Q1.

1. Distribute the 3 across the terms inside the parentheses $2x - 4$:

$$3 \times 2x = 6x, \quad 3 \times (-4) = -12$$

   So $3(2x - 4) = 6x - 12$.
2. Distribute the -2 across the terms inside the parentheses $(x - 1)$:

$$-2 \times x = -2x, \quad -2 \times (1) = +2$$

   So $-2(x - 1) = -2x + 2$.
3. Combine like terms:

$$(6x - 12) + (-2x + 2) = 6x - 2x - 12 + 2 = 4x - 10.$$

Hence, the simplified form of the expression $3(2x - 4) - 2(x - 1)$ is

$$4x - 10.$$

Q2.

1. **Evaluate** $(-2)^0$:
   Any non-zero number raised to the 0 power is 1.

$$(-2)^0 = 1$$

2. **Evaluate** $(-2)^{-3}$:
   A negative exponent indicates a reciprocal, so

$$(-2)^{-3} = \frac{1}{(-2)^3}.$$

   Since $(-2)^3 = -8$, we have

$$\frac{1}{-8} = -\frac{1}{8}.$$

3. **Multiply the two results:**

$$(-2)^0 \times (-2)^{-3} = 1 \times \left(-\frac{1}{8}\right) = -\frac{1}{8}.$$

$$(-2)^0 \times (-2)^{-3}$$
$$-\frac{1}{8}.$$

Q3.

1. **Identify and factor out the greatest common factor (GCF):**
   Both terms $27y^2$ and $-3x^2$ have a common factor of 3

$$27y^2 - 3x^2 = 3(9y^2 - x^2)$$

2. **Recognize the difference of squares:**
   $9y^2 - x^2$ can be written as $(3y)^2 - (x)^2$
   The difference of squares $a^2 - b^2$ factors as $(a - b)(a + b)$
   Therefore,

$$9y^2 - x^2 = (3y)^2 - x^2 = (3y - x)(3y + x).$$

3. **Combine both steps:**

$$3(9y^2 - x^2) = 3\big((3y - x)(3y + x)\big).$$

Hence, the completely factored form of $27y^2 - 3x^2$ is

$$3(3y - x)(3y + x).$$

Q4.

1. Start with the given equation of the line:

$$2x - y = 5.$$

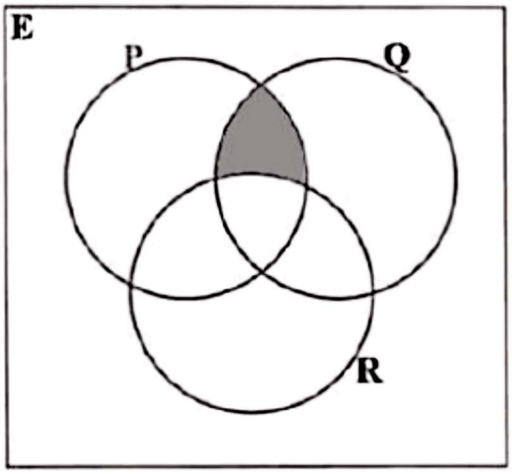
2. Rearrange to the slope-intercept form $y = mx + c$:

$$-y = 5 - 2x \quad \Longrightarrow \quad y = 2x - 5.$$

3. The coefficient of x in this form (2) is the gradient (slope) of the line.

$$\text{Gradient} = 2.$$

Q5.



Q6.

1. Identify the coordinates of P and Q

$$P \text{ has position vector } \overrightarrow{OP} = \begin{pmatrix} 5 \\ 0 \end{pmatrix} \quad \Longrightarrow \quad P = (5, 0).$$

$$Q \text{ has position vector } \overrightarrow{OQ} = \begin{pmatrix} 17 \\ y \end{pmatrix} \quad \Longrightarrow \quad Q = (17, y).$$

3. Use the magnitude condition

$$\text{The magnitude of } \overrightarrow{PQ} \text{ is given as } 20.$$
$$\|\overrightarrow{PQ}\| = \sqrt{(12)^2 + (y)^2} = 20.$$

Squaring both sides:

$$(12)^2 + y^2 = 20^2 \quad \Longrightarrow \quad 144 + y^2 = 400.$$

4. Solve for y

$$y^2 = 400 - 144 = 256 \quad \Longrightarrow \quad y = \pm 16.$$

We are asked for the positive value of y, so

$$y = 16.$$

Q7.

(a)

Given

$$A = \begin{pmatrix} 4 & 5 \\ 1 & 1 \end{pmatrix}$$

its transpose A^T is obtained by swapping rows and columns:

$$A^T = \begin{pmatrix} 4 & 1 \\ 5 & 1 \end{pmatrix}$$

(b)

1. Compute the product AB:

$$AB = \begin{pmatrix} 4 & 5 \\ 1 & 2 \end{pmatrix} \begin{pmatrix} x-1 & 1 \\ 2 & 0 \end{pmatrix} = \begin{pmatrix} 4(x-1) + 5 \cdot 2 & 4 \cdot 1 + 5 \cdot 0 \\ 1(x-1) + 2 \cdot 2 & 1 \cdot 1 + 2 \cdot 0 \end{pmatrix}.$$

Simplify each element:

$$= \begin{pmatrix} 4x - 4 + 10 & 4x + 4 \\ x - 1 + 4 & 1 \end{pmatrix} = \begin{pmatrix} 4x + 6 & 4x + 4 \\ x + 3 & 1 \end{pmatrix}.$$

2. Equate this to the given matrix $\begin{pmatrix} 10 & 4 \\ 2 & 1 \end{pmatrix}$ and compare corresponding entries:

$$4x + 6 = 10 \implies 4x = 4 \implies x = 1.$$

(We can also check the bottom-left entries: $x + 1 = 2$ also yields $x = 1$.)

$$\text{Hence, the required value of } x \text{ is: } x = 1.$$

Q8.

(a)

Substitute $n = 6$ into the formula:

$$a_6 = 99 + (6 - 1)(-7) = 99 + 5 \times (-7) = 99 - 35 = 64$$

Hence, the 6th term is $\boxed{64}$

(b)

Use the same formula for any general n:

$$a_n = 99 + (n - 1)(-7).$$

Simplify:

$$a_n = 99 - 7(n - 1) = 99 - 7n + 7 = 106 - 7n.$$

Thus, the n-th term of the A.P. is

$$\boxed{106 - 7n}.$$

Q9

(a)

A standard six-sided die has faces numbered 1 through 6.

The multiples of 3 in $\{1, 2, 3, 4, 5, 6\}$ are 3 and 6.

Hence, there are 2 favorable outcomes (3, 6) out of 6 total possible outcomes.

Probability:

$$\frac{2}{6} = \frac{1}{3}.$$

(b)

1. **Take the square root of both sides (remembering the $\pm$):**

$$1 - 2t = \pm 5.$$

2. **Case 1:** $1 - 2t = 5$

$$-2t = 5 - 1 = 4 \quad \Longrightarrow \quad t = -2.$$

3. **Case 2:** $1 - 2t = -5$

$$-2t = -5 - 1 = -6 \quad \Longrightarrow \quad t = 3.$$

Thus, the solutions to the equation $(1 - 2t)^2 = 25$ are

$$t = -2 \quad \text{or} \quad t = 3.$$

Q10

(a)

1: Find A'.

$$A = \{1,2,3,4,5,6,7,8,9\} \; - \{2,4,6,8\} = \{1,3,5,7,9\}$$

2: Find $A' \cap B$.

$$A' \cap B = \{1,3,5,7,9\} \; \cap \; \{2,3,5,7\}$$

The common elements are $\{3,5,7\}$

$$\therefore A' \cap B = \{3,5,7\}$$

(b)

For an isosceles triangular prism (with base PQR where $PQ = QR$), there is exactly **one** plane of symmetry:

- **Reason:** An isosceles triangle PQR (with $PQ = QR$) has exactly one axis of symmetry — through vertex Q and the midpoint of the opposite side PR. In the prism, that axis extends as a plane cutting through the corresponding edges on the top face (i.e., through U and the midpoint of TS).
- No other symmetry planes exist because the triangle is not equilateral, so the other sides do not generate additional lines of symmetry.

Hence, the prism has

$$\boxed{\text{1 plane of symmetry.}}$$

Q11

(a)

1. **Identify longitudes (from the diagram or description):**

$$\text{Town } A \text{ is at } 75^\circ\text{W} \quad \text{Town } C \text{ is at } 45^\circ\text{E}$$

2. **Compute the difference in longitude:**
   Since A is 75° west and C is 45° east, the total difference is

$$75^\circ + 45^\circ = 120^\circ$$

3. **Convert longitude differences to time difference:**
   The Earth rotates 360° in 24 hours, i.e., 15° per hour. Thus,

$$120^\circ \div 15^\circ = 8 \text{ hours difference}$$

Because C is to the east of A, C is 8 hours ahead of A

4. **Add 8 hours to A's time:**
   If A's local time is 11:22, then C's time is

$$11{:}22 + 8 \text{ hours} = 19{:}22 \quad (\text{i.e. } 7{:}22 \text{ p.m.})$$

Therefore, the time at C is

$$\boxed{19{:}22\ (7{:}22 \text{ p.m.})}$$

(b)

The plane covers a distance of 7,200 nautical miles (nm) in 9 hours

Speed is distance ÷ time:

$$\text{Speed} = \frac{7{,}200\,\text{nm}}{9\,\text{hours}} = 800\,\text{nm/h}$$

In aviation, nm/h is often referred to as **knots**. So the speed is

$$\boxed{800 \text{ knots}}$$

Q12

(a)

1. Start with the given equation:

$$3^{1-2x} + 4 = 5$$

2. Isolate the exponential term:

$$3^{1-2x} = 5 - 4 = 1$$

3. Recognize that $3^{1-2x} = 1$ implies $3^0 = 1$. Thus,

$$1 - 2x = 0$$

4. Solve for x:

$$1 - 2x = 0 \implies 2x = 1 \implies x = \tfrac{1}{2}$$

Hence, the solution is

$$\boxed{x = \tfrac{1}{2}}$$

(b)

1. Recall the formula for the area of a sector (when the angle θ is in degrees):

$$\text{Area of sector} = \frac{\theta}{360} \times \pi r^2.$$

2. Plug in the known values (with $\pi = \frac{22}{7}$, $r = 14$, and area $= 231 \text{ cm}^2$):

$$231 = \frac{\theta}{360} \times \frac{22}{7} \times 14^2.$$

Note that $14^2 = 196$. So:

$$231 = \frac{\theta}{360} \times \frac{22}{7} \times 196.$$

3. Simplify:

$$231 = \frac{\theta}{360} \times \frac{22 \times 196}{7} = \frac{\theta}{360} \times 22 \times 28 = \frac{\theta}{360} \times 616.$$

So,

$$231 = \frac{\theta \times 616}{360}.$$

Multiply both sides by 360:

$$231 \times 360 = \theta \times 616.$$

Hence,

$$\theta = \frac{231 \times 360}{616}.$$

Compute the fraction:

$$\theta = \frac{231 \times 360}{616}.$$

Factor and cancel common terms:

$$231 = 3 \times 7 \times 11, \quad 360 = 8 \times 45, \quad 616 = 7 \times 8 \times 11.$$

Thus,

$$\theta = \frac{(3 \times 7 \times 11)\,(8 \times 45)}{(7 \times 8 \times 11)} = 3 \times 45 = 135.$$

Therefore,

$$\boxed{\theta = 135^\circ}.$$

Q13

(a)

1. Write $g(x)$ in the form $y = \ldots$:

$$y = \frac{x+4}{3}$$

2. Solve for x in terms of y:

$$y = \frac{x+4}{3} \implies 3y = x + 4 \implies x = 3y - 4$$

3. Hence, the inverse function is:

$$g^{-1}(y) = 3y - 4$$

By convention, replace y with x for the function notation:

$$g^{-1}(x) = 3x - 4$$

(b)

1. Compute $f(x)$:

$$f(x) = 3x + 5.$$

2. Plug $f(x)$ into g:

$$g(f(x)) = g(3x+5) = \frac{(3x+5)+4}{3} = \frac{3x+9}{3} = x + 3.$$

3. Therefore,

$$gf(x) = x + 3.$$

(c)

1. First, evaluate $f(4)$:

$$f(4) = 3 \cdot 4 + 5 = 12 + 5 = 17.$$

2. Then compute $g(17)$:

$$g(17) = \frac{17+4}{3} = \frac{21}{3} = 7.$$

3. Hence,

$$gf(4) = 7.$$

Q14

(a)

When a measurement is given to the nearest 0.1 kg, the **absolute uncertainty** (or half the smallest division) is

$$0.1 \div 2 = 0.05\,\text{kg}.$$

Hence, the tolerance is

$$\pm 0.05\,\text{kg}.$$

(b)

The relative (or fractional) error is given by

$$\frac{\text{absolute error}}{\text{measured value}} = \frac{0.05}{15.4}$$

Convert 0.05 to a fraction and simplify:

$$0.05 = \frac{5}{100} = \frac{1}{20},$$

so

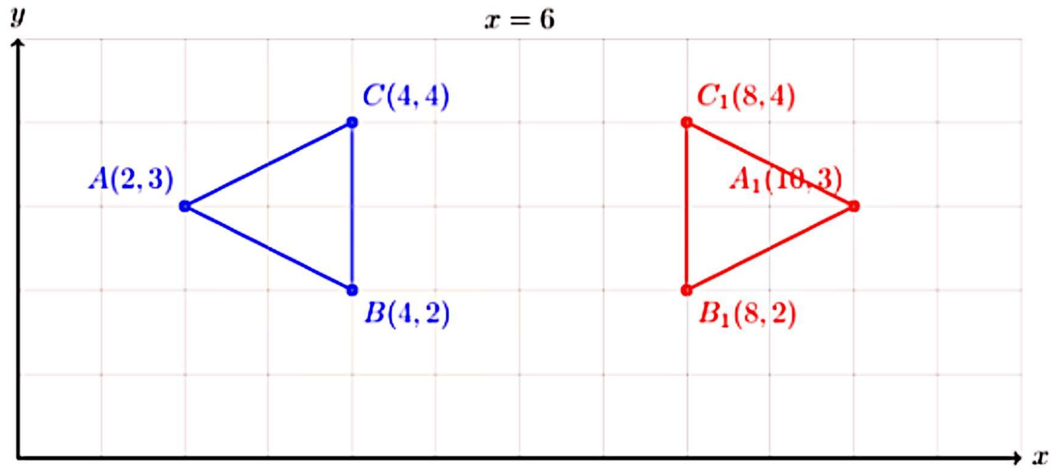
$$\frac{0.05}{15.4} = \frac{\frac{1}{20}}{15.4} = \frac{1}{20 \times 15.4} = \frac{1}{308}$$

Therefore, the relative error in simplest fractional form is

$$\boxed{\frac{1}{308}}$$

Q15

(a)



(b)

Given:

$$y = x - 2x^2 + \frac{1}{3x^2},$$

we want to find $\frac{dy}{dx}$.

1. Differentiate each term separately with respect to x:

$$\frac{d}{dx}(x) = 1, \quad \frac{d}{dx}(-2x^2) = -4x, \quad \frac{d}{dx}\left(\frac{1}{3x^2}\right)$$

First rewrite $\frac{1}{3x^2}$ as $\frac{1}{3} \cdot x^{-2}$. Its derivative is:

$$\frac{d}{dx}\left(\frac{1}{3}x^{-2}\right) = \frac{1}{3} \cdot (-2)x^{-3} = -\frac{2}{3}x^{-3}$$

2. Combine these results to get the full derivative:

$$\frac{dy}{dx} = 1 \; - \; 4x \; - \; \frac{1}{3x^2}$$

Hence, the derivative of y with respect to x is:

$$\frac{dy}{dx} = 1 - 4x - \frac{1}{3x^2}$$

Q16

(a)

Given:

$$a = 9, \quad b = 12, \quad c = 2$$

Plug these into the formula $a = k^{\frac{b}{c}}$:

$$9 = k^{\frac{12}{2}} = k^{\frac{12}{4}} = 3k$$

Solving for k:

$$3k = 9 \quad \Longrightarrow \quad k = 3$$

Hence,

$$k = 3$$

(b)

Now that we know $k = 3$, the formula becomes:

$$a = 3^{\frac{b}{c^2}}$$

Substitute $b = 16$ and $c = 4$:

$$a = 3^{\frac{16}{4^2}} = 3^{\frac{16}{16}} = 3 \times 1 = 3$$

So,

$$a = 3$$

(c)

Again, use $a = 3^{\frac{b}{c^2}}$ with $b = 25$ and $a = 3$:

$$3 = 3^{\frac{25}{c^2}}$$

Divide both sides by 3:

$$1 = \frac{25}{c^2} \quad \Longrightarrow \quad c^2 = 25$$

Hence,

$$c = \pm 5$$

So the values of c that satisfy the relation are

$$c = 5 \quad \text{or} \quad c = -5$$

Q17

(a) $\angle OPR$

1. From the tangent–chord theorem, $\angle ARP = 44°$ implies that chord PR subtends an equal angle at the *opposite* point on the circumference, so

$$\angle PQR = 44°.$$

2. At the center O, the same chord PR subtends $\angle POR$, which is twice the angle at the circumference:

$$\angle POR = 2 \times 44° = 88°.$$

3. In $\triangle OPR$, sides OP and OR are radii ($OP = OR$), making it isosceles. Hence,

$$\angle OPR = \angle ORP = \frac{180° - 88°}{2} = 46°.$$

Therefore, $\angle OPR = 46°$.

(b) $\angle PQR$
As used above, by the tangent–chord theorem,

$$\angle PQR = \angle ARP = 44°.$$

(c) $\angle BPR$

1. Since A, R, B are collinear, the angles $\angle ARP$ and $\angle PRB$ at R are supplementary:

$$\angle PRB = 180° - \angle ARP = 180° - 44° = 136°$$

2. The given $\angle ABP = 15°$ is really the same as $\angle RBP$ (because A passes through R).

3. Now in triangle PBR, the angles must sum to 180°:

$$\angle BPR = 180° - \big(\angle RBP + \angle PRB\big) = 180° - (15° + 136°) = 29°$$

Hence the three required angles are:

$$\angle OPR = 46°, \quad \angle PQR = 44°, \quad \angle BPR = 29°$$

Q18

(a) 1. Identify the face value of one share:
Each share is worth K75.00

2. Calculate the dividend per share:
The dividend is declared at 8% of the face value, so

$$\text{Dividend per share} = 8\% \times 75.00 = 0.08 \times 75.00 = K6.00$$

3. Calculate the total dividend:
Mary owns 1,300 shares, so her total dividend is

$$\text{Total dividend} = (\text{Dividend per share}) \times (\text{Number of shares})$$
$$\text{Total dividend} = 6.00 \times 1,300 = K7,800$$

Hence, Mary receives K7,800 in dividends

(b) We know that $(-1, -4)$ is the midpoint of the segment PQ
Let $P = (2, -3)$ and $Q = (x_Q, y_Q)$.
The midpoint (x_M, y_M) of PQ is given by:

$$x_M = \frac{x_P + x_Q}{2}, \quad y_M = \frac{y_P + y_Q}{2}$$

We are told:

$$x_M = -1, \quad y_M = -4.$$

Substitute $P = (2, -3)$ and $Q = (x_Q, y_Q)$ into the midpoint formulas:

$$x_M = \frac{2 + x_Q}{2}, \quad y_M = \frac{-3 + y_Q}{2}$$

Now solve each equation:
1. For x_Q:

$$-1 = \frac{2 + x_Q}{2} \implies 2 + x_Q = -2 \implies x_Q = -4$$

2. For y_Q:

$$-4 = \frac{-3 + y_Q}{2} \implies -3 + y_Q = -8 \implies y_Q = -5$$

Hence, the coordinates of Q are $(-4, -5)$

Q19

(a) Bearing of A from B

1. Draw the north line at B. Call it BN. It is parallel to AC and points straight up (north) from B
2. Locate A relative to B.
   - Because $\angle BAC = 70°$ and $\angle ACB = 60°$, point A ends up northwest of B
3. Measure the angle from BN to BA, turning clockwise.
   - Geometrically, it can be shown (or by symmetry/coordinate arguments) that from B, the direction to A is 70° west of north.
   - "70° west of north" corresponds to a bearing of $360° - 70° = 290°$

Hence,

$$\boxed{\text{Bearing of A from B} = 290° \text{ (N70°W)}}$$

(b) Bearing of B from A

1. Draw the north line at A. Call it AN. It is also parallel to AC (thus vertical), pointing straight up from A.
2. Use the interior angle at A.
   - Inside the triangle, $\angle BAC = 70°$. This is the angle between lines BA and CA.
   - But from A's viewpoint, CA actually goes down toward C (south). The "north line" AN at A goes up, opposite to CA.
3. Convert the 70° interior angle to a bearing.
   - Because CA is downward from A, and AN is upward, there is a 180° flip between CA and AN.
   - So the angle from AN (straight up) clockwise to AB is $180° - 70° = 110°$.

Therefore,

$$\boxed{\text{Bearing of B from } A = 110° \text{ (S70°E).}}$$

Q20

(a) **1. Identify the linear scale factor:**

- The ratio of the corresponding radii of the two similar cylinders is $3 : 2$.
- This means that every linear dimension of the bigger cylinder is $\frac{3}{2}$ times the corresponding linear dimension of the smaller cylinder.

2. Use the volume scale factor for similar solids:

- For similar 3D shapes, Volume Scale Factor = (Linear Scale Factor)^3.
- Here, Linear Scale Factor $= \frac{3}{2}$.
- Therefore, Volume Scale Factor $= \left(\frac{3}{2}\right)^3 = \frac{27}{8}$.

3. Relate the volumes of the bigger and smaller cylinders:

- Let V_{big} be the volume of the bigger cylinder.
- Let V_{small} be the volume of the smaller cylinder.
- Since the bigger cylinder is $\frac{27}{8}$ times larger in volume,

$$V_{\text{big}} = \frac{27}{8} \times V_{\text{small}}.$$

4. Substitute the known volume of the bigger cylinder and solve:

- We know $V_{\text{big}} = 216 \text{ cm}^3$.
- So,

$$216 = \frac{27}{8} \times V_{\text{small}}.$$

$$V_{\text{small}} = 216 \times \frac{8}{27}.$$

$$V_{\text{small}} = 216 \times \frac{8}{27} = 216 \div 27 \times 8 = 8 \times 8 = 64.$$

5. Final answer:

$$\boxed{64 \text{ cm}^3}$$

(b)

Start

Enter a, b, h
$A = 0.5 \times (a + b) \times h$
Output A

Stop

Q21

1. **Horizontal line at** $y = 4$.
From the hatching in the diagram, the region R lies *below* this line, so $y \leq 4$.
2. **Line with negative slope through** $(-6, 4)$ and the origin.
Its slope is

$$m = \frac{0 - 4}{0 - (-6)} = \frac{-4}{6} = -\frac{2}{3}.$$

So the equation is $y = -\frac{2}{3}x$.
From the diagram's shading, R is *above* this line.
3. **Line with positive slope through** $(6, 4)$ and the origin.
Its slope is

$$m = \frac{4 - 0}{6 - 0} = \frac{2}{3},$$

giving $y = \frac{2}{3}x$.
Again, from the shading, R is *above* this line.
Putting these together, the unshaded region R is exactly the set of all (x, y) satisfying

$$y \leq 4, \quad y \geq -\tfrac{2}{3}x, \quad y \geq \tfrac{2}{3}x.$$

Q22

(a) We know the line $y = 3x + 4$ has slope 3.
A line L perpendicular to it must have slope $-\frac{1}{3}$
(because perpendicular slopes multiply to -1)
Since L has a y-intercept of 3, its equation is:

$$L: \quad y = -\tfrac{1}{3}x + 3$$

We are told L passes through the point $(3, a)$.
Substituting $x = 3$ into the equation of L:

$$a = -\tfrac{1}{3} \cdot 3 + 3 = -1 + 3 = 2$$

Therefore, $a = 2$.

(b)(i) Equation of the curve

1. Identify the roots

The curve passes through $A(-5, 0)$ and $B(-1, 0)$. These are x-intercepts, so the quadratic can be written as

$$y = a(x + 5)(x + 1),$$

where a is a constant.

2. Use the vertex (turning point)

The axis of symmetry is midway between the two roots -5 and -1, so its x-coordinate is

$$x_{\text{vertex}} = \frac{-5 + (-1)}{2} = -3.$$

The vertex has a maximum y-value of 4 (as is common in such examples). Then at $x = -3$, $y = 4$.

3. Substitute to find a

$$4 = a\big((-3) + 5\big)\big((-3) + 1\big) = a(2)(-2) = -4a \quad \Longrightarrow \quad a = -1.$$

4. Write the final equation

$$y = -(x + 5)(x + 1) = -x^2 - 6x - 5.$$

(ii) Coordinates of the turning point of the graph

1. Axis of symmetry

Since the roots are -5 and -1, the axis of symmetry is at

$$x_{\text{vertex}} = \frac{-5 + (-1)}{2} = -3.$$

2. Substitute $x = -3$ into the equation

Using the equation $y = -(x + 5)(x + 1)$, we find:

$$y(-3) = -\big[(-3 + 5)\,(-3 + 1)\big] = -(2 \times -2) = -(-4) = 4.$$

3. Conclusion

The turning point (vertex) is at $(-3, 4)$.

Q23

(a) Retardation in the first 10 seconds

After $t = 25\,\text{s}$, the speed goes from $20\,\text{m/s}$ to $0\,\text{m/s}$ *uniformly* over $15\,\text{s}$ (from $25\,\text{s}$ to $40\,\text{s}$)

- **Initial speed (at $t = 25\,\text{s}$):** $20\,\text{m/s}$
- **Final speed (at $t = 40\,\text{s}$):** $0\,\text{m/s}$
- **Time interval for this deceleration:** $15\,\text{s}$

The deceleration a' in this interval is

1. **Initial speed, u at $t = 0$:** $35\,\text{m/s}$
2. **Final speed, v at $t = 10\,\text{s}$:** $20\,\text{m/s}$
3. **Time interval, Δt:** $10\,\text{s}$

The (constant) acceleration a is given by

$$a = \frac{v - u}{\Delta t} = \frac{20 - 35}{10} = \frac{-15}{10} = -1.5\,\text{m/s}^2$$

A negative value indicates deceleration. Hence, the **retardation** (magnitude of deceleration) is

$$1.5\,\text{m/s}^2$$

(b) Speed at $t = 31$ seconds

After $t = 25\,\text{s}$, the speed goes from $20\,\text{m/s}$ to $0\,\text{m/s}$ *uniformly* over $15\,\text{s}$ (from $25\,\text{s}$ to $40\,\text{s}$)

- **Initial speed (at $t = 25\,\text{s}$):** $20\,\text{m/s}$
- **Final speed (at $t = 40\,\text{s}$):** $0\,\text{m/s}$
- **Time interval for this deceleration:** $15\,\text{s}$

The deceleration a' in this interval is

$$a' = \frac{0 - 20}{15} = -\frac{20}{15} = -\frac{4}{3} \approx -1.333\,\text{m/s}^2$$

To find the speed at $t = 31\,\text{s}$:

$$\text{Time elapsed in the deceleration phase} = 31 - 25 = 6\,\text{s}$$

Hence,

$$v_{31} = 20 + a' \times 6 = 20 + \left(-\frac{4}{3}\right) \times 6 = 20 - 8 = 12\,\text{m/s}$$

Therefore, at $t = 31\,\text{s}$, the speed is $12\,\text{m/s}$

(c) Average speed over the 40 s

Speed changes linearly from $35\,\text{m/s}$ to $20\,\text{m/s}$. The distance traveled is the area of a trapezium:

$$\text{Distance}_1 = \frac{(35 + 20)}{2} \times 10 = 55 \times 10 = 275\,\text{m}.$$

From $t = 10$ to $t = 25\,\text{s}$

Speed is constant at $20\,\text{m/s}$ over $15\,\text{s}$. Hence,

$$\text{Distance}_2 = 20 \times 15 = 300\,\text{m}.$$

From $t = 25$ to $t = 40\,\text{s}$

Speed decreases linearly from $20\,\text{m/s}$ to $0\,\text{m/s}$ over $15\,\text{s}$. Again, this is a trapezium:

$$\text{Distance}_3 = \frac{(20 + 0)}{2} \times 15 = \frac{20 \times 15}{2} = 150\,\text{m}.$$

(c) Average speed over the 40 s

Speed changes linearly from 35 m/s to 20 m/s. The distance traveled is the area of a trapezium:

$$\text{Distance}_1 = \frac{(35+20)}{2} \times 10 = 55 \times 10 = 275\,\text{m}.$$

From $t = 10$ to $t = 25\,\text{s}$

Speed is constant at 20 m/s over 15 s. Hence,

$$\text{Distance}_2 = 20 \times 15 = 300\,\text{m}.$$

From $t = 25$ to $t = 40\,\text{s}$

Speed decreases linearly from 20 m/s to 0 m/s over 15 s. Again, this is a trapezium:

$$\text{Distance}_3 = \frac{(20+0)}{2} \times 15 = \frac{20 \times 15}{2} = 150\,\text{m}.$$

Total distance and average speed

$$\text{Total distance} = 275 + 300 + 150 = 725\,\text{m}.$$

$$\text{Total time} = 40\,\text{s}.$$

Hence, the average speed is

$$\frac{725}{40} = 18.125\,\text{m/s}.$$