FOR 2019 ASPIRANTS **MEDICAL EDT - 4** **DATE: 28 -03- 2019**

SOLUTIONS

1. (1)

$T = 2\pi\sqrt{\frac{l}{g}}$

For a second pendulum T = 2 sec = constant

$\therefore \quad l = \frac{gT^2}{4\pi^2} = \frac{9.8\times(2)^2}{4\times(3.14)^2} \approx 1m$

At moon

$\therefore \quad l' = \frac{g'T^2}{4\pi^2} = \frac{1}{6}.\frac{gT^2}{4\pi^2} = \frac{1}{6}m$

2. (1)

$T = 2\pi\sqrt{\frac{1}{8}} \text{ or } T\alpha\frac{1}{\sqrt{g}}$

$\therefore \frac{T'}{T}\sqrt{\frac{g}{g'}} = \sqrt{\frac{g}{g/2}} = \sqrt{2}$

$T' = T\sqrt{2} = 2\sqrt{2}\,\text{sec}$

3. (3)

$T = 2\pi\sqrt{\frac{M}{K}} \Rightarrow T\alpha\sqrt{M}$

4. ()

Initial frequency $f = \frac{1}{2\pi}\sqrt{\frac{2K}{M}}$

(since $\underline{K_{eff}}$ = 2K)

When one spring is removed.
Final frequency,

$f' = \frac{1}{2\pi}\sqrt{\frac{K}{M}}$

$\therefore \quad \frac{f'}{f} = \frac{1}{\sqrt{2}} \Rightarrow f' = f/\sqrt{2}$

5. ()

When a little mercury drains, its centre of gravity moves downward, *i.e.*, effective length increases; hence time period increases.

6. ()

$a = -bx$; standard equation is $a = -\omega^2 x$

$\omega = \sqrt{b}; T = \dfrac{2\pi}{\omega} = \dfrac{2\pi}{\sqrt{b}}$

7. ()

In case (A), $(K_{eff})_A = \dfrac{K_1 K_2}{K_1 + K_2} = \dfrac{K.K}{2K} = \dfrac{K}{2}$

In case (B), $(K_{eff})_B = K_1 + K_2 = 2K$

$\therefore f = \dfrac{1}{2\pi}\sqrt{\dfrac{K_{eff}}{m}} \alpha \sqrt{K_{eff}}$

$\therefore \quad \dfrac{f_A}{f_B} = \sqrt{\dfrac{(K_{eff})_A}{(K_{eff})_B}} = \sqrt{\dfrac{K/2}{2K}} = \dfrac{1}{2}.$

8. ()

The phase difference between sine and cosine of same angle is $\dfrac{\pi}{2}$.

$\therefore \quad A = \sqrt{3^2 + 4^2} = 5m.$

9. ()

$U = U_0 - U_0 \cos ax$

$\Rightarrow F = -\dfrac{dU}{dx} = -U_0 a \sin ax$

Acceleration $= -\dfrac{aU_0}{m} \sin ax$

For small oscillations $\sin ax = ax$

$\therefore$ acceleration $= -\dfrac{a^2 U_0}{m} x$

Standard equation of SHM is

Acceleration $= -\omega^2 x$

$\Rightarrow \omega^2 = \dfrac{a^2 U_0}{m}$

$T = \dfrac{2\pi}{\omega} = \dfrac{2\pi}{a}\sqrt{\dfrac{m}{U_0}}$

10. ()

The coin leaves contact when upward restoring force exceeds the weight of coin, *i.e.*,

$m\omega^2 A \geq mg \Rightarrow A \geq \dfrac{g}{\omega^2}$

11. ()

Sudden process is adiabatic. In an adiabatic process

$TV^{\gamma-1} = \text{constant}$

$T_1 V_1^{\gamma-1} = T_2 V_2^{\gamma-1}$

$$\Rightarrow T_2 = \left(\frac{V_1}{V_2}\right)^{\gamma-1} T_1$$

$$T_1 = 8\left(\frac{5}{3}-1\right) \times 290$$

$$= (2)^2 \times 290 = 1160\,K = 887°C.$$

12. ()
Isothermal process
Isothermal Process

$$PV = P_i'V'$$

$$\Rightarrow \quad P_i' = \frac{V}{V'}P = 2P.$$

Adiabatic Process

$$PV^{\gamma} = P_a'\,V'^{\gamma}$$

$$P_a' = P\left(\frac{V}{V'}\right)^r$$

$$P_a' = (2)^r.P$$

'r' is always more than 1 so P_a' always greater than P_i'

13. ()
Work = area enclosed by cycle

$$= \frac{1}{2}3P_1 \times 2V_1 = \mathbf{3P_1V_1.}$$

14. ()
Data based

15. ()

$$W = P\Delta V = P(V_2 - V_1)$$

$$= 50(4-10) = -300J$$

$$Q = 100J$$

$$\Delta U = Q - W = 100 - (-300) = +400J$$

16. ()
Work done = area enclosed by *P-V* curve and volume axis as area enclosed increases continuously, therefore work done by system increases continuously.

17. ()

$$\frac{\Delta U}{Q} = \frac{nC_V\Delta T}{nC_P\Delta T} = \frac{C_V}{C_P}$$

$$= \frac{(5/2)R}{(7/2)R} = \frac{5}{7}.$$

18. ()

$$\eta = \frac{W}{Q_1} = 1 - \frac{T_2}{T_1}$$

$$\Rightarrow W = Q_1\left(1 - \frac{T_2}{T_1}\right)$$

$$= 3000\left(1 - \frac{300}{900}\right)$$

$$= 3000 \times \frac{6}{9} = 2000 \ kilocal$$

$$= 2000 \times 4.2 \times 10^3 = 8.4 \times 10^6 J$$

19. ()

$$\eta = \frac{Q_2}{W} = \frac{T_2}{T_1 - T_2}$$

$$\Rightarrow Q_2 = \left(\frac{T_2}{T_1 - T_2}\right)W = \left(\frac{273}{300 - 273}\right) \times 1$$

$$= \frac{273}{27} \approx 10J.$$

20. ()
For an ideal gas U=0, E=K

21. ()

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\Rightarrow P_2 = \frac{V_1}{V_2} \cdot \frac{T_2}{T_1} P_1$$

$$= \frac{(30 \text{ litres})}{(5{\cdot}2 \text{ litres})} \times \frac{(-73 + 273)}{(27 + 273)} \times 1 \text{ atm}$$

$$= \frac{30}{5{\cdot}2} \times \frac{200}{300} \times 1 \text{ atm} = \mathbf{3{\cdot}86 \text{ atm.}}$$

22. ()
Pressure on both sides is same but force on right side is more than that towards left

23. ()

$P \, \alpha \, mv^2$

$$\frac{P}{P_o} = \frac{m/2.(v \times 2)^2}{mv^2} = 2P_o$$

24. ()

For jar A, $\frac{PV}{T} = nR$.

For jar B, $\frac{2P\left(\frac{V}{4}\right)}{2T} = n'R$.

In dividing $\frac{n}{n'} = \frac{4}{1}$.

25. ()

According to ideal gas equation

$PV = nRT$ or $\frac{V}{T} = \frac{nR}{P}$

At constant pressure

$\frac{V}{T}$ = constant

Hence graph (a) is correct.

26. ()

As $\theta_2 > \theta_1 \Rightarrow \tan\theta_2 > \tan\theta_1 \Rightarrow \left(\frac{T}{P}\right)_2 > \left(\frac{T}{P}\right)_1$

Also from $PV = \mu RT$; $\frac{T}{P} \propto V \Rightarrow V_2 > V_1$.

27. ()

$$\lambda = \frac{1}{\lambda d^2 n\sqrt{2}} = \frac{1}{4\pi r^2 n\sqrt{2}}$$

$$\lambda \alpha \frac{1}{r^2}.$$

28. ()

As the temperature increases, the average velocity increases. So the collisions are faster.

29. ()

Theory based

30. ()

During formation of ice cubes orderedness increases hence entropy decreases.

31. (3)

As internal energy is a point function therefore change in internal energy does not depend upon the path followed, i.e., $\Delta U_I = \Delta U_{II}$

32. ()

Efficiency of a heat engine, $\eta = 1 - \frac{T_2}{T_1}$

For $\eta = 1$ (*i.e.*, 100%) either, $T_1 = \infty$ or $T_2 = 0K$

As source at infinite temperature or sink at 0 K are not attainable, therefore heat engine cannot have efficiency 1.

33. ()

In a refrigerator, the heat dissipated in the atmosphere is more than that taken from the cooling chamber, therefore the room is heated if the door of a refrigerator is kept open.

34. ()

Coefficient of performance

$$K = \frac{T_2}{T_1 - T_2} = \frac{273}{303 - 273} = \frac{273}{30} = 9.1 \approx 9.$$

35. ()

In first case $\eta_1 = \frac{T_1 - T_2}{T_1}$

In second case $\eta_2 = \frac{2T_1 - 2T_2}{2T_1} = \frac{T_1 - T_2}{T_1} = \eta$.

36. ()

Factual

37. ()

$\beta = \frac{Q_2}{W} = \frac{T_2}{T_1 - T_2}$ (Where Q_2 is heat removed)

$\Rightarrow \frac{600 \times 4.2}{W} = \frac{277}{303 - 277}$

$\Rightarrow W = 236.5\,Joule$

$\Rightarrow$ Power$= \frac{W}{t} = \frac{236.5\,Joule}{1\,sec} = 236.5\,watt.$

38. ()

Internal energy of a gas is

$U = \frac{3}{2} nRT$

For a given number of moles of the same gas, U depends only T

Therefore U_B at $2T < U_A$ at temperature T is a wrong statement.

39. ()

Work done = Area enclosed by indicator diagram

$$= \frac{1}{2} \times (3V - V)(4P - P) = 3PV.$$

40. ()

Acceleration $= -\omega^2 y$. So $F = -m\omega^2 y$

y is sinusoidal function.

So F will be also sinusoidal function with phase difference π

41. ()

K.E. is maximum at mean position. Whereas P.E. is minimum.
At extreme position, K.E. is minimum and P.E. is maximum.

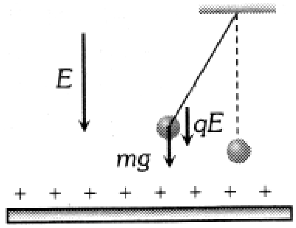
42. ()

Motion given here is SHM starting from rest with some initial phase difference

43. ()

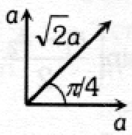
In this case time period of pendulum becomes

$$T' = 2\pi\sqrt{\frac{l}{\left(g + \frac{qE}{m}\right)}}$$



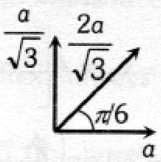
$\Rightarrow T' < T.$

44. ()



for first S.H.M.
Ratio of amplitude

$$\frac{a_1}{a_2} = \frac{\sqrt{3}}{\sqrt{2}}$$



for second S.H.M.
Phase difference is

$$\frac{\pi}{4} - \frac{\pi}{6} = \frac{\pi}{12}.$$

45. ()

Body collides elastically with walls of room. So there will be no loss in its energy and it will be no loss in its energy and it will remain colliding with walls of room after a regular time interval, so it's motion will be periodic. Since acceleration is not proportional to displacement, so it's motion is not SHM.

(46) $M.M_{CH_3COOH} = 24 + 4 + 32 = 60$

$M.M_{Dimer} = 120$

(47) $\frac{4}{4+1}$

(48) $A_xB_y \rightleftharpoons xA^{+y} + yB^{-x}$

a — —

$a(1-\alpha) \quad x a\alpha \quad y a\alpha$

$i = \frac{a - a\alpha + xa\alpha + ya\alpha}{a}$

$\Rightarrow \frac{i-1}{} = \frac{(x+y-1)\alpha}{1}$

(49) $(\pi)(V) = \left(\frac{m_2}{M_2}\right)RT$

(51) $(1)(V_1) + (5)(V_2) = (2)(2)$

$V_1 + V_2 = 2L$

$\Rightarrow 4V_2 + 2 = 4$

$V_2 = 0.5$, $\Rightarrow V_1 = 1.5$

(53) $N = M \times n\text{-factor}$

n-factor of $H_3PO_4 = 3$

(54)

$\Delta T = K_f \cdot m$

$(0.124) = (1.86)\dfrac{(0.4/M.M)}{(0.1)}$

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(55) $0.93 = (1.86)\left(\dfrac{6.8/M.M}{0.1}\right)$

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(56) NH_2CONH_2, Na^+Cl^-, $2Na^+\ SO_4^{2-}$

1 particle, 2 particles, 3 particles

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(58)

$n_{moles} = \dfrac{648}{18}$

$W_{solvent} = 0.648$ kg $m = 1000/18$

$V_{sol^n} = 0.648$ L $M = 1000/18$

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(60) $\dfrac{(7.4)}{[0.821][300]} = \dfrac{n}{V}$

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(65) $(23.75) - (22.8) = \dfrac{x/342}{\left(\dfrac{x}{342} + \dfrac{150}{18}\right)}$

find 'x'

(67)

$$\frac{(7.65)(V)_{mL}}{1000} = \frac{wt.}{M.M.} \times R \times T_{(K)}$$

$$\frac{Wt.}{V_{mL}} \times 100 = \underline{ANS}$$

(68) $E^{\circ}_{cell} = E_A - E_B$

(71) $\Delta G = -(nFE^{\circ}) = -(2)(96500)(1.1)$ Joules

(72) Fe^{+2} is oxidizing, thus acting as a reducing agent.

(73) $E_{cell} = E^{\circ}_{cell} - \frac{0.059}{2} \log\left[\frac{PH_2}{[H^+]^2}\right]$

E°_{cell} for H_2/H^+ is zero

(75)

$$E^{\circ}_{cell} = +0.34 + 0.13 = 0.47$$

$$E_{cell} \approx 0.47 - \frac{.06}{2} \log\left[\frac{[Sn^{+2}][Tl^{+}]^2}{[Sn^{+4}]}\right]$$

$$\Rightarrow E_{cell} \approx 0.47 - 0.03\left(\log\left(\frac{(1)(10)^2}{(1)}\right)\right)$$

$$\approx 0.47 - 0.06$$

(76)

$$0.463 = E^{\circ}_{cell} - \frac{0.06}{2} \log\left[\frac{[Cu^{+2}]}{[Ag^+]^2}\right]$$

$$0.463 = E^{\circ}_{Ag^+/Ag} + E^{\circ}_{Cu/Cu^{+2}} - 0$$

$$0.463 = x - 0.337$$

(80)

$$91 - 126.45 + 426.16$$

(81)

$$\frac{0.504}{2} = n_{H_2}$$

1 mole H_2 requires 2 moles electrons.

$$\Rightarrow n_{H_2} = n_{Cu}$$

1 mole Cu^{+2} requires 2 moles electrons for deposition of Cu.

$$\Rightarrow W_{Cu} = \frac{0.504}{2} \times 63.5$$

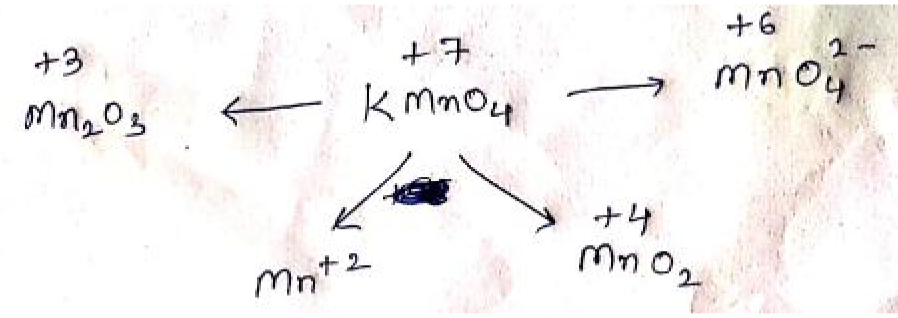
(82)

$$\Delta G^{o}_{Cu^{+}/Cu} = \Delta G^{o}_{Cu^{+2}/Cu} - \Delta G^{o}_{Cu^{+2}/Cu^{+}}$$

$$-(1)F E^{o}_{Cu^{+}/Cu} = -(2)F E^{o}_{Cu^{+2}/Cu} - \left[(-1)F E^{o}_{Cu^{+2}/Cu^{+}}\right]$$

$$\Rightarrow E^{o}_{Cu^{+}/Cu} = (2 \times 0.337) - (1 \times 0.153)$$

84.



(87) Factual

(88) 1 mole Ag deposition requires 1 mole e^-
1 mole Cu deposition from $CuSO_4$ requires 2 mole e^-

$\Rightarrow$ For same charge passage

$n_{Ag} : n_{Cu} = 1 : 0.5$

$w_{Ag} : w_{Cu} = (107.9) : \left(\frac{63.5}{2}\right)$

$= 107.9 : 31.77$

91. Photosynthesis in Plants : Pg 210
92. Photosynthesis in Plants : NCERT : Pg 212
93. Respiration in Plant : NCERT : Pg 229
94. Respiration in Plant : NCERT : Pg 229
95. Photosynthesis in Plants : NCERT : Pg 212
96. Respiration in Plant : End product of glycolysis is pyruvic acid H_3C CO COOH
97. Photosynthesis in Plants : NCERT : Pg 214
98. Respiration in Plant : NCERT : Pg 230
99. Photosynthesis in Plants : NCERT : Pg 214; Pg 215
100. Respiration in Plant : NCERT : Pg 230
101. Photosynthesis in Plants : NCERT : Pg 217
102. Respiration in Plant : NCERT : Pg 229, 232
103. Photosynthesis in Plants: NCERT : Pg 218
104. Respiration in Plant : NCERT : Pg 233
105. Photosynthesis in Plants : C_4 Plants show oxalo acetate as first product
106. Respiration in Plant : NCERT : Pg 237
107. Photosynthesis in Plants : NCERT : Pg 220
108. Respiration in Plant : NCERT : Pg 235
109. Photosynthesis in Plants : NCERT : Pg 216, 217, 218, 219
110. Respiration in Plant : NCERT : Pg 229 1 glucose forms 2 pyraric acid molecules
111. Photosynthesis in Plants : NCERT : Pg 208
112. Respi : NCERT : Pg 229
113. Photosynthesis in Plants : NCERT : Pg 208
114. Respiration in Plant : NCERT : Pg 230
115. Photosynthesis in Plants : NCERT : Pg 222
116. Respiration in Plant : NCERT : Pg 236
117. Photosynthesis in Plants : NCERT : Pg 219
118. Respiration in Plant : NCERT : Pg 227,229,232
119. Photosynthesis in Plants : As oxygen is not used in photosynthesis, it is not a limiting factor.
120. Respiration in Plant : NCERT : Pg 229, 231, 232
121. Photosynthesis in Plants : NCERT : Pg 214
122. Respiration in Plant : NCERT : Pg 231
123. Photosynthesis in Plants : NCERT : Pg 215

124. Respiration in Plant : Complex I is NADH Dehydrogenase, through which IONADH$_2$ pass yielding 30 ATP, If It turns out to be nonfunctional, only 4 ATPs will be formed during ETS
125. Photosynthesis in Plants : NCERT : Pg 218
126. Respiration in Plant : NCERT : Pg 237
127. Photosynthesis in Plants : NCERT : Pg 212
128. Respiration in Plant : NCERT : Pg 230
129. Photosynthesis in Plants : NCERT : Pg 223
130. Respiration in Plant : NCERT : Pg 229
131. Photosynthesis in Plants : NCERT : Pg 212, 213
132. Respiration in Plant : NCERT : Pg 230, 231
133. Photosynthesis in Plants : NCERT : Pg 213, 214
134. Respiration in Plant : NCERT : Pg 232
135. Photosynthesis in Plants : NCERT : Pg 219
136. Parathyroid gland secrete PTH or Parathormone.
138. Hormones control metabolism and hence body growth.They are organic molecules.
139. Low blood sugar can be due to increased level of beta cells during tumour that secrete insulin which lowers blood sugar level.
140. Relaxin is secreted only during parturition.
141. Increased level of Testosterone inhibits secretion of FSH.
143. Aldosterone regulates sodium level in blood.
144. Relaxin helps in parturition and inhibin inhibits secretion of FSH.
146. During stress sympathetic neural system is activated.
147. Iodine is essential for mental foetal growth.
149. Oestrogen is essential for bone formation as it deposits Ca in bones.
150. Cortisol or Glucagon is for gluconeogenesis.
152. GnRH controls secretion of FSH and LH and hence androgens.
154. Steroid hormones binds with intracellular receptors.
155. CCK or PZ
157. Purkinje cells are neurons of cerebellum.
158. Afferent nerve fibres are sensory.
159. Sympathetic neural system inhibits digestive system.
164. Calcium is essential for transmission of nerve impulse.
167. Cerebellum is for muscle coordination.
168. Knee jerk reflex is an example of simple reflex.
172. Midbrain has corpora quadrigemina for vision.
175. Lens is flexible to change its curvature for adjusting focal length.
176. Only one end is swollen as ampulla.
178. 5 pairs of cranial nerves are motor.Mixed nerves are both sensory and motor.