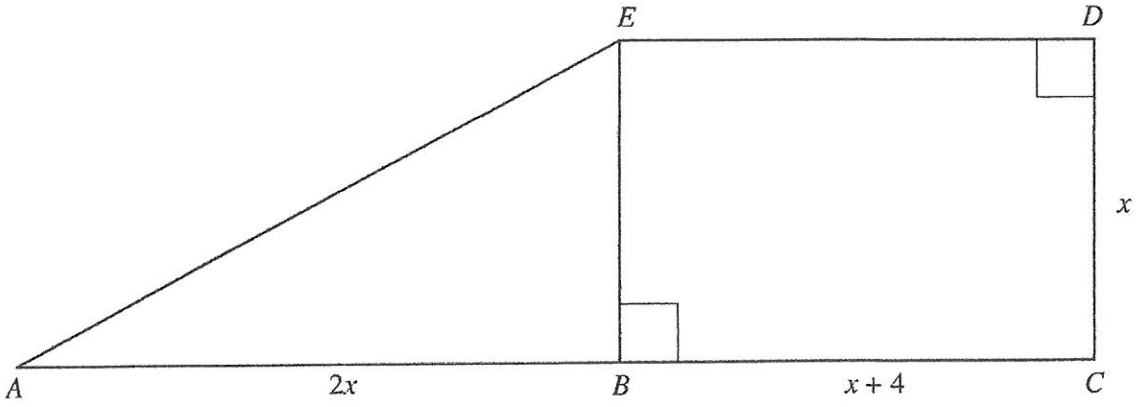
11. *(a)* In the diagram ABC is a straight line and $BCDE$ is a rectangle. The side DC is of length x cm, BC is of length $(x + 4)$ cm and AB is of length $2x$ cm.



The diagram is not drawn to scale and the measurements are in centimetres.

The area of the whole shape $ABCDE$ is 48 cm^2.
Giving full details of all your working, show clearly that x satisfies the equation

$$x^2 + 2x - 24 = 0.$$

Area of rectangle $= (x+4) \times x = x^2 + 4x$

Area of $\Delta = \frac{1}{2} \times 2x \times x = x^2$

Total Area = Area of Δ + Area of $\square$ $= x^2 + x^2 + 4x = 48$

$2x^2 + 4x - 48 = 0$

$\div 2$ $\quad x^2 + 2x - 24 = 0$

[2]

(b) Solve the equation to find the length of DC.

24 1
12 2
6 4

$x^2 + 2x - 24 = 0$

$(x + 6)(x - 4) = 0$

either $x + 6 = 0$ or $x - 4 = 0$

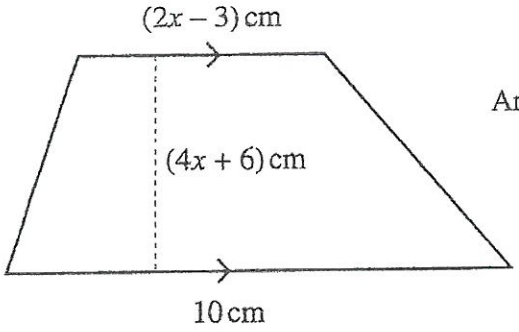
$x = -6$ ✗ $\quad x = 4$ ✓

Can't have negative length

So $x = 4 = DC$

[2]

17. The diagram shows a trapezium.



Area = 70 cm^2

Diagram not drawn to scale.

The parallel sides of a trapezium are of lengths 10 cm and $(2x - 3)$ cm. The height of the trapezium is $(4x + 6)$ cm and its area is 70 cm^2.

(a) Show that $4x^2 + 20x - 49 = 0$.

$\text{Area} = \frac{1}{2}(10 + 2x - 3) \times (4x + 6) = 70$

$\times 2 \quad (2x + 7)(4x + 6) = 140$

$8x^2 + 12x + 28x + 42 - 140 = 0$

$8x^2 + 40x - 98 = 0$

$\div 2 \quad 4x^2 + 20x - 49 = 0$

[3]

(b) Use the quadratic formula to solve the equation $4x^2 + 20x - 49 = 0$. Give your answers correct to one decimal place.

$a = 4 \quad b = 20 \quad c = -49$

$x = \frac{-(20) \pm \sqrt{20^2 - 4(4)(-49)}}{2(4)}$

$x = \frac{-20 \pm \sqrt{1184}}{8}$

either $x = \frac{-20 + \sqrt{1184}}{8} = 1.8$ ✓

or $x = \frac{-20 - \sqrt{1184}}{8} = -6.8$ ✗

$x = 1.8$

[3]

(c) Hence write down the height of the trapezium.

height $4(1.8) + 6 = 13.2$ cm

[1]

Examiner only

19. The diagram shows a hexagonal prism.

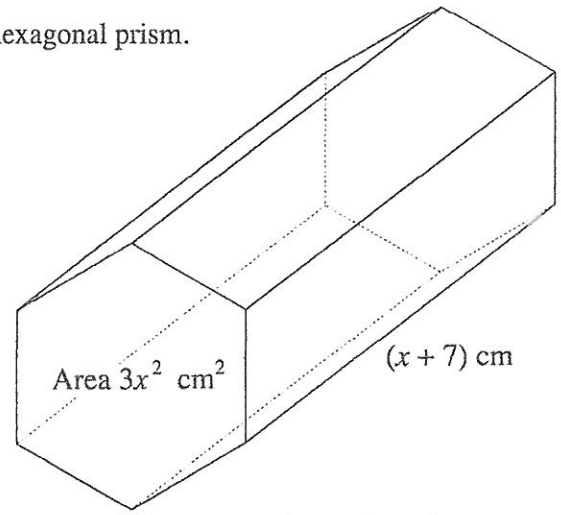


Diagram not drawn to scale.

The area of the cross-section of the prism is $3x^2$ cm^2 and the length of the prism is $(x + 7)$ cm. The volume of the prism is $(3x^3 + 2x + 1)$ cm^3.

(a) Show that $21x^2 - 2x - 1 = 0$.

Volume = $3x^2 \times (x+7) = 3x^3 + 2x + 1$

$3x^3 + 21x^2 - 3x^3 - 2x - 1 = 0$

$21x^2 - 2x - 1 = 0$

[2]

(b) Use the quadratic formula to solve $21x^2 - 2x - 1 = 0$, giving solutions correct to two decimal places.

$a = 21 \quad b = -2 \quad c = -1$

$x = \dfrac{-(-2) \pm \sqrt{(-2)^2 - 4(21)(-1)}}{2(21)}$

$x = \dfrac{2 \pm \sqrt{88}}{42}$ with $x = \dfrac{2 + \sqrt{88}}{42} = 0.27$ ✓

or $x = \dfrac{2 - \sqrt{88}}{42} = -0.18$ x length

[3]

(c) Hence evaluate the volume of the prism, giving your answer correct to one decimal place.

$3(0.27)^3 + 2(0.27) + 1 = 1.6$

[1]

Turn over.

Dist = Speed × time

Examiner only
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19. For the first x seconds of a journey the average speed of a cyclist is 4 m/s. For the next $(5x + 2)$ seconds the average speed is x m/s. The total distance travelled is 128 metres.

(a) Show that x satisfies the equation $5x^2 + 6x - 128 = 0$.

dist in first part of journey = $4 \times x = 4x$

" " 2nd " " " " = $x \times (5x+2) = 5x^2 + 2x$

Total Dist = $4x + 5x^2 + 2x = 128$

$5x^2 + 6x - 128 = 0$

[3]

(b) Use the formula method to solve the equation $5x^2 + 6x - 128 = 0$, giving solutions correct to one decimal place.

$a = 5 \quad b = 6 \quad c = -128$

$$x = \frac{-(6) \pm \sqrt{(6)^2 - 4(5)(-128)}}{2(5)}$$

$$x = \frac{-6 \pm \sqrt{2596}}{10}$$

either $x = \frac{-6 + \sqrt{2596}}{10} = 4.5$ ✓

or $x = \frac{-6 - \sqrt{2596}}{10} = -5.7$ × can't have negative time.

[3]

(c) Hence find the total time for the journey.

$x + (5x + 2)$

$4.5 + (5(4.5) + 2) = 29$ seconds.

[1]

Examiner only

16. For the first x seconds of a journey the average speed of a cyclist is 3 m/s. For the next $(3x + 2)$ seconds the average speed is $7x$ m/s. The total distance travelled is 250 metres.

(a) Show that x satisfies the equation $21x^2 + 17x - 250 = 0$.

dist in first part = $3 \times x = 3x$

dist in 2nd part = $7x \times (3x+2) = 21x^2 + 14x$

Total Dist = $3x + 21x^2 + 14x = 250$

$21x^2 + 17x - 250 = 0$

[3]

(b) Use the formula method to solve the equation $21x^2 + 17x - 250 = 0$, giving solutions correct to two decimal places.

$a = 21 \quad b = 17 \quad c = -250$

$$x = \frac{-(17) \pm \sqrt{(17)^2 - 4(21)(-250)}}{2(21)}$$

$$x = \frac{-17 \pm \sqrt{21289}}{42}$$

either $x = \dfrac{-17 + \sqrt{21289}}{42} = 3.07$ ✓

or $x = \dfrac{-17 - \sqrt{21289}}{42} = -3.88$ × time can't be negative

[3]

(c) Hence find the total time for the journey.

total time $x + 3x + 2$

$3.07 + 3(3.07) + 2 = 14.28$ sec

[2]