Section A (1 point each)

- **1.** (C) $3200 + 40 + 80 + 1$. The calculation for

  41×81 is $(40 + 1) \times (80 + 1)$, which expands to $40 \times 80 + 40 \times 1 + 1 \times 80 + 1 \times 1 = 3200 + 40 + 80 + 1$.

- **2.** (D) 6. A median divides the side of a triangle into two equal parts. The length of the first half is 3 cm, so the total length of the bottom side is

  $3 \times 2 = 6$ cm.
- **3.** (C) $2x + 10 = 20$. Let the shorter side be

  x and the longer side be $x + 10$. The perimeter is

  $2(\text{shorter side} + \text{longer side}) = 40$. So,

  $2(x + x + 10) = 40$, which simplifies to $2(2x + 10) = 40$, and further to $2x + 10 = 20$.
- **4.** (C) $\sqrt{3}$. The two given sides are 1 and 1. The length of the first diagonal is

  $\sqrt{1^2 + 1^2} = \sqrt{2}$. The fourth side is the hypotenuse of a right triangle with sides 1 and

  $\sqrt{2}$, so its length is $\sqrt{(\sqrt{2})^2 + 1^2} = \sqrt{2 + 1} = \sqrt{3}$.
- **5.** (A) 12. Let the two numbers be

  x and y. Their sum is 19 (

  $x + y = 19$) and their difference is 5 ($x - y = 5$). Adding the two equations gives

  $2x = 24$, so $x = 12$.
- **6.** (C) 2:3. The horizontal lines are parallel and at equal distance apart. The ratio of the segments cut by the transversal is the same as the ratio of the number of spaces between the parallel lines. Segment AB spans 2 spaces and BC spans 3 spaces. Therefore, AB:BC = 2:3.

- **7.** (iii) Both are true and B is the reason for A. Statement A is true because 2 is not a perfect square of a natural number or fraction, as its square root is irrational. Statement B is also true because

  $\sqrt{2}$ is between 1 and 2, since $1^2 = 1$ and $2^2 = 4$. Statement B is the reason for A as it explains why

  $\sqrt{2}$ is an irrational number.
- **8.** (iv) Both are true and B is not the reason for A. Statement A, regarding the area of a triangle formed by midpoints, is a correct application of the Midpoint Theorem. Statement B, regarding parallel lines and transversals, is a correct application of Thales's Intercept Theorem. Both are true, but they are not directly related.

Section B (3 points each)

- **9.**
  - (i) The area of the square is found using the Pythagorean theorem. The sides of the right triangle are 3 cm and the hypotenuse is 4 cm. The side of the square is the height of the triangle. So, side$^2 + 3^2 = 4^2 \implies$ side$^2 = 16-9=7$. The area is 7 square centimetres.
  - (ii) To draw a square with area 11 sq.cm, we need a side length of $\sqrt{11}$ cm. This can be constructed as the hypotenuse of a right triangle with legs of lengths 1 cm and $\sqrt{10}$ cm (or 3 cm and $\sqrt{2}$ cm).
- **10.**
  - (i) Using distribution,

    $(x+1)(y+1) = xy + x + y + 1.$
  - (ii) Let the numbers be x and y. Their sum is

    $x + y = 40$ and their product is $xy = 375$. The product of the numbers next to them,

    $(x+1)$ and $(y+1)$, is $(x+1)(y+1) = xy + x + y + 1$. This is $375 + 40 + 1 = 416$.
  - (iii) The product of the natural numbers 1 less than each is $(x-1)(y-1) = xy - (x + y) + 1$. This is $375 - 40 + 1 = 336$.

Section C (4 points each)

- **15. (A)**
  - (i) In a calendar square, consecutive dates in the same column are 7 apart. The number below 5 is

$5 + 7 = 12$. The missing date is

12.

- (ii) Let the top-left date be x. The four dates in the square are $x, x + 1, x + 7$, and $x + 8$. The product of one diagonal is

  $x(x + 8)$, and the product of the other is $(x + 1)(x + 7)$. The difference of these products is

  $$(x + 1)(x + 7) - x(x + 8) = (x^2 + 8x + 7) - (x^2 + 8x) = 7.$$

- **16.** Let the price of a notebook be n and the price of a pen be p.
  - The two equations are

    $2n + 3p = 95$ and $5n + 2p = 210$.

  - To solve, multiply the first equation by 5 and the second by 2: $10n + 15p = 475$ and $10n + 4p = 420$.
  - Subtracting the second from the first gives $11p = 55$, so $p = 5$.
  - Substitute $p = 5$ into the first equation: $2n + 3(5) = 95 \implies 2n + 15 = 95 \implies 2n = 80 \implies n = 40$.
  - (i) The price of a notebook is

    40 rupees.

  - (ii) The price of a pen is

    5 rupees.

- **19.**
  - (i) The medians of a triangle intersect at the centroid, which divides each median in a 2:1 ratio. Therefore, AG is

    $\frac{2}{3}$ of the length of AD.

  - (ii) A median divides a triangle into two triangles of equal area. Thus, the area of triangle ABD is

    $\frac{1}{2}$ the area of triangle ABC.

- (iii) In $\triangle ABD$, BG is a median. Medians divide triangles into smaller triangles of equal area. So, the area of triangle ABG is

  $\frac{2}{3}$ of the area of triangle ABD.

- (iv) The area of triangle ABG is $\frac{2}{3}$ of the area of ABD, and the area of ABD is $\frac{1}{2}$ the area of ABC. Therefore, Area(ABG) = $\frac{2}{3} \times \frac{1}{2}\text{Area(ABC)} = \frac{1}{3}\text{Area(ABC)}$.

Section D (5 points each)

- **21. (A)**
  - Let the fraction be $\frac{x}{y}$. The first condition gives

    $\frac{x+2}{y} = \frac{1}{4}$. This implies

    $$4(x+2) = y \implies y = 4x + 8.$$
  - The second condition gives

    $\frac{x}{y+2} = \frac{1}{5}$. This implies

    $$5x = y + 2.$$
  - Substitute the first equation into the second: $5x = (4x+8) + 2 \implies 5x = 4x + 10 \implies x = 10$.
  - Substitute $x = 10$ back into the first equation: $y = 4(10) + 8 = 48$. The fraction is $\frac{10}{48}$.
- **23.**
  - (i) The diagonals of the right triangles in the picture form a spiral. The first right triangle has sides 1 metre and 1 metre, so its hypotenuse (diagonal) is

    $\sqrt{1^2 + 1^2} = \sqrt{2}$ metres. The next triangle has sides 1 metre and

    $\sqrt{2}$ metres, and its diagonal is $\sqrt{1^2 + (\sqrt{2})^2} = \sqrt{3}$ metres. The diagonals of the triangles are $\sqrt{2}, \sqrt{3}, \sqrt{4}, \ldots$ metres.
  - (ii) The perimeter of the ninth triangle is the sum of its sides: 1 metre, the length of the previous diagonal (

    $\sqrt{9}$ metres), and the new diagonal ($\sqrt{10}$ metres). So,

    $1 + \sqrt{9} + \sqrt{10} = 1 + 3 + \sqrt{10} = 4 + \sqrt{10}$ m. The perimeter of the tenth triangle is $1 + \sqrt{10} + \sqrt{11}$ m. The difference is $(1 + \sqrt{10} + \sqrt{11}) - (4 + \sqrt{10}) = \sqrt{11} - 3$ metres.
- **24.**

- (i) The numbers 10 and 19 have a remainder of 1 when divided by 3. The product is

  $10 \times 19 = 190$. Dividing 190 by 3 gives $190 = 3 \times 63 + 1$. The remainder is **1**.

- (ii) Let the two numbers be $3k + 2$ and $3m + 2$. Their product is

  $(3k + 2)(3m + 2) = 9km + 6k + 6m + 4$. This can be rewritten as $3(3km + 2k + 2m + 1) + 1$, which shows that the product leaves a remainder of

  1 when divided by 3.
- (iii) For the product to have a remainder of 2, one number must have a remainder of 1 and the other a remainder of 2 when divided by 3. An example is 4 (remainder 1) and 5 (remainder 2). Their product is

  $4 \times 5 = 20$, which leaves a remainder of 2 when divided by 3.

- **25.**
  - (i) The sum of the digits of a two-digit number is 13. Some such numbers are

    49, 58, 67, 76, 85, 94.
  - (ii) Let the number be $10t + u$. The sum of the digits is $t + u = 13$. The number with reversed digits is

    $10u + t$. This number is 27 more than the original:

    $10u + t = 10t + u + 27 \implies 9u - 9t = 27 \implies u - t = 3$. Adding the two equations ($t + u = 13$ and $u - t = 3$) gives $2u = 16$, so $u = 8$. Substituting back, $t = 5$. The number is **58**.