Monthly Progessive Test (Solution)

Academic Excellence Programme
TECHNO ACE

Class: XI

Subject: PCMB

Test Booklet No.: MPT04 | **Test Date:** 2 4 0 7 2 0 2 4

Physics

1. Ⓐ

$$R=\frac{2.(4)(3)}{g}=2.4\text{ m.}$$

2. Ⓒ

$$R\max=\frac{u^2}{g}=\frac{144}{10}=14.4\text{ m.}$$

3. Ⓐ

$$50=\frac{u^2\,\text{Sin}\,30^\circ}{g}=\frac{u^2}{20}$$

$$u^2=1000$$

$$R\max=\frac{u^2}{g}=\frac{100\not{0}}{1\not{0}}=100\text{ m}$$

4. Ⓓ

u : not mentioned

5. Ⓐ

$$u\cos\theta=1$$

$$u\ \text{Sin}\theta=2$$

$$u^2=4+1=5$$

$$y=x\tan\theta-\frac{1}{2}.g.\frac{x^2}{(u\cos\theta)^2}$$

$$=2x-5x^2$$

6. Ⓒ

$40\cos 60^\circ$

$= 20$ m/s

7. Ⓓ

$$\text{Roman} = \frac{u^2}{g}$$

$$u^2 = g \times 125$$

$u = \sqrt{125} \times \sqrt{g}$ Time of flight $= \dfrac{2u\,\text{Sin}\,\theta}{g}$ put $\theta = 45^0$

8. Ⓓ

$$\frac{2x}{\frac{x}{v_1} + \frac{x}{v_2}} = \frac{2v_1v_2}{v_1 + v_2}$$

$$= \frac{2 \times 4\not{0} \times 6\not{0}}{1\not{0}\,\not{0}}$$

$= 48\ \text{km / hrs.}$

9. Ⓑ

$$\frac{v_1.t + v_2.t}{2t} = \frac{v_1 + v_2}{2}$$

10. Ⓑ

Maximum range.

11. Ⓓ

$$R = \frac{2u^2\,\text{Sin}\,\theta\cos\theta}{g}; \quad H = \frac{u^2\,\text{Sin}^2\,\theta}{2g}$$

$$R = 4\frac{u^2\,\text{Sin}^2\,\theta}{2g} \times \cot\theta \Rightarrow 4H. \Rightarrow R\tan\theta$$

$$(\tan 30^\circ)R = 4H$$

$$R = 4\sqrt{3}\,H$$

12. Ⓐ

$$\sqrt{(500)^2 + (90)^2}$$

13. Ⓐ

$$R = \frac{u^2}{g} \qquad H = \frac{u^2}{4g}$$

$$\tan \in = \frac{2H}{R} = \frac{1}{2}$$

14. Ⓑ

$$R \quad v = (3i + 4j) + 10(0.1i + 0.3j)$$
$$= 4i + 7j$$
$$v = \sqrt{16 + 49} = \sqrt{65}$$

15. Ⓒ

$v \sin 45^0 - (-v \sin 45^0) = 2v \sin 45^0 = \sqrt{2}v$

16. Ⓐ

$$\frac{\frac{a}{2}(10-1)}{\frac{a}{2}(8-1)} = \frac{9}{7}$$

17. Ⓓ

Separation remains same.

18. Ⓐ

u (upward) = u (downword)

19. Ⓑ

$$v = \frac{ds}{dt} = a + 2bt$$
$$a = \frac{dv}{dt} = 2b$$

20. Ⓐ

$$\vec{V}_{r,w} = -3\hat{j}\,m/s, \vec{V}_{w,g} = 4\hat{i}\,m/s$$
$$\vec{V}_{r,w} = \vec{V}_{r,g} - \vec{V}_{w,g}$$
$$= -3\hat{j} = \vec{V}_{r,g} - 4\hat{i}$$
$$\therefore \vec{V}_{r,g} = (4\hat{i} - 3\hat{j})\,m/s$$

21. Ⓐ

$$a = \frac{20}{2}$$
$$= 10\,m/s^2$$

22. Ⓑ

$F = \sqrt{1+1} = \sqrt{2}\ N$

23. Ⓒ

$a = \frac{F}{m} = \sqrt{9+16} = 5\ m/s^2$

24. Ⓐ

m (v–u)
= (1) (3)
= 3 kgm/s.

25. Ⓑ

(3i+4j+k)N

Chemistry

26. Ⓑ

Orbital angular momentum of an electron is $\mu_l = \frac{h}{2\pi}\sqrt{l(l+1)}$ where l = azimuthal quantum number and h = Planck's constant

27. Ⓓ

For 3d orbital, the correct representation is n = 3, l = 2

Hence the correct representation is n = 3, l = 2, ml = 1, s = $+\frac{1}{2}$

28. Ⓓ

In case of d7 configuration, there are 4 paired electrons and 3 unpaired electrons. Now, the formula of total spin is $\pm\frac{n}{2}$ where n = number of unpaired electrons

So, for d7 configuration, the value of total spin is $\pm\frac{3}{2}$

29. Ⓐ

The relationship between atomic radius and electronegetivity is given below

$$\text{atomic radius } \alpha \ \frac{1}{\text{electronegetivity}}$$

Correct order of atomic radius is Br > Cl > O > F
Hence the correct order of electronegetivity will be F > O > Cl > Br

30. Ⓐ

If a bond is formed by two elements A and B then the Pauling's equation will be

$X_A - X_B = 0.208\sqrt{\Delta}$

31. Ⓑ

Ionic character of a compound depends on the radius of both cation and anion. Lower the size of the anion, ionic character increases. Higher the ionic character, lattice packing is very much efficient and hence melting point will be high

32. Ⓐ

When an anion comes contact with water then the δ^+ part of the water molecule is attracted by the electron cloud of the anion (ion - dipole interaction). Thus large anion can attract the water molecule more strongly with respect to the smallar anion.

33. Ⓐ

In case of photoelectric effect, $(KE)_{\text{released electron}}\ \alpha$ Frequency of radiation

And if a photon strikes at higher energy then higher amount of energy will be transferred to the electons

34. Ⓐ

Fomula of velocity of an electron in a Bohr orbit is $v = \frac{Z}{n} \times \left(2.188 \times 10^8\right)$ cm.sec^{-1}

So, velocity of an electron $\alpha \dfrac{1}{\text{number of Bohr orbit}}$

Now, velocity of an electron in 1st Bohr orbit of H atom = $\left(2.188 \times 10^8\right)$ cm.sec^{-1}

Now, velocity of an electron in 1st Bohr orbit of Li2+ ion = $\left(3 \times 2.188 \times 10^8\right)$ cm.sec^{-1}

35. Ⓓ

The correct (n + l) value of 4f is (4 + 3) = 7 and the correct (n + l) value of 5d is (5 + 2) = 7

Now, according to Aufbau principle, that orbital will be filled earlier where the value of principal quantum number (n) is lower

The correct electronic configuration of Mn (25) is given below

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^5$

Now for Mn3+ ion it will be $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^4$. Now, according to Hund's rule 4 different orbitals of 3d subshell will receive one elecron each. So the number of unpaired electrons in Mn^{3+} is 4

36. Ⓑ

The formula of energy of a Bohr orbit is $E_n = -13.6 \times \frac{Z^2}{n^2}$ eV

So, that for 2nd Bohr orbit of Be3+ (Z = 4) the correct value of energy is

$$E_n = -13.6 \times \frac{(4)^2}{(2)^2} = -54.4 \text{ eV}$$

37. Ⓓ

The formula of radius of Bohr orbit is $r_n = 0.529 \times \frac{n^2}{Z}$ Å
So, the value of radius of 4th Bohr orbit of Be^{3+} (Z = 4) is

$$r_n = 0.529 \times \frac{n^2}{Z} \text{ Å} = 0.529 \times \frac{(4)^2}{(4)} \text{ Å} = 2.116 \text{ Å}$$

38. Ⓓ

Potential energy = 0
Now, total energy = kinetic energy + potential energy
Total energy = - 13.6 eV = - kinetic energy = $\frac{\text{potential energy}}{2}$
$E_P = -(2 \times 13.6) = -27.2$ eV
If $E_P = 0$, then
$E_K = (27.2 - 13.6) = 13.6$ eV
$E_T = (27.2 + 13.6) = 40.8$ eV

For 2^{nd} orbit, $E_T = -\frac{13.6}{4} = -3.4$ eV

$\therefore E_T = (27.2 - 3.4) = 23.8$ eV

39. Ⓑ

The formula for magnetic moment $= \sqrt{n(n+2)}$

$\therefore \sqrt{n(n+2)} = \sqrt{15}$

$\therefore n^2 + 2n - 15 = 0$

$\therefore (n-3)(n+5) = 0$

$\therefore n = 3, n = -5$

So, there are 3 unpaired electrons

Now the electronic configuration of the element of atomic number is

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^5$

3 unpaired electrons means total 4 electrons are released. So, X = 4

40. Ⓓ

According to photoelectric effect,

$$h\upsilon = h\upsilon_o + \frac{1}{2}mv^2$$

$$\therefore \frac{1}{2}mv^2 = (h\upsilon - h\upsilon_o) = h(\upsilon - \upsilon_o) = h\Delta\upsilon$$

$$\lambda = \frac{h}{mv}$$

$$\text{Hence, } v = \frac{h}{m\lambda}$$

$$\therefore h\Delta\upsilon = \left(\frac{1}{2}m\right)\left(\frac{h^2}{m^2\lambda^2}\right)$$

$$\therefore \Delta\upsilon = \frac{h}{2m\lambda^2}$$

$$\therefore \lambda = \sqrt{\frac{h}{2m(\upsilon - \upsilon_o)}}$$

41. Ⓑ

The related equation is $5CO + I_2O_5 \longrightarrow I_2 + 5\ CO_2$

Now, 2.54 gm I_2 is formed by $\left[\frac{5 \times 28 \times 2.54}{254}\right] = 1.4$ gm

So, precentage of CO = $\left[\frac{1.4 \times 100}{2}\right] = 70\%$

So, percentage of CO_2 = (100 - 70) = 30%

42. Ⓓ

The working formula is

$$V_T S_T = V_1 S_1 + V_2 S_2$$

$$S_T(300+200) = (200\times 1) + (300\times 0.2)$$

$$\therefore\ S_T = \frac{260}{500} = 0.52\ M$$

43. Ⓒ

One $CaCO_3$ molecule contains 5 atoms and molecular weight of $CaCO_3$ = [40 + 12 + 48] = 100

$$100\ \text{gm}\ CaCO_3\ \text{contain}\ \left(5\times 6.02\times 10^{23}\right)\ \text{atoms}$$

$$\therefore 20\ \text{gm}\ CaCO_3\ \text{contain}\ \left(\frac{5\times 6.02\times 10^{23}\times 20}{100}\right) = 6.02\times 10^{23}\ \text{atoms}$$

44. Ⓓ

According to the equation, 4 gm oxygen reacts with $\left[\frac{4\times 17\times 4}{5\times 32}\right] = 1.7\ \text{gm}\ NH_3$

So, NH_3 is the limiting reagent

Now, 1.7 gm NH_3 produces $\left[\frac{4\times 30\times 1.7}{4\times 17}\right] = 3\ \text{gm NO}$

45. Ⓐ

Initial concentration of urea solution = $\left[\frac{0.3}{60}\times\frac{1000}{500}\right] = 0.01\ M$

Now final concentration = $\left[\frac{500\times 0.01}{1250}\right] = 0.004\ M$

46. Ⓐ

According to Bohr's theory

$$mvr = \frac{nh}{2\pi}$$

$$\therefore mv = \frac{nh}{2\pi r}$$

According to de - Broglie hypothesis,

$$\lambda = \frac{h}{mv} = \frac{h \times 2\pi r}{nh} = \frac{2\pi r}{n}$$

$\therefore 2\pi r = n\lambda$

So, there will be 5 waves

47. Ⓐ

$E = E_1 + E_2$

$$\frac{1}{\lambda} = \frac{1}{\lambda_1} + \frac{1}{\lambda_2}$$

$$\frac{1}{300} = \frac{1}{760} + \frac{1}{\lambda_2}$$

$$\therefore \frac{1}{\lambda_2} = 2.02 \times 10^{-3} (nm)^{-1} = 2.02 \times 10^{6} m^{-1}$$

$$\therefore \text{wave number } (\bar{\upsilon}) = \frac{1}{\lambda_2} = 2.02 \times 10^{6} m^{-1}$$

48. Ⓑ

The correct representation is $H_\gamma \rightarrow n_1 = 2, n_2 = 5, Z = 1$

$$\frac{1}{\lambda} = 109678 \times (1)^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] = 109678 \left[\frac{1}{2^2} - \frac{1}{5^2}\right] = 109678 \times \frac{21}{100}$$

$\therefore \lambda = 4298 \overset{o}{A}$

49. Ⓑ

At node, the probability of finding the electron is zero

50. Ⓑ

one d - orbital can accomodate maximum 2 electrons

Mathematics

51. Ⓐ

Given $\tan x = \frac{b}{a}$. $a\cos 2x + b\,\text{Sin}\,2x$

$$= a.\frac{1-\tan^2 x}{1+\tan^2 x} + b.\frac{2\tan x}{1+\tan^2 x}$$

$$= a\frac{a^2-b^2}{a^2+b^2} + \frac{2ab^2}{a^2+b^2}$$

$$= \frac{a^3-ab^2+2ab^2}{a^2+b^2}$$

$$= \frac{a^3-ab^2+2ab^2}{a^2+b^2}$$

$$= \frac{a^3+ab^2}{a^2+b^2}$$

$$= \frac{a(a^2+b^2)}{(a^2+b^2)}$$

$= a$

52. Ⓑ

$$\sum_{i=1}^{13} i^n + i^{n+1}$$

$$\left(i^1+i^2+i^3+\ldots.+i^{13}\right)+\left(i^2+i^3+\ldots.+i^{14}\right)$$

$= i^{13}+i^{14}$ (as sum of 4 consequtive powers of i is zero).

$= i+i^2$ (as $i^{4k}=1,\ i^{4k+1}=i,\ i^{4k+2}=i^2,\ i^{4k+3}=i^3$)

$= i - 1$

53. Ⓒ

$$\left((1+i)^2\right)^n = \left((1-i)^2\right)^n$$

$$\Rightarrow (\cancel{1} + \cancel{i^2} + 2i)^n = (1 + i^2 - 2i)^n$$

$$\Rightarrow \quad \cancel{2^n} i^n = \cancel{2^n} (-i)^n$$

$$\Rightarrow \quad i^n = (-1)^n i^n$$

$\Rightarrow i^n \left(1 - (-1)^n\right) = 0$

as $i^n \neq 0 \quad 1 - (-1)^n = 0$

$\Rightarrow$ n is any even integer

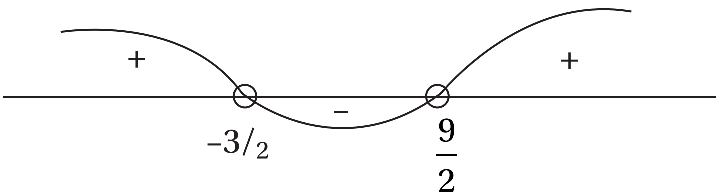
$\therefore n = 2$ ($\because$ n is smallest positive integer)

54. Ⓓ

$$\frac{2x+3}{2x-9} < 0$$

Critical points are : $2x + 3 = 0$ and $2x - 9 = 0$

$x = \frac{-3}{2}$ $\qquad$ $x = \frac{9}{2}$



$$x \in \left(\frac{-3}{2}, \frac{9}{2}\right)$$

55. Ⓒ

$3 \le 3t - 18 \le 18$

$\Rightarrow 3 + 18 \le 3t \le 18 + 18$

$\Rightarrow 21 \le 3t \le 36$

$\Rightarrow 7 \le t \le 12$

$7 + 1 \le t + 1 \le 12 + 1$

$8 \le t + 1 \le 13$

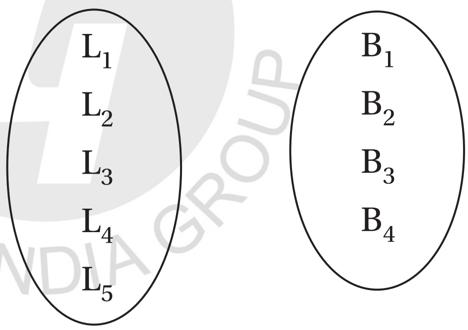
56. Ⓒ BANANA

$\frac{6!}{3! \times 2!} = \frac{720}{6 \times 2} = \frac{\cancel{720}}{\cancel{12}} = 60$

(A) (N)

57. Ⓓ

5 letters, 4 Boxes



For L1 we have 4 options

Similarly for L_2, L_3, L_4, L_5

Req. options = $4 \times 4 \times 4 \times 4 \times 4 = 4^5$

58. Ⓑ

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

$\cos 3\theta = 4\cos^3\theta - 3\cos\theta$

$$= \cancel{4} \times \frac{1}{\cancel{8}_2}\left(a + \frac{1}{a}\right)^3 - \frac{3}{2}\left(a + \frac{1}{a}\right)$$

$$=\frac{1}{2}\left[a^3+3\cancel{a^2}^{a}\cdot\frac{1}{\cancel{a}}+3\cancel{a}\cdot\frac{1}{\cancel{a}\,\cancel{2}_{a}}+\frac{1}{a^3}-\cancel{3a}-\frac{\cancel{3}}{\cancel{a}}\right]$$

$$=\frac{1}{2}\left(a^3+\frac{1}{a^3}\right)$$

59. Ⓐ

$$(2+i)(2+2i)(2+3i)\dots(2+9i)=x+iy$$

$$\Rightarrow |2+i|\;|2+2i|\;|2+3i|\dots\;|2+9i|=|x+iy|$$

$$\Rightarrow \sqrt{5}\times\sqrt{8}\times\sqrt{13}\times\dots\dots\times\sqrt{85}=\sqrt{x^2+y^2}$$

$$\Rightarrow 5.8.13\,.......85=x^2+y^2$$

60. Ⓐ

$$B_1G_1B_2G_2B_3G_3B_4G_4B_5G_5 \rightarrow \underset{(\text{for Boys})}{5!} \times \underset{(\text{for Girls})}{5!}$$

$$G_1B_1G_2B_2G_3B_3G_4B_4G_5B_5 \rightarrow \underset{(\text{for Girls})}{5!} \times \underset{(\text{for Boys})}{5!}$$

By addition principle,

Required ways = $(5!)^2+(5!)^2=2(5!)^2$

61. Ⓐ

$$(A):\quad \left(\frac{\cos A+\cos B}{\sin A-\sin B}\right)^n+\left(\frac{\sin A+\sin B}{\cos A-\cos B}\right)^n$$

$$=\left\{\frac{\cancel{2}\cos\left(\cancel{\frac{A+B}{2}}\right)\cos\left(\frac{A-B}{2}\right)}{\cancel{2}\cos\left(\cancel{\frac{A+B}{2}}\right)\sin\left(\frac{A-B}{2}\right)}\right\}^n+\left\{\frac{\cancel{2}\sin\left(\cancel{\frac{A+B}{2}}\right)\cos\left(\frac{A-B}{2}\right)}{\cancel{2}\sin\left(\cancel{\frac{A+B}{2}}\right)\sin\left(\frac{B-A}{2}\right)}\right\}^n$$

$$= \cot^n\left(\frac{A-B}{2}\right) + (-1)^n \cot^n\left(\frac{A-B}{2}\right)$$

$$= \cot^n\left(\frac{A-B}{2}\right) - \cot^n\left(\frac{A-B}{2}\right) \text{ when n is odd}$$

$= 0$ True

(R) : $\dfrac{\cos A + \cos B}{\sin A - \sin B} = \cot\left(\dfrac{A-B}{2}\right)$ True

62. Ⓐ

(A) : $\dfrac{x-1}{x-2} - 2 > 0 \Rightarrow \dfrac{x-1-2x+4}{x-2} > 0 \Rightarrow \dfrac{3-x}{x-2} > 0$

$\Rightarrow \dfrac{x-3}{x-2} < 0 \Rightarrow x \in (2,3)$ True

(R) : True

63. Ⓒ

$8_{c_7} \times 8_{c_6} = {}^4\cancel{8} \times \dfrac{8\times 7}{\cancel{2}} = 224$

64. Ⓐ $8_{c_7} \times 7_{c_6} = 8 \times 7 = 56$

65. Ⓑ

$8_{c_8} \times 8_{c_6} = \dfrac{1\times \cancel{8}^4 \times 7}{1\times \cancel{2}} = 28$

66. Ⓑ

$$\frac{1}{1+x^{a-b}} + \frac{1}{1+x^{b-a}}$$

$$= \frac{1}{1+\frac{x^a}{x^b}} + \frac{1}{1+\frac{x^b}{x^a}}$$

$$= \frac{x^b}{x^b+x^a} + \frac{x^a}{x^a+x^b}$$

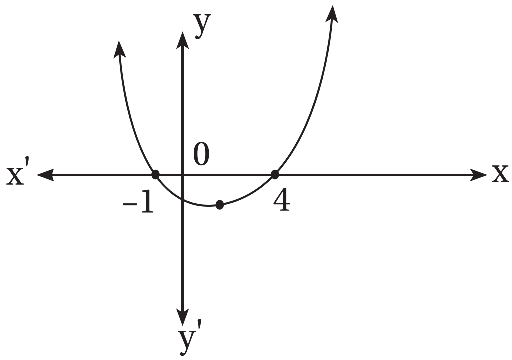
$$= \frac{\cancel{x^a+x^b}}{\cancel{x^a+x^b}}$$

$= 1$

67. Ⓑ

Parabota $Y = x^2 - 3x - 4$

$= (x-4)(x+1)$



68. Ⓐ

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

$$y + yx^2 = x$$

$$\Rightarrow yx^2 - x + y = 0 \,;\, y \neq 0$$

$$x \in R \Rightarrow D \geq 0 \;\Rightarrow\; (-1)^2 - 4.y.\,y \geq 0$$

$$\Rightarrow 4y^2 - 1 \;\leq 0$$

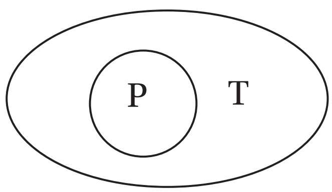
$$\Rightarrow (2y-1)(2y+1) \leq 0$$

$$\therefore y \in \left[-\frac{1}{2}, \frac{1}{2}\right]$$

69. Ⓐ

$P \cap T$

$= P$ as $P \subset T$



70. Ⓒ

$$\tan(A-B) = \frac{\tan A - \tan B}{1 + \tan A \tan B} \qquad \Rightarrow 1 = \frac{\tan A - \tan B}{1 + \tan A \tan B}$$

$$\Rightarrow \tan A - \tan B = 1 + \tan A \tan B \Rightarrow (1+\tan A)(1-\tan B) = 2$$

$$\therefore\; y=2,\ (y+1)^{y+1} = (3)^3 = 27$$

71. Ⓐ $^{10}C_4 = 210$

72. Ⓑ $^{10}P_4 = 5040$

73. Ⓒ

Out of 7 we have to select only 1 in $^7C_1$ ways i.e. in 7 ways.

74. Ⓐ

(A) : Modulus of z is the distance of z from origin which is always non negative. (True)

(R) : $|z| = \sqrt{x^2 + y^2}$ (True)

75. Ⓐ

$(A): z = 3 + 4i$

$|z| = \sqrt{9+16} = \sqrt{25}$

$|z|^2 = 25$

$z\bar{z} = (3+4i)\ (3-4i)$

$= 9 + 16 = 25$

$\therefore z\bar{z} = |z|^2$ (True)

(R) :

$z\bar{z} = (x+iy)\ (x-iy)$

$= x^2 + y^2$

$= |z|^2$ (True)

Biology

76. Ⓐ

Modified leaf

77. Ⓓ

All of these

78. Ⓓ

All of the above

79. Ⓓ

Both 1 and 2

80. Ⓐ

Phloem and xylem

81. Ⓑ

Nucleated and with haemoglobin

82. Ⓑ

Hyoid apparatus

83. Ⓐ

Both A and R are true and R is the correct explanation of A

84. Ⓒ

A is true but R is false

85. Ⓐ

Both A and R are true and R is the correct explanation of A

86. Ⓑ

Dicot root

87. Ⓐ

Epidermis and stele

88. Ⓑ

Suberin

89. Ⓒ

Pericycle

90. Ⓒ

Pericycle, vascular strand and pith

91. Ⓒ

Echinoderms

92. Ⓐ

Pteridophytes

93. Ⓐ

Dinoflagellates

94. Ⓒ

Basidiomycetes

95. Ⓐ

Ostracodermi

96. Ⓓ

Endosperm gets used up by the developing embryo during seed development

97. Ⓑ

Indigofera

98. Ⓓ

Dicot stem

99. Ⓓ

Pinus

100. Ⓐ

Kidney