endothermic reaction.

84 (d)

Sol. In exothermic reactions heat is evolute.

85. (b)

Sol. Graphite $\longrightarrow$ diamond $\Delta H_t = (x - y) kJ\, mol^{-1}$.

86. (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.

87. (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 $-90 = \frac{1}{2} \times 430 + \frac{1}{2} \times 240 - E_{HCl}$

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

88. (b)

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

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

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

89. (a)

Sol. $\Delta G = \Delta H - T\Delta S = 31400 - 1273 \times 32$

$= 31400 - 40736 = -9336\, cal$

90. (a)

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

For the given curve ΔH and ΔS both should be positive.

91. (a)

Sol. For spontaneous process, $\Delta G = -$ ve, K > 1 and $E^0_{cell} = +$ ve.

92. (a)

Sol. $\Delta H = H_p - H_R = 15 - 40 = -25$ kJ.

93. (a)

Sol. We know that $\Delta E = Q + W = 600 + (-300) = 300$ J

W = – 300, because the work done by the system.

94. (b)

Sol. $q = \Delta E - W, q = 0$ for adiabatic process, then $\Delta E = W$

95. (b)

Sol. Since the system is insulated, heat is not allowed to enter or leave the system.

Thus, $q = 0, \Delta E = q + W \Rightarrow \Delta E = W$

96. (a)

Sol. $\Delta n_g = 12 - 15 = -3$

$q_P - q_v = \Delta n_g RT = -3 \times \frac{8.314}{1000} \times 298 = -7.43 kJ$.

97. (d)

Sol. $CH_4 \rightarrow 4C - H;\quad \Delta H = 320$

$1E_{C-H} = \frac{320}{4} = 80$ calories then $6E_{C-H} = 480$ *cal.*

$C_2H_6 \rightarrow E_{C-C} + 6E_{C-H}; \Delta H = 360$ *cal.*

$360 = E_{C-C} + 480$

$E_{C-C} = 360 - 480 = -120 cal$

98. (d)

Sol. Let the bond dissociation energy of XY, X_2 and Y_2 be x,x and x, $\frac{x}{2}$ KJ/mol respectively,

$\frac{1}{2}X_2 + \frac{1}{2}Y_2 \rightarrow XY;\ \Delta H f = -200$ KJ mol^{-1}.

ΔH reaction = [(sum of bond dissociation energy of all reactants) – (sum of bond dissociation energy of all product)]

$= \left[\frac{1}{2}\Delta H_{X2} + \frac{1}{2}\Delta H_{Y2} - \Delta H_{XY}\right] = \frac{x}{2} + \frac{0.5x}{2} - x = -200$

$\therefore\ x = \frac{200}{0.25} = 800$ KJ mol^{-1}.

99. (c)

Sol. Work done by the gas in the cyclic process = Area bounded (ABCA) = $5P_1V_1$

100. (c)

Sol. According to 1st law of thermodynamics,

$\Delta E = q + w$.

For isothermal process, $\Delta E = 0$. Hence, q = – w

For cyclic process, $\Delta E = 0$ Hence,

For expansion into vacuum, w = 0. hence $\Delta E = q$.

BOTANY									
Q.	**Ans.**	**Q.**	**Ans.**	**Q.**	**Ans.**	**Q.**	**Ans.**	**Q.**	**Ans.**
101	**B**	**113**	**D**	**125**	**C**	**136**	**B**	**148**	**B**
102	**B**	**114**	**C**	**126**	**D**	**137**	**C**	**149**	**A**
103	**B**	**115**	**D**	**127**	**A**	**138**	**C**	**150**	**D**
104	**D**	**116**	**C**	**128**	**C**	**139**	**D**		
105	**B**	**117**	**B**	**129**	**D**	**140**	**B**		
106	**D**	**118**	**C**	**130**	**C**	**141**	**C**		
107	**C**	**119**	**D**	**131**	**C**	**142**	**C**		
108	**D**	**120**	**D**	**132**	**C**	**143**	**D**		
109	**D**	**121**	**C**	**133**	**D**	**144**	**A**		
110	**D**	**122**	**A**	**134**	**B**	**145**	**D**		
111	**C**	**123**	**B**	**135**	**D**	**146**	**C**		
112	**D**	**124**	**A**			**147**	**C**		

ZOOLOGY									
Q.	ANS.	Q.	ANS.	Q.	ANS	Q.	ANS.	Q.	ANS
151	B	163	A	175	B	186	D	198	B
152	C	164	C	176	B	187	C	199	D
153	B	165	C	177	C	188	C	200	A
154	A	166	C	178	A	189	B		
155	B	167	C	179	D	190	B		
156	B	168	B	180	B	191	D		
157	C	169	B	181	A	192	D		
158	C	170	D	182	D	193	A		
159	C	171	A	183	C	194	D		
160	A	172	C	184	B	195	C		
161	B	173	B	185	B	196	C		
162	D	174	D			197	C		