ANSWERS/HINTS

EXERCISE 1.1

1. Yes. $0 = \frac{0}{1} = \frac{0}{2} = \frac{0}{3}$ etc., denominator q can also be taken as negative integer.

2. There can be infinitely many rationals betwen numbers 3 and 4, one way is to take them

$3 = \frac{21}{6+1}$, $4 = \frac{28}{6+1}$ · Then the six numbers are $\frac{22}{7}, \frac{23}{7}, \frac{24}{7}, \frac{25}{7}, \frac{26}{7}, \frac{27}{7}$ ·

3. $\frac{3}{5} = \frac{30}{50}, \frac{4}{5} = \frac{40}{50}$ · Therefore, five rationals are : $\frac{31}{50}, \frac{32}{50}, \frac{33}{50}, \frac{34}{50}, \frac{35}{50}$

4. (i) True, since the collection of whole numbers contains all the natural numbers.

(ii) False, for example -2 is not a whole number.

(iii) False, for example $\frac{1}{2}$ is a rational number but not a whole number.

EXERCISE 1.2

1. (i) True, since collection of real numbers is made up of rational and irrational numbers.

(ii) False, no negative number can be the square root of any natural number.

(iii) False, for example 2 is real but not irrational.

2. No. For example, $\sqrt{4} = 2$ is a rational number.

3. Repeat the procedure as in Fig. 1.8 several times. First obtain $\sqrt{4}$ and then $\sqrt{5}$.

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EXERCISE 1.3

1. (i) 0.36, terminating. (ii) $0.\overline{09}$, non-terminating repeating.

(iii) 4.125, terminating. (iv) $0.\overline{230769}$, non-terminating repeating.

(v) $0.\overline{18}$ non-terminating repeating. (vi) 0.8225 terminating.

2. $\frac{2}{7} = 2 \times \frac{1}{7} = 0.\overline{285714}$, $\frac{3}{7} = 3 \times \frac{1}{7} = 0.\overline{428571}$, $\frac{4}{7} = 4 \times \frac{1}{7} = 0.\overline{571428}$,

$\frac{5}{7} = 5 \times \frac{1}{7} = 0.\overline{714285}$, $\frac{6}{7} = 6 \times \frac{1}{7} = 0.\overline{857142}$

3. (i) $\frac{2}{3}$ [Let $x = 0.666\ldots$ So $10x = 6.666\ldots$ or, $10x = 6 + x$ or, $x = \frac{6}{9} = \frac{2}{3}$]

(ii) $\frac{43}{90}$ (iii) $\frac{1}{999}$

4. 1 [Let $x = 0.9999\ldots$ So $10\,x = 9.999\ldots$ or, $10\,x = 9 + x$ or, $x = 1$]

5. $0.\overline{0588235294117647}$

6. The prime factorisation of q has only powers of 2 or powers of 5 or both.

7. 0.01001000100001..., 0.202002000200002..., 0.003000300003...

8. 0.75075007500075000075..., 0.767076700767000767..., 0.808008000800008...

9. (i) and (v) irrational; (ii), (iii) and (iv) rational.

EXERCISE 1.4

1. (i) Irrational (ii) Rational (iii) Rational (iv) Irrational

(v) Irrational

2. (i) $6 + 3\sqrt{2} + 2\sqrt{3} + \sqrt{6}$ (ii) 6 (iii) $7 + 2\sqrt{10}$ (iv) 3

3. There is no contradiction. Remember that when you measure a length with a scale or any other device, you only get an approximate rational value. So, you may not realise that either c or d is irrational.

4. Refer Fig. 1.17.

5. (i) $\frac{\sqrt{7}}{7}$ (ii) $\sqrt{7} + \sqrt{6}$ (iii) $\frac{\sqrt{5} - \sqrt{2}}{3}$ (iv) $\frac{\sqrt{7} + 2}{3}$

EXERCISE 1.5

1. (i) 8 (ii) 2 (iii) 5 **2.** (i) 27 (ii) 4 (iii) 8 (iv) $\frac{1}{5}\left[(125)^{-\frac{1}{3}} = \left(5^3\right)^{-\frac{1}{3}} = 5^{-1}\right]$

3. (i) $2^{\frac{13}{15}}$ (ii) 3^{-21} (iii) $11^{\frac{1}{4}}$ (iv) $56^{\frac{1}{2}}$

EXERCISE 2.1

1. (i) and (ii) are polynomials in one variable, (v) is a polynomial in three variables, (iii), (iv) are not polynomials, because in each of these exponent of the variable is not a whole number.

2. (i) 1 (ii) –1 (iii) $\frac{\pi}{2}$ (iv) 0

3. $3x^{35} - 4$; $\sqrt{2}\,y^{100}$ (You can write some more polynomials with different coefficients.)

4. (i) 3 (ii) 2 (iii) 1 (iv) 0

5. (i) quadratic (ii) cubic (iii) quadratic (iv) linear
(v) linear (vi) quadratic (vii) cubic

EXERCISE 2.2

1. (i) 3 (ii) –6 (iii) –3

2. (i) 1, 1, 3 (ii) 2, 4, 4 (iii) 0, 1, 8 (iv) –1, 0, 3

3. (i) Yes (ii) No (iii) Yes (iv) Yes
(v) Yes (vi) Yes

(vii) $-\frac{1}{\sqrt{3}}$ is a zero, but $\frac{2}{\sqrt{3}}$ is not a zero of the polynomial (viii) No

4. (i) –5 (ii) 5 (iii) $\frac{-5}{2}$ (iv) $\frac{2}{3}$
(v) 0 (vi) 0 (vii) $-\frac{d}{c}$

EXERCISE 2.3

1. $(x + 1)$ is a factor of (i), but not the factor of (ii), (iii) and (iv).

2. (i) Yes (ii) No (iii) Yes

3. (i) -2 (ii) $-\left(2+\sqrt{2}\right)$ (iii) $\sqrt{2}-1$ (iv) $\frac{3}{2}$

4. (i) $(3x-1)(4x-1)$ (ii) $(x+3)(2x+1)$ (iii) $(2x+3)(3x-2)$ (iv) $(x+1)(3x-4)$

5. (i) $(x-2)(x-1)(x+1)$ (ii) $(x+1)(x+1)(x-5)$

(iii) $(x+1)(x+2)(x+10)$ (iv) $(y-1)(y+1)(2y+1)$

EXERCISE 2.4

1. (i) $x^2+14x+40$ (ii) $x^2-2x-80$ (iii) $9x^2-3x-20$

(iv) $y^4-\frac{9}{4}$ (v) $9-4x^2$

2. (i) 11021 (ii) 9120 (iii) 9984

3. (i) $(3x+y)(3x+y)$ (ii) $(2y-1)(2y-1)$ (iii) $\left(x+\frac{y}{10}\right)\left(x-\frac{y}{10}\right)$

4. (i) $x^2+4y^2+16z^2+4xy+16yz+8xz$

(ii) $4x^2+y^2+z^2-4xy-2yz+4xz$

(iii) $4x^2+9y^2+4z^2-12xy+12yz-8xz$

(iv) $9a^2+49b^2+c^2-42ab+14bc-6ac$

(v) $4x^2+25y^2+9z^2-20xy-30yz+12xz$

(vi) $\frac{a^2}{16}+\frac{b^2}{4}+1-\frac{ab}{4}-b+\frac{a}{2}$

5. (i) $(2x+3y-4z)(2x+3y-4z)$ (ii) $\left(-\sqrt{2}\,x+y+2\sqrt{2}\,z\right)\left(-\sqrt{2}\,x+y+2\sqrt{2}\,z\right)$

6. (i) $8x^3+12x^2+6x+1$ (ii) $8a^3-27b^3-36a^2b+54ab^2$

(iii) $\frac{27}{8}x^3+\frac{27}{4}x^2+\frac{9}{2}x+1$ (iv) $x^3-\frac{8}{27}y^3-2x^2y+\frac{4xy^2}{3}$

7. (i) 970299 (ii) 1061208 (iii) 994011992

8. (i) $(2a+b)(2a+b)(2a+b)$ (ii) $(2a-b)(2a-b)(2a-b)$

(iii) $(3-5a)(3-5a)(3-5a)$ (iv) $(4a-3b)(4a-3b)(4a-3b)$

(v) $\left(3p-\frac{1}{6}\right)\left(3p-\frac{1}{6}\right)\left(3p-\frac{1}{6}\right)$

10. (i) $(3y+5z)(9y^2+25z^2-15yz)$ (ii) $(4m-7n)(16m^2+49n^2+28mn)$

11. $(3x+y+z)(9x^2+y^2+z^2-3xy-yz-3xz)$

12. Simiplify RHS.

13. Put $x+y+z=0$ in Identity VIII.

14. (i) -1260. Let $a=-12$, $b=7$, $c=5$. Here $a+b+c=0$. Use the result given in Q13.

(ii) 16380

15. (i) One possible answer is : Length $= 5a-3$, Breadth $= 5a-4$

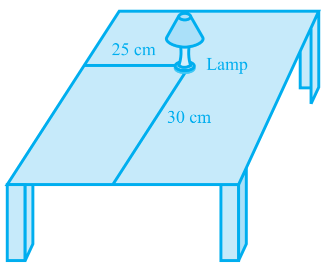
(ii) One possible answer is : Length $= 7y-3$, Breadth $= 5y+4$

16. (i) One possible answer is : 3, x and $x-4$.

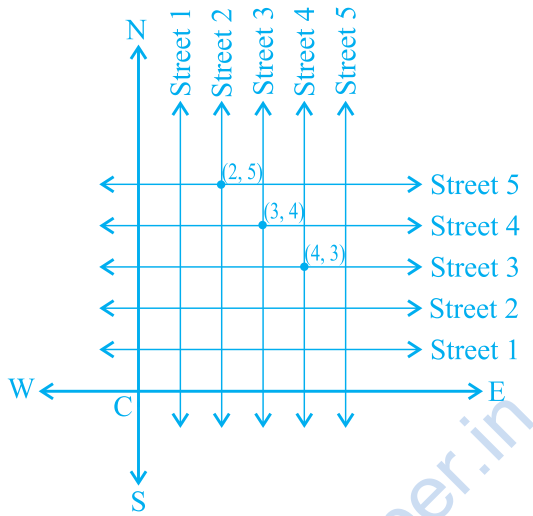
(ii) One possible answer is : $4k$, $3y+5$ and $y-1$.

EXERCISE 3.1

1. Consider the lamp as a point and table as a plane. Choose any two perpendicular edges of the table. Measure the distance of the lamp from the longer edge, suppose it is 25 cm. Again, measure the distance of the lamp from the shorter edge, and suppose it is 30 cm. You can write the position of the lamp as (30, 25) or (25, 30), depending on the order you fix.



2. The Street plan is shown in figure given below.



Both the cross-streets are marked in the figure above. They are *uniquely* found because of the two reference lines we have used for locating them.

EXERCISE 3.2

1. (i) The x - axis and the y - axis (ii) Quadrants (iii) The origin

2. (i) $(-5, 2)$ (ii) $(5, -5)$ (iii) E (iv) G (v) 6 (vi) -3 (vii) $(0, 5)$ (viii) $(-3, 0)$

EXERCISE 4.1

1. $x - 2y = 0$

2. (i) $2x + 3y - 9.3\overline{5} = 0;\ a = 2, b = 3, c = -9.3\overline{5}$

(ii) $x - \dfrac{y}{5} - 10 = 0;\ a = 1, b = \dfrac{-1}{5}, c = -10$

(iii) $-2x + 3y - 6 = 0;\ a = -2, b = 3, c = -6$

(iv) $1.x - 3y + 0 = 0;\ a = 1, b = -3, c = 0$

(v) $2x + 5y + 0 = 0;\ a = 2, b = 5, c = 0$

(vi) $3x + 0.y + 2 = 0;\ a = 3, b = 0, c = 2$

(vii) $0.x + 1.y - 2 = 0;\ a = 0, b = 1, c = -2$

(viii) $-2x + 0.y + 5 = 0;\ a = -2, b = 0, c = 5$

EXERCISE 4.2

1. (iii), because for every value of x, there is a corresponding value of y and vice-versa.

2. (i) (0, 7), (1, 5), (2, 3), (4, –1)

(ii) $(1, 9-\pi)$, (0, 9), $(-1, 9+\pi)$, $\left(\frac{9}{\pi}, 0\right)$

(iii) (0, 0), (4, 1), (–4, 1), $\left(2, \frac{1}{2}\right)$

3. (i) No (ii) No (iii) Yes (iv) No (v) No

4. 7

EXERCISE 5.1

1. (i) False. This can be seen visually by the student.

(ii) False. This contradicts Axiom 5.1.

(iii) True. (Postulate 2)

(iv) True. If you superimpose the region bounded by one circle on the other, then they coincide. So, their centres and boundaries coincide. Therefore, their radii will coincide.

(v) True. The first axiom of Euclid.

3. There are several undefined terms which the student should list. They are consistent, because they deal with two different situations — (i) says that given two points A and B, there is a point C lying on the line in between them; (ii) says that given A and B, you can take C not lying on the line through A and B.

These 'postulates' do not follow from Euclid's postulates. However, they follow from Axiom 5.1.

4.
$$AC = BC$$

So, $AC + AC = BC + AC$ (Equals are added to equals)

i.e., $2AC = AB$ (BC + AC coincides with AB)

Therefore, $AC = \frac{1}{2} AB$

5. Make a temporary assumption that different points C and D are two mid-points of AB. Now, you show that points C and D are not two different points.

6.
$AC = BD$ (Given) (1)

$AC = AB + BC$ (Point B lies between A and C) (2)

$BD = BC + CD$ (Point C lies between B and D) (3)

Substituting (2) and (3) in (1), you get

$$AB + BC = BC + CD$$

So, $AB = CD$ (Subtracting equals from equals)

7. Since this is true for any thing in any part of the world, this is a universal truth.

EXERCISE 6.1

1. 30°, 250° **2.** 126° **4.** Sum of all the angles at a point = 360°

5. $\angle QOS = \angle SOR + \angle ROQ$ and $\angle POS = \angle POR - \angle SOR$. **6.** 122°, 302°

EXERCISE 6.2

1. 126° **2.** 126°, 36°, 54° **3.** 60° **4.** 50°, 77°

5. Angle of incidence = Angle of reflection. At point B, draw $BE \perp PQ$ and at point C, draw $CF \perp RS$.

EXERCISE 7.1

1. They are equal. **6.** $\angle BAC = \angle DAE$

EXERCISE 7.2

6. $\angle BCD = \angle BCA + \angle DCA = \angle B + \angle D$ **7.** each is of 45°

EXERCISE 7.3

3. **(ii)** From (i), $\angle ABM = \angle PQN$

EXERCISE 8.1

3. (i) From Δ DAC and Δ BCA, show $\angle DAC = \angle BCA$ and $\angle ACD = \angle CAB$, etc.

(ii) Show $\angle BAC = \angle BCA$, using Theorem 8.4.

EXERCISE 8.2

2. Show PQRS is a parallelogram. Also show PQ || AC and PS || BD. So, $\angle P = 90°$.

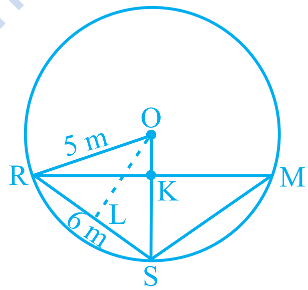
5. AECF is a parallelogram. So, AF || CE, etc.

EXERCISE 9.1

1. Prove exactly as Theorem 9.1 by considering chords of congruent circles.
2. Use SAS axiom of congruence to show the congruence of the two triangles.

EXERCISE 9.2

1. 6 cm. First show that the line joining centres is perpendicular to the radius of the smaller circle and then that common chord is the diameter of the smaller circle.
2. If AB, CD are equal chords of a circle with centre O intersecting at E, draw perpendiculars OM on AB and ON on CD and join OE. Show that right triangles OME and ONE are congruent.
3. Proceed as in Example 2.
4. Draw perpendicular OM on AD.
5. Represent Reshma, Salma and Mandip by R, S and M respectively. Let KR = x m (see figure).



Area of Δ ORS $= \frac{1}{2} x \times 5$. Also, area of Δ ORS $=$ $\frac{1}{2}$ RS $\times$ OL $= \frac{1}{2} \times 6 \times 4$.

Find x and hence RM.

6. Use the properties of an equilateral triangle and also Pythagoras Theorem.

EXERCISE 9.3

1. 45°	**2.** 150°, 30°	**3.** 10°
4. 80°	**5.** 110°	**6.** $\angle$BCD = 80° and $\angle$ECD = 50°

8. Draw perpendiculars AM and BN on CD (AB || CD and AB < CD). Show ΔAMD $\cong$ ΔBNC. This gives $\angle$C = $\angle$D and, therefore, $\angle$A + $\angle$C = 180°.

EXERCISE 10.1

1. $\frac{\sqrt{3}}{4}a^2$, 900, 3 cm^2	**2.** ₹ 1650000	**3.** $20\sqrt{2}$ m^2
4. $21\sqrt{11}$ cm^2	**5.** 9000 cm^2	**6.** $9\sqrt{15}$ cm^2

EXERCISE 11.1

1. 165 cm^2
2. 1244.57 m^2
3. (i) 7 cm (ii) 462 cm^2
4. (i) 26 m (ii) ₹ 137280
5. 63 m
6. ₹ 1155
7. 5500 cm^2
8. ₹ 384.34 (approx.)

EXERCISE 11.2

1. (i) 1386 cm^2 (ii) 394.24 cm^2 (iii) 2464 cm^2
2. (i) 616 cm^2 (ii) 1386 cm^2 (iii) 38.5 m^2
3. 942 cm^2
4. 1 : 4
5. ₹ 27.72
6. 3.5 cm
7. 1 : 16
8. 173.25 cm^2
9. (i) $4\pi r^2$ (ii) $4\pi r^2$ (iii) 1 : 1

EXERCISE 11.3

1. (i) 264 cm^3 (ii) 154 cm^3
2. (i) $1.232\, l$ (ii) $\frac{11}{35}\, l$
3. 10 cm
4. 8 cm
5. $38.5\, kl$
6. (i) 48 cm (ii) 50 cm (iii) 2200 cm^2
7. $100\pi \text{ cm}^3$
8. $240\pi \text{ cm}^3$; 5 : 12
9. $86.625x \text{ m}^3$, 99.825 m^2

EXERCISE 11.4

1. (i) $1437\frac{1}{3} \text{ cm}^3$ (ii) 1.05 m^3 (approx.)
2. (i) $11498\frac{2}{3} \text{ cm}^3$ (ii) 0.004851 m^3
3. 345.39 g (approx.)
4. $\frac{1}{64}$
5. $0.303\, l$ (approx.)
6. 0.06348 m^3 (approx.)
7. $179\frac{2}{3} \text{ cm}^3$
8. (i) 249.48 m^2 (ii) 523.9 m^3 (approx.)
9. (i) $3r$ (ii) 1 : 9
10. 22.46 mm^3 (approx.)

EXERCISE 12.1

1. (ii) Reproductive health conditions.

3. (ii) Party A **4.** (ii) Frequency polygon (iii) No **5.** (ii) 184

8.

Age (in years)	Frequency	Width	Length of the rectangle
1 - 2	5	1	$\frac{5}{1} \times 1 = 5$
2 - 3	3	1	$\frac{3}{1} \times 1 = 3$
3 - 5	6	2	$\frac{6}{2} \times 1 = 3$
5 - 7	12	2	$\frac{12}{2} \times 1 = 6$
7 - 10	9	3	$\frac{9}{3} \times 1 = 3$
10 - 15	10	5	$\frac{10}{5} \times 1 = 2$
15 - 17	4	2	$\frac{4}{2} \times 1 = 2$

Now, you can draw the histogram, using these lengths.

9. (i)

Number of letters	Frequency	Width of interval	Length of rectangle
1 - 4	6	3	$\frac{6}{3} \times 2 = 4$
4 - 6	30	2	$\frac{30}{2} \times 2 = 30$
6 - 8	44	2	$\frac{44}{2} \times 2 = 44$
8 - 12	16	4	$\frac{16}{4} \times 2 = 8$
12 - 20	4	8	$\frac{4}{8} \times 2 = 1$

Now, draw the histogram.

(ii) 6 - 8

EXERCISE A1.1

1. (i) False. There are 12 months in a year.
   (ii) Ambiguous. In a given year, Diwali may or may not fall on a Friday.
   (iii) Ambiguous. At some time in the year, the temperature in Magadi, may be 26° C.
   (iv) Always true.
   (v) False. Dogs cannot fly.
   (vi) Ambiguous. In a leap year, February has 29 days.
2. (i) False. The sum of the interior angles of a quadrilateral is 360°.
   (ii) True (iii) True (iv) True
   (v) False, for example, $7 + 5 = 12$, which is not an odd number.
3. (i) All prime numbers greater than 2 are odd. (ii) Two times a natural number is always even. (iii) For any $x > 1$, $3x + 1 > 4$. (iv) For any $x \geq 0$, $x^3 \geq 0$.
   (v) In an equilateral triangle, a median is also an angle bisector.

EXERCISE A1.2

1. (i) Humans are vertebrates. (ii) No. Dinesh could have got his hair cut by anybody else. (iii) Gulag has a red tongue. (iv) We conclude that the gutters will have to be cleaned tomorrow. (v) All animals having tails need not be dogs. For example, animals such as buffaloes, monkeys, cats, etc. have tails but are not dogs.
2. You need to turn over B and 8. If B has an even number on the other side, then the rule has been broken. Similarly, if 8 has a consonant on the other side, then the rule has been broken.

EXERCISE A1.3

1. Three possible conjectures are:
   (i) The product of any three consecutive even numbers is even. (ii) The product of any three consecutive even numbers is divisible by 4. (iii) The product of any three consecutive even numbers is divisible by 6.
2. Line 4: $1\ 3\ 3\ 1 = 11^3$; Line 5: $1\ 4\ 6\ 4\ 1 = 11^4$; the conjecture holds for Line 4 and Line 5; No, because $11^5 \neq 15101051$.
3. $T_4 + T_5 = 25 = 5^2$; $T_{n-1} + T_n = n^2$.
4. $111111^2 = 12345654321$; $1111111^2 = 1234567654321$
5. Student's own answer. For example, Euclid's postulates.

EXERCISE A1.4

1. (i) You can give any two triangles with the same angles but of different sides.

(ii) A rhombus has equal sides but may not be a square.

(iii) A rectangle has equal angles but may not be a square.

(iv) For $a = 3$ and $b = 4$, the statement is not true.

(v) For $n = 11$, $2n^2 + 11 = 253$ which is not a prime.

(vi) For $n = 41$, $n^2 - n + 41$ is not a prime.

2. Student's own answer.

3. Let x and y be two odd numbers. Then $x = 2m + 1$ for some natural number m and $y = 2n + 1$ for some natural number n.

$x + y = 2(m + n + 1)$. Therefore, $x + y$ is divisible by 2 and is even.

4. See Q.3. $xy = (2m + 1)(2n + 1) = 2(2mn + m + n) + 1$.

Therefore, xy is not divisible by 2, and so it is odd.

5. Let $2n$, $2n + 2$ and $2n + 4$ be three consecutive even numbers. Then their sum is $6(n + 1)$, which is divisible by 6.

7. (i) Let your original number be n. Then we are doing the following operations:

$$n \to 2n \to 2n + 9 \to 2n + 9 + n = 3n + 9 \to \frac{3n+9}{3} = n + 3 \to n + 3 + 4 = n + 7 \to n + 7 - n = 7.$$

(ii) Note that $7 \times 11 \times 13 = 1001$. Take any three digit number say, abc. Then $abc \times 1001 = abcabc$. Therefore, the six digit number $abcabc$ is divisible by 7, 11 and 13.

EXERCISE A2.1

1. **Step 1: Formulation :**

The relevant factors are the time period for hiring a computer, and the two costs given to us. We assume that there is no significant change in the cost of purchasing or hiring the computer. So, we treat any such change as irrelevant. We also treat all brands and generations of computers as the same, i.e. these differences are also irrelevant.

The expense of hiring the computer for x months is ₹ $2000x$. If this becomes more than the cost of purchasing a computer, we will be better off buying a computer. So, the equation is

$$2000x = 25000 \qquad (1)$$

Step 2 : Solution : Solving (1), $x = \frac{25000}{2000} = 12.5$

Step 3 : Interpretation : Since the cost of hiring a computer becomes more **after** 12.5 months, it is cheaper to buy a computer, if you have to use it for more than 12 months.

2. **Step1 : Formulation :** We will assume that cars travel at a constant speed. So, any change of speed will be treated as irrelevant. If the cars meet after x hours, the first car would have travelled a distance of $40x$ km from A and the second car would have travelled $30x$ km, so that it will be at a distance of $(100 – 30x)$ km from A. So the equation will be $40x = 100 – 30x$, i.e., $70x = 100$.

   Step 2 : Solution : Solving the equation, we get $x = \frac{100}{70}$.

   Step 3 : Interpretation : $\frac{100}{70}$ is approximately 1.4 hours. So, the cars will meet after 1.4 hours.

3. **Step1 : Formulation :** The speed at which the moon orbits the earth is
$$\frac{\text{Length of the orbit}}{\text{Time taken}}.$$

   Step 2 : Solution : Since the orbit is nearly circular, the length is $2 \times \pi \times 384000$ km $= 2411520$ km

   The moon takes 24 hours to complete one orbit.

   So, speed $= \frac{2411520}{24} = 100480$ km/hour.

   Step 3 : Interpretation : The speed is 100480 km/h.

4. **Formulation :** An assumption is that the difference in the bill is only because of using the water heater.

   Let the average number of hours for which the water heater is used $= x$

   Difference per month due to using water heater = ₹ 1240 – ₹ 1000 = ₹ 240

   Cost of using water heater for one hour = ₹ 8

   So, the cost of using the water heater for 30 days $= 8 \times 30 \times x$

   Also, the cost of using the water heater for 30 days = Difference in bill due to using water heater

   So, $$240x = 240$$

   Solution : From this equation, we get $x = 1$.

   Interpretation : Since $x = 1$, the water heater is used for an average of 1 hour in a day.

EXERCISE A2.2

1. We will not discuss any particular solution here. You can use the same method as we used in last example, or any other method you think is suitable.

EXERCISE A2.3

1. We have already mentioned that the formulation part could be very detailed in real-life situations. Also, we do not validate the answer in word problems. Apart from this word problem have a 'correct answer'. This need not be the case in real-life situations.
2. The important factors are (ii) and (iii). Here (i) is not an important factor although it can have an effect on the number of vehicles sold.

NOTES

EXERCISE 1.3

1. (i) 0.36, terminating. (ii) $0.\overline{09}$, non-terminating repeating.

(iii) 4.125, terminating. (iv) $0.\overline{230769}$, non-terminating repeating.

(v) $0.\overline{18}$ non-terminating repeating. (vi) 0.8225 terminating.

2. $\frac{2}{7} = 2 \times \frac{1}{7} = 0.\overline{285714}$, $\frac{3}{7} = 3 \times \frac{1}{7} = 0.\overline{428571}$, $\frac{4}{7} = 4 \times \frac{1}{7} = 0.\overline{571428}$,

$\frac{5}{7} = 5 \times \frac{1}{7} = 0.\overline{714285}$, $\frac{6}{7} = 6 \times \frac{1}{7} = 0.\overline{857142}$

3. (i) $\frac{2}{3}$ [Let $x = 0.666\ldots$ So $10x = 6.666\ldots$ or, $10x = 6 + x$ or, $x = \frac{6}{9} = \frac{2}{3}$]

(ii) $\frac{43}{90}$ (iii) $\frac{1}{999}$

4. 1 [Let $x = 0.9999\ldots$ So $10x = 9.999\ldots$ or, $10x = 9 + x$ or, $x = 1$]

5. $0.\overline{0588235294117647}$

6. The prime factorisation of q has only powers of 2 or powers of 5 or both.

7. 0.01001000100001. . ., 0.202002000200002. . ., 0.003000300003. . .

8. 0.75075007500075000075. . ., 0.767076700767000767. . ., 0.808008000800008. . .

9. (i) and (v) irrational; (ii), (iii) and (iv) rational.

EXERCISE 1.4

1. (i) Irrational (ii) Rational (iii) Rational (iv) Irrational

(v) Irrational

2. (i) $6 + 3\sqrt{2} + 2\sqrt{3} + \sqrt{6}$ (ii) 6 (iii) $7 + 2\sqrt{10}$ (iv) 3

3. There is no contradiction. Remember that when you measure a length with a scale or any other device, you only get an approximate rational value. So, you may not realise that either c or d is irrational.

4. Refer Fig. 1.17.

5. (i) $\frac{\sqrt{7}}{7}$ (ii) $\sqrt{7} + \sqrt{6}$ (iii) $\frac{\sqrt{5} - \sqrt{2}}{3}$ (iv) $\frac{\sqrt{7} + 2}{3}$

EXERCISE 1.5

1. (i) 8 (ii) 2 (iii) 5 **2.** (i) 27 (ii) 4 (iii) 8 (iv) $\frac{1}{5}\left[(125)^{-\frac{1}{3}}=\left(5^{3}\right)^{-\frac{1}{3}}=5^{-1}\right]$

3. (i) $2^{\frac{13}{15}}$ (ii) 3^{-21} (iii) $11^{\frac{1}{4}}$ (iv) $56^{\frac{1}{2}}$

EXERCISE 2.1

1. (i) and (ii) are polynomials in one variable, (v) is a polynomial in three variables, (iii), (iv) are not polynomials, because in each of these exponent of the variable is not a whole number.

2. (i) 1 (ii) –1 (iii) $\frac{\pi}{2}$ (iv) 0

3. $3x^{35}-4$; $\sqrt{2}\,y^{100}$ (You can write some more polynomials with different coefficients.)

4. (i) 3 (ii) 2 (iii) 1 (iv) 0

5. (i) quadratic (ii) cubic (iii) quadratic (iv) linear
(v) linear (vi) quadratic (vii) cubic

EXERCISE 2.2

1. (i) 3 (ii) –6 (iii) –3

2. (i) 1, 1, 3 (ii) 2, 4, 4 (iii) 0, 1, 8 (iv) –1, 0, 3

3. (i) Yes (ii) No (iii) Yes (iv) Yes
(v) Yes (vi) Yes
(vii) $-\frac{1}{\sqrt{3}}$ is a zero, but $\frac{2}{\sqrt{3}}$ is not a zero of the polynomial (viii) No

4. (i) –5 (ii) 5 (iii) $\frac{-5}{2}$ (iv) $\frac{2}{3}$
(v) 0 (vi) 0 (vii) $-\frac{d}{c}$

EXERCISE 2.3

1. $(x + 1)$ is a factor of (i), but not the factor of (ii), (iii) and (iv).
2. (i) Yes (ii) No (iii) Yes
3. (i) -2 (ii) $-\left(2+\sqrt{2}\right)$ (iii) $\sqrt{2}-1$ (iv) $\frac{3}{2}$
4. (i) $(3x-1)(4x-1)$ (ii) $(x+3)(2x+1)$ (iii) $(2x+3)(3x-2)$ (iv) $(x+1)(3x-4)$
5. (i) $(x-2)(x-1)(x+1)$ (ii) $(x+1)(x+1)(x-5)$
   (iii) $(x+1)(x+2)(x+10)$ (iv) $(y-1)(y+1)(2y+1)$

EXERCISE 2.4

1. (i) $x^2+14x+40$ (ii) $x^2-2x-80$ (iii) $9x^2-3x-20$
   (iv) $y^4-\frac{9}{4}$ (v) $9-4x^2$
2. (i) 11021 (ii) 9120 (iii) 9984
3. (i) $(3x+y)(3x+y)$ (ii) $(2y-1)(2y-1)$ (iii) $\left(x+\frac{y}{10}\right)\left(x-\frac{y}{10}\right)$
4. (i) $x^2+4y^2+16z^2+4xy+16yz+8xz$
   (ii) $4x^2+y^2+z^2-4xy-2yz+4xz$
   (iii) $4x^2+9y^2+4z^2-12xy+12yz-8xz$
   (iv) $9a^2+49b^2+c^2-42ab+14bc-6ac$
   (v) $4x^2+25y^2+9z^2-20xy-30yz+12xz$
   (vi) $\frac{a^2}{16}+\frac{b^2}{4}+1-\frac{ab}{4}-b+\frac{a}{2}$
5. (i) $(2x+3y-4z)(2x+3y-4z)$ (ii) $\left(-\sqrt{2}\,x+y+2\sqrt{2}\,z\right)\left(-\sqrt{2}\,x+y+2\sqrt{2}\,z\right)$
6. (i) $8x^3+12x^2+6x+1$ (ii) $8a^3-27b^3-36a^2b+54ab^2$
   (iii) $\frac{27}{8}x^3+\frac{27}{4}x^2+\frac{9}{2}x+1$ (iv) $x^3-\frac{8}{27}y^3-2x^2y+\frac{4xy^2}{3}$

7. (i) 970299 (ii) 1061208 (iii) 994011992

8. (i) $(2a+b)(2a+b)(2a+b)$ (ii) $(2a-b)(2a-b)(2a-b)$

(iii) $(3-5a)(3-5a)(3-5a)$ (iv) $(4a-3b)(4a-3b)(4a-3b)$

(v) $\left(3p-\frac{1}{6}\right)\left(3p-\frac{1}{6}\right)\left(3p-\frac{1}{6}\right)$

10. (i) $(3y+5z)(9y^2+25z^2-15yz)$ (ii) $(4m-7n)(16m^2+49n^2+28mn)$

11. $(3x+y+z)(9x^2+y^2+z^2-3xy-yz-3xz)$

12. Simiplify RHS.

13. Put $x+y+z=0$ in Identity VIII.

14. (i) -1260. Let $a=-12$, $b=7$, $c=5$. Here $a+b+c=0$. Use the result given in Q13.

(ii) 16380

15. (i) One possible answer is : Length $= 5a-3$, Breadth $= 5a-4$

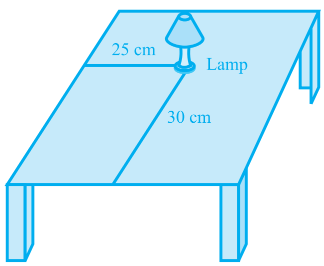
(ii) One possible answer is : Length $= 7y-3$, Breadth $= 5y+4$

16. (i) One possible answer is : 3, x and $x-4$.

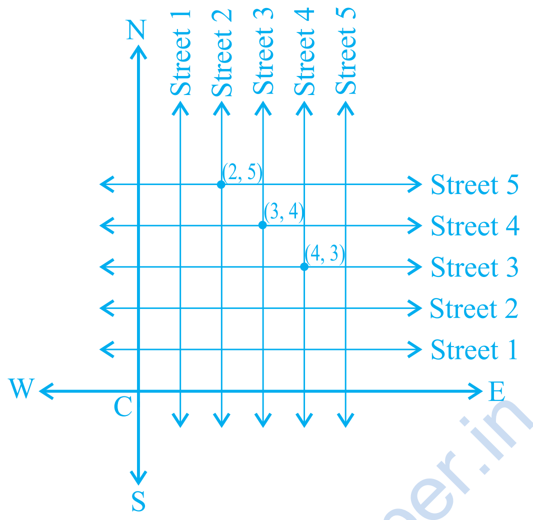
(ii) One possible answer is : $4k$, $3y+5$ and $y-1$.

EXERCISE 3.1

1. Consider the lamp as a point and table as a plane. Choose any two perpendicular edges of the table. Measure the distance of the lamp from the longer edge, suppose it is 25 cm. Again, measure the distance of the lamp from the shorter edge, and suppose it is 30 cm. You can write the position of the lamp as (30, 25) or (25, 30), depending on the order you fix.



2. The Street plan is shown in figure given below.



Both the cross-streets are marked in the figure above. They are *uniquely* found because of the two reference lines we have used for locating them.

EXERCISE 3.2

1. (i) The x - axis and the y - axis (ii) Quadrants (iii) The origin

2. (i) $(-5, 2)$ (ii) $(5, -5)$ (iii) E (iv) G (v) 6 (vi) -3 (vii) $(0, 5)$ (viii) $(-3, 0)$

EXERCISE 4.1

1. $x - 2y = 0$

2. (i) $2x + 3y - 9.3\overline{5} = 0;\ a = 2, b = 3, c = -9.3\overline{5}$

(ii) $x - \dfrac{y}{5} - 10 = 0;\ a = 1, b = \dfrac{-1}{5},\ c = -10$

(iii) $-2x + 3y - 6 = 0;\ a = -2, b = 3, c = -6$

(iv) $1.x - 3y + 0 = 0;\ a = 1, b = -3, c = 0$

(v) $2x + 5y + 0 = 0;\ a = 2, b = 5, c = 0$

(vi) $3x + 0.y + 2 = 0;\ a = 3, b = 0, c = 2$

(vii) $0.x + 1.y - 2 = 0;\ a = 0, b = 1, c = -2$

(viii) $-2x + 0.y + 5 = 0;\ a = -2, b = 0, c = 5$

EXERCISE 4.2

1. (iii), because for every value of x, there is a corresponding value of y and vice-versa.

2. (i) (0, 7), (1, 5), (2, 3), (4, –1)

(ii) $(1, 9-\pi), (0, 9), (-1, 9+\pi), \left(\frac{9}{\pi}, 0\right)$

(iii) $(0, 0), (4, 1), (-4, 1), \left(2, \frac{1}{2}\right)$

3. (i) No (ii) No (iii) Yes (iv) No (v) No

4. 7

EXERCISE 5.1

1. (i) False. This can be seen visually by the student.

(ii) False. This contradicts Axiom 5.1.

(iii) True. (Postulate 2)

(iv) True. If you superimpose the region bounded by one circle on the other, then they coincide. So, their centres and boundaries coincide. Therefore, their radii will coincide.

(v) True. The first axiom of Euclid.

3. There are several undefined terms which the student should list. They are consistent, because they deal with two different situations — (i) says that given two points A and B, there is a point C lying on the line in between them; (ii) says that given A and B, you can take C not lying on the line through A and B.

These 'postulates' do not follow from Euclid's postulates. However, they follow from Axiom 5.1.

4. $AC = BC$

So, $AC + AC = BC + AC$ (Equals are added to equals)

i.e., $2AC = AB$ (BC + AC coincides with AB)

Therefore, $AC = \frac{1}{2} AB$

5. Make a temporary assumption that different points C and D are two mid-points of AB. Now, you show that points C and D are not two different points.

6. $AC = BD$ (Given) (1)

$AC = AB + BC$ (Point B lies between A and C) (2)

$BD = BC + CD$ (Point C lies between B and D) (3)

Substituting (2) and (3) in (1), you get

$$AB + BC = BC + CD$$

So, $AB = CD$ (Subtracting equals from equals)

7. Since this is true for any thing in any part of the world, this is a universal truth.

EXERCISE 6.1

1. 30°, 250° **2.** 126° **4.** Sum of all the angles at a point = 360°

5. $\angle QOS = \angle SOR + \angle ROQ$ and $\angle POS = \angle POR - \angle SOR$. **6.** 122°, 302°

EXERCISE 6.2

1. 126° **2.** 126°, 36°, 54° **3.** 60° **4.** 50°, 77°

5. Angle of incidence = Angle of reflection. At point B, draw $BE \perp PQ$ and at point C, draw $CF \perp RS$.

EXERCISE 7.1

1. They are equal. **6.** $\angle BAC = \angle DAE$

EXERCISE 7.2

6. $\angle BCD = \angle BCA + \angle DCA = \angle B + \angle D$ **7.** each is of 45°

EXERCISE 7.3

3. **(ii)** From (i), $\angle ABM = \angle PQN$

EXERCISE 8.1

3. (i) From Δ DAC and Δ BCA, show $\angle DAC = \angle BCA$ and $\angle ACD = \angle CAB$, etc.

(ii) Show $\angle BAC = \angle BCA$, using Theorem 8.4.

EXERCISE 8.2

2. Show PQRS is a parallelogram. Also show $PQ \parallel AC$ and $PS \parallel BD$. So, $\angle P = 90°$.

5. AECF is a parallelogram. So, $AF \parallel CE$, etc.

EXERCISE 9.1

1. Prove exactly as Theorem 9.1 by considering chords of congruent circles.
2. Use SAS axiom of congruence to show the congruence of the two triangles.

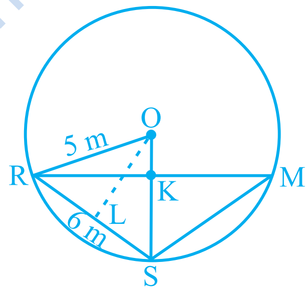
EXERCISE 9.2

1. 6 cm. First show that the line joining centres is perpendicular to the radius of the smaller circle and then that common chord is the diameter of the smaller circle.
2. If AB, CD are equal chords of a circle with centre O intersecting at E, draw perpendiculars OM on AB and ON on CD and join OE. Show that right triangles OME and ONE are congruent.
3. Proceed as in Example 2.
4. Draw perpendicular OM on AD.
5. Represent Reshma, Salma and Mandip by R, S and M respectively. Let KR = x m (see figure).

   Area of Δ ORS $= \frac{1}{2} x \times 5$. Also, area of Δ ORS $=$

   $\frac{1}{2}$ RS $\times$ OL $= \frac{1}{2} \times 6 \times 4$.

   Find x and hence RM.



6. Use the properties of an equilateral triangle and also Pythagoras Theorem.

EXERCISE 9.3

1. 45°
2. 150°, 30°
3. 10°
4. 80°
5. 110°
6. $\angle$BCD = 80° and $\angle$ECD = 50°
8. Draw perpendiculars AM and BN on CD (AB || CD and AB < CD). Show ΔAMD $\cong$ ΔBNC. This gives $\angle$C = $\angle$D and, therefore, $\angle$A + $\angle$C = 180°.

EXERCISE 10.1

1. $\frac{\sqrt{3}}{4} a^2$, 900, 3 cm^2
2. ₹ 1650000
3. $20\sqrt{2}$ m^2
4. $21\sqrt{11}$ cm^2
5. 9000 cm^2
6. $9\sqrt{15}$ cm^2

EXERCISE 11.1

1. 165 cm^2 **2.** 1244.57 m^2 **3.** (i) 7 cm (ii) 462 cm^2

4. (i) 26 m (ii) ₹ 137280 **5.** 63 m **6.** ₹ 1155

7. 5500 cm^2 **8.** ₹ 384.34 (approx.)

EXERCISE 11.2

1. (i) 1386 cm^2 (ii) 394.24 cm^2 (iii) 2464 cm^2

2. (i) 616 cm^2 (ii) 1386 cm^2 (iii) 38.5 m^2

3. 942 cm^2 **4.** 1 : 4 **5.** ₹ 27.72

6. 3.5 cm **7.** 1 : 16 **8.** 173.25 cm^2

9. (i) $4\pi r^2$ (ii) $4\pi r^2$ (iii) 1 : 1

EXERCISE 11.3

1. (i) 264 cm^3 (ii) 154 cm^3 **2.** (i) 1.232 l (ii) $\frac{11}{35}\,l$

3. 10 cm **4.** 8 cm **5.** 38.5 kl

6. (i) 48 cm (ii) 50 cm (iii) 2200 cm^2 **7.** 100π cm^3 **8.** 240π cm^3; 5 : 12

9. 86.625x m^3, 99.825 m^2

EXERCISE 11.4

1. (i) $1437\frac{1}{3}$ cm^3 (ii) 1.05 m^3 (approx.)

2. (i) $11498\frac{2}{3}$ cm^3 (ii) 0.004851 m^3 **3.** 345.39 g (approx.) **4.** $\frac{1}{64}$

5. 0.303l (approx.) **6.** 0.06348 m^3 (approx.)

7. $179\frac{2}{3}$ cm^3 **8.** (i) 249.48 m^2 (ii) 523.9 m^3 (approx.) **9.** (i) $3r$ (ii) 1 : 9

10. 22.46 mm^3 (approx.)

EXERCISE 12.1

1. (ii) Reproductive health conditions.

3. (ii) Party A **4.** (ii) Frequency polygon (iii) No **5.** (ii) 184

8.

Age (in years)	Frequency	Width	Length of the rectangle
1 - 2	5	1	$\frac{5}{1} \times 1 = 5$
2 - 3	3	1	$\frac{3}{1} \times 1 = 3$
3 - 5	6	2	$\frac{6}{2} \times 1 = 3$
5 - 7	12	2	$\frac{12}{2} \times 1 = 6$
7 - 10	9	3	$\frac{9}{3} \times 1 = 3$
10 - 15	10	5	$\frac{10}{5} \times 1 = 2$
15 - 17	4	2	$\frac{4}{2} \times 1 = 2$

Now, you can draw the histogram, using these lengths.

9. (i)

Number of letters	Frequency	Width of interval	Length of rectangle
1 - 4	6	3	$\frac{6}{3} \times 2 = 4$
4 - 6	30	2	$\frac{30}{2} \times 2 = 30$
6 - 8	44	2	$\frac{44}{2} \times 2 = 44$
8 - 12	16	4	$\frac{16}{4} \times 2 = 8$
12 - 20	4	8	$\frac{4}{8} \times 2 = 1$

Now, draw the histogram.

(ii) 6 - 8

EXERCISE A1.1

1. (i) False. There are 12 months in a year.
   (ii) Ambiguous. In a given year, Diwali may or may not fall on a Friday.
   (iii) Ambiguous. At some time in the year, the temperature in Magadi, may be 26° C.
   (iv) Always true.
   (v) False. Dogs cannot fly.
   (vi) Ambiguous. In a leap year, February has 29 days.
2. (i) False. The sum of the interior angles of a quadrilateral is 360°.
   (ii) True (iii) True (iv) True
   (v) False, for example, $7 + 5 = 12$, which is not an odd number.
3. (i) All prime numbers greater than 2 are odd. (ii) Two times a natural number is always even. (iii) For any $x > 1$, $3x + 1 > 4$. (iv) For any $x \geq 0$, $x^3 \geq 0$.
   (v) In an equilateral triangle, a median is also an angle bisector.

EXERCISE A1.2

1. (i) Humans are vertebrates. (ii) No. Dinesh could have got his hair cut by anybody else. (iii) Gulag has a red tongue. (iv) We conclude that the gutters will have to be cleaned tomorrow. (v) All animals having tails need not be dogs. For example, animals such as buffaloes, monkeys, cats, etc. have tails but are not dogs.
2. You need to turn over B and 8. If B has an even number on the other side, then the rule has been broken. Similarly, if 8 has a consonant on the other side, then the rule has been broken.

EXERCISE A1.3

1. Three possible conjectures are:
   (i) The product of any three consecutive even numbers is even. (ii) The product of any three consecutive even numbers is divisible by 4. (iii) The product of any three consecutive even numbers is divisible by 6.
2. Line 4: $1\,3\,3\,1 = 11^3$; Line 5: $1\,4\,6\,4\,1 = 11^4$; the conjecture holds for Line 4 and Line 5; No, because $11^5 \neq 15101051$.
3. $T_4 + T_5 = 25 = 5^2$; $T_{n-1} + T_n = n^2$.
4. $111111^2 = 12345654321$; $1111111^2 = 1234567654321$
5. Student's own answer. For example, Euclid's postulates.

EXERCISE A1.4

1. (i) You can give any two triangles with the same angles but of different sides.

(ii) A rhombus has equal sides but may not be a square.

(iii) A rectangle has equal angles but may not be a square.

(iv) For $a = 3$ and $b = 4$, the statement is not true.

(v) For $n = 11$, $2n^2 + 11 = 253$ which is not a prime.

(vi) For $n = 41$, $n^2 - n + 41$ is not a prime.

2. Student's own answer.

3. Let x and y be two odd numbers. Then $x = 2m + 1$ for some natural number m and $y = 2n + 1$ for some natural number n.

$x + y = 2(m + n + 1)$. Therefore, $x + y$ is divisible by 2 and is even.

4. See Q.3. $xy = (2m + 1)(2n + 1) = 2(2mn + m + n) + 1$.

Therefore, $x\,y$ is not divisible by 2, and so it is odd.

5. Let $2n$, $2n + 2$ and $2n + 4$ be three consecutive even numbers. Then their sum is $6(n + 1)$, which is divisible by 6.

7. (i) Let your original number be n. Then we are doing the following operations:

$$n \to 2n \to 2n + 9 \to 2n + 9 + n = 3n + 9 \to \frac{3n+9}{3} = n + 3 \to n + 3 + 4 = n + 7 \to n + 7 - n = 7.$$

(ii) Note that $7 \times 11 \times 13 = 1001$. Take any three digit number say, abc. Then $abc \times 1001 = abcabc$. Therefore, the six digit number $abcabc$ is divisible by 7, 11 and 13.

EXERCISE A2.1

1. **Step 1: Formulation :**

The relevant factors are the time period for hiring a computer, and the two costs given to us. We assume that there is no significant change in the cost of purchasing or hiring the computer. So, we treat any such change as irrelevant. We also treat all brands and generations of computers as the same, i.e. these differences are also irrelevant.

The expense of hiring the computer for x months is ₹ $2000x$. If this becomes more than the cost of purchasing a computer, we will be better off buying a computer. So, the equation is

$$2000x = 25000 \qquad (1)$$

Step 2 : Solution : Solving (1), $x = \frac{25000}{2000} = 12.5$

Step 3 : Interpretation : Since the cost of hiring a computer becomes more **after** 12.5 months, it is cheaper to buy a computer, if you have to use it for more than 12 months.

2. **Step1 : Formulation :** We will assume that cars travel at a constant speed. So, any change of speed will be treated as irrelevant. If the cars meet after x hours, the first car would have travelled a distance of $40x$ km from A and the second car would have travelled $30x$ km, so that it will be at a distance of $(100 - 30x)$ km from A. So the equation will be $40x = 100 - 30x$, i.e., $70x = 100$.

   Step 2 : Solution : Solving the equation, we get $x = \frac{100}{70}$.

   Step 3 : Interpretation : $\frac{100}{70}$ is approximately 1.4 hours. So, the cars will meet after 1.4 hours.

3. **Step1 : Formulation :** The speed at which the moon orbits the earth is
$$\frac{\text{Length of the orbit}}{\text{Time taken}}.$$

   Step 2 : Solution : Since the orbit is nearly circular, the length is $2 \times \pi \times 384000$ km $= 2411520$ km

   The moon takes 24 hours to complete one orbit.

   So, speed $= \frac{2411520}{24} = 100480$ km/hour.

   Step 3 : Interpretation : The speed is 100480 km/h.

4. **Formulation :** An assumption is that the difference in the bill is only because of using the water heater.

   Let the average number of hours for which the water heater is used $= x$

   Difference per month due to using water heater = ₹ 1240 – ₹ 1000 = ₹ 240

   Cost of using water heater for one hour = ₹ 8

   So, the cost of using the water heater for 30 days $= 8 \times 30 \times x$

   Also, the cost of using the water heater for 30 days = Difference in bill due to using water heater

   So, $$240x = 240$$

   Solution : From this equation, we get $x = 1$.

   Interpretation : Since $x = 1$, the water heater is used for an average of 1 hour in a day.

EXERCISE A2.2

1. We will not discuss any particular solution here. You can use the same method as we used in last example, or any other method you think is suitable.

EXERCISE A2.3

1. We have already mentioned that the formulation part could be very detailed in real-life situations. Also, we do not validate the answer in word problems. Apart from this word problem have a 'correct answer'. This need not be the case in real-life situations.
2. The important factors are (ii) and (iii). Here (i) is not an important factor although it can have an effect on the number of vehicles sold.