Physics

1. **(d)** $M = L = \frac{\phi}{I}$

2. **(b)** $X_L = X_C$ circuit is in resonance

$V = V_L - V_C = 0$

$I = \frac{V}{R} = \frac{90}{45} = 2$

3. **(c)** $K = \frac{1}{LC} \Rightarrow K \propto \frac{1}{C}$

4. **(b)** $\frac{1}{2}LI_0^2 = \frac{Q_0^2}{2C} \Rightarrow Q_0 = I_0\sqrt{LC}$

5. **(c)**

6. **(b)** Accelerated charges can produce electromagnetic waves

7. **(b)** When a light wave passes from one medium to other, then due to change in refractive index its velocity and wavelength changes.
So due to change in its velocity and direction, wave bents.

8. **(d)** $\frac{f_w}{f_a} = \frac{(\mu_g - 1)}{\left(\frac{\mu_g}{\mu_w} - 1\right)}$

9. **(d)** $p_1 = \frac{1}{f_1} + \frac{1}{f_2}, p_2 = \frac{1}{f_1} - \frac{1}{f_3}, p_3 = \frac{1}{f_2} - \frac{1}{f_3}$

10. **(b)** $V = f = 30\ \text{cm}, \frac{I}{O} = m = \frac{f}{f - u'}, u' = (30 - 26)\text{cm}$

11. **(b)** $n\lambda = a\sin\theta$

12. **(a)**

13. **(b)**

$I_R = 4I_0\cos^2\frac{\phi}{2}, \frac{\phi}{2} = \pi(\Delta x) = \pi d\frac{x}{D}$

14. **(d)** $\frac{1}{2}mv^2 = E - W_0$

15. **(d)**

$\frac{{p_1}^2}{2\,m} = \frac{1}{8}mc^2, p_2 = mc$

16. **(d)**

17. **(b)** $E = -13.6eV\frac{Z^2}{n^2}$

18. **(d)** Number of stationary waves is 6 i.e., $n = 6$

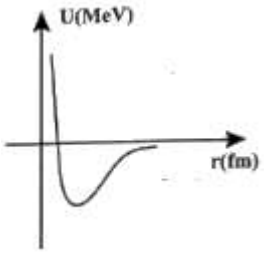
$$r = \frac{n^2\varepsilon_0^2h^2}{\pi me^2}$$
$$= \frac{36\varepsilon_0^2h^2}{\pi me^2}$$

19. **(b)**

$$\lambda = \frac{h}{p} = \frac{hr}{mvr} = \frac{hr}{\left(\frac{3\,h}{2\pi}\right)}$$

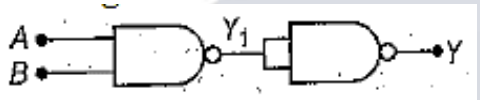
$$r = a_0\left(\frac{n^2}{z}\right)$$

20. (d)



21. (b) Elastic collision of neutrons with heavy nuclei will not slow them down
22. (b) The circuit can be shown as in figure

The two gates shown are NAND gates
The output of first gate $Y_1 = A.\,B$
The output of second gate $Y = \overline{Y_1 \cdot Y_1} = \overline{\overline{A \cdot B} \cdot \overline{A \cdot B}} = \overline{\overline{A.B}} = A.B$
Thus the given combination behaves as an AND gate.



23. (d) LED is heavily doped operates in forward bias.
24. (a)
25. (b) $S =$ Area under $v - t$ graph
Area under uniform motion > Area under triangle
26. (b)

$V_{max} =$ area of $a - t$ graph

$$V_{max} = \frac{1}{2}(10)(8) = 40\ m/s$$

27. (c)

$$\frac{u^2}{g} = 16(10)^3 \Rightarrow u = \sqrt{16 \times 10^3 \times g} = 400\ m/s$$

28. (d)
29. (a) Only one point
30. (d)

$$x = u_x t + \frac{1}{2}a_x t^2 \Rightarrow 16 = 0 + \frac{1}{2}(8)t^2 \Rightarrow t = 2\ s$$

$$\therefore y = u_y t + \frac{1}{2}a_y t^2 \Rightarrow y = 10(2) + \frac{1}{2}(2)(2)^2 = 24\ m$$

31. (a) $mr\omega^2 = \mu mg \Rightarrow r \propto \frac{1}{\omega^2} \Rightarrow r_2 = r_1\left(\frac{\omega_1}{\omega_2}\right)^2$

32. (b)

$$V_1 = \frac{(m_1 - em_2)u_1 + m_2(1+e)u_2}{m_1 + m_2}$$

$$V_2 = \frac{m_1(1+e)u_1 + (m_2 - em_1)u_2}{m_1 + m_2}$$

$u_1 = 12\ m/s, u_2 = -24\ m/s, m_1 = 1\ kg,\ m_2 = 2\ kg$

33. (c)

34. (c)

$$\frac{1}{2}mv^2(1+\beta) = E$$

$$\frac{1}{2}\ m(1+\beta) = \frac{3}{2}$$

$$1 + \beta = \frac{3}{2}$$

$$\beta = \frac{1}{2}$$

35. (b) $F = \frac{Gm_1\ m_2}{r^2}$

$$F_1 = \frac{G(16)}{1}$$

$$F_2 = G(16)$$

$$F' = \sqrt{F_1^2 + F_2^2 + 2\ F_1\ F_2 \cos\theta}$$

$$= 16h$$

$$F' + F'' = 0$$

$$16G + \frac{8G}{r^2} = 0$$

$$\frac{8G}{r^2} = -16G$$

$$r^2 = \frac{1}{2} \Rightarrow r = \frac{1}{\sqrt{2}}$$

36. (b) $h \propto \frac{1}{r}$

37. (b) We know $PV = nRT$ or $\frac{1}{T} = \frac{nR}{PV}$

Since, P is constant, $P\Delta V = nR\Delta T$

(or) $\frac{\Delta V}{\Delta T} = \frac{nR}{P}$

Coefficient of volume expansion $\alpha_v = \frac{\Delta V}{V\Delta T}$

$\alpha_v = \frac{nR}{PV} = \frac{1}{T}$

38. (b) $n = 1 - \frac{T_L}{T_H}$ At constant T_L, efficiency increases with the increase in T_H.

39. (c) $du = \frac{f}{2}nRT$

40. (a)

41. (d) Young's and Bulk modulus

42. (a) $F = ma$

$qE = m\omega^2 x$

43. (b) $E = \frac{\lambda}{2\pi\varepsilon_0 r}$

44. (c)

$EqX = \frac{1}{2}mv^2$

45. (b) $x = t\left(1 - \frac{1}{k}\right)$

46. (a) $C' = n^{\frac{1}{3}}C$

47. (c) Do not possess permanent dipole moments

48. (d) No. of capacitors in a row,

$$n = \frac{\text{desired voltage}}{\text{voltage across each capacitor}}$$

$n = \frac{1500}{500} = 3$

No. of rows, $m = \frac{\text{desired capacitance}}{\text{Total capacitance in each row}}$

$m = \frac{6}{\left(\frac{2}{3}\right)} = 9$

Total no. of capacitors $= n \times m = 3 \times 9 = 27$

49. (b) $C = \frac{Q}{V}$

$U = \frac{1}{2}QV$

50. (d) $R \propto \ell^2$

51. (c)

$R = \frac{\rho l}{\pi r^2}$

52. (d) time $T = \frac{L}{V_d}, I = neAV_d$

53. (b) If charges mode without collisions through the conductor, kinetic energy would also change so that the total energy is unchanged.
Then $\Delta K = -\Delta U = IV\Delta t$

54. (c)

55. (a)

$$\frac{F}{L}=\frac{\mu_0 I_1 I_2}{2\pi r}$$

56. (d) for $r < R_1, B = 0$

for $R_1 < r < R_2$, $B =$ Cons tant

57. (b) $V = \frac{BqR}{2\,m}$

58. (b)

59. (c) Time varying magnetic field causes time varying electric field.

60. (b) $e = L\frac{dI}{dt}$

$= 3 \times 10^{-4}$

Chemistry

61. (c) $A_{(g)} + B_{(g)} \rightleftharpoons C_{(g)} + D_{(g)}; \Delta H = -QKJ$

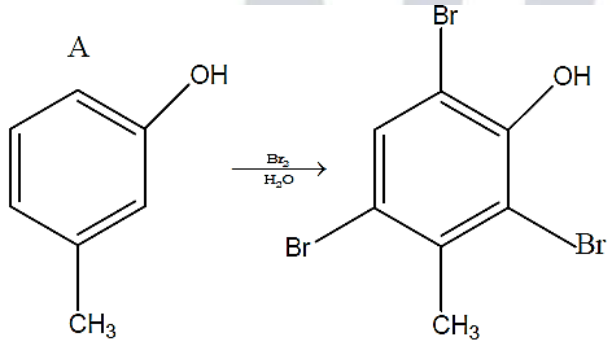
Pressure has no effect on equilibrium state if $\Delta n = 0$

62. (c)

$$CH_3 - \overset{X}{C}H_2 - OH \xrightarrow[CH_2Cl_2]{PCC} CH_3 - \overset{Y}{C}HO \xrightarrow[NaOH]{I_2} CHI_3 + HCOONa$$

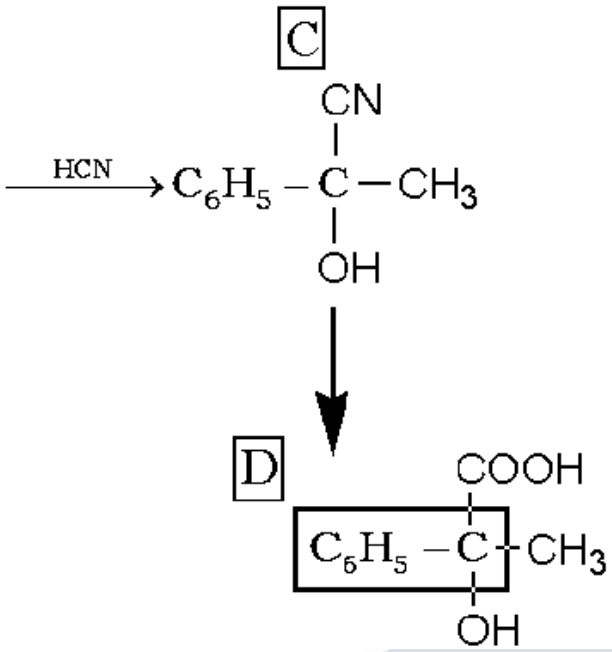
$$\therefore X = CH_3CH_2OH$$

63. (b)



64. (d)

$$CH_3-COOH \xrightarrow{SoCl_2} \overset{A}{CH_3COCl} \xrightarrow[\text{anhydrous } AlCl_3]{C_6H_6} \overset{B}{C_6H_5COCH_3}$$



65. (d) Acidic strength ∝ Ka

The conjugate base of a weakest acid is strongest ∴ HCN($K_a = 4 \times 10^{-10}$) (least value)

66. (c)

$$A \rightarrow CH \equiv CH \xrightarrow[H_2SO_4]{HgSO_4} CH_2 = CH-OH \underset{\text{Tautamerises}}{\rightleftharpoons} CH_3CHO$$

$$B \rightarrow CH_3CH_2OH \xrightarrow{PCC} CH_3CHO$$

$$C \rightarrow CH_3CN \xrightarrow[(ii)\,H_3O^+]{(i)\,SnCl_2/HCl} CH_3CHO$$

67. (a)

$$CH_3COOH \xrightarrow{LiAlH_4} CH_3CH_2OH$$

68. (b)

$$CH_3CHO \xrightarrow[(ii)\,H_3O^+]{(i)\,CH_3MgBr} \underset{A}{CH_3-\overset{CH_3}{\overset{|}{C}}H-OH} \xrightarrow[\Delta]{conc.H_2SO_4}$$

$$\underset{B}{CH_3-CH=CH_2} \xrightarrow[(ii)\,H_2O,OH^-]{(i)\,B_2H_6} \underset{C}{CH_3CH_2CH_2OH}$$

∴ A and C are position isomers.

69. (d)

70. (c)

71. (a)

$$C_6H_5CH_2Cl \xrightarrow{alc.NH_3} C_6H_5\overset{A}{C}H_2NH_2 \xrightarrow{2CH_3Cl} C_6H_5CH_2\overset{B}{N}(CH_3)_2$$

72. (d)
73. (c)
74. (b) Optically active compound is option B.
75. (a)
76. (c)
77. (c)
78. (a)
79. (a)
80. (b)

Be Al O = No. of oxide ions invoved in CCP

Sol. $\frac{N}{4} : \frac{2N}{4} : N \therefore$ octahedral voids = N

1: 2 : 4 Tetrahedral voids = 2 N

81. (c) Frenkel defect - dislocation defect

Schottky defect - decreases density

F-centre - Trapping of on electrons in the lattices

82. (a)

$$d = \frac{ZM}{a^3 N_A}$$

$$M = \frac{da^3 N_A}{Z} = \frac{6.15 \times (300 \times 10^{-10})^3 \times 6 \times 10^{23}}{2}$$
$$\cong 50 \text{ g mol}^{-1}$$

83. (a) $P_{N_2} = X_{N_2} \cdot P_{total}$

$= 0.8 \times 5 = 4$ atm

$P_{N_2} = K_H \cdot X_{N_2}$

$4 = 10^5 . X_{N_2}$

$X_{N_2} = 4 \times 10^{-5}$

$X_{N_2} = \frac{n_{N_2}}{n_{N_2} + n_{H_2O}} (n_{N_2} \ll\ll\ll n_{H_2O})$

$4 \times 10^{-5} = \frac{n_{N_2}}{10}$

$n_{N_2} = 4 \times 10^{-4}$

84. (d)

$2.4\ \text{gC} = \frac{2.4}{12} = 0.2\ \text{mol}$

1.2×10^{23} atoms of $\text{H} = \frac{1.2\times10^{23}}{6\times10^{23}} = 0.2\ \text{mol}$

0.2 mole of 'O' atoms

$\therefore$ simplest ratio $= \text{C: H: O}$

$0.2: 0.2: 0.2$
$=\text{CHO}$

85. (c) K_H value changes with solvent nature Higher the K_H less is solubility K_H value increase with increase of ' T ' Eerily liquefied gases have high K_H value

86. (a) $P_H = K_H \times$

$K_H \propto \frac{1}{X(\text{ solubility })}$

$\therefore$ more is the K_H less is the solubility

87. (a)

$P_{\text{total}} = P_A^O X_A + P_B^O X_B = P_A^\circ X_A + P_B^O(1 - X_A)$

$600 = 450.X_A + 700(1 - X_A)$

$X_A = 0.4$

$X_B = 1 - 0.4 = 0.6$

88. (c)

$Zn^{2+}{}_{(aq)} + 2e^- \rightarrow Zn_{(s)}$

$E_{red} = E_{red}^\Theta - \frac{0.059}{n}\log\frac{1}{[Zn^{2+}]}$

$E_{red} = -0.76 + \frac{0.059}{2}\log[Zn^{2+}]$

as$[Zn^{2+}] \uparrow E_{red} \uparrow$

89. (b) No. of angular nodes $= l = 1$ (3p)

No. of radial nodes $= n - l - 1 = 3 - 1 - 1 = 1$

90. (a)

$G^* = KR$

$= 0.146 \times 10^{-3} \times 1500$
$= 0.219$

91. (a)

$$\log K_c = \frac{E^{\Theta}_{cell} \times n}{0.059} = \frac{0.22 \times 2}{0.059} = 7.45$$

$$K_c = \text{Antilog}(7.45) = 2.8 \times 10^7$$

92. (a) As ['B'] increase, $t_{\frac{1}{2}}$ remains same

i.e. 1^{st} order with respect to ' B '

rate $= k[A]^0[B]^1$

overall order $= 1$

$\therefore$ units of $k = S^{-1}$

93. (b)
94. (a)

$$t = \frac{2.303}{k}\log\frac{[R]_0}{[R]}$$

$$= \frac{2.303}{k}\log\left(\frac{100}{1}\right)$$

$$= \frac{4.606}{k}$$

95. (c)

$$\text{rate} = K[A]^1[B]^2 = K\left[\frac{n}{v}\right]_A^1\left[\frac{n}{v}\right]_B^2$$

$$= K\left[\frac{\frac{n}{v}}{2}\right]^1\left[\frac{n}{v}\right]^2$$

$$=' 8' K\left[\frac{n}{v}\right]^1\left[\frac{n}{v}\right]^2$$

'8'times increases

96. (a)
97. (c)
98. (d)
99. (a) As ions are moving toward anode i.e. negatively charged colloid

$$\text{Coagulation value} \propto \frac{1}{\text{cogulating power}}$$

$\therefore Na^{+1} > Ba^{+2} > Al^{+3}$

100. (d)
101. (c)
102. (b)
103. (b)

104. **(b)**
105. **(c)**

$XeF_6 + H_2O \rightarrow XeOF_4 + 2HF(XeOF_4$ - square pyramidal)

$XeF_6 + 2H_2O \rightarrow XeO_2F_2 + 4HF(XeO_2F_2 - \text{See} - \text{saw})$

106. **(c)**

$$\underset{P}{2NO} + O_2 \rightarrow \underset{Q}{2NO_2} \rightarrow \underset{R}{N_2O_4} \xrightarrow{2NO} \underset{S}{2N_2O_3}$$

107. **(c)**
108. **(d)**
109. **(b)**

$PV = nRT$

$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$ $\frac{P \times V_1}{T} = \frac{P}{2} \times \frac{V_2}{2T}$ $V_2 = 4V_1$

110. **(d)**
111. **(b)**
112. **(b)**
113. **(a)**
114. **(c)**
115. **(a)** Wave length of light absorbed is inversely proportional to strength of the ligand.
116. **(b)** Free radical substitution of alkane part. (Benzyl free radical) takes place.
117. **(c)** Assume bond strength of $A_2 = 2X$, then, $B_2 = X, AB = 2X$

$\Delta_r H^\Theta = \sum \Delta_{diss} H^\Theta_{(R)} - \sum \Delta_{diss} H^\Theta_{(P)}$

$\frac{1}{2} A_2 + \frac{1}{2} B_2 \rightarrow AB$

$-100 = \frac{1}{2}2X + \frac{1}{2}X - 2$

$X = 200$

118. **(a)**
119. **(a)**

$$CH_2 = CH - CH_2OH \xrightarrow[\text{Excess}]{HBr} CH_3CH(Br) -$$
$$CH_2OH \xrightarrow{HBr} CH_3CH(Br) - CH_2Br$$

120. **(a)** A is phenol

B is acetone

Acetone when treated with $Ba(OH)_2$ Undergoes aldol condensation and followed by heating gives 4-methylpent -3-en-2-one

Mathematics

121. **(b)** $A(-3,4,11)B(1,-2,7)$Dr 's of AB

$(a,b,c) = 1-(-3),(-2,-4)7,-11$

$4,-6,-4$

$=-2,3,2$

122. **(c)**

$$\cos\theta = \left|\frac{\sqrt{3}}{4}\times\frac{\sqrt{3}}{4}+\frac{1}{4}\times\frac{1}{4}-\frac{\sqrt{3}}{2}\times\frac{\sqrt{3}}{2}\right| = \left(\frac{-1}{2}\right), \theta = \frac{\pi}{3}$$

123. **(b)** $(1,2,3) = \left(\frac{a}{3},\frac{b}{3},\frac{c}{3}\right), a=3, b=6, c=9$

124. **(a)** $\frac{1}{2}(\overline{AC}\times\overline{BD}) = 9$ sq. units

125. **(c)** $x \le 6, y \le 3, 5x+4y \ge 20$

126. **(b)** $\frac{1}{2} = P\frac{(A\cap B)}{\frac{3}{5}} \Rightarrow P(A\cap B) = \frac{3}{10}$

$$\frac{4}{5} = \frac{3}{5} + P((A) - \frac{3}{10} \Rightarrow P((A) = \frac{1}{2}$$

127. **(c)** $P((A) = P((B) = P((C) = P$

$$P((A)\cdot P((B)\cdot P((C) + 3\cdot P^2(1-p)$$
$$P^3 + 3p^2(1-P) = 3P^2 - 2P^3$$

128. **(c)**

$(1,1)(1,2)(1,3)(1,4)(2,1)(2,2)(2,3)$

$(3,1)(3,2)(4,1)\ P((B)\ = \frac{10}{36}$

$n((A) = (1,2)(2,1)\ P((A) = \frac{2}{36}$

$$P\left(\frac{B}{A}\right) = \frac{\frac{2}{36}}{\frac{10}{36}} = \frac{2}{10} = \frac{1}{5}$$

129. **(c)**

$$= \frac{\frac{70}{100}\times\frac{80}{100}}{\frac{70}{100}\times\frac{80}{100}+\frac{90}{100}\times\frac{30}{100}} = \frac{56}{83}$$

130. **(b)** $x = \frac{65x}{100} + 15000 - \frac{15x}{100} = 30{,}000$

131. **(d)** $n(A\times(B) = 35 = 7\times5, 7_{C_5} = 7_{C_2} = 21$

132. **(d)** $|x| \neq 1$

133. **(a)** $\cos(3\times360^\circ+120^\circ) + \tan(4\times360^\circ+45^\circ)$

$= 1/2$

134. **(b)** $\tan\theta \cdot \cot\theta = 1$

135. **(d)** $\left(\frac{1+i}{1-i}\right)^x = 1 \Rightarrow i^x = 1$

136. **(a)** $R(x) - c(x) > 0; 60x + 2000 - 20x - 4000 > 0\ x > 50$

137. **(c)** ${}^{13}C_{10} - {}^{6}C_3 = 286 - 20 = 266$

138. **(a)** mid -term is $T_{26} = 300$

$T_1 = 300 - 25\ d; T_{51} = 300 + 25\ d$

$S = \frac{51}{2}[300 - 25\ d + 300 + 25\ d]$

$\frac{51}{2}[600] = 15{,}300$

139. **(b)**

$$\frac{x}{\sin\theta} - \frac{y}{\cos\theta} = \frac{a\cos^3\theta}{\sin\theta} - \frac{a\sin^3\theta}{\cos\theta}$$
$$\frac{x\cos\theta - y\sin\theta}{\sin\theta\cos\theta} = \frac{a(\cos 2\theta)}{\sin\theta\cos\theta}$$
$$x\cos\theta - y\sin\theta = a\cos 2\theta$$

140. **(b)**

$$\left(\frac{1+0+2}{3}, \frac{5+4+3}{3}, \frac{-1-2+4}{3}\right)$$

$$\left(1, 4, \frac{1}{3}\right)$$

141. **(b)** statement 1 is true

Statement 2 is false

$$\left[\frac{a+b+c}{a+b+c} = 1\right]$$

$\lim_{x\to -2} \frac{\frac{1}{x}+\frac{1}{2}}{x+2}$ is $-\frac{1}{4}$

142. **(b)** $\frac{d}{dx}\left(\frac{a}{x^4} - \frac{b}{x^2} + \cos x\right) = \left(-\frac{4a}{x^5} + \frac{2b}{x^3} - \sin x\right)$

$= ma + nb - p$

$m = -\frac{4}{x^5}; n = \frac{+2}{x^3}; p = \sin x$

143. **(c)** S.D. $= \sqrt{\frac{n^2-1}{12}} (n = 17)$

$$= \sqrt{\frac{17^2 - 1}{12}}$$

$= 2\sqrt{6}$

144. **(c)** $P(A^1 \cap B^1) = 1 - P(A \cup (B)$

$= 1 - [0.59 + 0.3 - 0.21]$

$= 0.32$

145. **(d)** $f(-2) + f(3) + f(4)$

$-6 + 9 + 8$

$= 11$

146. **(a)** $f'(x) = \frac{-2}{(x-1)^2} < 0$

f is s.d.

f is one-one

$\frac{2x}{x-1} = y \Rightarrow x = \frac{y}{y-2} \notin \pi$ for $y = 2$

f is not out

147. **(a)**

$f = \sqrt{3}\sin 2x - \cos 2x + 4 = 2\left[\sin\left(2x - \frac{\pi}{6}\right)\right] + 4$

f is one-one

$-\frac{\pi}{2} \leq 2x - \frac{\pi}{6} \leq \frac{\pi}{2}$

$\Rightarrow -\frac{\pi}{6} \leq x \leq \frac{\pi}{3}$

$\left[-\frac{\pi}{6}, \frac{\pi}{3}\right]$

148. **(a)**

$[x^2] - [x] - 6 > 0\ ([x] - 3)([x] + 2) > 0$

$[x] < -2, [x] > 3 \Rightarrow x \in (-\infty, -2) \cup [4, \infty)$

149. **(d)** $\cos\left(\pi - \frac{\pi}{6} + \frac{\pi}{6}\right) = \cos\pi = -1$

150. **(c)** $\left(\frac{\pi}{6}\right)^2$

151. **(b)** $AB = \begin{pmatrix} -3 & -2 \\ 10 & 7 \end{pmatrix}$

$(AB)^T = \begin{pmatrix} -3 & 10 \\ -2 & 7 \end{pmatrix}$

152. **(c)** $m = \begin{pmatrix} a & 0 \\ 0 & a \end{pmatrix}$

m is invertible.

153. **(b)** $|3AB| = 3^3|AB|$

$= 27 \times 3 \times 5$

$= 405$

154. **(d)** $(A + B)^{-1} = B^{-1} + A^{-1}$

155. **(a)** $f(x) = 4\cos^3 x - 3\cos x$

$= \cos 3x$

$\lim_{x\to\pi} \cos 3x = \cos 3\pi$

$= -1$

156. **(a)** $(x - 2)(x^2 - 9) = 0$

$x = 2,3,-3$

$f(x) = |A| = -12x + 60$

Max value at $x = -3$

$\therefore |A| = 96$

157. **(b)** $\lim_{x\to 1+} x^3 - 1 = 0$

$\lim_{x\to 1^-} (x - 1) = 0$

F is continuous

$f'(x) = \begin{cases} 3x^2 & 1 < x < \infty \\ 1 & -\infty < x < \end{cases}$

$f'(1^+) = 3, f'(1^-) = 1$

$\Rightarrow$ f is not differentiable

158. **(c)** $\frac{dy}{dx} = 2\cos x^2 \cdot (-\sin x^2)2x$

$= -2x\sin(2x^2)$

159. **(b)** $\frac{d}{dx}(x^x + x^a + a^x + a^a)$

160. **(a)** $x^x(1 + \log x) + ax^{a-1} + a^x \log_e^a$

$$y = \frac{\log x}{\log 10} + \log x$$

$$\frac{dy}{dx} = \frac{1}{x\log 10} + \frac{1}{x}$$

161. **(d)** $\frac{dx}{d\theta} = -\sin\theta + \frac{1}{\tan\left(\frac{\theta}{2}\right)} \cdot \sec^2\left(\frac{\theta}{2}\right)\frac{1}{2}$

$$= -\sin\theta + \frac{1}{2\sin\left(\frac{\theta}{2}\right)\cos\left(\frac{\theta}{2}\right)} = -\sin\theta + \frac{1}{\sin\theta}$$

$$= \frac{1-\sin^2\theta}{\sin\theta}; \frac{dx}{d\theta} = \frac{\cos^2\theta}{\sin\theta}; \frac{dy}{d\theta} = \cos\theta$$

$$\frac{dy}{dx} = 0; \tan\theta = 0$$

$$\theta = n\pi, n \in Z$$

162. **(d)** $\log y = 2\log(x-1) + 3\log(x-2) + 5\log(x-3)$

$$\frac{dy}{dx} = (x-1)^2(x-2)^2(x-3)^5\left[\frac{2}{x-1} + \frac{3}{x-2} + \frac{5}{x-3}\right]$$

$$\left(\frac{dy}{dx}\right)_{x=4} = 516$$

163. **(d)** $\frac{d\theta}{dt} = \frac{2t}{20} + \frac{1}{5}$

$$= \frac{t}{10} + \frac{1}{5}$$

$$\left(\frac{d\theta}{dt}\right)_{\varepsilon=4} = \frac{4}{10} + \frac{1}{5}$$

$$k = \frac{3}{5}$$

$$5k = 3$$

164. **(c)** $y = \alpha x^2 - 6x + \beta$ passes through $(0,2)$ $2 = \beta$

$$\frac{dy}{dx} = 2\alpha x - 6$$

$$\left(\frac{dy}{dx}\right)_{x=\frac{3}{2}} = 0$$

$$2\alpha\left(\frac{3}{2}\right) - 6 = 0$$

$$3\alpha = 6$$

$$\alpha = 2$$

165. **(a)** $f'(x) < 0; 2(x-1) < 0$

$$x < 1;\ x \in (-\infty, 1)$$

166. **(c)** Slope $m = \frac{dy}{dx} = -3x^2 + 6x + 2$

$\frac{dm}{dx} = 0\ ;\ -6x + 6 = 0$

$x = 1;\ m = -3 + 6 + 2 = 5$

167. **(a)** $\text{Tan}^{-1}x^4 = t; \frac{4x^3}{1+x^8}dx = dt$

$I = \frac{1}{4}\int \sin t dt = \frac{-1}{4}\cos t + c = \frac{-1}{4}\cos(\text{Tan}^{-1}x^4) + c$

168. **(c)** $x^3 = t\ 3x^2dx = dt$

$I = \frac{1}{3}\int \frac{1}{\sqrt{t^2 + (a^3)^2}}dt = \frac{1}{3}\log\left[t + \sqrt{t^2 + a^6}\right]$

$= \frac{1}{3}\log\left[x^3 + \sqrt{x^6 + a^6}\right] + c$

169. **(d)** $\int \frac{(x+1-1)e^x}{(1+x)^2}dx = \int e^x\left(\frac{1}{1+x} - \frac{1}{(1+x)^2}\right)dx = \frac{e^x}{1+x} + c$

170. **(a)** $\int e^x\left(\frac{1+2\sin\frac{x}{2}\cos\frac{x}{2}}{2\cos^2\frac{x}{2}}\right)dx$

$= \int e^x\left(\frac{1}{2}\sec^2\frac{x}{2} + \text{Tan}\frac{x}{2}\right)dx$

$= e^x\text{Tan}\frac{x}{2} + c$

171. **(d)** $I_n + I_{n-2} = \frac{1}{n-1}$

172. **(b)**

$\int_a^b \frac{f(x)}{f(x) + f(a+b-x)}dx = \frac{b-a}{2}$

173. **(a)** $x^2 + y^2 = 16$

$\frac{1}{2}\pi(4)^2 = 8\pi$

174. **(a)** $\frac{x^2}{25} + \frac{y^2}{\lambda^2} = 1$

$\pi ab = \pi.5.|\lambda| = 20\pi$

$|\lambda| = 4 \Rightarrow \lambda = \pm 4$

175. **(c)** $xdy = ydx$

$\frac{dy}{dx} = \frac{y}{x}$

$m = \frac{y}{x}$

$y = mx$

176. **(b)**

177. **(b)** $\bar{a} = \hat{i} + \hat{j} + \hat{k}$

$$\frac{\bar{b} \cdot \bar{a}}{|\bar{a}|} = \frac{5 + 7 - 1}{\sqrt{3}} = \frac{11}{\sqrt{3}}$$

178. **(d)**

$$\bar{a} = \frac{\bar{d}_1 + \bar{d}_2}{2} = \frac{2i + 4j - 10k}{2} = i + 2j - 5k$$

$$|\bar{a}| = \sqrt{30}$$

$$|\bar{b}| = \frac{\bar{d}_1 - \bar{d}_2}{2} = \frac{4i + 8j + 6k}{2} = 2i + 4j + 3k$$

$$|\bar{b}| = \frac{2}{\sqrt{4 + 16 + 9}} = \sqrt{29}$$

179. **(d)** $\cos 60 = \frac{(\bar{a}+\bar{b})\cdot\bar{a}}{|\bar{a}+\bar{b}||\bar{a}|} = \frac{|\bar{a}|^2+0}{\sqrt{|\bar{a}|^2+|\bar{b}|^2}} =$

$$\frac{1}{2} = \frac{|\bar{a}|}{\sqrt{|\bar{a}|^2 + |\bar{b}|^2}}$$

$$|\bar{a}|^2 + |\bar{b}|^2 = 4|\bar{a}|^2$$

$$|\bar{b}|^2 = 3|\bar{a}|^2$$

$$|\bar{b}| = \sqrt{3}|\bar{a}|$$

180. **(c)** $|\bar{a} \times \bar{b}| = 15$

$$|(3\bar{a} + 2\bar{b}) \times (\bar{a} + 3\bar{b})| = |9(\bar{a} + \bar{b}) \times 2(\bar{b} + \bar{a})|$$
$$= |7(\bar{a} \times \bar{b})| = 7 \times 15 = 105$$

Biology

181. **(b)**
182. **(b)**
183. **(a)**
184. **(b)**
185. **(a)**
186. **(c)**
187. **(c)**
188. **(b)**
189. **(d)**
190. **(b)**
191. **(a)**
192. **(c)**
193. **(c)**
194. **(b)**
195. **(b)**
196. **(d)**

197. (c)
198. (c)
199. (c)
200. (d)
201. (a)
202. (b)
203. (c)
204. (d)
205. (b)
206. (d)
207. (b)
208. (d)
209. (c)
210. (a)
211. (a)
212. (c)
213. (a)
214. (b)
215. (c)
216. (c)
217. (c)
218. (b)
219. (a)
220. (d)
221. (d)
222. (c)
223. (a)
224. (c)
225. (c)
226. (c)
227. (a)
228. (a)
229. (d)
230. (b)
231. (d)
232. (a)
233. (d)
234. (a)
235. (d)
236. (a)
237. (d)
238. (c)
239. (a)
240. (a)