Test Booklet Code

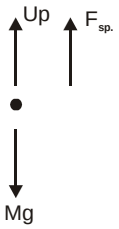
P

JEE (Main)
2013
Answers Keys with Explanations

Physics				Chemistry				Mathematics			
1	3	**16**	3	**31**	3	**46**	3	**61**	3	**76**	4
2	4	**17**	3	**32**	1,2	**47**	2	**62**	3	**77**	1
3	4	**18**	3	**33**	3	**48**	1	**63**	3	**78**	3
4	2	**19**	4	**34**	4	**49**	2	**64**	3	**79**	2
5	2	**20**	3	**35**	1	**50**	3	**65**	3	**80**	3
6	3	**21**	4	**36**	1	**51**	1	**66**	4	**81**	1
7	2	**22**	2	**37**	3	**52**	4	**67**	3	**82**	2
8	2	**23**	4	**38**	3	**53**	4	**68**	2	**83**	3
9	1	**24**	1	**39**	1	**54**	4	**69**	2	**84**	1
10	3	**25**	4	**40**	2	**55**	2	**70**	1	**85**	2
11	1	**26**	4	**41**	1	**56**	4	**71**	3	**86**	1
12	2	**27**	3	**42**	4	**57**	2	**72**	1	**87**	2
13	3	**28**	1	**43**	3	**58**	2	**73**	2	**88**	1
14	4	**29**	2	**44**	1,2,3,4	**59**	1	**74**	3	**89**	2
15	2	**30**	4	**45**	4	**60**	2	**75**	4	**90**	4

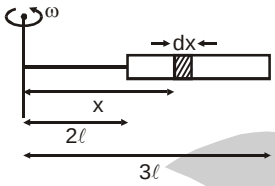
Physics

1. 3 For equilibrium $\Sigma F = 0$



$$x_0 = \frac{Mg}{k}\left(1 - \frac{\sigma LA}{2M}\right)$$

2. 4



$$\varepsilon = \int_{2\ell}^{3\ell} Bx\omega dx = \frac{5B\omega\ell^2}{2}$$

3. 4 $\Delta K = \frac{1}{2}\left(\frac{mM}{m+M}\right)v^2$

Maximum loss in kinetic energy in perfectly inelastic collision.

4. 2

5. 2 $y = x\tan\theta - \frac{1}{2}\frac{gx^2}{u^2\cos^2\theta}$

$\tan\theta = 2, u\cos\theta = 1$

$\Rightarrow y = 2x - 5x^2$

6. 3 Taking $A = A_0e^{-kt}$
At t = 5 sec $A = 0.9A_0$

$\therefore e^{-5k} = 0.9$

At t = 15 sec, $A = A_0\left(e^{-5t}\right)^3$

Hence, $A = 0.729\ A_0$

7. 2 $q_1 = q_2$
$\Rightarrow c_1(120) = c_2\ (200)$
$\Rightarrow 3c_1 = 5c_2$

8. 2 $\nu = \frac{V}{2\ell}, V = \sqrt{\frac{T}{\mu}}$

$T = \left(Y \times \frac{\ell}{L}\right)A$

$\mu = \rho A$
Hence, $\nu = 178.2$ Hz

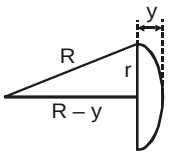
9. 1 Due to mutual induction, the current will established in larger ring.
Hence, magnetic field at the centre of the smaller ring

$$B = \left[\frac{\mu_0 i r_2^2}{2(r_2^2 + x^2)^{3/2}}\right]$$

Hence flux passes through bigger loop.

$$\phi = \left[\frac{\mu_0 i r_2^2}{2(r_2^2 + x^2)^{3/2}}\right]\pi r_1^2 = 9.1\times10^{-11}\ \text{weber}$$

10. 3 $\frac{1}{f} = \frac{\mu - 1}{R}$



$R = \frac{r^2}{2y} = 15$ cm

$f = \frac{R}{\mu - 1} = 30$ cm

11. 1 $\frac{-GMm}{R} + K = \frac{-GMm}{6R} \Rightarrow K = \frac{5GMm}{6R}$

12. 2 $f_{max} = \frac{1}{0.6\times2\pi RC} = 10.6\times10^3$

13. 3 $I' = \frac{I_0}{2}\cos^2\phi = \frac{I_0}{2}\cos^2 45° = \frac{I_0}{4}$

14. 4 $R_{60} = \frac{(120)^2}{60} = 240\ \Omega$

$R_{240} = \frac{(120)^2}{240} = 60\ \Omega$

Voltage across heater.

$V_i = \frac{120}{246}\times240 = 117.07$ V

Voltage after joining the new heater

$V_f = \frac{120}{54}\times48 = 106.66$ V

$\Delta V = 10.4$ V

15. 2 Heat extracted will be in the process AB and BC.

$Q_{AB} = \frac{3}{2}P_0V_0$

$Q_{BC} = \frac{10}{2}P_0V_0$

Total heat extracted $Q_{AB} + Q_{BC} = \frac{13}{2}P_0V_0$

16. 3 Angular momentum about point of contact remains conserved.

17. 3 Dimensionally option (3) is correct.

18. 3 According to Newton's law of Cooling, the option (3) is correct.

19. 4 To increase the range a smaller resistance is needed and that is achieved by using additional shunt.

20. 3 Work done by battery is double the energy dissipated in the resistor.

At $t = \tau$, $q = CV\left(1-\frac{1}{e}\right)$

At $t = 2\tau$, $q = CV\left(1-\frac{1}{e^2}\right)$

At $t = \frac{\tau}{2}$, $q = CV\left(1-\frac{1}{\sqrt{e}}\right)$

21. 4 The fring pattern on the screen is concentric circles.

22. 2 $\frac{E_0}{B_0} = c$

23. 4 At λ_{max} photo current becomes zero.
For $\lambda < \lambda_{max}$, current increases till attaining a saturation value.

24. 1 As wavelength decreases, forward voltage of p-n junction of an LED increases.

25. 4 $\frac{\delta}{\delta r}(4\pi r^2 T) = 8\pi r dr\, T = mL$

$8\pi r dr\, T = 4\pi r^2 dr\, \rho L$

$\Rightarrow r = \frac{2T}{\rho \ell}$

26. 4 $\nu \propto \left[\frac{1}{(n-1)^2} - \frac{1}{n^2}\right]$

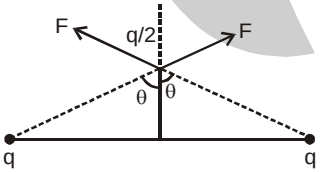
$\nu \propto \frac{1}{n^3}$

27. 3 The closest correct graph is option (3).

28. 1 $F_{net} = 2F\cos\theta$

$\simeq \frac{kq^2}{a^2}\left(\frac{y}{a}\right)$

$F \propto y$



29. 2 $B_1 = \frac{\mu_0}{4\pi}\frac{M_1}{r^3} = \frac{1.2}{(0.1)^3}\times 10^{-7}$

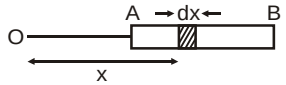
$B_1 = \frac{\mu_0}{4\pi}\frac{M_2}{r^3} = \frac{10^{-7}}{(0.1)^3}$

$B_1 + B_2 = 2.2\times 10^{-4}$

$B_{earth} = 0.36\times 10^{-4}$

$B_{net} = 2.56\times 10^{-4}$ weber/m²

30. 4



$dV = \frac{1}{4\pi\varepsilon_0}\frac{Q}{L}\frac{dx}{x}$

$V = \frac{Q}{4\pi\varepsilon_0 L}\int_L^{2L}\frac{dx}{x} = \frac{Q}{4\pi\varepsilon_0 L}\ln 2$

Chemistry

31. 3 $\left[Co(NH_3)_3Cl_3\right]$ don't show optical isomerism due to plane of symmetry.

32. 1,2 Electronic configuration of C_2

$= \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^0$

Electronic configuration of N_2

$= \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2$

33. 3 $SbCl_5$ forms carbocation with (–)–1–chloro–1– Phenylethane.

34. 4 For strongest oxidising agent, reduction potential should be maximum.

35. 1 q = +208 J,

$w = -nRT\ln\frac{V_2}{V_1} = -0.04\times 8.314\times 310\ln\frac{375}{50}$

$= -207.73$ J $\simeq -208$ J

36. 1 $N_{mix.}V_{mix.} = N_1V_1 + N_2V_2$ [For HCl (N = M)]
$N_{mix.} \times 1000 = 0.5 \times 750 + 2 \times 250$
$N_{mix.} = M_{mix.} = 0.875$

37. 3 As electron withdrawing goup increases acidity while donating group decrases acidity.

38. 3 The ratio is in order of

$\sqrt{\frac{2RT}{M}} : \sqrt{\frac{8RT}{\pi M}} : \sqrt{\frac{3RT}{M}} = 1 : 1.128 : 1.225$

39. 1 $\log\frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$

$\log\frac{2k_1}{k_1} = \frac{E_a}{2.303\times 8.314}\left[\frac{1}{300} - \frac{1}{310}\right]$

$E_a = 53598.1971$ J $= 53.6$ kJ mol^{-1}

40. 2 When NH_2 reacts with CH_3COCl, $-NHCOCH_3$ is formed.
Now mass gained during acylation = 210
Mass gained due to replacement of NH_2 by $-NHCOCH_3$ = 42

No. of molecules of NH_2 = $\frac{210}{42} = 5$

41. 1 No. of unpaired electrons in $Fe^{2+} = 3d^6\ 4s^0 = 4$
No. of unpaired electrons in $Mn^{2+} = 3d^5\ 4s^0 = 5$
No. of unpaired electrons in $Cr^{2+} = 3d^4\ 4s^0 = 4$
No. of unpaired electrons in $V^{2+} = 3d^3\ 4s^0 = 3$

42. 4 The correct order is III > I > II.

43. 3 $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$

44. 1,2,3,4
All are correct and ozone is violet black solid below 80 k.

45. 4 Amount of C = $\frac{12}{44} \times 3.08 = 0.84$ gm

Amount of H = $\frac{2}{18} \times 0.72 = 0.08$ gm

So, % of C = $\frac{0.84}{0.92} \times 100 = 91\%$

% of H = $\frac{0.08}{0.92} \times 100 = 9\%$

Hence hydrocarbon is C_7H_8.

46. 3 H_2^{2+}, He_2 both don't exist as their bond order is zero.

47. 2 Silicon exist as covalent crystals in solid form.

48. 1 Synthesis of 1 molecule of glucose requires 18 molecules of ATP.

49. 2 The more valency, the more coagulating power.

50. 3 The correct order of first ionization enthalpy is Ba < Ca < Se < S < Ar.

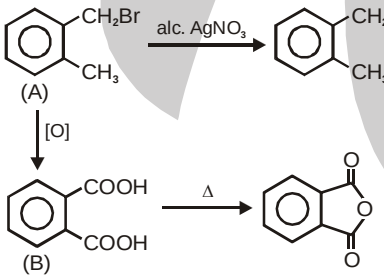
51. 1 $\Delta E = E_2 - E_1$

$= 2.178 \times 10^{-18} \times \frac{3}{4}$

Now, $\frac{6.6 \times 10^{-34} \times 3 \times 10^8}{\lambda} = 2.178 \times 10^{-18} \times \frac{3}{4}$

$\lambda = 1.214 \times 10^{-7}$ m

52. 4



53. 4 $E^0_{Cr^{3+}/Cr^{2+}} = -0.424$ V

$E^0_{Mn^{3+}/Mn^{2+}} = 1.5$ V

$E^0_{Fe^{3+}/Fe^{2+}} = 0.771$ V

$E^0_{Co^{3+}/Co^{2+}} = 1.92$ V

54. 4 Given pH = 1
[H] = 10^{-1} = 0.1 M
Required pH = 2, $[H^+] = 10^{-2}$ = 0.01 M

$10^{-2} = \frac{10^{-1}}{V_f} \Rightarrow V_f = 10$ litre

So, volume of water added = 10 – 1 = 9 litre

55. 2 Given $Na \rightarrow Na^+(g) + e^-, \Delta H = 5.1$ eV

$Na^+(g) + e^- \rightarrow Na(g), \Delta H = -5.1$ eV

56. 4 $\underset{(A)}{CH_3CH_2COOH} + NH_3 \longrightarrow \underset{(B)}{CH_3CH_2COO^-NH_4^+}$

$CH_3CH_2CONH_2 + H_2O \xrightarrow[\text{Hoffmann bromamide reaction}]{Br_2+KOH} CH_3CH_2NH_2$

57. 2 Bond order of Li_2 = 1

Bond order of $Li_2^+ = 0.5$

Bond order of $Li_2^- = 0.5$

So, correct order is $Li_2 > Li_2^+ > Li_2^-$.

58. 2 As carbocation is formed so mechanism will be S_N1.
So tertiary alcohol reacts fastest and by S_N1.

59. 1 Methyl isocyanate($CH_3 - N = C = O$) was leaked in Bhopal gas tragedy.

60. 2 $M_{0.98}O_{1.00}$, Let $M^{2+} = x$, $M^{3+} = 0.98 - x$

$\Rightarrow xM^{2+} + (0.98 - x)M^{3+} = 2$
$\Rightarrow 2x + 3(0.98 - x) = 2$
$\Rightarrow x = 0.94$
So, $M^{2+} = 0.94$, $M^{3+} = 0.4$

So, fraction as $M^{3+} = \frac{0.4}{0.98} \times 100 = 4.08\%$

Mathematics

61. 3 $2x + y + 2z - 8 = 0$

$\Rightarrow 4x + 2y + 4z - 16 = 0$ …(i)

and $4x + 2y + 4y + 5 = 0$ …(ii)

$d = \frac{|-16 - 5|}{\sqrt{4^2 + 2^2 + 4^2}} = \frac{21}{6} = \frac{7}{2}$

62. 3 $\frac{dP}{dx} = 100 - 12\sqrt{x}$

$\int_0^{\Delta P} dP = \int_0^{25} \left(100 - 12\sqrt{x}\right) dx$

$\Delta P = 100(25) - 12\left[\frac{x^{3/2}}{3/2}\right]_0^{25}$

$= 2500 - 12 \times \frac{2}{3}(25)^{3/2}$

$= 2500 - 8 \times 125$

$= 2500 - 1000 = 1500$

$\therefore$ Total production = 2000 + 1500 = 3500

63. 3 Total subsets of A × B = 2 × 4 = 8

$\therefore \ {}^8C_3 + {}^8C_4 + \cdots {}^8C_8 = 2^8 - \left({}^8C_0 + {}^8C_1 + {}^8C_2\right)$

$= 256 - (1 + 8 + 28)$

= 256 – 37

= 219

64. 3 $\begin{vmatrix} 2-1 & 3-4 & 4-5 \\ 1 & 1 & -k \\ k & 2 & 1 \end{vmatrix} = 0$

$\begin{vmatrix} 1 & -1 & -1 \\ 1 & 1 & -k \\ k & 2 & 1 \end{vmatrix} = 0$

$1(1 + 2k) + (1 + k^2) - 1(2 - k) = 0$

$k^2 + 3k = 0, \ k(k + 3) = 0, \ k = 0, -3$

65. 3 Let D is mid point of BC, $\overrightarrow{AD} = \dfrac{\overrightarrow{AB} + \overrightarrow{AC}}{2}$

$= 4\hat{i} - \hat{j} + 4\hat{k}$

$\therefore \ \overrightarrow{AD} = \sqrt{(4)^2 + (-1)^2 + (4)^2} = \sqrt{33}$

66. 4 $f(x) = 2x^3 + 3x + k$

$f'(x) = 6x^2 + 3 > 0$

$\therefore$ function is increasing

$\therefore$ there will be only one real root.

67. 3 $S = 0.7 + 0.77 + \cdots$

$= 7(0.1 + 0.11 + \cdots)$

$\dfrac{S}{7} = 0.1 + 0.11 + \cdots$

$\dfrac{9S}{7} = 0.9 + 0.99 + \cdots$

$= (1 - 0.1) + (1 - 0.01) + \cdots$ 20 terms

$= 20 - \dfrac{0.1\left(1 - (0.1)^{20}\right)}{1 - 0.1}$

$= 20 - \dfrac{1}{9}\left[1 - (10)^{-20}\right] = \dfrac{179 + 10^{-20}}{9}$

$= \dfrac{7}{81}\left(179 + 10^{-20}\right)$

68. 2 $y = -\dfrac{1}{\sqrt{3}}x + 1$

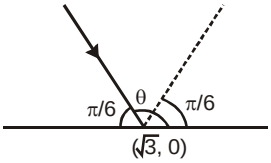
$\tan\theta = \dfrac{5\pi}{6}$

equation of reflected ray

$y - 0 = \tan\dfrac{\pi}{6}\left(x - \sqrt{3}\right)$

$y = \dfrac{1}{\sqrt{3}}\left(x - \sqrt{3}\right)$

$\sqrt{3}y = x - \sqrt{3}$



69. 2 $\Delta = \begin{vmatrix} k+1 & 8 \\ k & k+3 \end{vmatrix} = 0$

$\Rightarrow \ (k + 1)(k + 3) - 8k = 0$

$\Rightarrow \ k^2 - 4k + 3 = 0$

$k = 1, 3$

for k = 1 both equations are identical

for k = 3 system has no solution.

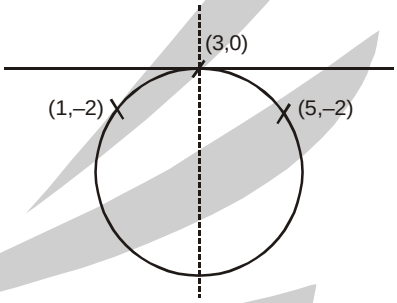
70. 1 $x^2 + 2x + 3 = 0$

$D < 0, \therefore$ roots will be complex

$\therefore \ ax^2 + bx + c = 0$ and $x^2 + 2x + 3 = 0$ have both roots common.

$\therefore \ \dfrac{a}{1} = \dfrac{b}{2} = \dfrac{c}{3}$

71. 3 Another point will be image of (1, –2) about the line x = 3



72. 1 $\because \ y - x = z - y$

and $\tan^{-1}y - \tan^{-1}x = \tan^{-1}z - \tan^{-1}y$

$\Rightarrow \ \tan^{-1}\dfrac{y - x}{1 + xy} = \tan^{-1}\dfrac{z - y}{1 + yz}$

$\Rightarrow \ xy = yz \Rightarrow x = y = z$

73. 2 **Statement-I**

p	q	~ p	~ q	$p \wedge \sim q$	$\sim p \wedge q$	$(p \wedge \sim q) \wedge (\sim p \wedge q)$
T	T	F	F	F	F	F
T	F	F	T	T	F	F
F	T	T	F	F	T	F
F	F	T	T	F	F	F

$\therefore$ Statement-I is correct

Statement-II

p	q	~ p	~ q	$p \to q$	$\sim q \to \sim p$	$(p \to q) \leftrightarrow (\sim q \to \sim p)$
T	T	F	F	T	T	T
T	F	F	T	F	F	T
F	T	T	F	T	T	T
F	F	T	T	T	T	T

74. 3 $x^3 = t$

$3x^2dx = dt$

$\int x^5 f(x^3)dx = \frac{1}{3}\int tf(t)dt$

$= \frac{1}{3}\left[t\int f(t)dt - \int\left(1.\int f(t)dt\right)dt\right]$

$= \frac{1}{3}\left[x^3\psi(x^3) - \int \psi(t)dt\right]$

$= \frac{1}{3}\left[x^3\psi(x^3) - \int \psi(x^3).3x^2dx\right]$

$= \frac{1}{3}x^3\psi(x^3) - \int x^2\psi(x^3)dx$

75. 4 $\lim\limits_{x\to 0}\frac{(2\sin^2 x)(3+\cos x)}{x\tan 4x}$

$= \lim\limits_{x\to 0}\frac{2\left(\frac{\sin x}{x}\right)^2(3+\cos x)}{4\left(\frac{\tan 4x}{4x}\right)}$

= 2

76. 4 $I = \int_{\pi/6}^{\pi/3}\frac{dx}{1+\sqrt{\tan x}}$

$= \int_{\pi/6}^{\pi/3}\frac{\sqrt{\cos x}}{\sqrt{\cos x}+\sqrt{\sin x}}dx$

$= \int_{\pi/6}^{\pi/3}\frac{\sqrt{\sin x}}{\sqrt{\sin x}+\sqrt{\cos x}}dx$ using $\int_a^b f(x)dx = \int_a^b f(a+b-x)dx$

$\Rightarrow 2I = \int_{\pi/6}^{\pi/3}dx = \frac{\pi}{6} \Rightarrow I = \frac{\pi}{12}$

Statement-I is false and statement-2 is true.

77. 1 $\frac{x^2}{16}+\frac{y^2}{9} = 1$

$e = \sqrt{1-\frac{9}{16}} = \frac{\sqrt{7}}{4}$

foci $(\pm ae, 0) = (\pm\sqrt{7}, 0)$

radius of circle = 4

$\therefore$ equation of circle is $x^2 + (y-3)^2 = 4^2$

$= x^2 + y^2 - 6y - 7 = 0$

78. 3 p = probability of getting correct answer by guessing = $\frac{1}{3}$

hence, $q = 1-p = \frac{2}{3}$

$P(X \ge 4) = {}^5C_4\left(\frac{1}{3}\right)^4\left(\frac{2}{3}\right) + {}^5C_5\left(\frac{1}{3}\right)^5 = \frac{11}{3^5}$

79. 2 The vertices of triangle are (0, 0), (0, 2), (2, 0)

Length of sides are $2, 2\sqrt{2}, 2$ respectively

Hence, x coordinate of the incentre is given by

$\frac{2\times 2 + 2\times 0 + 2\sqrt{2}\times 0}{2+2+2\sqrt{2}} = 2-\sqrt{2}$

80. 3 The given expression can be written as

$\frac{\left(x^{5/6}-1\right)^{10}}{x^5}$

General term of the expansion

$\left(x^{5/6}-1\right)^{10} = {}^{10}C_k\left(x^{5/6}\right)^{10-k}(-1)^k$

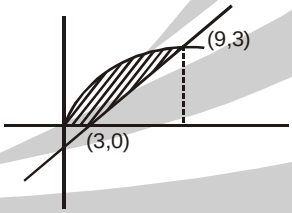
For coefficient of x^5, $\frac{5}{6}(10-k) = 5$

$\Rightarrow$ k = 4

$\therefore$ required coefficient $= {}^{10}C_4 = 210$

81. 1 point of intersection of the curves $y = \sqrt{x}, 2y - x + 3 = 0$ is 9, 3

$\therefore$ area bounded = $\int_0^9\sqrt{x}\,dx - \frac{1}{2}(9-3)\times 3 = 9$



82. 2 $T_{n+1} - T_n = 10$

$\Rightarrow {}^{n+1}C_3 - {}^nC_3 = 10$

$\Rightarrow n(n-1) = 20 \therefore n = 5$

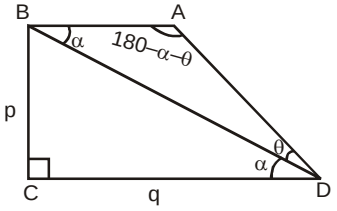
83. 3 $|z| = 1 \Rightarrow z\bar{z} = 1 \text{ or } \bar{z} = \frac{1}{z}$

Now, $\frac{(1+z)}{1+\bar{z}} = \frac{1+z}{1+\frac{1}{z}} = z$

$\Rightarrow \text{Arg}\left(\frac{1+z}{1+\bar{z}}\right) = \text{Arg}(z) = \theta$

84. 1 Let $\angle ABD = \alpha$

$\sin\alpha = \frac{p}{BD}, \cos\alpha = \frac{q}{BD};\ BD = \sqrt{p^2+q^2}$



Using sine rule in ΔABD

$$\frac{AB}{\sin\theta} = \frac{BD}{\sin(180-\alpha-\theta)} = \frac{BD}{\sin(\alpha+\theta)}$$

$$\Rightarrow \quad AB = \frac{(BD)^2\sin\theta}{p\cos\theta + q\sin\theta} = \frac{(p^2+q^2)\sin\theta}{q\sin\theta + p\cos\theta}$$

85. 2 $P = \begin{bmatrix} 1 & \alpha & 3 \\ 1 & 3 & 3 \\ 2 & 4 & 4 \end{bmatrix}$ is adjoint of matrix **A**

$\because \quad |adjA| = |A|^2$ for 3 × 3 matrix

$|P| = |2\alpha - 6| = |A|^2 = 16$

$\Rightarrow 2\alpha - 6 = \pm 16$

$\therefore \quad \alpha = 11, -5$

86. 1 $x \geq 0, y = \int_0^x |t|\,dt = \frac{x^2}{2}$

$x < 0, y = \int_0^x |t|\,dt = -\frac{x^2}{2}$

equation of tangents to the curve $y = \frac{\pm x^2}{2}$ is given by

$y + \frac{t^2}{2} = \pm xt$

$\because$ tangent is parallel to y = 2x $\therefore \quad t = \pm 2$

hence, tangents are $y + 2 = \pm 2x$

$\therefore$ intercepts are given by ± 1

87. 2 Equation of tangent to the parabola is

$$y = mx + \frac{\sqrt{5}}{m}$$

Applying condition of tangency for the cirlce

$$x^2 + y^2 = \frac{5}{2}$$

we get $\frac{\left|\frac{\sqrt{5}}{m}\right|}{\sqrt{m^2+1}} = \sqrt{\frac{5}{2}}$

Hence $m^4 + m^2 - 2 = 0$

$\Rightarrow \quad m = \pm 1$

which satisfy the equation $m^4 - 3m^2 + 2 = 0$

Hence tangents are given by $y = x + \sqrt{5}, y = -x - \sqrt{5}$

88. 1 $y = \sec\left(\tan^{-1}x\right)$

$y = \sqrt{1+x^2}$

$\therefore \quad \frac{dy}{dx} = \frac{x}{\sqrt{1+x^2}} = \frac{1}{\sqrt{2}}$ at $x = 1$

89. 2 $\frac{\tan A}{1-\cot A} + \frac{\cot A}{1-\tan A}$

$= \frac{\tan^2 A}{\tan A - 1} + \frac{\cot A}{1-\tan A} = \frac{1-\tan^3 A}{\tan A(1-\tan A)}$

$= \tan A + \cot A + 1$

$= \sec A\,\text{cosec}A + 1$

90. 4 Mean and Median are bound to change with the change in observation.
Since, mode is dependent on mean and median, so it will also change.