FOR 2019 ASPIRANTS **MEDICAL PCT - 1** **DATE: 24 -03- 2019**

SOLUTIONS

1. (4)

As $\mu = \dfrac{\text{velocity of light in vacuum}}{\text{velocity of light in medium}}$, hence μ is dimensionless. Thus each term on the RHS of given equation should be dimensionless.

$\therefore \dfrac{B}{\lambda^2}$ is dimensionless, *i.e.*, *B* should have dimensions of λ^2, *i.e.*, cm^2 , *i.e.*, area.

2. (3)

$P + \dfrac{1}{2}\rho v^2 + \rho gh = K$

K has the same dimension as each one of the factors on the L.H.S. *i.e.* $P, \dfrac{1}{2}\rho v^2$ and ρgh.

$\therefore \dfrac{[K]}{[P]} = [\theta]$

3. (1)

Moment of inertia (I)= mr^2

$\therefore \quad [I] = [ML^2]$

Moment of force $(\vec{\tau}) = \vec{r} \times \vec{F}$

$\therefore [\tau] = [r][F] = [L][MLT^{-2}]$

or $[\tau] = [ML^2T^{-2}]$

Moment of inertia and moment of a force do not have identical dimensions.

4. (4)

In the expression $U = \dfrac{A\sqrt{x}}{x^2 + B}$

B must have the dimensions x^2 *i.e.*, $[L^2]$

Dimensions of $A = \dfrac{Ux^2}{\sqrt{x}} = \dfrac{[ML^2T^{-2}][L^2]}{[L^{1/2}]}$

$= [ML^{7/2}T^{-2}]$

$\therefore AB = [ML^{7/2}T^{-2}][L^2] = [M^1L^{11/2}T^{-2}]$

5. (4)

$$\frac{A^2}{Mass(m)} = \text{K.E.} = \frac{1}{2}mv^2$$

$$A^2 = \frac{1}{2}m^2v^2$$

$\therefore$ A has the dimensions of mv = [MLT^{-1}] which are the dimensions of impulse ($F \times t$).

6. (2)
The two bodies will collide at the highest point if both cover the same vertical height in the same time. So $\frac{v_1^2 \sin^2 30°}{2g} = \frac{v_2^2}{2g}$ or $\frac{v_2}{v_1} = \sin 30° = \frac{1}{2} = 0.5$

7. (2)
Maximum acceleration is represented by maximum slope of velocity-time graph. It is for portion CD of graph.

Slope of $CD = \frac{60-20}{40-30} = \frac{40}{10} = 4\text{m/s}^2$

8. (1)
$t = ax^2 + bx$
Differentiate the equation with respect to t

$1 = 2ax\frac{dx}{dt} + b\frac{dx}{dt}$

or 1=2axv + bv $\left(As\frac{dx}{dt} = v\right)$

or $v = \frac{1}{2ax+b}$

or $\frac{dv}{dt} = \frac{-2a(dx/dt)}{(2ax+b)^2} = 2av \times v^2$

or Acceleration = -2av^3

9. (2)
$v = \alpha\sqrt{x}$

or $\frac{dx}{dt} = \alpha\sqrt{x}$ or $\frac{dx}{\sqrt{x}} = \alpha dt$

or $\int\frac{dx}{\sqrt{x}} = \alpha\int dt$ or $2x^{1/2} = \alpha t + C_1 2$

where C_1 is the constant of integration
Given : x = 0, t = 0
$\therefore C_1 = 0$

$\therefore 2x^{1/2} = \alpha t$ or $x = \left(\frac{\alpha}{2}\right)^2 t^2$ or $x \infty t^2$

10. (2)
Let v_w be the velocity of water and v_b be the velocity of motor boat in still water. If x is the distance covered, then as per question

$x = (v_b + v_w) \times 6 = (v_b - v_w) \times 10$

On solving, $v_w = \frac{vb}{4}$

$\therefore \left[v_b + \frac{v_b}{4}\right] \times 6 = 7.5vb$

Time taken by motor boat to cross the same distance in still water is

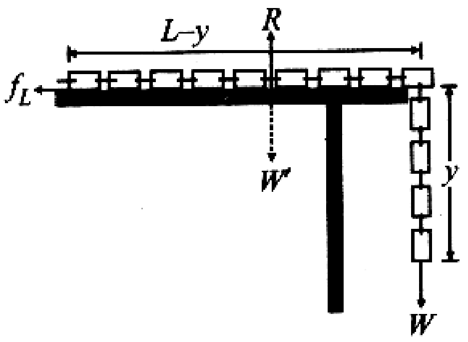
$t = \frac{x}{v_b} = \frac{7.5v_b}{v_b} = 7.5$ hours

11. (1)

(a) : If y is the maximum length of chain which can hang outside the table without sliding, then for equilibrium of the chain, the weight of hanging part must be balanced by force of friction on the portion on the table :

$W = f_L$ ...(i)

But from figure



$W = \frac{M}{L} yg$ and $R = W' = \frac{M}{L}(L - y)g$

so that $f_L = \mu R = \mu \frac{M}{L}(L - y)g$

Substituting these values of W and f_L in eqn. (i), we get

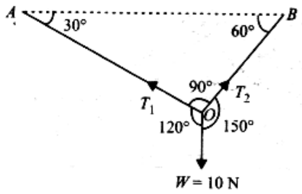
$$\frac{M}{L} yg = \mu \frac{M}{L}(L - y)g$$

On simplification we get $y = \left(\frac{\mu L}{1+\mu}\right)$

12. (3)

Various forces acting on the ball are shown in figure.

Using Laxi's therorem, according to figure,



$$\frac{T_1}{\sin 150°} = \frac{T_2}{\sin 120°} = \frac{10}{\sin 90°}$$

$$\frac{T_1}{\sin 30°} = \frac{T_2}{\sin 60°} = \frac{10}{1}$$

$T_1 = 10 \sin 30° = 10 \times 0.5 = 5$ N

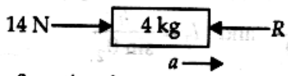
and $T_2 = 10 \sin 60° = 10 \times \frac{\sqrt{3}}{2} = 5\sqrt{3}$ N

13. (2)

Common acceleration of the system,

$$a = \frac{14\text{ N}}{4\text{ kg} + 2\text{ kg} + 1\text{ kg}} = \frac{14}{7}\text{ ms}^{-2} = 2\text{ ms}^{-2}$$

Let R be the contact force between 4 kg and 2 kg blocks. The free body diagram of 4 kg block is as shown in the figure.



The equation of motion is

$14 - R = 4a$

$R = 14 - 4 \times 2 = 6$ N

14. (1)

On smooth inclined plane, the acceleration of body down the plane = g sin θ. For rough inclined plane, the downward acceleration of body = g sin θ - μg cos θ: Let l be length of inclined plane, then

$$l = \frac{1}{2}(g \sin\theta)t^2$$

And $l = \frac{1}{2}(g \sin\theta - \mu g \cos\theta)\,(nt)^2$

$$\therefore \frac{1}{2}(g \sin\theta)\,t^2 = \frac{1}{2}(g \sin\theta - \mu g \cos\theta)(nt)^2$$

$\sin\theta = (\sin\theta - \mu\cos\theta)n^2$

$= n^2 \sin\theta - \mu n^2 \cos\theta$

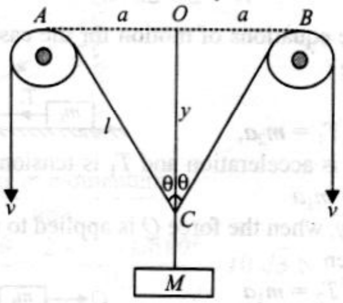
or $\mu n^2 \cos\theta = (n^2 - 1)\sin\theta$

or $\mu = \frac{(n^2-1)\sin\theta}{n^2\cos\theta}$

or $\mu = \tan\theta\left(1 - \frac{1}{n^2}\right)$

15. (4)

Let $AC = l$, $AO = a$ and $OC = y$



As shown in figure

$$l^2 = a^2 + y^2$$

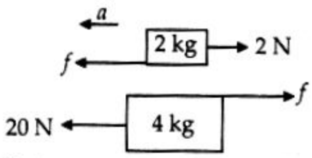
Differentating it with respect to time, we have

$$2l\frac{dl}{dt} = 2y\frac{dy}{dt} \qquad (\because a = \text{constant})$$

or $$\frac{dy}{dt} = \frac{l}{y}\frac{dl}{dt} = \frac{1}{\cos\theta}\frac{dl}{dt} = \frac{v}{\cos\theta} \qquad \left[\because \frac{dl}{dt} = v\right]$$

16. (1)

Let f be the force of friction between the two blocks. Let a be the acceleration of the two blocks to the left. The free body diagram of two blocks is shown in the figure.



Their equations of motion are

$$f - 2 = 2a \qquad ...(i)$$

$$20 - f = 4a \qquad ...(ii)$$

Solving (i) and (ii), we get $f = 8$ N

Maximum force of friction,

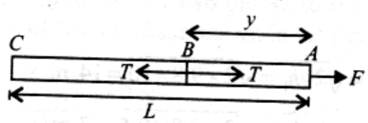
$$f_{max} = \mu mg = \frac{1}{2} \times 2 \times 10 = 10 \text{ N}$$

As the blocks move together, $f < f_{max}$

$\therefore$ $f = 8$ N.

17. (3)

Acceleration of the rope, $a = (F/M)$ ... (i)



Now, considering the motion of the part AB of the rope [which has mass $(M/L)y$ and acceleration given by eq.(i)] assuming that tension at B is T.

$$F - T = \left(\frac{M}{L}y\right) \times a \quad \text{or} \quad F - T = \frac{M}{L}y \times \frac{F}{M} = \frac{Fy}{L}$$

or $$T = F - F\frac{y}{L} = F\left(1 - \frac{y}{L}\right)$$

18. (2)

Just before the string is cut, force on the spring pulling up $= kx = 3mg$

After string is cut, free body diagram of block A is as shown in figure (i).

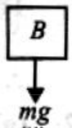
(i)

$\therefore\ 2ma_A = 3mg - 2mg$

or $a_A = \dfrac{mg}{2m} = \dfrac{g}{2}$

Free body diagram of block B as shown in figure (ii).

$\therefore\ ma_B = mg$ or $a_B = g$



(ii)

19. (4)

Change of momentum of one bullet

$= m(v-u)$

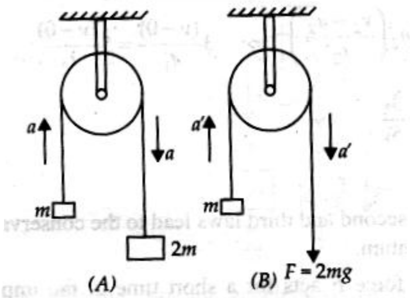
$= 0.03 \times \{50 - (-30)\}$

$= 2.4\ \text{kg m s}^{-1}$

Average force = rate of change of momentum of 200 bullets

$= 200 \times 2.4 = 480\ \text{N}$

20. (3)



In case A, the acceleration of mass m is

$a = \dfrac{(2m-m)g}{m+2m} = \dfrac{g}{3}$

In case B, the acceleration of mass m is

$a' = \dfrac{2mg - mg}{m} = g$

$\therefore\ \dfrac{a}{a'} = \dfrac{1}{3}$

46. (2)

$$\text{Molarity} = \frac{10\text{xdx}(\text{m/m})\%}{\text{Molarmassofsolute}} = \frac{10\times 98\times 1.96}{98} = 19.6\,\text{M}$$

Normality of $H_2SO_4 = 2\times\text{Molarity} = 2\times 19.6 = 39.2\,\text{N}$

47. (2)

10 mg per mL $\Rightarrow 10\,\text{g}$ per litre $= \dfrac{10}{40}\text{M} = 0.25\,\text{M}$

Use , $M_1V_1 = M_RV_R$; $M_1 = 0.5$M, $V_1 = 300$ml , $M_2 = 0.25$ M, $V_R = 300\text{ml} + V_2$

So on solving , the Volume of water added is 300 ml.

48. (2)

Number of atoms $= 3\times$ Number of moles $\times$ Avogadro Number

$$= 3\times 0.1\times 6.02\times 10^{23} = 1.806\times 10^{23}$$

49. (4)

$$\text{Molarity} = \frac{\text{Moles}}{\text{V in mL}} = \frac{\left(6.02\times 10^{20}\right)/\left(6.02\times 10^{23}\right)}{(100)/(1000)} = 0.01$$

50. (4)

$$\underset{\substack{24+12+48 \\ =84}}{MgCO_3} \longrightarrow \underset{\substack{24+16 \\ =40}}{MgO} + CO_2$$

40 g MgO $\equiv$ 84 g $MgCO_3$

$$8\text{ g MgO} = \frac{84\times 8}{40} = 16.8$$

$$\%\text{purityofMgCO}_3 = \frac{16.8\times 100}{20} = 84\%$$

51. (3)

Let 100 g of iron be kept inair and x g be oxidized (rusted)

$$4Fe + 3O_2 \rightarrow 2Fe_2O_3$$

For 4×56 g Fe, increase in weight $= 3\times 32$ g

For x g Fe, increase in weight $= \frac{3\times 32\times x}{4\times 56} = 0.428\,x$ gram

For 100 g iron, total increase in weight $0.428x = 4.28$ (given)

$$x = \frac{4.28}{0.428} = 10$$

52. (3)

$$m = \frac{n_B}{w_A\,(kg)} = \frac{0.01}{60}\times\frac{1}{0.3} = 5.55\times 10^{-4}$$

53. (3)

Order of difference of energy $E_2 - E_1 > E_3 - E_2 > E_4 - E_3 > \ldots$

So, $E_6 - E_1 > E_5 - E_3 > E_5 - E_4 > E_6 - E_5$

54. (2)

Orbital angular momentum $= \sqrt{l(l+1)}\times\frac{h}{2\pi} = \sqrt{1(1+1)}\times\frac{h}{2\pi}$ (For p, $l = 1$)

$$= \sqrt{2}\times\frac{h}{2\pi} = \frac{h}{\sqrt{2}\pi}$$

55. (3)

Valence electron is $5s^1 \rightarrow n = 5, l = 0, m = 0, s = +\frac{1}{2}$

56. (1)

$\lambda = \dfrac{h}{mv}; KE = \dfrac{1}{2}mv^2 \quad \Rightarrow \quad KE = \dfrac{h^2}{2m\lambda^2}$

For h and λ being constant, $KE \propto \dfrac{1}{m}$

57. (4)

No. of spectral lines $= \sum \Delta n = \sum(6-3) = \sum 3 = 3+2+1 = 6$. There is no line in Balmer series as the electron comes to 3rd shell

58. (2)

Spherical nodes for $3p_z n - l - 1 = 3-1-1 = 1$

Angular nodes for $3p_z = l = 1$

Nodal planes for $3p_z = l = 1$

59. (4)

$r_n = 0.529 \times \dfrac{n^2}{Z} Å$

$n^2 = \dfrac{8.46 \times 1}{0.529}$

Electrons $= 2n^2 = 2 \times \dfrac{8.46}{0.529} = 32$

60. (2)

Down the group ionization enthalpy decreases.

61. (3)

Higher the s-character, higher is th eelectronegativity.

62. (2)

Though 'b' and 'd' have the same electronic configuration in valence shell., yet 'b' is smaller in size.

63. (4)

64. (1)

The species are isoelectronic. Higher the charge of nucleus, smaller the size.

65. (2)

Negative ion O^- repels the incoming electron.

66. (4)

All pairs show diagonal relation.

67. (1)

68. (1)

69. (3)

SF_4 and I_3^- and PCl_5 are sp^3d-hybridised. In general $PCl_5(g)$ is considered sp^3d. In solid state, PCl_5 exists as $(PCl_4)^{\oplus}(PCl_6)^-$ with sp^3 and sp^3d^2-hybridizations respectively.

$SbCl_5^{2-}$ has 5σ bonds and one lone pair. It is sp^3d^2-hybridised.

70. (1)

In SF_4,sulphur atom is sp^3d-hybridised with two axial and two equatorial F-atoms and one lone pair on equatorial position.

71. (4)

Highest product of charges of ions

72. (1)

Radii of cations, $Si^{4+} < Al^{3+} < Mg^{2+} < Na^+$. So, the covalent character of chloride are a sper the choice (a) according to Fajan's rule

73. (1)

74. (1)

75. (3) a (van der Walls' constant) is a measure of attractive force. Larger the value of a greater the liquefaction.

76. (4)

$$n_{H_2} = \frac{pV}{RT} = \frac{20000}{RT}$$

$$n_{He} = \frac{pV}{RT} = \frac{20000}{RT}$$

$$\therefore \quad n_{H_2} + n_{He} = \frac{40000}{RT}$$

Total volume = 300 mL

$$p = \frac{n}{V}RT = \frac{40000}{RT}$$

Total volume = 300 mL

$$p = \frac{n}{V}RT = \frac{40000\,RT}{RT \times 300}$$

$$= \frac{400}{3} = 133.33\,\text{Torr}$$

77. (2)

$$\frac{r_{H_2}}{r_{O_2}} = \sqrt{\frac{32}{2}} = 4$$

$$r_{H_2} = 4r_{O_2} = 4 \times \frac{4}{32}\,\text{mol}\,H_2 = \frac{4 \times 4 \times 2}{32}\,\text{g}\;H_2 = 1\text{g}$$

78. (3)

79. (1)

80. (4)

81. (2) $\frac{pV}{RT} = z, \quad z < 1$

$\therefore \quad \frac{pV}{RT} < 1$

at STP $\quad \frac{p}{RT} = \frac{1}{0.0821 \times 273} = \frac{1}{22.4}$

$\therefore \quad \frac{V_m}{22.4} < 1$

82. (1) $pV = nRT$

$n \propto T^{-1}$

$\frac{n_2}{n_1} = \frac{T_1}{T_2} = \frac{300}{400} = \frac{3}{4}$

(91) (3)
(92) "ORDER" ends with ale
(93) NCERT. Pg No. 11 Table 1.1
(94) NCERT. Pg No. 12
(95) NCERT. Pg No. 20
(96) Spore mother cell undergoes meiosis to produce spore
(97) NCERT. Pg No. 20
(98) NCERT. Pg No. 24
(99) Bacteria divides once in 30 mins
Given duration is 12 hrs = 720 mins
No. of generation = $\frac{720}{30}$ =24
Thus 2^{24} bacteria formed after 12 hours
(100) NCERT. Pg No. 26
(101) NCERT. Pg No. 27
(102) NCERT. Pg No. 23,24
(103) NCERT. Pg No. 32,33,34
(104) NCERT. Pg No. 38
(105) NCERT. Pg No. 35
(106) NCERT. Pg No. 33
(107) NCERT. Pg No. 30
(108) NCERT. Pg No. 32
(109) NCERT. Pg No. 30
(110) The sequence of stages are
Protonema $\rightarrow$ Gametophore $\rightarrow$ Gamete $\rightarrow$ Embryo $\rightarrow$ Sporophyte
[structure containing sex organs]
(111) NCERT. Pg No. 42
Funaria is a bryophyte.
(112) NCERT. Pg No. 35,36

(113) Sperm mother cell is a part of gametophytic body, thus haploid, rest all are diploid
(114) NCERT. Pg No. 32

136. (1)
Monocytes – WBC – Phagocytosis
Heparin is secreted by mast cell & Basophils.
137. (2)
138. (4)
139. (4)
140. (3)
141. (2)
142. (2)
143. (3)
In cockroach, each ovary made of 8 ovarioles larval stage is called nymph. They are uricotelic
144. (3)
145. (3)
146. (1)
Crocodiles have 4 chambered heart. Fishes heart pumps deoxygenated blood. Both vertebrates and in vertebrates have heart
147. (2)
Ornithorhynchus, Hemidactylus, Neophronn and struthio are oviparous.
148. (2)
149. (1)
Devil fish – Octopus (Mullusca)
Cuttle fish – Sepia (")
Silver fish – Lepisma (Arthropoda)
150. (3)
9n Echinoderms anus is dorsally located
151. (2)
Fasciola has protonephridia for excretion
152. (4)
153. (2)
154. (2)
Fasciola shows blind sac pattern
155. (3)
156. $1700\,\overset{o}{A}/3.4\,\overset{o}{A} = 500$ base pairs $\rightarrow$ 1000 bases/nucleotides
157. product accumulation decreases the enzyme activity so decreasing product will prevent inhibition of enzymes
158. On heating or hydrogenation, unsaturated fats become saturated.
159. (1)
a- transferase – hexokinase that transfers phosphate group
b- isomerase as both glucose 6- phosphate and fructose 6- phosphate are isomers
160. (1)
161. Adenine & thymine are N_2 bases only.
162. $Km\,\alpha \dfrac{1}{\text{affinity}}$ b/w E & S
163. All PUFA are Essential fatty acids.
164. Parietal cells secrete HCl which convert pepsinogen into pepsin
165. (2)
166. (2)
167. (1)

168. B_{12} (cobalamine) B_9 (Folic acid)
169. (3)
170. V $\rightarrow$ Mucosa, W $\rightarrow$ Submucosa
171. CO_2 is more soluble, diffusion capacity of CO_2 is 4ml / dl of blood, at low pH. Oxyhaemoglobin dissociates.
172. H^+ bind readily with Hb in presence of CO_2 (Bohr's effect)
173. (2)
174. (2)
175. (1)
176. (4)
177. Pneumotaxic centre in pons control switch off point of inspiration.
178. (2)

179. (4)
Osteichthyes have swim bladder not chondrichthyes.

180. (4)
Reptiles , Aves and mammals have amniotic egg.