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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION

CLASS - 9

Question Paper Code : UN484

KEY

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SOLUTIONS

MATHEMATICS

01. (A) LHS =

$$\frac{1}{\sqrt{3.25}+\sqrt{2.25}} \times \frac{\sqrt{3.25}-\sqrt{2.25}}{\sqrt{3.25}-\sqrt{2.25}} +$$

$$\frac{1}{\sqrt{4.25}+\sqrt{3.25}} \times \frac{\sqrt{4.25}-\sqrt{3.25}}{\sqrt{4.25}-\sqrt{3.25}} +$$

$$\frac{1}{\sqrt{5.25}+\sqrt{4.25}} \times \frac{\sqrt{5.25}-\sqrt{4.25}}{\sqrt{5.25}-\sqrt{4.25}} +$$

$$\frac{1}{\sqrt{6.25}+\sqrt{5.25}} \times \frac{\sqrt{6.25}-\sqrt{5.25}}{\sqrt{6.25}-\sqrt{5.25}}$$

$= \sqrt{3.25}-\sqrt{2.25} + \sqrt{4.25}-\sqrt{3.25}$

$+ \sqrt{5.25}-\sqrt{4.25} + \sqrt{6.25}-\sqrt{5.25}$

$= -1.5 + 2.5 = 1$

02. (D) $(x^4 - x^3 + x - 1) = x^3(x-1) + 1(x-1)$

$= (x-1)(x^3+1)$

$= (x-1)(x+1)(x^2 - x + 1)$

$x^4 + x^2 + 1 = x^4 + x^2 + 1 + x^2 - x^2$

$= (x^4 + 2x^2 + 1) - x^2$

$= (x^2+1)^2 - x^2$

$= (x^2 + x + 1)(x^2 - x + 1)$

$\therefore$ HCF $= (x^2 - x + 1)$

03. (C) $(3x + 4)(5x - 4) + 9$

$= 15x^2 - 12x + 20x - 16 + 9$

$= 15x^2 + 8x - 7$

$= 15x^2 + 15x - 7x - 7$

$= 15x(x + 1) - 7(x + 1)$

$= (x + 1)(15x - 7)$

04. (C) $S = \frac{a+b+c}{2} = \frac{61\text{ cm} + 102\text{ cm} + 109\text{ cm}}{2}$

$= \frac{272}{2}\text{cm} = 136\text{ cm}$

Area of $\Delta ABC = \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{136 \times 75 \times 34 \times 27}\ \text{cm}^2$

$= \sqrt{8 \times 17 \times 5 \times 5 \times 3 \times 2 \times 17 \times 3 \times 9}\ \text{cm}^2$

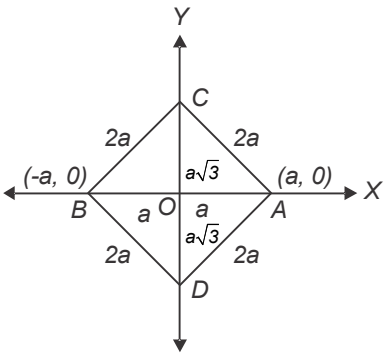
$= \sqrt{16 \times 17^2 \times 5^2 \times 9^2}\ \text{cm}^2$

$= 4 \times 17 \times 5 \times 9\ \text{cm}^2$

$= 3060\ \text{cm}^2$

05. (C) AB = OA + OB = a + a = 2a

Given ΔABC and ΔABD are equilateral triangles



$\Rightarrow$ AB = BC = AC = 2a and

AB = BD = AD = 2a

We know that, height of an equilateral triangle = $\frac{\sqrt{3}}{2}$(side)

$\Rightarrow$ OC = OD = $\frac{\sqrt{3}}{2}(2a) = a\sqrt{3}$

$\therefore$ As C lies on the positive side of y–axis and D lies on –ve side of y–axis, their coordinates are $(0, a\sqrt{3})$ and $(0, -a\sqrt{3})$ respectively.

06. (A) $LHS = (2x + y - 3z)(4x^2 + y^2 + 9z^2 - 2xy + 3yz) + 6zx) - (8x^3 + y^3 - 27z^3 - 18xyz)$

$= (2x)^3 + y^3 + (-3z)^3 - 3(2x)(y)(-3z) - 8x^3 - y^3 + 27y^3 + 18xyz$

$= 8x^3 + y^3 - 27z^3 + 13xyz - 8x^3 - y^3 + 27z^3 + 13xyz$

$= 36xyz$

07. (D) Given (2p, p–3) lies on $2x + 3y - 12 = 0$

$\therefore$ 2(2p) + 3(p –3) – 12 = 0

4p + 3p – 9 – 12 = 0

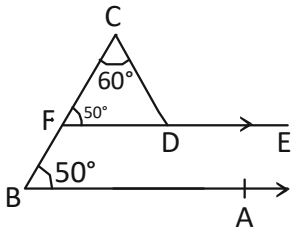
7p – 21 = 0

7p = 21

$p = \frac{21}{7} = 3$

08. (C) AP + PB = AB

09. (C) Construction:- Extend $\overline{ED}$ up to F



$\therefore \angle CFD = \angle B = 50°$

[$\because$ corresponding angles]

In ΔCDF, $\angle CDE = \angle C + \angle CFD$

$= 50° + 60° = 110°$

[$\because$ In a triangle if one side is produced so that the exterior angle formed is equal to sum of the interior opposite angles]

10. (A) Let $a = \frac{1}{33}$, $b = \frac{1}{44}$ & $c = \frac{-7}{132}$

$\therefore a + b + c = \frac{1}{33} + \frac{1}{44} - \frac{7}{132}$

$= \frac{4+3-7}{132}$

If a + b + c = 0

$\therefore a^3 + b^3 + c^3 = 3abc$

$\therefore \left(\frac{1}{33}\right)^3 + \left(\frac{1}{44}\right)^3 - \left(\frac{7}{132}\right)^3$

$= 3 \times \frac{1}{33} \times \frac{1}{44} \times \frac{-7}{132}$

$= \frac{-7}{63,888}$

11. (B) In ΔBOC

$\angle OCB = \angle OBC$ [$\because$ OB = OC = r]

But $\angle OBC + \angle OCB = \angle AOC$

[$\because$ $\angle AOC$ is the exterior angle of ΔBOC]

$\Rightarrow \angle OBC + \angle OBC = 130°$

$\Rightarrow 2\angle OBC = 130°$

$\angle OBC = \frac{130°}{2} = 65° = \angle OCB$

ABCD is a cyclic quadrilateral

$\angle DAB + \angle BCD = 180°$

$45° + \angle BCD = 180°$

$\angle BCD = 180° - 45°$

$\angle BCO + \angle OCD = 135°$

$65° + \angle OCD = 135°$

$\angle OCD = 135° - 65° = 70°$

12. (C) In ΔABD,

$\angle ADB = \angle ABD$. ($\because$ AB = AD)

$\therefore$ $\angle ABD = 180° - 110° = 70°$

$\therefore$ $\angle ADB = \angle ABD = 70°$

But $\angle ADB = \angle DAC + \angle ACD$

(Exterior angle of ΔADC)

$\Rightarrow 70° = x° + 25°$

$\Rightarrow x° = 70° - 25° = 45°$

13. (D) Given $\frac{\sqrt{3}}{2}a = 7\sqrt{3}$ cm

$a = 7\sqrt{3} \times \frac{2}{\sqrt{3}}$ cm = 14 cm

Area of an equilateral triangle $= \frac{\sqrt{3}}{4}a^2$

$= \frac{\sqrt{3}}{4} \times 14 \times 14$ cm^2

$= 49\sqrt{3}$ cm^2

14. (B) In $||^{gm}$ ABCD, AC is the diagonal

$\therefore$ ar(ΔABC) = ar(ΔADC)

In ΔADC, AL is the median

$\therefore$ ar(ΔADL) = ar (ΔACL)

$= \frac{1}{2}(\Delta ADC)$

ar (quad ABCL) = 72 cm^2 = $\frac{3}{4}$ of ar parallelogram ABCD

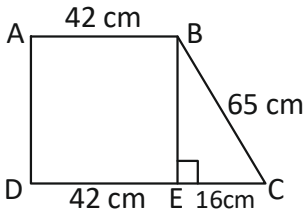
$\therefore$ Area of parallelogram ABC = 72 cm^2 $\times \frac{4}{3}$

= 96 cm^2 = ar($||^{gm}$ ABCD)

$\therefore$ ar (ΔADC) = $\frac{1}{2}$ ar ($||^{gm}$ ABCD)

$= \frac{1}{2} \times 96 = 48$ cm^2

15. (A)



Construction: Draw BE $\perp$ CD

$\therefore$ ABED is a rectangle

DE = AB = 42 cm

$\therefore$ EC = CD $-$ DE = 58 cm $-$ 42 cm = 16 cm

In ΔBCE, $\angle E = 90°$

$BC^2 = BE^2 + EC^2$

$65^2 = BE^2 + 16^2$

$65^2 - 16^2 = BE^2$

$BE = \sqrt{4225 - 256} = \sqrt{3969}$

BE = 63 cm

$\therefore$ Area of the trapezium ABCD

$= \frac{1}{2}h(a + b)$

$= \frac{1}{2} \times 63 \times (42 + 58)$cm^2

$= 3150$ cm^2

$= 63 \times 50$ cm^2

$= 3150$ cm^2

16. (C) Let OM = x cm

$\therefore$ MA = $(5 - x)$ cm

Now, $BM^2 = 5^2 - x^2$ ..... (i)

Again,

$BM^2 = 6^2 - (5 - x)^2$ ..... (ii)

From (i) and (ii), we have

$6^2 - (5 - x)^2 = 5^2 - x^2$

$36 - 25 - x^2 + 10x = 25 - x^2$

$10x = 14 \Rightarrow x = 1.4$ cm

17. (C) Given $l = 3b$

$2h(l + b) = 720\ m^2$

$2 \times 5m\ (3b + b) = 720\ m^2$

$$4b = \frac{720\ m^2}{10\ m}$$

$$b = \frac{72m}{4}$$

$b = 18$ m

$l = 3b = 18m \times 3 = 54$ m

Volume = $lbh = 54 \times 18 \times 5m^3 = 4860\ m^3$

18. (A) Let the side of cube be 2rcm

$\therefore$ Volume of the cube = $(2r\ cm)^3 = 8r^3\ cm^3$

Radius of the biggest possible sphere

curved from cube = $\frac{2r}{2}$ cm = rcm

$\therefore$ Volume of sphere = $\frac{4}{3}\pi r^3 = \frac{4}{3} \times \frac{22}{7} r^3\ cm^3$

$$= \frac{88}{21}\ r^3\ cm^3$$

Volume of wood waste = $\left(8r^3 - \frac{88}{21}r^3\right) cm^3$

$$= \left(\frac{168r^3 - 88r^3}{21}\right) cm^3$$

$$= \frac{80r^3}{21}\ cm^3$$

$\therefore$ Percentage of wood wasted

$$= \frac{\text{Volume of waste wood}}{\text{volume of total wood}} \times 100$$

$$= \frac{\frac{80r^3}{21} cm^2}{8r^3} \times 100$$

$$= \frac{1000}{21}$$

$$= 47\frac{13}{21}\%$$

19. (D) $\angle ADB = 90°$ [$\because$ Angle in a semicircle]

In Δ ABD, $35° + 90° + \angle ABD = 180°$

$\angle ABD = 180° - 125° = 55°$

ABDC is a cyclic quadrilateral

$\angle ABD + \angle ACD = 180°$

$\therefore 55° + \angle ACD = 180°$

$\therefore \angle ACD = 125°$

Given CD||AB

$\angle ACD + \angle CAB = 180°$

$125° + \angle CAD + 35° = 180°$

$\therefore \angle CAD = 180° - 160° = 20°$

20. (C) Given $x = 2.\overline{23} = 2.232323.....$

$\therefore 100x = 223.2323....$

$x = 2.2323$

(–) (–)

$99x = 221$

$$x = \frac{221}{99}$$

Given $y = 0.363636.....$

$\therefore$ $100y = 36.3636....$

$y = 0.3636$

$99y = 36$

$$y = \frac{36}{99}$$

$$\therefore 2.\overline{23} + 0.\overline{36} = \frac{221}{99} + \frac{36}{99} = \frac{257}{99}$$

21. (C) Given $\angle A = 42° + \angle B$ &

$\angle C = \angle B - 21°$

But $\angle A + \angle B + \angle C = 180°$

$42° + \angle B + \angle B + \angle B - 21° = 180°$

$3\angle B + 21° = 180°$

$3\angle B = 180° - 21° = 159°$

$\angle B = \frac{159°}{7} = 53°$

But $\angle A = 42° + \angle B = 42 + 53° = 95°$

22. (A) Given in ΔABC,

$54° + 61° + \angle C = 180°$

$\angle C = 180° - 115°$

$\angle C = 65°$

$\therefore \angle C$ is the largest angle

$\therefore$ AB is the largest side of ΔABC

23. (D) Let the smallest angle be x

$\therefore$ Largest angle $= 2x - 36°$

Given $x + 2x - 36° = 180°$

[$\because$ Adjacent angles of parallelogram]

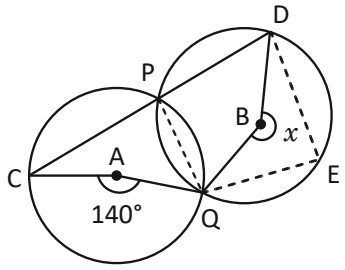
$3x = 180° + 36°$

$3x = 216°$

$x = \frac{216°}{3} = 72°$

$\therefore$ Largest angle $= 180° - x = 180° - 72° = 108°$

24. (C) Construction:



Join PQ–Notice a point 'E' on the circumference of circle of centre B. Join EQ & DE

$\angle CPQ = \frac{\angle CAQ}{2} = \frac{140°}{2} = 70°$

$\therefore \angle QPD = 180° - \angle CPQ = 110°$

PQED is a cycle quadrilateral

$\therefore \angle QED + \angle QPD = 180°$

$\therefore \angle QED + 110° = 180°$

$\therefore \angle QED = 70°$

$\therefore \angle QBD = 2\angle QED = 140°$

$\therefore x = 360° - \angle QBD = 360° - 140° = 220°$

25. (B) Given $\pi r(l + r) = 7920\ cm^2$

$\pi rl + \pi r^2 = 7920\ cm^2$

given $\pi rl = 4070\ cm^2$

$\therefore \pi rl + \pi r^2 - \pi rl = (7{,}920 - 4070) cm^2$

$\frac{22}{7} \times r^2 = 3850$

$r^2 = 3850 \times \frac{7}{22}$

$r = \sqrt{7 \times 5 \times 5 \times 7\ cm^2}$

$r = 35$ cm

Given $\frac{22}{7} \times 35\ cm \times l = 4070\ cm^2$

$l = \frac{4070\ cm^2}{22 \times 5\ cm} = 37$ cm

$h = \sqrt{l^2 - r^2}$

$= \sqrt{37^2 - 35^2}$

$= \sqrt{(37+35)(37-35)}$

$= \sqrt{72 \times 2}$

$r = \sqrt{144}$

$r = 12$ cm

PHYSICS

26. (D) The horizontal motion across the frictionless tables is unaffected by (vertical) gravitational acceleration. It would take as much force to acceleration the block across the table on the earth as it would on the moon. (If friction were taken into account, then the smaller weight of the block on the moon would imply a smaller normal force by the table and hence a smaller frictional force. Less force would be needed on the moon in this case).

27. (B) m = 5 kg, t = 2 s, u = 3 m s^{-1}, v = 7 m s^{-1}, F = ?

$$F = ma = \frac{m(v-u)}{t} = \frac{5(7-3)}{2} = 10 \text{ N}$$

In the second case, F = 10 N, t = 5 s, v = ? u = 3 m/s

$$a = \frac{F}{m} = \frac{10}{5'} = 2 \text{ m/s}^2$$

From v = u + at, v = 3 + 2 × 5 = 13 m/s

28. (D) In order for the work to be done, there must be a distance moved by the load in the direction of applied force by the man. As the man has exerted a large force and held the load stationary above his head, no work is done.

29. (D) Displacement along east = 30 m,

$$\text{Time taken} = \frac{30}{2} = 15 \text{ s}$$

Displacement along north = 40 m,

$$\text{Time taken} = \frac{40}{3/2} = \frac{80}{3} \text{s}$$

Total distance travelled = 30 + 40 = 70 m

$$\text{Total displacement} = \sqrt{30^2 + 40^2} = 50 \text{ m}$$

$$\text{Total time} = \left(15 + \frac{80}{3}\right) \text{s}$$

$$\text{Average speed} = \frac{70}{\left(15 + \frac{80}{3}\right)} = \frac{42}{25} \text{ m s}^{-1}$$

$$\text{Average velocity} = \frac{50}{\left(15 + \frac{80}{3}\right)} = \frac{6}{5} \text{ m s}^{-1}$$

30. (B) As the person is not accelerating, the net force he feels must be zero. Therefore, the magnitude of the upward normal force from the floor must balance with that of the downward gravitational force. Although these two forces have equal magnitudes, they do not form an action/reaction pair because they both act on the same object (namely, the person). The forces in an action/reaction pair always act on different objects.

31. (D) First, the kinetic energy the block gains is the same as the potential energy it loses, which is mgh. As this is equal to $\frac{1}{2}mv^2$, we find that $v = \sqrt{2gh}$. Plugging in g = 10 m/s^2 and h = 4 m, we get $v = \sqrt{80} = 9$ m/s.

32. (A) Motion of an object once around a circular path means that the final position coincides with the initial position. Therefore, the displacement is zero. The average speed is the total distance travelled divided by elapsed time, cannot be zero. And as the velocity changed (because its direction changed), there was a non-zero acceleration.

33. (C) As the mass is a measure of inertia, the solid of same shape and same volume having more mass than other solids will have highest inertia. Out of aluminium, steel, cork and wood, density of steel is maximum. Therefore, solid made up of steel would have highest inertia.

34. (A) As the lady accelerates between the second and the third step both the K.E and P.E. increases.

35. (B) Pressure P = $\frac{\text{Force}}{\text{Area}} = \frac{\text{Weight}}{\text{Area}}$

$\frac{\text{Weight of Boy P}}{\text{Area of his feet}} = \frac{200\text{ N}}{270\text{ cm}^2} = 0.74\text{ N/cm}^2$

$\frac{\text{Weight of Boy Q}}{\text{Area of his feet}} = \frac{300\text{ N}}{250\text{ cm}^2} = 1.2\text{ N/cm}^2$

$\frac{\text{Weight of Boy R}}{\text{Area of his feet}} = \frac{400\text{ N}}{500\text{ cm}^2} = 0.8\text{ N/cm}^2$

$\frac{\text{Weight of Boy S}}{\text{Area of his feet}} = \frac{500\text{ N}}{560\text{ cm}^2} = 0.89\text{ N/cm}^2$

So, Boy Q will fall through as he exerted a pressure of 1.2 N/cm^2 on the ice that is greater than 1.0 N/cm^2.

CHEMISTRY

36. (D) In the 1st oxide, oxygen = 27.6 parts,

Metal = 100 – 27.6 = 72.4 parts,

In the 2nd oxide, oxygen = 30 parts,

Metal = 100 – 30 = 70 parts.

As 1st oxide is M_3O_4, 72.4 parts of M = 3 atoms of M and 27.6 parts of O = 4 atoms of O.

$\therefore$ 70 parts of M = $\frac{3}{72.4} \times 70$ atoms of M

= 2.9 atoms of M

30 parts of O = $\frac{4}{27.6} \times 30$ atoms of O

= 4.35 atoms of O

$\therefore$ Ratio fo M : O in the 2nd oxide

= 2.9 : 4.35 = 1 : 1.5 = 2:3.

37. (C) $2P + Q \rightarrow P_2Q$

The product P_2Q is a new compound formed. Hence, it does not show properties of P and Q. The product formed is a compound and not an element.

38. (C) Valency of M in MCl_3 is + 3

So, the formula of the oxide of element M is M_2O_3

Mass of element M in MCl_3 = 118.5 – 3(35.5) = 12

Molecular mass of M_2O_3 = (2 × 12) + (3 × 16) = 72

39. (C) A dilute solution has a small amount of solute dissolved in a large amount of solvent.

40. (D) When water is boiled, its temperature starts to increase.

Option (A) is wrong because it shows the temperature to be decreasing.

Option (B) is wrong because it shows the temperature of water in the beaker to be 0°C at the beginning, whereas at 0°C, water exists as solid ice.

Option (C) is wrong because it shows no change in the temperature of the water.

Option (D) is correct as it shows the temperature to be above 0°C in the beginning and increasing with time.

41. (A) $CaCO_3 \rightarrow CaO + CO_2$

By law of conservation of mass, CO_2 released into the atmosphere = 10 – 5.6 g = 4.4 g

44 g of CO_2 at STP has a volume = 22.4 L

$\therefore$ 4.4 g CO_2 at STP has a volume = 2.24 L

42. (C) When the amount of water taken is reduced by 20 percent, then the amount of water available.

$= 100 - \frac{100 \times 20}{100}$

= 100 – 20 = 80 g

$\because$ In 100 g, the amount of ammonium chloride at 353 K is 66 g.

$\because$ In 80 g, the amount of ammonium chloride required at 353 K is

$= \frac{66 \times 80}{100}$ = 52.8 g = 53 g.

43. (B) (A) 50 g of NO_2

Molecular mass of NO_2

= 14 + 2 × 16 = 46 g

Number of N atoms in 46 g

= 6.023×10^{23}

Number of N atoms in 50 g

$= \frac{6.023 \times 10^{23}}{46} \times 50$

= 6.55×10^{23}

(B) Mass = Volume × Density

Mass = 150 × 0.983 = 147.45 g

Molecular mass of pyridine = 5 × 12 + 5 × 1 = 14

(C_2H_5N) = 60 + 5 + 14 = 79 g

79 g of pyridine contains = 6.023×10^{23} atoms

147.45 g will contain

$= \frac{6.023 \times 10^{23}}{79} \times 147.45$

= 11.24×10^{23} atoms

(C) 25 g of N_2O

Molecular mass of $N_2O = 2 \times 14 + 16 = 44$

44 g of N_2O contains

$= \frac{2 \times 6.023 \times 10^{23}}{44}$ N atoms

25 g of N_2O will contain

$= \frac{2 \times 6.023 \times 10^{23}}{44} \times 25$

= 6.84×10^{23}

(D) 1 mol of N_2 contains

= $2 \times 6.023 \times 10^{23}$ N atoms

0.5 mol of N_2 contains

= $0.5 \times 2 \times 6.023 \times 10^{23}$

= 6.023×10^{23}

Thus, maximum number of N atoms are present in 150 mL of pyridine.

44. (A) $\text{Mass\%} = \frac{\text{Grams of solute}}{\text{Grams in solution}} \times 100$

$15\% = \frac{X}{175 \times 100}$

$\Rightarrow \quad X = \frac{15 \times 175}{100} = 26.25$ g

The amount of NaCl = 26.25 g

Mass of water = Total mass – Mass of NaCl = 175 – 26.25 = 148.75 g

45. (C) Adding 273 to each temperature in the given centrigrade scale, we get, 273 + 35 = 308 K, 273 + 56 = 329 K, 273 + 118 = 391 K.

BIOLOGY

46. (C) Y is lymphocyte. Lymphocyte produces antibodies to fight pathogen.

47. (A) Rhizobium bacteria plays an important role in the nitrogen-cycle.

48. (B) Cholera is a water-borne and food-borne disease.

49. (A) Virus reproduces in a host cell.

50. (C) The given diagram is of adipose tissue.

51. (B) The carbon cycle is responsible for most of the global warming.

52. (B) Most of the animals belonging to classes - Pisces and Reptiles have scales on their bodies. Pangolins are the only mammals with scales.

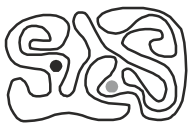
53. (A) Tendons are fibrous tissue with great strength and limited flexibility. It connects muscles to bones. Cartilage is widely space and smoothens bone surfaces at joints.

54. (C) Of the biogeochemical cycles, process of respiration and photosynthesis play a central role in carbon and oxygen cycles.

55. (B) The drawing shows a plant cell, as seen by the presence of the cell wall, cell membrane and tonoplast. The long cytoplasmic extension is the root hair.

CRITICAL THINKING

56. (D)



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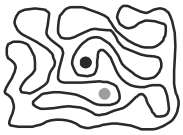

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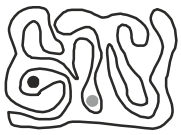

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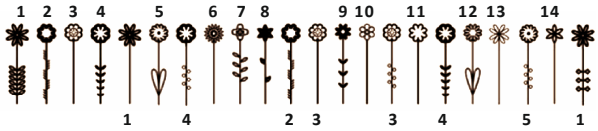
57. (D) 3, 2, 1, 4, 5

Title → Contents → Index → Chapters → Introduction

Sequence of any book

58. (B)



59. (D) If neither I nor II is strong

60. (B) Pulley wheel B

The End