Key

SECTION – I

1. B	6. B	11. C	16. B	21. A	26. C
2. C	7. C	12. C	17. C	22. D	27. A
3. D	8. C	13. B	18. D	23. B	28. A
4. D	9. B	14. D	19. B	24. C	29. A
5. D	10. D	15. D	20. C	25. D	30. B

SECTION – II

1. C	6. D	11. A	16. C	21. A	26. A
2. B	7. B	12. C	17. C	22. B	27. C
3. A	8. D	13. C	18. B	23. D	28. C
4. D	9. C	14. C	19. C	24. A	29. C
5. B	10. B	15. B	20. B	25. C	30. B

Solutions

SECTION – I

Solutions for questions 1 to 5:

1. $f_1(x) = \dfrac{2}{2+x}$ and $f_n(x) = \dfrac{1}{1+f_{n-1}(x)}$

$\Rightarrow f_1(1) = \dfrac{2}{2+1} = \dfrac{2}{3}$ $\quad \Rightarrow f_2(1) = \dfrac{1}{1+\frac{2}{3}} = \dfrac{3}{5}$

$\Rightarrow f_3(1) = \dfrac{1}{1+\frac{3}{5}} = \dfrac{5}{8}$ $\quad \Rightarrow f_4(1) = \dfrac{1}{1+\frac{5}{8}} = \dfrac{8}{13}$

Hence, the percentage change in the value of $f_n(x)$ decreases as n increases.

Now, when n is large $f_n(x) \cong \dfrac{1}{1+f_n(x)}$

Let $f_n(x) = y$

$\therefore y = \dfrac{1}{1+y}$

$y^2 + y - 1 = 0$

$y = -\dfrac{-1 \pm \sqrt{1+4}}{2}$

Since $y > 0$, therefore $y = \dfrac{\sqrt{5}-1}{2}$

$y \cong 0.618.$

Alternative Solution:

After observing that the percentage change in the value of $f_n(x)$ w.r.t. $f_{n-1}(x)$ decreases with increasing 'n', we can simply consider $f_1(1)$, $f_2(1)$, $f_3(1)$, etc., and see that the values progress as 0.66, 0.6, 0.625, 0.615, increasing and decreasing with lesser and lesser variation. Hence, answer will lie between 0.625 and 0.615. Hence, choice (B).

Choice (B)

2. The marbles with A, B, C at the four different stages are tabulated below. We can fill up the table from the bottom row, upwards.

	A	B	C
Initial	115 9	72	5 27
After B distributes	124 4	36 12	32
After C distributes	128	48 16	16 48
After A distributes	64	64	64

We see that initially C had 5 and A had 115, i.e., 110 more than C.

Choice (C)

3. Consider the following time chart for Rosagollas:

t = 0 min	24
t = 1 min	Anil Abhilash (24) – (x) – (2x)
t = 2 min	Anil Abhilash (24 – 3x) – (x) – (2x)

Time charts for Kulfis.

t = 0	36
t = 1	Anand Abhilash (36) – y – (3y)
t = 2	Anand Abhilash (36 – 4y) – y – (3y)

Given, ratio of number of Rosagullas and Kulfis after 2 mins is 1;

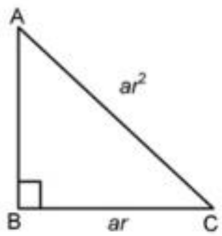
$\Rightarrow \dfrac{24-6x}{36-8y} = 1$

$\Rightarrow 8y - 6x = 12$

$\Rightarrow 4y - 3x = 6$ --- (1)
by trial and error; $y = 3$; $x = 2$

Hence; the required ratio = $\frac{3y}{x} = \frac{9}{2}$ Choice (D)

4.



Let the sides of the triangle be a, ar and ar^2. Since it is a right-angled triangle, $a^2 + (ar)^2 = (ar^2)^2$ (By Pythagoras theorem)
$1 + r^2 = r^4$ or, $r^4 - r^2 - 1 = 0$

$\therefore r^2 = \frac{1 \pm \sqrt{5}}{2}$

Now, since $r^2 > 0$

$\therefore r^2 = \frac{\sqrt{5}+1}{2}$

The ratio of the sines of its acute angles = $\frac{\sin A}{\sin C}$

$\frac{AB}{\sin C} = \frac{BC}{\sin A}$

$\therefore \frac{\sin A}{\sin C} = \frac{BC}{AB} = \frac{ar}{a} = r = \sqrt{\frac{\sqrt{5}+1}{2}}$.

Alternative Solution:

In any right triangle, the ratio of the sines of the acute angles will simply be the ratio of the perpendicular sides. We can use this idea to eliminate the choices. For, example in choice (B), if AB : BC = $\sqrt{3}$, then the hypotenuse will be 2 (i.e., $\sqrt{3^2+1^2} = 2$). But 1, $\sqrt{3}$ and 2 are not in G.P. Similarly choice (A) is eliminated and choice (C) also is eliminated (by approximating $\frac{\sqrt{5}+1}{2} \cong \frac{2.2+1}{2} \cong 6$).

That is 1, (1.6), and $\sqrt{1^2+(1.6)^2}$ are not in G.P.

Hence, choice (D) must be the answer. Choice (D)

companies will definitely constitute more than $\frac{51 \cdot 5}{2} = 25 \cdot 75\%$ of the weightage of the sensex. Or in other words the bottom 30% of the middle group (companies with weightage of 20% to 50% of the total sensex) would definitely constitute less than 25·75%. By adding this value to that of the weightage of bottom 20% of the companies in the sensex, we get the maximum weightage of the bottom 50%. If the companies that constitute the sensex is 5·5 + 25·75 = 31·25% S – we can't definitely say whether the bottom 50% of the companies constitute less than 30% of the weightage of the sensex.

Proceeding in this way for other groups, we can find that only for DOW JONES, NIFTY, FTSE 100 and HANG SENG can we definitely say the weightage would be less than 30%.
For example max. weightage of bottom 50% of the companies in the NIFTY = $5 \cdot 1 + \frac{48 \cdot 5}{2} = 5 \cdot 1 + 24 \cdot 25$ = 29.35% (Note 48·5 = 100 – (46·4 + 5·1))

6. The indices that satisfy the condition are DOW JONES, NIFTY, FTSE 100 and HANG SENG. Choice (B)

7. To find the minimum possible weightage of the company that is ranked 10th out of 30 companies in the sensex, we have to assume that the top 9 companies have equal weightage and all the remaining companies, excluding the bottom 20% after that also have the same weightage.
If is given that top 20% i.e. 6 companies constitute 43% of the sensex. If top 9 companies have the same weightage they will constitute $\frac{43}{6} \times 9 = 64 \cdot 5\%$ of the weightage.

Now the bottom 20% i.e., 6 companies have a weightage of 5·5%

$\therefore$ The top 9 and bottom 6 companies would at most contribute 64·5 + 5·5 = 70% of the weightage of the sensex. Now there are 15 more companies with ranks 10 to 24. Of these companies the weightage of the company ranked 10 would be the least if we assume all the 15 companies have the same weightage.
$\therefore$Min weightage of the company ranked 10th in the sensex = $\frac{30}{15} = 2\%$. Choice (C)

8. For this we follow the same logic as in the previous questions but divide the middle 60% of the companies into three equal groups of 20% each. The top 20% of those middle group (60% to 80% of the total) would at least

5. If speed of Sohan is v, then speed of Rohan = $9v$, Now, Rohan is faster than sohan by $9v - v = 8v$. (i.e., relative speed). Hence, if Sohan (while he is running) is Rohan's reference point, then in the time Sohan makes one round, Rohan makes eight rounds (i.e., eight times he goes around the track and overtakes Rohan). In each round Rohan is diametrically opposite Sohan exactly once. Hence, by the time Sohan makes one round, Rohan is diametrically opposite to him on exactly 8 occasions. Hence by the time Sohan makes three rounds, Rohan would be diametrically opposite Sohan on exactly $8 \times 3 = 24$ occasions. Choice (D)

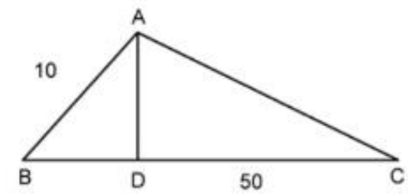
Solutions for questions 6 to 8:

The weightages of the top 20% of the companies and the bottom 20% of the companies are given.

For the sensex, it is 43% and 5·5% respectively. The remaining 51·5% (100 − (43 + 5·5)) is constituted by the 60% of the companies in the middle. If we divide this group of 60% into two, i.e., bottom 30% and the top 30%, the weightage of the companies that constitute those top 30% will definitely be more than that of the bottom 30%.
For the sensex, 51·5% of its weightage is contributed by the middle 60% of the companies. The top 30% of these middle constitute equal to those contributed by the other two groups. So find the weightage of the middle 60% of the companies, find one third of it (since we an dividing them into three groups of 20%) and add to the value of the top 20% of the companies. This will give the minimum weightage of the top 40% of the companies we can find that only for the SENSEX, DOW JONES, NIFTY, FTSE 100, HANG SENG and S & P 500 can we definitely say it would be more than 60%.
For example take that of S & P 500, minimum weightage of the top 40% of the companies = 42·6% (that of the top 20%) + $\frac{53 \cdot 3}{3} = 60 \cdot 4\%$ Choice (C)

Solutions for questions 9 to 18:

9.



Let the triangle be ABC.

Now, area of ΔABC = (1/2) (BC) (AD) (where D is chosen point on BC such that $AD \perp BC$)

Now, AD has to be equal to $\frac{\text{Area} \times 2}{BC}$

(Since area is given and BC is given)

$\therefore AD = \frac{(150)(2)}{50} m = 6 m$

Now ΔBDA is right-angled triangle

$\therefore BD^2 = AB^2 - AD^2 = 10^2 - 6^2 m^2 = 8^2 m^2$

$\Rightarrow$ BD = 8 m and DC = BC – BD = 42 m

$\therefore$ again ΔADC is right angled

$\therefore AC^2 = AD^2 + DC^2 = (6)^2 + (42)^2 m^2$

$\Rightarrow AC = \sqrt{1800} = 30\sqrt{2}$ m

Alternative solution:

$30\sqrt{2} \cong 42$

$40\sqrt{3} \cong 68$

$\sqrt{1560} \cong 39$

$\therefore$ Using the principle that the sum of any two side of a triangle is greater than the third side. The two given sides are 50 and 10.

From the choices the above condition is satisfied only for choice (B).

In choice (A) 10 + 50 < 68

In choice (C) 39 + 10 < 50

In choice (D) 32 + 10 < 50 Choice (B)

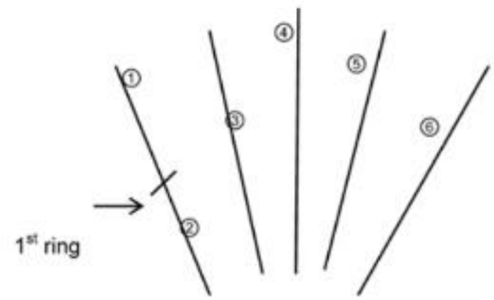
10. One can wear the rings in 3 ways.

1. One ring on each of the 3 fingers.
2. 2 rings on one finger and 1 ring on another.
3. All 3 rings on a single finger.

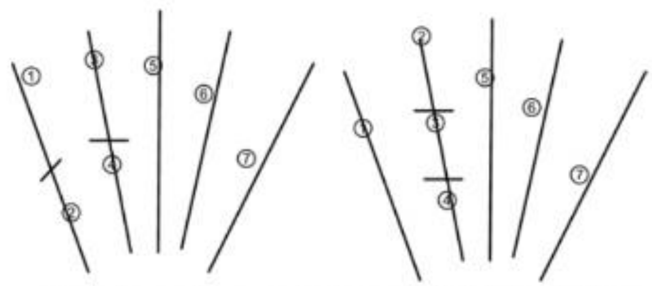
Case I: (111) The 3 fingers can be chose in ${}^5C_3$ ways. Now 3 rings can be arranged in those 3 fingers in 3! ways. Total 3! ${}^5C_3$ = 60 ways.

Case II: (2, 1, 0) The 2 fingers with rings can be chosen ${}^5C_2$ ways. Among them the finger with 2 rings in ${}^2C_1$ or 2 ways. Then the 2 rings on that finger can be chosen in ${}^3C_2$ ways and arranged in that finger in 2! ways.
Total ${}^5C_2$ ${}^2C_1$ ${}^3C_2$ (2!) = 120 ways.

Case III: (3, 0, 0) The finger can be chosen in ${}^5C_1$ ways and the 3 rings arranged on it in 3! ways.
Total = ${}^5C_1$ 3! = 30 ways
Total number of ways = 120 + 60 + 30 = 210



OR



In each case there are 7 places for the 3rd ring. So total number of ways = $5 \times 6 \times 7$ = 210 ways.

Alternative Solution II:

Let the number of rings in the five fingers be represented by *a, b, c, d, e* respectively.

Now, $a + b + c + d + e = 3$ where $a, b, c, d, e > 0$.

Number of non-negative integral solution for $a + b + c + d + e = 3$ is ${}^{3+5-1}C_{5-1} = {}^7C_4 = {}^7C_3 = 35$

Since, the rings are distinct, so they can be arrange among themselves in 3! ways.

Total 35 (6) = 210 ways. Choice (D)

11. Let the number of red, green and blue tokens be R, G and B respectively.

Initially, the total worth of tokens.

i.e., 20R + 50G + 100B = 18500 $\rightarrow$ (1)

After revision in the value of the red tokens, the total worth of all the tokens is 200R + 50G + 100B = 27500 – (2)

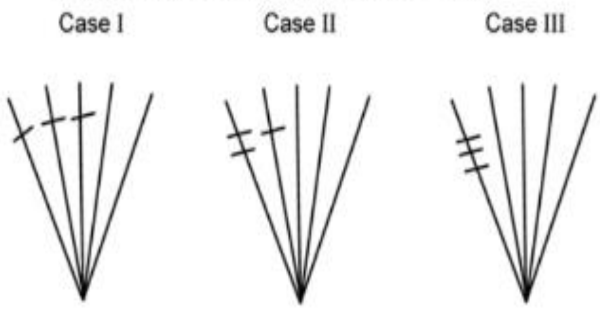
(2) – (1) gives180R = 9000.$\Rightarrow$ R = 50

i.e., The number of red tokens is 50

substituting this in (1),

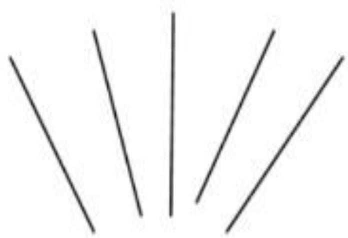
We get

1000 + 50G + 100B = 18500



Alternative Solution I:

There are 5 places for the first ring.
Now for each way in which one wears the 1^{st} ring, the second ring can be worn in 6 ways, for there are 6 places for the 2^{nd} ring.



Similarly after wearing 2 rings, the situation would be as either.

$\Rightarrow G + 2B = 350 \rightarrow (3)$

Also, it is the average number of tokens per colour equal to the number of green tokens.

$$\Rightarrow \frac{R+B+G}{3} = G \Rightarrow R + B + G = 3G \Rightarrow 50 + B = 2G$$

$2G - B = 50 \rightarrow (4)$

Solving (3) & (4), G = 90, B = 130.

$\therefore R + G + B = 50 + 90 + 130 = 90(3) = 270$. Choice (C)

12. Consider a positive real number 'a' then

$$\frac{1+a+a^2}{a} = \frac{1}{a} + a + 1 \geq 3 \text{ (for all } a > 0)$$

$$\left[\because \frac{1}{a} + a + 1 = \left(\sqrt{a} - \frac{1}{\sqrt{a}}\right)^2 + 3\right]$$

So taking 'n' positive numbers all different a_i (i = 1, 2.....n)

$$\frac{(1+a_1+a_1^2)}{a_1} \cdot \frac{(1+a_2+a_2^2)}{a_2} \cdot \ldots\ldots \cdot \frac{(1+a_n+a_n^2)}{a_n}$$

$$\geq \underbrace{3.3 \ldots\ldots\ldots 3}_{n \text{ times}}, \text{ i.e., } 3^n$$

However, since all of a_1, a_2, a_3 .... a_n are distinct, the given product will be definitely greater than 3^n.

Choice (C)

13. $n^2 - n = n(n^2 - 1) = (n - 1)n(n + 1)$
We can observe that the given quantity is the product of three consecutive numbers. One of these three numbers (n – 1), n, or (n + 1) will be divisible by 3. Since x is an odd integer, one of (n – 1) or (n + 1) will be divisible by 2 and the other by 4.
Therefore $n^3 - n$ is always divisible by $2 \times 4 \times 3$, which is 24. Choice (B)

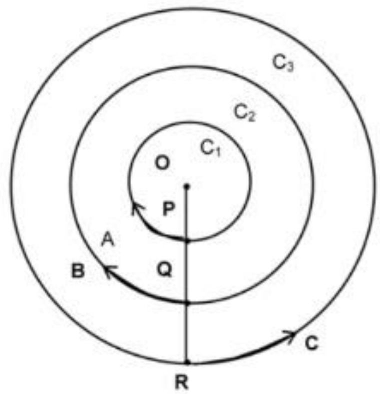
14. Consider the choices. Only choice (4) satisfies the given condition.
The equation is $D + \sqrt{M} = M^2$
M can be 1, 4, 9 only.
For M = 1, D = 0, not possible.
M = 4, D = 14, possible.
M = 9, D = 78, not possible Choice (D)

15. We need to make a single cut (across an area A, the cross section of the log) to make a log of wood into two cylindrical pieces. So, we need 3 such cuts to make a log of wood into 4 equal pieces.
To cut 60 logs into 4 equal pieces each, we need to make 60 (3) = 180 cuts
Each cut can be made by a manual saw by 4 workers in 2 hours (or) by a mechanized saw by 2 workers in 1 hour.
There are 12 workers, with 2 mechanised saws and 2 wound saws.
In 2 hours, 4 workers, using the 2 mechanized saws can make 4 cuts and 8 workers using the 2 manual saws can make 2 cuts.
∴ In 2 hours the 12 workers can make 6 cuts.
To make 180 cuts, they need $\frac{180}{6}(2) = 60$ hours
Choice (D)
Note: Even if the pieces are rearranged after a particular cut, there would be no difference in the time taken to make all the necessary cuts as the total area across which the cuts are made remains constant.

Alternative Solution:
This question can also be solved by back substitution of answer choices, as there is no "None of the above" given among the choices. For each answer choice, (i.e., time) we can find the angular location on the track, given by the fractional part of the number of rounds completed, for each of A, B, C (in their respective tracks at their respective speeds) and all three will be collinear and on the same side of the centre if the fractional part of the number of rounds completed is the same for A and B = say *k* (since A and B run in same direction) and that for C is equal to (1 – *k*) (since C is running in the opposite direction). Also, it is sufficient to start with the least value among the choices and work upwards and stop with the earliest choice that satisfies.
For example, consider choice (A). After 200 seconds
The number of rounds completed by A
$= \frac{200}{(400/5)} = 2.5$ rounds.
The number of rounds completed by B
$= \frac{200}{(600/9)} = 3$ rounds
Since the fractional parts (of number of rounds completed by A and B) do not match (2.5 vs 3.0), this choice is eliminated. Similarly, for choice (B), the number of round completed by A and B will be 5.0 and 6.0. Therefore A and B will be collinear with centre and on the same side. Now, checking for C, he will complete $\frac{400}{(800/8)} = 4.0$ rounds.
Hence C will also be collinear with A and B and on the same side of the centre. It is now not necessary to check choices (C) and (D) since they are both anyway greater than 400. Choice (B)

17. Since the line joining the mid-points of two sides of a triangle is parallel and equal to half the third side, we have PQ = 2(ST) ⇒ PQ = 12 cm

16.



We denote the three concentric tracks as C_1, C_2 and C_3 (C_1 is the inner-most track)

As far as the angular positions of A, B, C are concerned, we may assume that all of them are running on the same track (say C_1) with equivalent speed.

A is running on C_1 at 5 m/s.

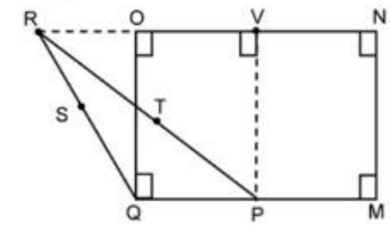
B is running on C_2 at 9 m/s or equivalently on C_1 at 6 m/s.

C is running on C_3 at 8 m/s or equivalently on C_1 at 4 m/s.

A and C 'meet' after every $\frac{400}{5+4}$ s or $\frac{400}{9}$ s

B leads A by a whole number of track lengths after every $\frac{400}{6-5}$ s or 400s.

Therefore, their three positions (actual) would be collinear with the centre for the first time after the LCM $\left(\frac{400}{9}, 400\right)$ s or 400 s.



Since, $PQ = \frac{2}{3}QM$

Now, $\angle ORP = 45°$

Draw $PV \perp ON$

In ΔRVP, $\tan 45° = \frac{PV}{VR} = \frac{PV}{OR+OV} = \frac{\text{breadth}}{12+OR}$

(Since OV = PQ = 12 cm) also $\text{breadth}^2 + OR^2 = (QR)^2$, in ΔROQ.

$\Rightarrow$ Breadth = x + 12 where OR = x

$\Rightarrow (x+12)^2 = \left(4\sqrt{17}\right)^2 - x^2$ (given that QR = $4\sqrt{17}$)

$\Rightarrow 2x^2 + 24x - 128 = 0$

$\Rightarrow x^2 + 12x - 24 = 0 \Rightarrow x = 4$ or -16

Since $x > 0$, $x = 4$

$\therefore$ Breadth = x + 12 i.e., 16 cm

$\Rightarrow$ Area of MNOQ = 16×18 = 288 sq.cm

Alternative Solution:

In ΔQRP, since S and T are midpoints of RQ and RP, QP = 2(ST) = 2(6) = 12 cm.

Given $QP = \frac{2}{3}QM$, $\Rightarrow$ QM = 18 cm. Also, since $\angle VRP$ = 45° (where $VP \perp RN$), RV = VP = MN. Since RV = VO + OR and VO = QP = 12, RV (and hence MN) must be

> 12. Hence, area of MNOQ = MN × QM = (>12) × (18) must be >(18)(12). Only options (C) and (D) are possible. Among them, only option (C) works, as MN = OQ

$= \frac{288}{18} = 16. \Rightarrow$ OR = 4 cm and

RQ = $\sqrt{4^2 + 16^2} = 4\sqrt{17}$ cm² Choice (C)

18. $t_9^2 - t_8^2 = 840$
$\Rightarrow (t_9 - t_8)(t_9 + t_8) = (28)(30)$ or $(12)(70)$
$t_9 = 29$ and $t_8 = 1$ satisfy the equation,
$t_9 = 41$ and $t_8 = 29$ also satisfy the equation. Choice (D)

Solutions for questions 19 to 21:

19. Total population of minors of all the states put together (in millions)
= 11.4 + 15 + 6.36 + 13.1 + 9.37 + 4.56 + 5.12 + 12.63
= 77.54
Total population of all the states put together (in millions)
= 29.7 + 45.7 + 21.3 + 30.2 + 26.1 + 10.3 + 11.7 + 38.5
= 213.5

$\therefore$Required % = $\frac{77.54}{213.5} \times 100 = 36\%$ Choice (B)

20. Total population of majors in states A, D and H (in millions)

$= 29.7 \times \frac{61.6}{100} + 30.2 \times \frac{56.6}{100} + 38.5 \times \frac{67.2}{100}$

= 18.3 + 17.1 + 25.87 = 61.27

$\therefore$Required% = $\frac{61.27}{(29.7 + 30.2 + 38.5)} \times 100$

$= \frac{61.27}{98.4} \times 100 = 62.26\%$

Alternative solution:

For each element $a_i \in$ A, we can put it in both P and Q, put it in Q but not in P, or put it in neither P nor Q, i.e., we can deal with each element in 3 ways to construct subsets P, Q which satisfy the condition that P $\subseteq$ Q. Having dealt with one element, we can deal with another in exactly the same way (or ways). Thus there are 3^n ways of constructing (or selecting) the two subsets.

Alternative Solution:

We can solve this question by assuming A to have a very small (and mangeable) number of elements, say 2 elements, {a, b}. Then the cases are (i) P = { } ⇒ Q = { }; (ii) P = {a} ⇒ Q = { } or {a}; (iii) P = {b} ⇒ Q = { } or {b}; and (iv) P = {a, b} ⇒ Q = { } or {a} or {b} or {a, b}.
Clearly, there are nine possible combinations in all for selecting P and Q. Choice (B)

24. Let the time taken by both A and B to do the work be *m* days.
$\therefore$A takes (*m* + *a*) days to do the work and B takes *m* + *b* days to do it.

$\frac{1}{m+a} + \frac{1}{m+b} = \frac{1}{m}$

$m(2m + a + b) = m^2 + ma + mb + ab$

$m^2 = ab$ or, $m = \sqrt{ab}$

Therefore both together can do the work in $\sqrt{18(8)}$ = 12 days.

In 10 days, they will complete $\frac{10}{12}^{th}$ or $\left(\frac{5}{6}\right)^{th}$ of the total work.

So, C does the remaining $\frac{1}{6}^{th}$ of the work.

Thus C gets $\frac{1}{6}(18000) = ₹3000$ Choice (C)

As the populations of A and D are nearly the same, the percentage in these two states put together is about 59 and if state H is also considered the percentage should be slightly above that as the value in state H is 67.2.
Choice (C)

21. Total population of female minors (in millions)

$= 29.7 \times \frac{18.1}{100} + 45.7 \times \frac{15.8}{100} + 21.3 \times \frac{14.6}{100} \simeq 6 + 7.2 + 3.1$

$= 16.3$ Choice (A)

Solutions for questions 22 to 24:

22. The given sequence is 1, 2, 3, …..n
After step 1, we have 2, 4, 6, 8, ……
After step 2, we have 4, 8, 12, 16, …..
After step 3, we have 8, 16, 24, 32, …..
∴After the last step (m^{th} step) we have the highest power of $2^m \leq n$.

If n = 1997, after step 10, we are left with only 1024.
Choice (D)

23. Let, A = {a_1, a_2, …., a_n}. For $a_i \in$ A, we have the following cases for the subsets P and Q of the set A:
(i) $a_i \notin$ P, $a_i \notin$ Q
(ii) $a_i \in$ P, $a_i \notin$ Q
(iii) $a_i \notin$ P, $a_i \in$ Q and
(iv) $a_i \in$ P, $a_i \in$ Q
The cases (i), (iii) and (iv) are favourable to us inorder to have P ⊆ Q. So, for every $a_i \in$ A (i = 1, 2, …..n), we have 3 favourable cases.
Hence, the number of ways of choosing the subsets P and Q $= 3 \times 3 \times \ldots \times 3 = 3^n$
The above process is explained more clearly, in words, as below:
The set A has n elements. We consider the number of ways of constructing subsets P and Q of A such that P ⊆ A

Solutions for questions 25 to 27:

The number of students who appeared for the exam in different subjects is as follows.

	Boys	Girls	Total
Mathematics	111	87	198
Physics	108	82	190
Chemistry	110	86	196
Botany	110	85	195
Zoology	112	89	201

25. As the number of students not appearing any exam is at most 15, the maximum number of students studying in class XII of the school = 15 + (The least number of students who appeared for any of the exams) = 15 + 190 = 205
Choice (D)

26. Maximum number of students who did not pass in Chemistry = Maximum number of students absent + Number of students getting less than 40 = (205 – 196) + (26 + 14) + (16 + 18) = 83
Choice (C)

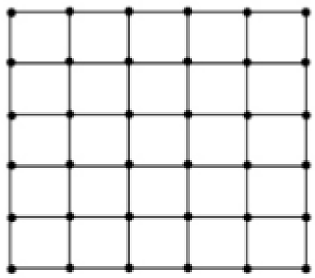
27. We know that the total number of students is at least 201 and at most 205 (from solution to Q.25). Hence, using this information we get the following table:

Subject	Number of boys missing the exam	Number of girls missing the exam
Maths	(0 – 4)	3
Physics	(3 – 7)	8
Chemistry	(1 – 5)	4
Botany	(1 – 5)	5
Zoology	(0 – 4)	1

Hence, only in Maths, Chemistry and Zoology, it is possible. That is three subjects. Choice (A)

Solutions for questions 28 to 30:

28. '6' posts per row and '6' posts per column, as shown below, will give the maximum number of squares.



So, a grid of 5 × 5. Hence 25 trees can be planted.

Choice (A)

29. Let $S = 1+\frac{2}{11}+\frac{5}{11^2}+\frac{10}{11^3}+\frac{17}{11^4}+$...........(1)

Multiplying by $\frac{1}{11}$,

we get $\frac{1}{11}S=\frac{1}{11}+\frac{2}{11^2}+\frac{5}{11^3}+\frac{10}{11^4}+\frac{17}{11^5}+$...........(2)

Subtracting (2) from (1),

we get $\frac{10}{11}S=1+\frac{1}{11}+\frac{3}{11^2}+\frac{5}{11^3}+\frac{7}{11^4}+$...........(3)

Multiplying by $\frac{1}{11}$,

we get $\frac{1}{11}\left(\frac{10}{11}S\right)=\frac{1}{11}+\frac{1}{11^2}+\frac{3}{11^3}+\frac{5}{11^4}+$...........(4)

Subtracting (4) from (3),

we get $\frac{10}{11}\left(\frac{10}{11}S\right)=1+\frac{2}{11^2}+\frac{2}{11^3}+\frac{2}{11^4}+$.......

$$=1+\frac{2}{11^2}\left(\frac{1}{1-\frac{1}{11}}\right)=1+\frac{2}{11\times11}\times\frac{11}{10}=\frac{56}{55}$$

$$S = \frac{56}{55}\times\frac{11\times11}{10\times10}=\frac{154}{125}$$

SECTION – II

Solutions for questions 1 to 3:

1. As the engineer is the son of the accountant, either Mr. Raj or his son must be the engineer.

Case (i): Mr. Raj's son is the engineer:
In this case either Mr. Raj or his wife must be the accountant. If Mr. Raj is the accountant then his wife must be the doctor and his mother must be the lawyer. This contradicts the condition that the accountant is not the son of the lawyer ⇒ Mr. Raj is not the accountant. If Mr. Raj's wife is the accountant then Mr. Raj and his mother are the doctor and lawyer in any order.

Case (ii) : Mr. Raj is the engineer:
If Mr. Raj is the engineer, then his mother must be the accountant ⇒ Mr. Raj's wife is the doctor and his son is the lawyer.
Thus we can see Mr. Raj's son cannot be the doctor in any case, but either of Mr. Raj or his wife or his mother can possibly be the doctor. Choice (C)

2. It is given that Roy is taller and heavier than Das. If Roy is heavier than Das, Abhishek is taller than Roy. If Abhishek is taller than Roy, Vivek is heavier than Ranjan. From the above information, it can be deduced that:
(1) Abhishek is taller than Roy.
(2) Vivek is heavier than Ranjan.
Information given in the question along with the above deductions is shown in the following table. [">" implies "more" in all the comparisons].

Height	Weight
Vivek > Abhishek	Abhishek > Vivek
Das > Ranjan	Ranjan > Das
Abhishek > Das	Vivek > Ranjan
Roy > Das	Roy > Das
Abhishek > Roy	Roy > Abhishek
Vivek > Abhishek > Roy > Das > Ranjan	Roy > Abhishek > Vivek > Ranjan > Das

Hence the lightest is Das. Choice (B)

3. Let us draw a diagram to understand the seating arrangement before solving this question.

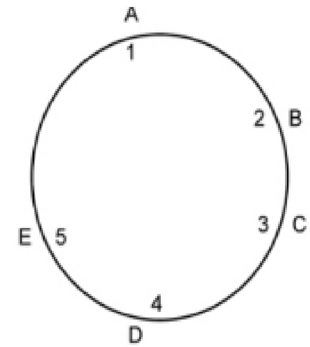
Alternative Solution:

By calculating the sum of the first three terms in the given series, we get that S will be slightly greater than 1.230. Quickly calculating choices, gives only choices (A) and (D) as close. However, choice (A) is 1.232, i.e., slightly greater than 1.230, whereas choice (D) is 1.228, which is slightly less than 1.230. Choice (A)

30. Let the number of chocolates given to A, B, C and D be denoted by a, b, c and d respectively i.e., $a + b + c + d = 40$, where $a \geq 0$, $b \geq 3$, $c \geq 0$ and $d \geq 5$.
Let $b = b^1 + 3$ and $d = d^1 + 5$
Now $a + b^1 + 3 + c + d^1 + 5 = 40$
Or, $a + b^1 + c + d^1 = 32$ where $a, b^1, c, d^1 \geq 0$
The number of non-negative integral solutions for this equation is ${}^{32+3}C_3 = {}^{35}C_3$

$$= \frac{35\,(34)\,(33)}{3(2)\,(1)} = 6545$$ Choice (B)

Difficulty level wise summary - Section I	
Level of Difficulty	Questions
Very Easy	–
Easy	19, 20, 21
Medium	2, 3, 4, 5, 9, 11, 12, 15, 17, 18, 24, 25, 26
Difficult	1, 6, 7, 8, 10, 13, 14, 16, 22, 23, 27, 28, 29, 30
Very Difficult	–



We already know that each person did not vote for his neighbours nor for himself.
It implies that

Person	Voted for
A	D or C
B	E or D
C	A or E
D	A or B
E	B or C

The first ballot was a tie-off, implies that all of them got one vote each. From the above table we can draw the following conclusions.