FOR 2019 ASPIRANTS **MEDICAL EDT - 5** **DATE: 02 -04- 2019**

SOLUTIONS

1. (1)

Time required for a point to move from maximum displacement to zero displacement is $t = \frac{T}{4} = \frac{1}{4n}$

$$\Rightarrow n = \frac{1}{4t} = \frac{1}{4 \times 0.170} = 1.47\,\text{Hz}$$

2. (4)

The given equation can be written as $y = 4\sin\left(4\pi t - \frac{\pi x}{16}\right) \Rightarrow$

$(v) = \frac{\text{Co-efficient of } t(\omega)}{\text{Co-efficient of } x(K)} \Rightarrow v = \frac{4\pi}{\pi/16} = 64\,\text{cm/sec}$ along $+x$ direction.

3. (3)

Standard wave equation which travel in negative x-direction is $y = A\sin(\omega t + kx + \varphi_0)$

For the given wave $\omega = 2\pi n = 15\pi,\ k = \frac{2\pi}{\lambda} = 10\pi$

Now $v = \frac{\text{Co-efficient of } t}{\text{Co-efficient of } x} = \frac{\omega}{k} = \frac{15\pi}{10\pi} = 1.5\,m/sec$

and $\lambda = \frac{2\pi}{k} = \frac{2\pi}{10\pi} = 0.2\,m$.

4. (3)

For interference, two waves must have a constant phase relation ship. Equation '1' and '3' and '2' and '4' have a constant phase relationship of $\frac{\pi}{2}$ out of two choices. Only one S_2 emitting '2' and S_4 emitting '4' is given so only (3) option is correct.

5. (4)

$$y = \frac{1}{\sqrt{a}}\sin\omega t \pm \frac{1}{\sqrt{b}}\sin\left(\omega t + \frac{\pi}{2}\right)$$

Here phase difference $= \frac{\pi}{2}$ $\therefore$ The resultant amplitude

$$= \sqrt{\left(\frac{1}{\sqrt{a}}\right)^2 + \left(\frac{1}{\sqrt{b}}\right)^2} = \sqrt{\frac{1}{a} + \frac{1}{b}} = \sqrt{\frac{a+b}{ab}}$$

6. (1)
Suppose n_A = known frequency = 100 *Hz*, n_B= ?
x = 2 = Beat frequency, which is decreasing after loading (*i.e.*$x\downarrow$)
Unknown tuning fork is loaded so $n_B\downarrow$
Hence $n_A - n_B\downarrow = x\downarrow$ $\longrightarrow$ ... (i) Wrong
$n_B\downarrow - n_A = x\downarrow$ ... (ii) $\longrightarrow$ Correct
$\Rightarrow n_B = n_A + x = 100 + 2 = 102$ *Hz*

7. (1)
$v_0 = 332$ *m/s*. Velocity sound at t°*C* is $v_t = (v_0 + 0.61t)$
$\Rightarrow v_{20} = v_0 + 0.61 \times 20 = 344.2 \text{ m/s}$
$\Rightarrow \Delta n = v_{20}\left(\frac{1}{\lambda_1} - \frac{1}{\lambda_2}\right) = 344.2\left(\frac{100}{50} - \frac{100}{51}\right) = 14$

8. (2)
At fixed end node is formed and distance between two consecutive nodes
$\frac{\lambda}{2} = 10 \text{ cm} \Rightarrow \lambda = 20 \text{ cm} \Rightarrow v = n\lambda = 20$ *m/sec*

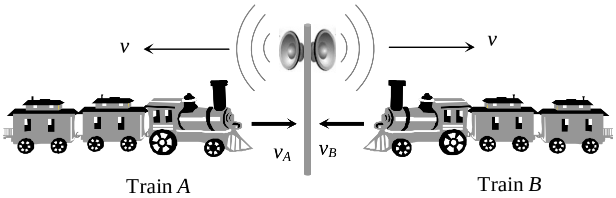
9. (4)
$n \propto \frac{1}{l} \Rightarrow \frac{n_2}{n_1} = \frac{l_1}{l_2} \Rightarrow n_2 = \frac{l_1}{l_2} n_1 = \frac{1 \times 256}{1/4} = 1024\text{Hz}$

10. (1)
The frequency of vibration of a string $n = \frac{p}{2l}\sqrt{\frac{T}{m}}$
Also number of loops = Number of antinodes.
Hence, with 5 antinodes and hanging mass of 9 *kg*.
We have p = 5 and $T = 9g \Rightarrow n_1 = \frac{5}{2l}\sqrt{\frac{9g}{m}}$
With 3 antinodes and hanging mass M
We have p = 3 and $T = Mg \Rightarrow n_2 = \frac{3}{2l}\sqrt{\frac{Mg}{m}}$
$\because n_1 = n_2 \Rightarrow \frac{5}{2l}\sqrt{\frac{9g}{m}} = \frac{3}{2l}\sqrt{\frac{Mg}{m}} \Rightarrow M = 25$ *kg*

11. (2)
$n_{open} = \frac{v}{2l_{open}}$
$n_{closed} = \frac{v}{4l_{closed}} = \frac{v}{4l_{open}/2} = \frac{v}{2l_{open}}$
$\left(\text{As } l_{closed} = \frac{l_{open}}{2}\right)$, *i.e.* frequency remains unchanged.

12. (2)

In both the cases observer is moving towards, the source. Hence by using $n' = n\left(\frac{v+v_0}{v}\right)$



When passenger is sitting in train A, then

$$5.5 = 5\left(\frac{v+v_A}{v}\right) \qquad \ldots(i)$$

when passenger is sitting in train B, then

$$6 = 5\left(\frac{v+v_B}{v}\right) \qquad \ldots(ii)$$

On solving equation (i) and (ii) we get $\frac{v_B}{v_A} = 2$

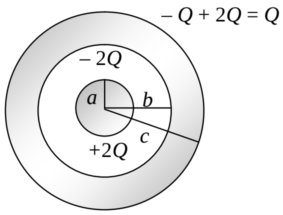
13. (2)

14. (2)

$$F \propto Q_1Q_2 \Rightarrow \frac{F_1}{F_2} = \frac{Q_1Q_2}{Q_1'Q_2'} = \frac{10\times -20}{-5\times -5} = -\frac{8}{1}$$

15. (1)

Surface charge density $(\sigma) = \frac{\text{Charge}}{\text{Surface area}}$

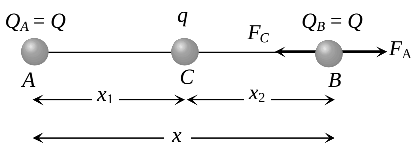


So $\sigma_{inner} = \frac{-2Q}{4\pi b^2}$ and $\sigma_{Outer} = \frac{Q}{4\pi c^2}$

16. (2)

Suppose in the following figure, equilibrium of charge B is considered. Hence for it's equilibrium $|F_A| = |F_C|$

$$\Rightarrow \frac{1}{4\pi\varepsilon_0}\frac{Q^2}{4x^2} = \frac{1}{4\pi\varepsilon_0}\frac{qQ}{x^2} \Rightarrow q = \frac{-Q}{4}$$



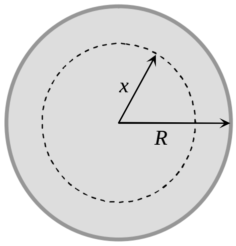
17. (3)
ABCDE is an equipotential surface, on equipotential surface no work is done in shifting a charge from one place to another.

18. (2)
$$\vec{E} = -\frac{\sigma}{2\varepsilon_o}\hat{k} - \frac{2\sigma}{2\varepsilon_o}\hat{k} - \frac{\sigma}{2\varepsilon_o}\hat{k} = -\frac{2\sigma}{\varepsilon_o}\hat{k}$$

19. (3)
When the dipole is rotated through at an angle of 90° about it's perpendicular axis then given point comes out to be on equator. So field will become $E/2$ at the given point.

20.
(4) $W = PE(1-\cos\theta)$ here $\theta = 180^o$
$\therefore W =$ $PE(1-\cos 180^o) = PE[1-(-1)] = 2PE$

21.
(3) Let sphere has uniform chare density $\rho\left(=\frac{3Q}{4\pi R^3}\right)$ and E is the electric field at distance x from the centre of the sphere.
Applying Gauss law



$$E.4\pi x^2 = \frac{q}{\varepsilon_0} = \frac{\rho V'}{\varepsilon_0} = \frac{\rho}{\varepsilon_0} \times \frac{4}{3}\pi x^3$$

($V' =$ Volume of dotted sphere)

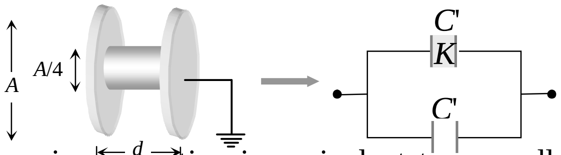
$$\therefore E = \frac{\rho}{3\varepsilon_0}x \Rightarrow E \propto x$$

22.
(2) When a dielectric K is introduced in a parallel plate condenser its capacity becomes K times. Hence $C' = 5C_0$. Energy stored $W_0 = \frac{q^2}{2C_0}$

$$\therefore W' = \frac{q^2}{2C'} = \frac{q^2}{2 \times 5C_0} \Rightarrow W' = \frac{W_0}{5}$$

23.
(4) Area of the given metallic plate $A = \pi r^2$
Area of the dielectric plate $A' = \pi\left(\frac{r}{2}\right)^2 = \frac{A}{4}$
Uncovered area of the metallic plates $A'' = A - A'$

$= A - \frac{A}{4} = \frac{3A}{4}$



The given situation is equivalent to a parallel combination of two capacitor. One capacitor (*C*') is filled

with a dielectric medium (*K* = 6) having area $\frac{A}{4}$ while the other capacitor (*C*'') is air filled having area $\frac{3A}{4}$

Hence $C_{eq} = C' + C'' = \frac{K\varepsilon_0 (A/4)}{d} + \frac{\varepsilon_0 (3A/4)}{d}$

$= \frac{\varepsilon_0 A}{d}\left(\frac{K}{4} + \frac{3}{4}\right) = \frac{\varepsilon_0 A}{d}\left(\frac{6}{4} + \frac{3}{4}\right) = \frac{9}{4}C \left(\because C = \frac{\varepsilon_0 A}{d}\right)$

24.

(1) Force on one plate due to another is

$F = qE = q \times \frac{\sigma}{2\varepsilon_0 K} = q\left(\frac{q}{2AK\varepsilon_0}\right) = \frac{q^2}{2AK\varepsilon_0}$

(where $\frac{\sigma}{2\varepsilon_0 K}$ is the electric field produced by one plate at the location of other).

25.

(1) In air the potential difference between the plates

$V_{air} = \frac{\sigma}{\varepsilon_0}.d$ ..... (i)

In the presence of partially filled medium potential difference between the plates

$V_m = \frac{\sigma}{\varepsilon_0}(d - t + \frac{t}{K})$ ..... (ii)

Potential difference between the plates with dielectric medium and increased distance is

$V_m' = \frac{\sigma}{\varepsilon_0}\left\{(d + d') - t + \frac{t}{K}\right\}$ ..... (iii)

According to question $V_{air} = V_m'$ which gives $K = \frac{t}{t - d'}$

Hence $K = \frac{2}{2 - 1.6} = 5$

26.

(1) Common potential $V = \frac{\text{Total charge}}{\text{Total capacitance}}$

$V = \frac{150 \times 10^{-6} \times 2}{4\pi\varepsilon_0 (10 \times 10^{-2} + 20 \times 10^{-2})} = 9 \times 10^6\ V$

27.

(2) In charging of capacitor half of the supplied energy is stored in the capacitor.

28.

(1) Initially when key is closed, the capacitor acts as short-circuit, so bulb will light up. But finally the capacitor becomes fully charged, so it will act as open circuit, so bulb will not glow.

29.

(1)

30.

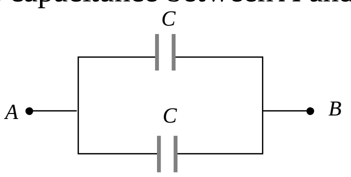
(3) $F_A = F_B$; because an uniform electric field produced between the plates.

31. (1)

32.

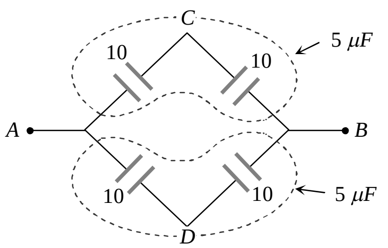
(1) The given circuit is equivalent to a parallel combination two identical capacitors
Hence equivalent capacitance between *A* and *B* is

$$C = \frac{\varepsilon_0 A}{d} + \frac{\varepsilon_0 A}{d}$$
$$= \frac{2\varepsilon_0 A}{d}$$



33.

(4) In the given system, no current will flow through the branch *CD* so it can be removed



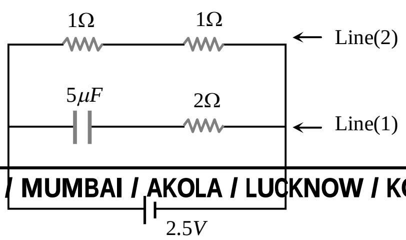
Effective capacitance of the system $= 5 + 5 = 10\mu F$

34.

(3) $Q_1 = Q_2 + Q_3$ because in series combination charge is same on both the condenser and $V = V_1 + V_2$ because in parallel combination $V_2 = V_3$.
Hence $V = V_1 + V_2$

35.

(3) In steady state condition. No current flows through line (1). Hence total current $i = \frac{2.5}{(1+1+0.5)} = 1A$



Potential difference a cross line (2) = potential difference a cross capacitor
$= 1 \times 2 = 2\,\text{Volt}$
So, charge on capacitor = 5 × 2 = 10 μC

36.
(3) $v_d = \frac{i}{nAe} = \frac{1.344}{10^{-6} \times 1.6 \times 10^{-19} \times 8.4 \times 10^{22}}$
$= \frac{1.344}{10 \times 1.6 \times 8.4} = 0.01\text{cm/s} = 0.1\text{mm/s}$

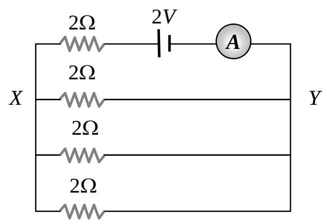
37.
(1) $R = \rho \frac{l}{A} = \frac{n}{ne^2\tau} . \frac{l}{A}$

38.
(1)Because as temperature increases, the resistivity increases and hence the relaxation time decreases for conductors $\left(\tau \propto \frac{1}{\rho}\right)$.

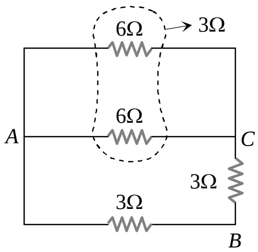
39.
(4) $R = 91 \times 10^2 \approx 9.1\text{k}\Omega$.

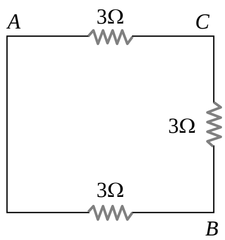
40.
(2) Resistance across $XY = \frac{2}{3}\Omega$

Total resistance
$= 2 + \frac{2}{3} = \frac{8}{3}\Omega$
Current through ammeter
$= \frac{2}{8/3} = \frac{6}{8} = \frac{3}{4}\text{A}$



41.
(2) Given circuit is equivalent to

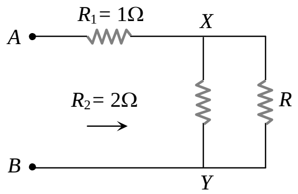




So the equivalent resistance between points A and B is equal to $R = \frac{6\times3}{6+3} = 2\Omega$

42.

(3) Let the resultant resistance be R. If we add one more branch, then the resultant resistance would be the same because this is an infinite sequence.

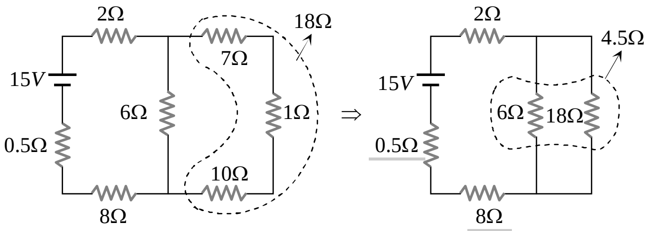


$$\therefore \frac{RR_2}{R+R_2} + R_1 = R \Rightarrow 2R + R + 2 = R^2 + 2R$$

$$\Rightarrow R^2 - R - 2 = 0 \Rightarrow R = -1 \text{ or } R = 2\,\text{ohm}$$

43.

(1) The given circuit can be simplified as follows



On further solving equivalent resistance $R = 15\Omega$

Hence current from the battery $i = \frac{15}{15} = 1A$

44.

(2) $P \propto V^2 \Rightarrow \frac{P}{P_0} = \left(\frac{V}{V_0}\right)^2 \Rightarrow P = \left(\frac{V}{V_0}\right)^2 P_0$

45.

(1) Resistance $\propto \frac{1}{\text{power}}$. Thus, 40 W bulb has a high resistance. Because of which there will be more potential drop across 40 W bulb. Thus 40 W bulb will glow brighter.

(46) Co^{+1} $3d^7 4s^1$

Co^{+2} $3d^7 4s^0$

Co^{+3} $3d^6 4s^0$

(47) Factual

(48) Cu, Fe, Mn are from 3d series
Ag is from 4d series

(49) CuO is basic because of it's low oxidation state.

(53) Lanthanide contraction causes the radius dependent properties such as lattice energy, solvation and stability constants.

(50) ↔ (52) factual

(54) ↔ (62) factual

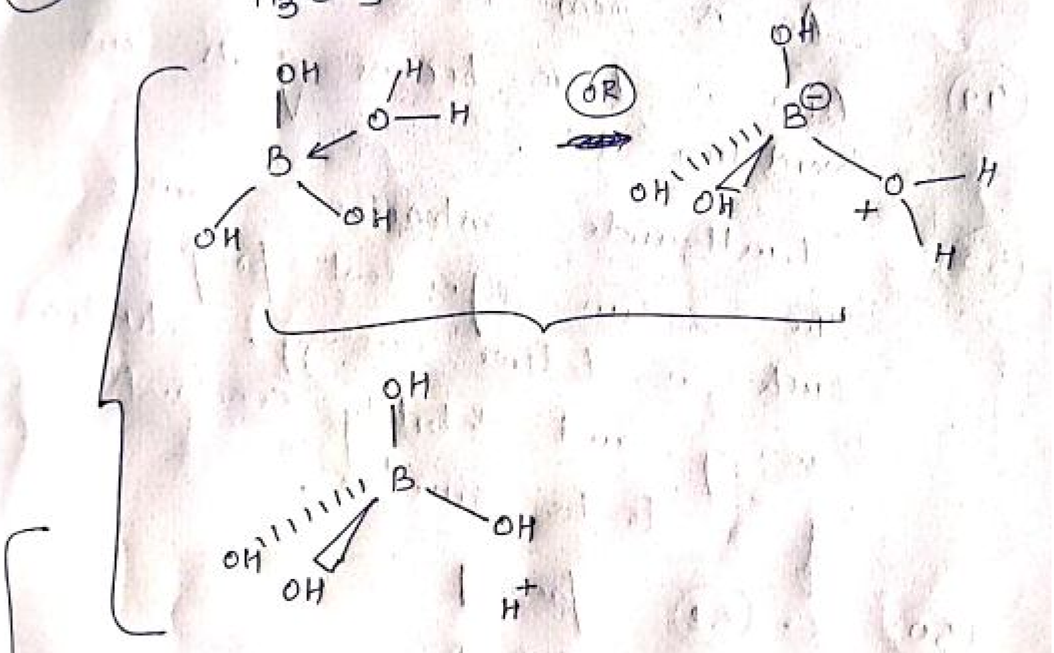
(64) Silicon can expand it's covalency by using empty 3d orbitals.

(65) Silicon's empty 3d orbitals provides a way to expand it's covalency.

(66) poor shielding of 3d-electrons and therefore, Higher Zeffective.

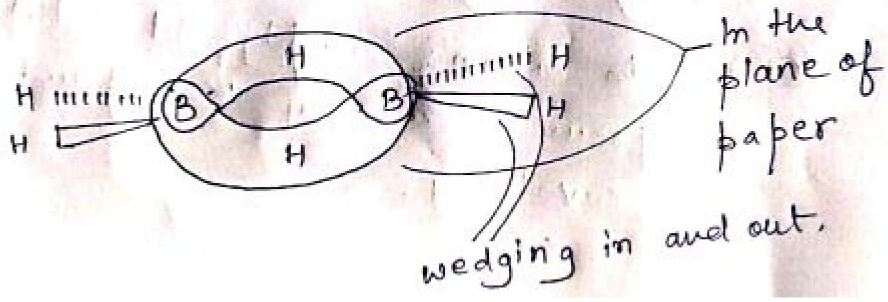
(67) In Group 14, lower elements are more stable in +2 oxidation state. (Inert pair effect)

(68) H_3BO_3 or $B(OH)_3$



$B(OH)_3 + H_2O \rightarrow B(OH)_4^- + H^+$

(70)



(74) Lowest van-der-waal forces

And [illegible] Much weaker H-bonding than NH_3

(75) High Electronegativity of Nitrogen pulls electron pairs (bp) towards itself which in-turn brings them closer to each other.

(76) In N_3H, the three nitrogen keep most of the electron cloud to themselves of the N—H bond which weakens the release of H^+. thereby easying the

(77) $NaOCl + NH_3 \longrightarrow NH_2Cl + NaOH$

$NH_2Cl + NH_3 + NaOH \longrightarrow N_2H_4 + NaCl + H_2O$

(78) P—F bonds are stronger than P—O bonds

(82) Because of excess OH^- ions from NaOH, the basic nature of $NaHCO_3$ diminishes and it acts acidic by producing H^+ and Na_2CO_3

(84) In Hydroxides, more electropositive the element, more basic is the hydroxide.

(87) CO_3^{2-} hydrolyses to give HCO_3^-, OH^- and traces of H_2CO_3

91	1	RGR= Growth per unit time x 100 / Initial Size Therefore, for leaf A, RGR is 5/20 x 100 = 25% For leaf B, RGR is 5/25 x 100 = 20%	PGD	244	M
92	2		PGD	247	E
93	2		PGD	248	E
94	4	Gibberellic acid delays ripening	PGD	249	M
95	3	Auxins and cytokinins promote cell divisions in tissue culture.	PGD	249	
96	1		PGD	246	E
97	2		PGD	248-250	M
98	1		PGD	250	E
99	2	In Richmond Lang effect, cytokinins retard the destruction of chlorophyll and yellowing of leaves.	PGD	Out of NCERT	M
100	1	Auxins are known to promote phototropism.	PGD	248	M
101	2	Pruning is removal tips of plant to remove effects of apical dominance by auxin and promote hedges formation of plants.	PGD	248	E
102	2	Light stimulus is perceived by mature leaves.	PGD	Out of NCERT	D
103	1		PGD	250	M
104	4	Cotyledons are non-photosynthetic during germination	PGD	Out of NCERT	E
105	3	Gibberellin helps secretion of hydrolytic enzymes, which mobilizes stored food.	PGD	249	E
106	1	Pr absorbs 660nm and gets converted to Pfr	PGD	Out of NCERT	M
107	3	.	PGD	249	M
108	4	SDPs do not flower when a flash of light interrupts the skotoperiod (dark period)	PGD	251	M
109	1	Potato, Banana and ginger plants arise from axillary buds present in the nodes	Reproduction	8	M
110	4	Binary fission occurs only in unicellular organisms. *Sargassum* is a multicellular	Reproduction	5,6	E

		algae.			
111	2	Fusion of similar or dissimilar gametes is fertilization. Autogamy is self-pollination Allogamy means cross pollination Dichogamy measn different maturation times of stamens and pistil within the same flower to prevent self-fertilization.	Reproduction	10,11	M
112	3	Explant is part of plant to be cultured.	Reproduction	Out of NCERT	E
113	3		Reproduction	Out of NCERT	M
114	1		Reproduction	Out of NCERT	M
115	4		Reproduction	14, 15	E
116	1		SRFP	38	E
117	3	Wheat is an annual plant, monocarpic, with no interflowering periods.	Reproduction	9	D
118	4	Isogametes are similar in size, heterogametes are dissimilar in size	Reproduction in organisms	10	E
119	4	One of the male gamete fuses with female gamete to form zygote, the other male gamete fuses with the secondary nucleus to form PEN	Sexual Reproduction in Flowering Plants (SRFP)	34	E
120	1	Porogamy is entry of pollen tube through Micropyle	SRFP	Out of NCERT	M
121	3	S.Nawaschin discovered double fertilization in the ovules of *Lilium* and *Fritilaria*	SRFP	Out of NCERT	D
122	3	When shed at 3 celled stage, the generative cell has already divided to produce 2 male gametes.	SRFP	33	E
123	3	2n female's secondary nucleus will be 2n (fusion of n + n polar nuclei), which when fused with 2n male gamete (half of 4n), the resultant PEN will be 4n	SRFP	34	D
124	2	If 3n=24, n=8. Hence, 2n of leaf will be 8*2=16 chromosomes	SRFP	34	D
125	1	In **helobial endosperm** formation, a cell wall is laid down between the first two nuclei, after which one half develops into cellular endosperm and the other half along the nuclear pattern. Helobial endosperm is most commonly found in the Alismatales (monocotyledons)	SRFP	Out of NCERT	D
126	3	Tender coconut water is actually its free nuclear endosperm.	SRFP	35	E
127	2	Eg in Coconut, the malai (cellular endosperm), starts forming from outside to inside, in centripetal order	SRFP	35	M
128	1	Initially the zygote divides to form an apical and a basal cell ; the former divides to become the **embryo**and the latter the suspenso, as is evident at the preglobular	SRFP	Out of NCERT, but depicted in diagrams, page 34	E

		stage.			
129	4	25 meiotic division will form 100 pollen grains and 100 divisions will be required to form 100 embryo sacs.	SRFP	22, 25	D
130	1	Adventive embryo has a 2n ploidy, hence will be same as secondary nucleus	SRFP	38	M
131	2		SRFP	34	E
132	2		SRFP	38	E
133	3	Apomixis occurs when a megaspore mother cell, without undergoing meiosis, produces a 2n egg cell. Such 2n egg cell can form a zygote, thus producing a seed.	SRFP	38	M
134	4	Since both veg propagation and apomixis is uniparental, the offspring produced are genetically identical to parent plant.	SRFP	38	M
135	3		SRFP	38	E

136	1	NCERT; XII; Chapter 3; Page: 51; figure 3.10
137	3	NCERT; XII; Chapter 3; Page: 43
138	4	NCERT; XII; Chapter 3; Page: 43
139	1	NCERT; XII; Chapter 3; Capacitation is activation of sperms before fertilization which involves changes in the membrane of sperm head. Such sperm is able to release acrosomal enzymes required for penetration of the cells and zona pellucida surrounding the egg.
140	4	NCERT; XII; Chapter 3; Page: 43
141	4	NCERT; XII; Chapter 3; Page: 45
142	3	NCERT; XII; Chapter 3; Page: 54
143	3	NCERT; XII; Chapter 3; Page: 53
144	3	NCERT; XII; Chapter 3; Among some other hormones, hCG is a hormone which is produced only during pregnancy and its concentration rapidly increases in first few weeks of pregnancy. The hormone is also excreted through the urine and the urine can be tested to test for pregnancy.
145	3	NCERT; XII; Chapter 3; Page: 51
146	4	NCERT; XII; Chapter 3; Page: 43
147	1	NCERT; XII; Chapter 3; Page: 51
148	1	NCERT; XII; Chapter 3; Generally only one ovum is released during ovulation. In case of non-identical twins two ova are fertilized by two sperms while in case of identical twins the zygote formed after fertilization splits during early embryonic development to give rise to identical twins.
149	2	NCERT; XII; Chapter 3; Page: 49-50
150	1	NCERT; XII; Chapter 3; Page: 44
151	3	NCERT; XII; Chapter 3; Amount of yolk and its distribution influences patterns of cleavage in zygote. In eggs with less yolk, the cleavage divisions are equal and produce similar size of blastomeres.
152	2	NCERT; XII; Chapter 3; Page: 50; figure 3.9
153	2	NCERT; XII; Chapter 3; Page: 51
154	2	NCERT; XII; Chapter 3; Page: 52-53
155	1	NCERT; XII; Chapter 3; Page: 48
156	2	NCERT; XII; Chapter 3; Page: 47-48
157	4	NCERT; XII; Chapter 3; Page: 48

158	2	NCERT; XII; Chapter 3; Page: 47
159	2	NCERT; XII; Chapter 3; Page: 47
160	1	NCERT; XII; Chapter 3; Page: 48
161	4	NCERT; XII; Chapter 3; Page: 47
162	1	NCERT; XII; Chapter 3; Cryptorchidism of failure of descent of one or both testis through inguinal canal into scrotum. This is one of the most common birth defects in males.
163	2	NCERT; XII; Chapter 3; Page: 44
164	2	NCERT; XII; Chapter 3; Sections 3.3 and 3.4
165	3	NCERT; XII; Chapter 3; Page: 43
166	1	NCERT; XII; Chapter 3; Page: 45-46
167	2	NCERT; XII; Chapter 3; Page: 43
168	2	NCERT; XII; Chapter 3; During cleavage divisions blastomeres become progressively smaller in size. During second cleavage division, division in one of the blastomeres starts later and a transient 3-celled stage can be seen.
169	1	NCERT; XII; Chapter 3; Page: 47
170	4	NCERT; XII; Chapter 3; Page: 54
171	2	NCERT; XII; Chapter 3; Page: 44
172	1	NCERT; XII; Chapter 3; Page: 43
173	3	NCERT; XII; Chapter 3; Page: 53
174	1	NCERT; XII; Chapter 3; Page: 52
175	3	NCERT; XII; Chapter 3; Page: 53
176	3	NCERT; XII; Chapter 3; both oestrogen and progesterone are steroidal hormones. Inhibin is a peptide hormone produced by gonads and suppress the secretion of FSH from anterior pituitary.
177	4	NCERT; XII; Chapter 3; Page: 47-48
178	4	NCERT; XII; Chapter 3; Page: 49
179	4	NCERT; XII; Chapter 3; Page: 52; Figure 3.11. The fluid filled space develops in blastula which is termed as blastocoele and is surrounded by blastoderm. This stage of embryo development is important for further differentiation of the cells in developing embryo.
180	3	NCERT; XII; Chapter 3; Page: 48-49