Chapter 9

MEASUREMENT: LENGTH AND AREA

EXERCISE 9A

1 **a** km **b** mm **c** m **d** cm **e** m **f** mm

2 **a** The length of a car would be **B** - 5 m.

b The length of a mosquito would be **C** - 11 mm.

c The distance from Darwin to Adelaide would be **C** - 3000 km.

3 **a** $4\text{ m} = (4 \times 100)\text{ cm} = 400\text{ cm}$

b $20\text{ mm} = (20 \div 10)\text{ cm} = 2\text{ cm}$

c $2.9\text{ m} = (2.9 \times 100)\text{ cm} = 290\text{ cm}$

d $3\text{ km} = (3 \times 1000)\text{ m} = 3000\text{ m} = (3000 \times 100)\text{ cm} = 300\,000\text{ cm}$

4 **a** $800\text{ cm} = (800 \div 100)\text{ m} = 8\text{ m}$

b $7\text{ km} = (7 \times 1000)\text{ m} = 7000\text{ m}$

c $120\text{ km} = (120 \times 1000)\text{ m} = 120\,000\text{ m}$

d $32\,000\text{ mm} = (32\,000 \div 1000)\text{ m} = 32\text{ m}$

5 **a** $9\text{ cm} = (9 \times 10)\text{ mm} = 90\text{ mm}$

b $3\text{ m} = (3 \times 1000)\text{ mm} = 3000\text{ mm}$

c $120\text{ cm} = (120 \times 10)\text{ mm} = 1200\text{ mm}$

d $450\text{ m} = (450 \times 1000)\text{ mm} = 450\,000\text{ mm}$

6 **a** $15\,000\text{ m} = (15\,000 \div 1000)\text{ km} = 15\text{ km}$

b $750\,000\text{ cm} = (750\,000 \div 100)\text{ m} = 7500\text{ m} = (7500 \div 1000)\text{ km} = 7.5\text{ km}$

c $600\text{ m} = (600 \div 1000)\text{ km} = 0.6\text{ km}$

d $2\,500\,000\text{ mm} = (2\,500\,000 \div 1000)\text{ m} = 2500\text{ m} = (2500 \div 1000)\text{ km} = 2.5\text{ km}$

7 **a** The length of the engine [AB] is 25 mm.

b The length of the carriage [CD] is 26 mm.

c The distance between the engine and the carriage [BC] is 8 mm.

d The total length [AD] is 59 mm.

e The height of a wheel [EF] is 5 mm.

f The train's height [EG] is 18 mm.

8 **a** $6\text{ cm} = (6 \times 10)\text{ mm} = 60\text{ mm}$

b $200\text{ cm} = (200 \div 100)\text{ m} = 2\text{ m}$

c $3000\text{ m} = (3000 \div 1000)\text{ km} = 3\text{ km}$

d $80\text{ mm} = (80 \div 10)\text{ cm} = 8\text{ cm}$

e $11\text{ m} = (11 \times 100)\text{ cm} = 1100\text{ cm}$

f $4\text{ km} = 4 \times 1000\text{ m} = 4000\text{ m}$

g 3.2 cm
$= (3.2 \times 10) \text{ mm}$
$= 32 \text{ mm}$

h 240 cm
$= (240 \div 100) \text{ m}$
$= 2.4 \text{ m}$

i 3800 m
$= (3800 \div 1000) \text{ km}$
$= 3.8 \text{ km}$

j 17 mm
$= (17 \div 10) \text{ cm}$
$= 1.7 \text{ cm}$

k 7.8 m
$= (7.8 \times 100) \text{ cm}$
$= 780 \text{ cm}$

l 0.6 km
$= (0.6 \times 1000) \text{ m}$
$= 600 \text{ m}$

9 **a** $4 \text{ m} + 50 \text{ cm} + 95 \text{ mm}$
$= (4 \times 100) \text{ cm} + 50 \text{ cm} + (95 \div 10) \text{ cm}$ {converting to centimetres}
$= 400 \text{ cm} + 50 \text{ cm} + 9.5 \text{ cm}$
$= 459.5 \text{ cm}$

b $5 \text{ m} + 12 \text{ cm} + 7 \text{ mm}$
$= (5 \times 100) \text{ cm} + 12 \text{ cm} + (7 \div 10) \text{ cm}$ {converting to centimetres}
$= 500 \text{ cm} + 12 \text{ cm} + 0.7 \text{ cm}$
$= 512.7 \text{ cm}$

c $3 \text{ km} + 430 \text{ m} + 220 \text{ cm}$
$= (3 \times 1000) \text{ m} + 430 \text{ m} + (220 \div 100) \text{ m}$ {converting to metres}
$= 3000 \text{ m} + 430 \text{ m} + 2.2 \text{ m}$
$= 3432.2 \text{ m}$

d $8 \text{ km} + 920 \text{ m} + 650 \text{ cm}$
$= (8 \times 1000) \text{ m} + 920 \text{ m} + (650 \div 100) \text{ m}$ {converting to metres}
$= 8000 \text{ m} + 920 \text{ m} + 6.5 \text{ m}$
$= 8926.5 \text{ m}$

10 We first convert the 320 km to m.
$320 \text{ km} = (320 \times 1000) \text{ m}$
$= 320\,000 \text{ m}$

$\therefore$ number of 8 m pipes required $= \dfrac{320\,000 \text{ m}}{8 \text{ m}}$
$= 40\,000$

11 We first find $28 \times 7 \text{ mm} = 196 \text{ mm}$.
We then convert to centimetres:
$196 \text{ mm} = (196 \div 10) \text{ cm}$
$= 19.6 \text{ cm}$
So, the height of the stack is 19.6 cm.

12 We first convert 1.5 km to m.
$1.5 \text{ km} = (1.5 \times 1000) \text{ m}$
$= 1500 \text{ m}$

$\therefore$ number of lengths of string $= \dfrac{1500 \text{ m} \times 2}{7.5 \text{ m} \times 2}$
$= \dfrac{3000 \text{ m}}{15 \text{ m}}$
$= 200$

So, 200 7.5 m lengths of string can be cut from a 1.5 km reel.

13 $90 \text{ cm} \times 12\,000 = 1\,080\,000 \text{ cm}$
$= (1\,080\,000 \div 100) \text{ m}$
$= 10\,800 \text{ m}$
$= (10\,800 \div 1000) \text{ km}$
$= 10.8 \text{ km}$
So, Marie walked 10.8 km.

EXERCISE 9B

1 **a** Perimeter
$= 1 + 4 + 1 + 4$ units
$= 10$ units

b Perimeter
$= 3 + 4 + 3 + 4$ units
$= 14$ units

c Perimeter
$= 5 + 4 + 5 + 4$ units
$= 18$ units

d Perimeter
$= 1 + 2 + 1 + 1 + 2 + 1 + 1 + 1 + 1 + 1$ units
$= 12$ units

e Perimeter
$= 1+2+1+1+2+1+1+2+1+1+2+1$ units
$= 16$ units

f Perimeter
$= 2+1+1+1+2+1+1+2+1+1+2+1+1+1+2+1+1+2+1+1$ units
$= 26$ units

2 **a** Perimeter
$= 32$ mm $+ 44$ mm $+ 36$ mm
$= 112$ mm

b Perimeter
$= 45$ mm $+ 35$ mm $+ 20$ mm $+ 25$ mm
$= 125$ mm

c Perimeter
$= 16$ mm $+ 18$ mm $+ 20$ mm $+ 15$ mm $+ 20$ mm
$= 89$ mm

3 **a** Perimeter
$= 7+3+5$ cm
$= 15$ cm

b Perimeter
$= 6+(4\times 2)$ cm
$= 14$ cm

c Perimeter
$= (4\times 2)+(3\times 2)+2$ cm
$= 16$ cm

d Perimeter
$= (3\times 4)+(6\times 4)$ cm
$= 36$ cm

e Perimeter
$= (1\times 4)+(5\times 4)+(8\times 4)$ m
$= 56$ m

f Perimeter
$= (1.3\times 6)+(2.8\times 6)$ m
$= 24.6$ m

4 **a** $P = 4s$
$\therefore\ P = 4\times 4$ m
$\therefore\ P = 16$ m

b $P = 2(a+b)$
$\therefore\ P = 2(16+6)$ cm
$\therefore\ P = 2\times 22$ cm
$\therefore\ P = 44$ cm

c $P = 2(a+b)$
$\therefore\ P = 2(2.6+4.9)$ m
$\therefore\ P = 2\times 7.5$ m
$\therefore\ P = 15$ m

d $P = 2(a+b)$
$\therefore\ P = 2(4+2)$ m
$\therefore\ P = 2\times 6$ m
$\therefore\ P = 12$ m

e $P = 4s$
$\therefore\ P = 4\times 1.6$ cm
$\therefore\ P = 6.4$ cm

f $P = 2(a+b)$
$\therefore\ P = 2(2.5+3.3)$ m
$\therefore\ P = 2\times 5.8$ m
$\therefore\ P = 11.6$ m

5 **a** $P = 1.3$ cm $+ (8\times 2)$ mm {adding all sides}
$\therefore\ P = 13$ mm $+ 16$ mm {converting to mm}
$\therefore\ P = 29$ mm $(= 2.9$ cm$)$

b $P = 2(a+b)$
$\therefore\ P = 2(3.5$ cm $+ 22$ mm$)$
$\therefore\ P = 2(35$ mm $+ 22$ mm$)$ {converting to mm}
$\therefore\ P = 2\times 57$ mm
$\therefore\ P = 114$ mm $(= 11.4$ cm$)$

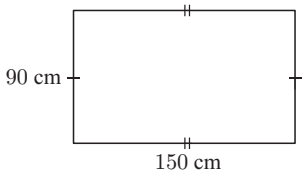
c $P = 2$ m $+ 4$ m $+ 360$ cm $+ 60$ cm {adding all sides}
$\therefore\ P = 200$ cm $+ 400$ cm $+ 360$ cm $+ 60$ cm {converting to cm}
$\therefore\ P = 1020$ cm $(= 10.2$ m$)$

d $P = 2(a+b)$
$\therefore\ P = 2(70$ cm $+ 1.5$ m$)$
$\therefore\ P = 2(70$ cm $+ 150$ cm$)$ {converting to cm}
$\therefore\ P = 2\times 220$ cm
$\therefore\ P = 440$ cm $(= 4.4$ m$)$

e $P = 2 \text{ km} + 1800 \text{ m} + 4.2 \text{ km} + 3.2 \text{ km} + 600 \text{ m}$ {adding all sides}
$\therefore\ P = 2000 \text{ m} + 1800 \text{ m} + 4200 \text{ m} + 3200 \text{ m} + 600 \text{ m}$ {converting to m}
$\therefore\ P = 11\,800 \text{ m}\ \ (= 11.8 \text{ km})$

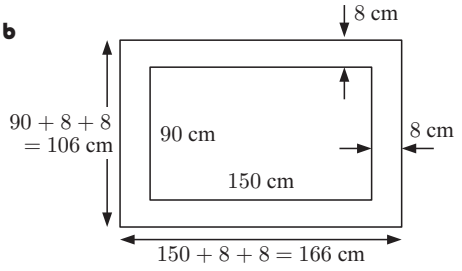
f $P = 2(a + b)$
$\therefore\ P = 2(900 \text{ m} + 1.7 \text{ km})$
$\therefore\ P = 2(900 \text{ m} + 1700 \text{ m})$ {converting to m}
$\therefore\ P = 2 \times 2600 \text{ m}$
$\therefore\ P = 5200 \text{ m}\ \ (= 5.2 \text{ km})$

6 a



$P = 2(a + b)$
$\therefore\ P = 2(90 + 150)$ cm
$\therefore\ P = 2 \times 240$ cm
$\therefore\ P = 480$ cm
So, the perimeter of the glass is 480 cm.

b



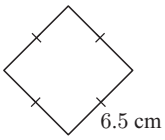
$P = 2(a + b)$
$\therefore\ P = 2(166 + 106)$ cm
$\therefore\ P = 2 \times 272$ cm
$\therefore\ P = 544$ cm
So, the perimeter of the table top is 544 cm.

7 $P = 4s$
$\therefore\ P = 4 \times 2.8$ cm
$\therefore\ P = 11.2$ cm
So, the perimeter of the watch face is 11.2 cm.

8 The perimeter of the field is $4 \times 850 = 3400$ metres.
So, we need $3 \times 3400 \text{ m} = 10\,200 \text{ m}$ of wire for the fence
and $10\,200 \text{ m} \times \$1.35$ per metre $= \$13\,770$.
So, the cost of fencing the field is $13 770.

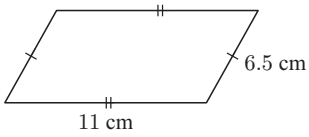
9 The perimeter of the block is $1.1 \text{ km} + 950 \text{ m} + 420 \text{ m}$
$= 1.1 \text{ km} + 0.95 \text{ km} + 0.42 \text{ km}$ {converting to km}
$= 2.47 \text{ km}$
and 14 laps $= 14 \times 2.47 \text{ km}$
$= 34.58 \text{ km}$
The cyclist cycled 34.58 km.

10 a i



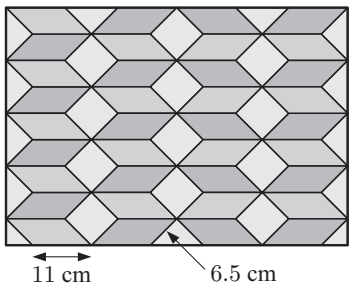
$P = 4s$
$\therefore\ P = 4 \times 6.5$ cm
$\therefore\ P = 26$ cm

ii



$P = 2(a + b)$
$\therefore\ P = 2(11 + 6.5)$ cm
$\therefore\ P = 2 \times 17.5$ cm
$\therefore\ P = 35$ cm

b



Total length of glue strips needed
$= (72 \times 6.5) + (32 \times 11)$ cm
$= 468$ cm $+ 352$ cm
$= 820$ cm $\quad (= 8.2$ m$)$

EXERCISE 9C

1 **a** $C = \pi d$
$\approx 3.14 \times 4$ m
≈ 12.56 m
≈ 12.6 m
The circumference is 12.6 m.

b $C = 2\pi r$
$\approx 2 \times 3.14 \times 3.3$ cm
≈ 20.724 cm
≈ 20.7 cm
The circumference is 20.7 cm.

c $C = \pi d$
$\approx 3.14 \times 9.2$ cm
≈ 28.888 cm
≈ 28.9 cm
The circumference is 28.9 cm.

2 **a** $C = 2\pi r$
$= 2 \times \pi \times 9$ m
≈ 56.55 m

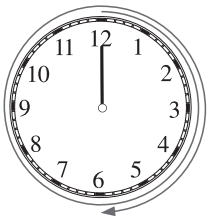
b $C = \pi d$
$= \pi \times 16$ cm
≈ 50.27 cm

c $C = 2\pi r$
$= 2 \times \pi \times 6.8$ km
≈ 42.73 km

3 $C = \pi d$
$= \pi \times 4$ cm
≈ 12.6 cm
The circumference of the deodorant can is 12.6 cm.

4 $C = 2\pi r$
$= 2 \times \pi \times 1.5$ m
≈ 9.42 m
The perimeter of the pond is 9.42 m.

5



Between 12 noon and 1:30 pm, the tip of the minute hand travels $1\frac{1}{2}$ times around the clock.

So, distance travelled $= 1\frac{1}{2} \times 2 \times \pi \times 6$ cm
≈ 56.5 cm
So, the tip travels 56.5 cm between 12 noon and 1:30 pm.

6 Perimeter of the rug $= 2\pi r$
$= 2 \times \pi \times 75$ cm
$= 2 \times \pi \times 0.75$ m $\quad$ {converting to m}
≈ 4.72 m $\quad$ {we round up so we do not leave a gap in the fringing}
Natalie will need 4.72 m of fringing.

7 **a** $C = \pi d$
$= \pi \times 70$ cm
≈ 220 cm
The circumference of the tyre is 220 cm.

b $20\,000 \times (70 \times \pi)$
$\approx 4\,398\,229$ cm
$\approx 43\,982$ m
≈ 44.0 km
If the tyre rotates 20 000 times, then 44 km would be travelled.

c We need to find $\quad 45$ km $\div (70 \times \pi)$ cm
$= 45\,000$ m $\div (70 \times \pi)$ cm
$= 4\,500\,000$ cm $\div (70 \times \pi)$ cm
$\approx 20\,463$
If the car travels 45 km, the wheel will have rotated 20 463 times.

8 The square has perimeter 4×8 cm $= 32$ cm.
So, if $C = 2\pi r$ then $2\pi r = 32$ cm

$$\therefore \quad r = \frac{32}{2\pi} \text{ cm}$$
$$\approx 5.09 \text{ cm}$$

The circle has radius 5.09 cm.

9 The two smaller semi-circles each have diameter 4 m.
Their total perimeter is $C = \pi d$
$= \pi \times 4$ or 4π m.

The perimeter of the larger semi-circle is half the perimeter of a circle with diameter 8 m.

$$\therefore \quad P = \frac{1}{2} \times \pi \times 8 \text{ m}$$
$$= 4\pi \text{ m}$$

So, both paths have equal length.

10 We need to find d such that $\frac{1}{2} \times \pi \times d = 100$ {the perimeter of a semi-circle is half the perimeter of a circle}

$$\therefore \quad \pi \times d = 200$$
$$\therefore \quad d = \frac{200}{\pi}$$
$$\approx 63.7 \text{ m}$$

The distance between the two straight sections of track is 63.7 m.

EXERCISE 9D.1

1 **a** Shaded area $= 20$ units^2 **b** Shaded area $= 6$ units^2 **c** Shaded area $= 33$ units^2 **d** Shaded area $= 35$ units^2

2 **a** m^2 **b** cm^2 **c** km^2 **d** mm^2

EXERCISE 9D.2

1 **a** $3.6 \text{ m}^2 = (3.6 \times 10\,000) \text{ cm}^2 = 36\,000 \text{ cm}^2$

b $0.4 \text{ km}^2 = (0.4 \times 100) \text{ ha} = 40 \text{ ha}$

c $83 \text{ cm}^2 = (83 \times 100) \text{ mm}^2 = 8300 \text{ mm}^2$

d $80 \text{ ha} = (80 \times 10\,000) \text{ m}^2 = 800\,000 \text{ m}^2$

e $15\,600 \text{ cm}^2 = (15\,600 \div 10\,000) \text{ m}^2 = 1.56 \text{ m}^2$

f $1200 \text{ ha} = (1200 \div 100) \text{ km}^2 = 12 \text{ km}^2$

g $900 \text{ mm}^2 = (900 \div 100) \text{ cm}^2 = 9 \text{ cm}^2$

h $76\,000 \text{ m}^2 = (76\,000 \div 10\,000) \text{ ha} = 7.6 \text{ ha}$

i $2.8 \text{ cm}^2 = (2.8 \times 100) \text{ mm}^2 = 280 \text{ mm}^2$

j $0.25 \text{ km}^2 = (0.25 \times 100) \text{ ha} = 25 \text{ ha}$

k $12.48 \text{ m}^2 = (12.48 \times 10\,000) \text{ cm}^2 = 124\,800 \text{ cm}^2$

l $0.0092 \text{ m}^2 = (0.0092 \times 10\,000) \text{ cm}^2 = 92 \text{ cm}^2 = (92 \times 100) \text{ mm}^2 = 9200 \text{ mm}^2$

2 $150 \text{ cm}^2 = (150 \times 100) \text{ mm}^2 = 15\,000 \text{ mm}^2$

3 We convert all areas to hectares.

Alessio: $2.15 \text{ km}^2 = (2.15 \times 100) \text{ ha} = 215 \text{ ha}$

Bruno: 320 ha

Carlos: $640\,000 \text{ m}^2 = (640\,000 \div 10\,000) \text{ ha} = 64 \text{ ha}$

a Bruno owns the largest block.

b Carlos owns the smallest block.

4 **a** $5.7 \text{ ha} = (5.7 \times 10\,000) \text{ m}^2 = 57\,000 \text{ m}^2$

b Fertiliser required $= 57\,000 \times 0.06 \text{ kg} = 3420 \text{ kg}$

So, 3420 kg of fertiliser will be needed.

c We need to find $\frac{3420 \text{ kg}}{25 \text{ kg}}$

$= 136.8$

≈ 137

So, the curator will need to buy 137 bags of fertiliser.

This will cost $137 \times \$19.85 = \$2759.45$

The curator will spend $\$2719.45$.

EXERCISE 9E.1

1 **a** Area $= \text{length} \times \text{width} = 8 \text{ cm} \times 5 \text{ cm} = 40 \text{ cm}^2$

b Area $= \text{length} \times \text{width} = 11 \text{ m} \times 20 \text{ m} = 220 \text{ m}^2$

c Area $= \text{length} \times \text{width} = 15 \text{ m} \times 15 \text{ m} = 225 \text{ m}^2$

d Area $= \text{length} \times \text{width} = 3 \text{ cm} \times 12 \text{ cm} = 36 \text{ cm}^2$

2 **b** Area $= \text{length} \times \text{width} = 21 \text{ cm} \times 29.7 \text{ cm} = 623.7 \text{ cm}^2 \approx 624 \text{ cm}^2$

3 **a** Area $= \text{length} \times \text{width} = 40 \text{ m} \times 60 \text{ m} = 2400 \text{ m}^2$

b $\frac{2400 \text{ m}^2}{30 \text{ m}^2} = 80$

So, it will take 80 minutes (or 1 hour 20 minutes) to mow the whole green.

4 **a** Area of driveway $= 3 \text{ m} \times 9 \text{ m} = 27 \text{ m}^2$

Area of paver $= 15 \text{ cm} \times 25 \text{ cm} = 375 \text{ cm}^2 = (375 \div 10\,000) \text{ m}^2 = 0.0375 \text{ m}^2$

$$\text{Number of pavers needed} = \frac{\text{Area of driveway}}{\text{Area of one paver}} = \frac{27 \text{ m}^2}{0.0375 \text{ m}^2} = 720$$

So, 720 pavers are needed to pave the driveway.

b $720 \times \$2.50 = \$1800$

The total cost of the pavers is \$1800.

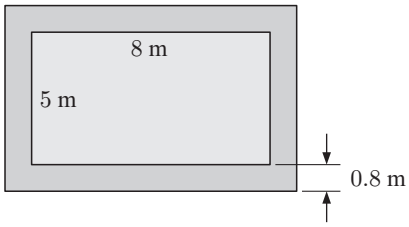
5 **a** Area $= \text{length} \times \text{width} = 7.2 \text{ km} \times 2000 \text{ m} = 7.2 \text{ km} \times 2 \text{ km} = 14.4 \text{ km} = (14.4 \times 100) \text{ ha} = 1440 \text{ ha}$

The field has an area of 1440 hectares.

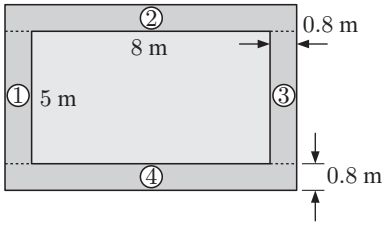
b $1440 \times \$1200 = \$1\,728\,000$

The value of the wheat is \$1 728 000.

6 **a**



b



Area of path
$= \text{area of } ① + \text{area of } ② + \text{area of } ③ + \text{area of } ④$
$= (0.8 \times 5) + (0.8 \times 9.6) + (0.8 \times 5) + (0.8 \times 9.6) \text{ m}^2$
$= 4 + 7.68 + 4 + 7.68 \text{ m}^2$
$= 23.36 \text{ m}^2$

c $23.36 \text{ m}^2 \times \$32 \text{ per m}^2 = \$747.52$
It will cost \$747.52 to cover the path with slate.

EXERCISE 9E.2

1 **a** $\text{Area} = \frac{1}{2}(\text{base} \times \text{height})$
$\therefore \quad A = \frac{1}{2}(9 \times 4) \text{ cm}^2$
$= 18 \text{ cm}^2$

b $\text{Area} = \frac{1}{2}(\text{base} \times \text{height})$
$\therefore \quad A = \frac{1}{2}(11 \times 12) \text{ m}^2$
$= 66 \text{ m}^2$

c $\text{Area} = \frac{1}{2}(\text{base} \times \text{height})$
$\therefore \quad A = \frac{1}{2}(8 \times 6) \text{ m}^2$
$= 24 \text{ m}^2$

d $\text{Area} = \frac{1}{2}(\text{base} \times \text{height})$
$\therefore \quad A = \frac{1}{2}(10 \times 7) \text{ cm}^2$
$= 35 \text{ cm}^2$

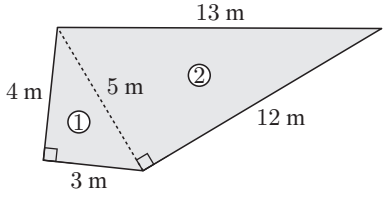
e $\text{Area} = \frac{1}{2}(\text{base} \times \text{height})$
$\therefore \quad A = \frac{1}{2}(18 \times 6) \text{ m}^2$
$= 54 \text{ m}^2$

f $\text{Area} = \frac{1}{2}(\text{base} \times \text{height})$
$\therefore \quad A = \frac{1}{2}(5 \times 3) \text{ cm}^2$
$= 7.5 \text{ cm}^2$

g $\text{Area} = \frac{1}{2}(\text{base} \times \text{height})$
$\therefore \quad A = \frac{1}{2}(2 \times 13) \text{ m}^2$
$= 13 \text{ m}^2$

h $\text{Area} = \frac{1}{2}(\text{base} \times \text{height})$
$\therefore \quad A = \frac{1}{2}(6 \times 15) \text{ cm}^2$
$= 45 \text{ cm}^2$

2



$\text{Total area} = \text{area of } ① + \text{area of } ②$
$= \frac{1}{2}(3 \times 4) + \frac{1}{2}(12 \times 5) \text{ m}^2$
$= 6 + 30 \text{ m}^2$
$= 36 \text{ m}^2$

3 $\text{Area} = \frac{1}{2}(\text{base} \times \text{height})$
$= \frac{1}{2}(12 + 7)$
$= 42 \text{ m}^2$
The area of the vegetable patch is 42 m^2.

4 **a** Area of logo $= s^2$
$= 20^2$ cm^2
$= 400$ cm^2

b Area of each triangle $= \frac{1}{2}$(base $\times$ height)
$= \frac{1}{2}(16 \times 16)$ cm^2
$= 128$ cm^2

c Area of stripe $=$ area of logo $- 2 \times$ area of triangle
$= 400$ cm$^2 - 2 \times 128$ cm^2
$= 144$ cm^2

5 **a** The whole square has side length 2 cm.
$\therefore$ its area $= 2^2$ cm^2
$= 4$ cm^2

b Area $= \frac{1}{2}$(base $\times$ height)
$= \frac{1}{2}(1 \times 1)$
$= 0.5$ cm^2

c Area of blue square
$=$ area of whole square $- 4 \times$ area of triangle
$= 4$ cm$^2 - 4 \times 0.5$ cm^2
$= 2$ cm^2

d Area $= s^2$
$\therefore \ s^2 = 2$ cm^2
$\therefore \ s = \sqrt{2}$ cm $\quad \{\text{since } s > 0\}$
$\therefore \ s \approx 1.41$ cm
The blue square has side length 1.41 cm.

EXERCISE 9E.3

1 **a** Area $=$ base $\times$ height
$\therefore \ A = 16$ cm $\times 5$ cm
$\therefore \ A = 80$ cm^2

b Area $=$ base $\times$ height
$\therefore \ A = 5$ cm $\times 4$ cm
$\therefore \ A = 20$ cm^2

c Area $=$ base $\times$ height
$\therefore \ A = 14$ m $\times 6$ m
$\therefore \ A = 84$ m^2

2 **a** Area $= \frac{1}{2}(x \times y)$
$\therefore \ A = \frac{1}{2}(7 \times 12)$ cm^2
$\therefore \ A = 42$ cm^2

b Area $= \frac{1}{2}(x \times y)$
$\therefore \ A = \frac{1}{2}(10 \times 17)$ m^2
$\therefore \ A = 85$ m^2

c Area $= \frac{1}{2}(x \times y)$
$\therefore \ A = \frac{1}{2}(8 \times 13)$ cm^2
$\therefore \ A = 52$ cm^2

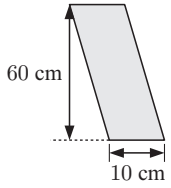
3 **a** Area $= \left(\frac{a+b}{2}\right) \times h$
$\therefore \ A = \left(\frac{3+5}{2}\right) \times 4$ cm^2
$\therefore \ A = 4 \times 4$ cm^2
$\therefore \ A = 16$ cm^2

b Area $= \left(\frac{a+b}{2}\right) \times h$
$\therefore \ A = \left(\frac{3+7}{2}\right) \times 5$ cm^2
$\therefore \ A = 5 \times 5$ cm^2
$\therefore \ A = 25$ cm^2

c Area $= \left(\frac{a+b}{2}\right) \times h$
$\therefore \ A = \left(\frac{5+8}{2}\right) \times 2$ m^2
$\therefore \ A = 6.5 \times 2$ m^2
$\therefore \ A = 13$ m^2

4 Area $= \frac{1}{2}(x \times y)$
$\therefore \ A = \frac{1}{2}(60$ cm $\times 1.1$ m$)$
$\therefore \ A = \frac{1}{2}(60 \times 110)$ cm^2
$\therefore \ A = 3300$ cm^2
So, 3300 cm^2 of material is required to make the kite.

5



Area $=$ base $\times$ height
$\therefore \ A = 10 \times 60$ cm^2
$\therefore \ A = 600$ cm^2
The area that needs to be repainted is 600 cm^2.

6 Area $= \frac{1}{2}(x \times y)$

$\therefore\ A = \frac{1}{2}(8 \text{ cm} \times 1.2 \text{ m})$

$\therefore\ A = \frac{1}{2}(8 \times 120) \text{ cm}^2$

$\therefore\ A = 480 \text{ cm}^2$

So, a total of 720 cm^2 of material is needed to finish this tie.

If an extra 50% more fabric is needed, then we need to find 150% of 480 cm^2

$= 1.5 \times 480 \text{ cm}^2$

$= 720 \text{ cm}^2$

7 Total area $= 6 \times$ area of one parallelogram

$\therefore\ A = 6 \times \text{base} \times \text{height}$

$\therefore\ A = 6 \times 1.3 \times 2.9 \text{ cm}^2$

$\therefore\ A = 22.62 \text{ cm}^2$

The total area of the stripes is 22.62 cm^2.

8 **a** Area $= \left(\frac{a+b}{2}\right) \times h$

$\therefore\ A = \left(\frac{160+120}{2}\right) \times 40 \text{ cm}^2$

$\therefore\ A = 140 \times 40 \text{ cm}^2$

$\therefore\ A = 5600 \text{ cm}^2$

The area of the sign which is white is 5600 cm^2.

b Area $= \frac{1}{2}(\text{base} \times \text{height})$

$\therefore\ A = \frac{1}{2}(120 \times 120) \text{ cm}^2$

$\therefore\ A = 7200 \text{ cm}^2$

The area of the sign which is red is 7200 cm^2.

EXERCISE 9F

1 **a** $A = \pi r^2$

$\therefore\ A = \pi \times 5^2 \text{ cm}^2$ {the radius is 5 cm}

$\therefore\ A \approx 78.54 \text{ cm}^2$

b $A = \pi r^2$

$\therefore\ A = \pi \times 39^2 \text{ cm}^2$ {the radius is 39 cm}

$\therefore\ A \approx 4778.36 \text{ cm}^2$

c $A = \pi r^2$

$\therefore\ A = \pi \times 23^2 \text{ mm}^2$

{the radius is $46 \div 2 = 23$ mm}

$\therefore\ A \approx 1661.90 \text{ mm}^2$

d $A = \pi r^2$

$\therefore\ A = \pi \times 2.6^2 \text{ m}^2$

{the radius is $5.2 \div 2 = 2.6$ m}

$\therefore\ A \approx 21.24 \text{ m}^2$

e $A = \frac{1}{2} \times \pi r^2$

$\therefore\ A = \frac{1}{2} \times \pi \times 5^2 \text{ m}^2$

{the radius is $10 \div 2 = 5$ m}

$\therefore\ A \approx 39.27 \text{ m}^2$

f $A = \frac{1}{4} \times \pi r^2$

$\therefore\ A = \frac{1}{4} \times \pi \times 9^2 \text{ mm}^2$

{the radius is 9 mm}

$\therefore\ A \approx 63.62 \text{ mm}^2$

2 **a** $P = \pi d$

$\therefore\ P = \pi \times 4.8 \text{ cm}$

$\therefore\ P \approx 15.08 \text{ cm}$

b $A = \pi r^2$

$\therefore\ A = \pi \times 2.4^2 \text{ cm}^2$ {the radius is $4.8 \div 2 = 2.4$ cm}

$\therefore\ A \approx 18.10 \text{ cm}^2$

3 $A = \pi r^2$

$\therefore\ A = \pi \times 13^2 \text{ cm}^2$ {the radius is $26 \div 2 = 13$ cm}

$\therefore\ A \approx 531 \text{ cm}^2$

The balloon wets an area of about 531 cm^2.

4 $A = \pi r^2$

$\therefore\ A = \pi \times 3.6^2 \text{ m}^2$ {the radius is 3.6 m}

$\therefore\ A \approx 40.7 \text{ m}^2$

The donkey can roam over an area of 40.7 m^2.

5 **a** **i** Area of the flag $=$ length $\times$ width
$= 40 \text{ cm} \times 60 \text{ cm}$
$= 2400 \text{ cm}^2$

ii Area of the circle $= \pi r^2$
$= \pi \times 10^2$
{the radius $= 20 \div 2 = 10$ cm}
$= 314 \text{ cm}^2$

b Percentage that is yellow $= \dfrac{314 \text{ cm}^2}{2400 \text{ cm}^2} \times 100\%$
$\approx 13.1\%$

c Area of the red part $=$ (area of flag $-$ area of circle) $\div 2$
$= (2400 \text{ cm}^2 - \pi \times 10^2) \div 2$
$\approx 1043 \text{ cm}^2$

REVIEW SET 9

1 **a** m^2 **b** km^2 **c** cm^2

2 **a** 12.9 cm
$= (12.9 \times 10) \text{ mm}$
$= 129 \text{ mm}$

b 3.95 km
$= (3.95 \times 1000) \text{ m}$
$= 3950 \text{ m}$

c 2.43 m
$= (2.43 \times 100) \text{ cm}$
$= 243 \text{ cm}$

d 1459 cm^2
$= (1459 \div 10\,000) \text{ m}^2$
$= 0.1459 \text{ m}^2$

e 9.4 ha
$= (9.4 \times 10\,000) \text{ m}^2$
$= 94\,000 \text{ m}^2$

f 12.8 cm^2
$= (12.8 \times 100) \text{ mm}^2$
$= 1280 \text{ mm}^2$

3 **a** $P = 4s$
$\therefore P = 4 \times 8.2 \text{ cm}$
$\therefore P = 32.8 \text{ cm}$

b $P = 2(a + b)$
$\therefore P = 2(1.54 + 2.62) \text{ m}$
$\therefore P = 2 \times 4.16 \text{ m}$
$\therefore P = 8.32 \text{ m}$

c $P = \pi d$
$\therefore P = \pi \times 10 \text{ m}$
$\therefore P \approx 31.4 \text{ m}$

4 **a** $A = s^2$
$\therefore A = 2.3^2 \text{ m}^2$
$\therefore A = 5.29 \text{ m}^2$

b $A = \frac{1}{2}(\text{base} \times \text{height})$
$\therefore A = \frac{1}{2}(15 \times 8) \text{ m}^2$
$\therefore A = 60 \text{ m}^2$

c $A = \left(\dfrac{a+b}{2}\right) \times h$
$\therefore A = \left(\dfrac{8+11}{2}\right) \times 9 \text{ cm}^2$
$\therefore A = 9.5 \times 9 \text{ cm}^2$
$\therefore A = 85.5 \text{ cm}^2$

5 **a** Circumference $= 2\pi r$
$\therefore C = 2 \times \pi \times 5.6 \text{ cm}$
$\therefore C \approx 35.2 \text{ cm}$

b Area $= \pi r^2$
$\therefore A = \pi \times 5.6^2 \text{ cm}^2$
$\therefore A \approx 98.5 \text{ cm}^2$

6 **a** $A = \pi r^2$
$\therefore A = \pi \times 4^2 \text{ m}^2$
{the radius is $8 \div 2 = 4$ m}
$\therefore A \approx 50.3 \text{ m}^2$

b $A =$ base $\times$ height
$\therefore A = 7 \times 5.5 \text{ cm}^2$
$\therefore A = 38.5 \text{ cm}^2$

c $A = \frac{1}{2}(a \times b)$
$\therefore A = \frac{1}{2}(5 \times 9) \text{ m}^2$
$\therefore A = 22.5 \text{ m}^2$

7 **a** Area $= 800 \text{ m} \times 2.3 \text{ km}$
$\therefore A = 800 \text{ m} \times 2300 \text{ m}$
{converting to m}
$\therefore A = 1\,840\,000 \text{ m}^2$
$\therefore A = (1\,840\,000 \div 10\,000) \text{ ha}$
$\therefore A = 184 \text{ ha}$
The reserve has an area of 184 ha.

b We need to find 184×20
$= 3680$
So, a total of 3680 trees are planted.

8 The perimeter of one triangle is $3 \times 15 \text{ cm} = 45 \text{ cm}$
$= (45 \div 100) \text{ m} \quad \{\text{converting to metres}\}$
$= 0.45 \text{ m}$
and $360 \text{ m} \div 0.45 \text{ m} = 800$
So, 800 triangles can be made with the wire.

9 The boom gate's length is divided into 20 equal lengths
and $3.5 \text{ m} \div 20 = 0.175 \text{ m}$
$= (0.175 \times 100) \text{ cm}$
$= 17.5 \text{ cm}$

a **i** Area of parallelogram
$=$ base $\times$ height
$= 17.5 \times 20 \text{ cm}^2$
$= 350 \text{ cm}^2$

ii Area of triangle
$= \frac{1}{2}(\text{base} \times \text{height})$
$= \frac{1}{2}(17.5 \times 20) \text{ cm}^2$
$= 175 \text{ cm}^2$

b The gate's area is made up of 19 parallelograms and 2 triangles.
$\therefore$ area of gate $= 19 \times 350 \text{ cm}^2 + 2 \times 175 \text{ cm}^2 \quad \{\text{using } \textbf{a i} \text{ and } \textbf{a ii}\}$
$= 6650 \text{ cm}^2 + 350 \text{ cm}^2$
$= 7000 \text{ cm}^2$
The gate's area can also be found by multiplying its length and width.
$\therefore$ area of gate $= 3.5 \text{ m} \times 20 \text{ cm}$
$= 350 \text{ cm} \times 20 \text{ cm} \quad \{\text{converting to cm}\}$
$= 7000 \text{ cm}^2 \quad \checkmark$

PRACTICE TEST 9A

1 The length of a downpipe from the gutter of a single storey building to the ground would most likely be 5 m.
$\therefore$ the answer is **C**.

2 3.25 m
$= (3.25 \times 1000) \text{ mm}$
$= 3250 \text{ mm}$
$\therefore$ the answer is **C**.

3 Area $= \pi r^2$
$= \pi \times 48^2 \quad \{\text{the radius is } 96 \div 2 = 48 \text{ cm}\}$
$= 2304\pi$
$\therefore$ the answer is **D**.

4 Total length $= 42 \times 20 \text{ cm}$
$= 840 \text{ cm}$
$= (840 \div 100) \text{ m}$
$= 8.4 \text{ m}$
$\therefore$ the answer is **E**.

5 We need to find $7.2 \text{ m} \div 12 \text{ cm}$
$= (7.2 \times 100) \text{ cm} \div 12 \text{ cm}$
$= 720 \text{ cm} \div 12 \text{ cm}$
$= 60$
So, 60 ribbons of length 12 cm can be cut from a 7.2 m reel.
$\therefore$ the answer is **C**.

6 $P = 2(a + b)$
$\therefore P = 2(3 + 5) \text{ cm}$
$\therefore P = 2 \times 8 \text{ cm}$
$\therefore P = 16 \text{ cm}$
$\therefore$ the answer is **E**.

7 $C = 2\pi r$
$\therefore C = 2 \times \pi \times 35 \text{ mm}$
$\therefore C \approx 220 \text{ mm}$
$\therefore$ the answer is **C**.

8 The units of measurement most appropriate for measuring the area of a book cover are cm^2.
$\therefore$ the answer is **B**.

9 Area = area of rectangle + area of triangle

$= \text{length} \times \text{width} + \frac{1}{2}(\text{base} \times \text{height})$

$= 8 \text{ m} \times 4 \text{ m} + \frac{1}{2}(8 \text{ m} \times 3 \text{ m})$

$= 32 \text{ m}^2 + 12 \text{ m}^2$

$= 44 \text{ m}^2$

$\therefore$ the answer is **A**.

10 We first check the shapes where all units are in cm.

Shape **B** has area $A = \left(\frac{10+6}{2}\right) \times 4 \text{ cm}^2$

$= 8 \times 4 \text{ cm}^2$

$= 32 \text{ cm}^2$ ✗

Shape **D** has area $A = \frac{1}{2}(16 \times 8) \text{ cm}^2$

$= \frac{1}{2} \times 128 \text{ cm}^2$

$= 64 \text{ cm}^2$ ✓

$\therefore$ the answer is **D**.

PRACTICE TEST 9B

1 **a** $299 \text{ mm}^2 = (299 \div 100) \text{ cm}^2 = 2.99 \text{ cm}^2$

b $49 \text{ mm} = (49 \div 10) \text{ cm} = 4.9 \text{ cm}$

c $6.84 \text{ km}^2 = (6.84 \times 100) \text{ ha} = 684 \text{ ha}$

2 **a** $P = 2(a+b)$, $\therefore P = 2(11+4) \text{ m}$, $\therefore P = 2 \times 15 \text{ m}$, $\therefore P = 30 \text{ m}$

b $P = 5 \text{ cm} + 7 \text{ cm} + 9 \text{ cm}$, $\therefore P = 21 \text{ cm}$

c $P = 2(a+b)$, $\therefore P = 2(9+13) \text{ cm}$, $\therefore P = 2 \times 22 \text{ cm}$, $\therefore P = 44 \text{ cm}$

3 **a** The unit of length most appropriate for measuring the width of a street is m.

b The unit of length most appropriate for measuring the length of an eraser is mm (or cm).

4 **a** Area $= \frac{1}{2}(\text{base} \times \text{height})$

$\therefore A = \frac{1}{2}(12 \times 5) \text{ m}^2$

$\therefore A = 30 \text{ m}^2$

b Area $= \pi r^2$

$\therefore A = \pi \times 7.1^2 \text{ mm}^2$

$\therefore A \approx 158 \text{ mm}^2$

5 **a** Circumference $= \pi d$

$\therefore C = \pi \times 22 \text{ cm}$

$\therefore C \approx 69.1 \text{ cm}$

b Area $= \pi r^2$

$\therefore A = \pi \times 11^2$

{the radius is $22 \div 2 = 11$ cm}

$\therefore A \approx 380 \text{ cm}^2$

6 **a** Area $= \frac{1}{2}(\text{base} \times \text{height})$

$\therefore A = \frac{1}{2}(10 \times 12) \text{ cm}^2$

$\therefore A = 60 \text{ cm}^2$

b Area $= \frac{1}{2}(a \times b)$

$\therefore A = \frac{1}{2}(9 \times 15.09) \text{ m}^2$

$\therefore A = 67.905 \text{ m}^2$

$\therefore A \approx 67.9 \text{ m}^2$

7 Total length required $= 30 \text{ cm} + (3.9 \text{ m} \times 2) + 4.5 \text{ m} + 1.1 \text{ m} + 90 \text{ cm}$

$= 0.3 \text{ m} + 7.8 \text{ m} + 4.5 \text{ m} + 1.1 \text{ m} + 0.9 \text{ m}$ {converting to m}

$= 14.6 \text{ m}$

So, Adam will need 14.6 m of skirting board.

8 The pitch has area $100\text{ m} \times 75\text{ m} = 7500\text{ m}^2$
and $7500\text{ m}^2 \div 10\text{ m}^2 = 750$
$\therefore$ 750 kg of fertiliser is needed.
It comes in 20 kg bags, so $750\text{ kg} \div 20\text{ kg} = 37.5$
≈ 38 {round up to nearest whole number}
So, 38 bags are needed.
$\therefore$ the total cost $= \$15 \times \$38$
$= \$570$
It will cost \$570 to fertilise the soccer pitch.

9 **a** Perimeter $= 2(2 + 4)$ cm
$\therefore\ P = 12$ cm

b Area $= \frac{1}{2}(5 \times 3)\text{ cm}^2$
$\therefore\ A = 7.5\text{ cm}^2$

10 *Eliza's pizza*:
$A = \pi r^2$
$\therefore\ A = \pi \times 9\text{ cm}^2$ {the radius $= 18 \div 2 = 9$ cm}
$\therefore\ A \approx 254\text{ cm}^2$

Claire's pizza:
$A = s^2$
$\therefore\ A = 16^2\text{ cm}^2$
$\therefore\ A = 256\text{ cm}^2$

So, Claire's pizza is larger.

PRACTICE TEST 9C

1 **a** Flag area = length × width
$= 50\text{ cm} \times 30\text{ cm}$
$= 1500\text{ cm}^2$

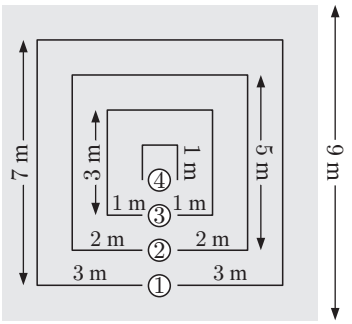
b **i** Area of red triangle $= \frac{1}{2}$(base × height)
$= \frac{1}{2}(33 \times 30)\text{ cm}^2$
$= 495\text{ cm}^2$

ii Area of white stripe = base × height
$= 44.6 \times 1.5\text{ cm}^2$
$= 66.9\text{ cm}^2$

c Area of black stripe = area of flag $- 2 \times$ area of red triangle $- 2 \times$ area of white stripe
$= 1500\text{ cm}^2 - 2 \times 495\text{ cm}^2 - 2 \times 66.9\text{ cm}^2$ {using parts **a** and **b**}
$= 376.2\text{ cm}^2$

d Percentage of the flag which is black $= \frac{376.2\text{ cm}^2}{1500\text{ cm}^2} \times 100\%$
$= 25.08\%$
$\approx 25.1\%$
So, 25.1% of the flag is black.

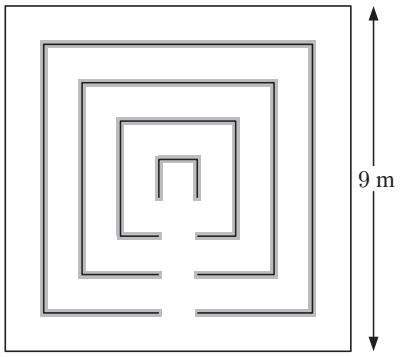
2



a The innermost square (square 4 on the diagram) needs $1\text{ m} + 1\text{ m} + 1\text{ m}$
$= 3\text{ m}$ of wire.

b Square ① needs $4 \times 7 - 1\text{ m} = 27\text{ m}$ of wire.
Square ② needs $4 \times 5 - 1\text{ m} = 19\text{ m}$ of wire.
Square ③ needs $4 \times 3 - 1\text{ m} = 11\text{ m}$ of wire.
Square ④ needs 3 m of wire. {from **a**}
So, total length of wire needed
$= 27\text{ m} + 19\text{ m} + 11\text{ m} + 3\text{ m}$
$= 60\text{ m}$
Fran will need 60 m of wire for her garden.

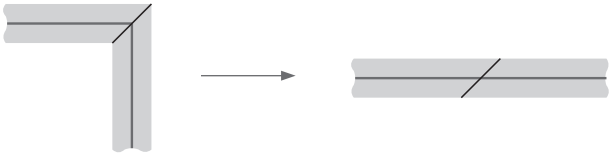
c



The shaded parts represent the area of dirt in the garden.

Consider a corner of the wire, which has 10 cm of dirt either side.

If we divide the garden bed and rearrange as shown below, we can see that we get the same area of dirt if we straighten out all the wires.



There is a total of 60 m of wire used. {from **a**}
The dirt lies 10 cm beyond the end of the wires as well.
We can therefore think of the area of dirt as a single rectangle 0.2 m wide,
and $60 \text{ m} + (8 \times 0.1) \text{ m} = 60.8 \text{ m}$ long.
This has an area of $0.2 \text{ m} \times 60.8 \text{ m} = 12.16 \text{ m}^2$.
So, the total area of dirt in the garden is 12.16 m^2.

d Area of garden that is lawn = area of garden − area of dirt in garden
$= (9 \times 9) \text{ m}^2 - 12.16 \text{ m}^2$ {using **c**}
$= 81 \text{ m}^2 - 12.16 \text{ m}^2$
$= 68.84 \text{ m}^2$

3 **a** **i** Circumference $= \pi d$
$\therefore \ C = \pi \times 45$ cm
$\therefore \ C \approx 141$ cm

ii Area $= \pi r^2$
$\therefore \ A = \pi \times 22.5^2$
{the radius $= 45 \div 2 = 22.5$ cm}
$\therefore \ A \approx 1590 \text{ cm}^2$

b **i** If the outer boundary has diameter 45 cm, then the inner boundary has diameter
$45 \text{ cm} - 8 \text{ mm} - 8 \text{ mm}$
$= 450 \text{ mm} - 8 \text{ mm} - 8 \text{ mm}$
$= 434 \text{ mm}$
$\therefore$ the diameter of the inner boundary of the 'double' ring is 434 mm.

ii Circumference $= \pi d$
$\therefore \ C = \pi \times 434$ mm {from **b i**}
$\therefore \ C \approx 1363$ mm

c **i** Wire needed
$= 450 \times \pi + 434 \times \pi$ mm
≈ 2777 mm

ii 2777 mm $= (2777 \div 1000)$ m
$= 2.777$ m
Cost of wire $= \$0.55 \times 2.777$ m
$\approx \$1.53$

4 **a** Wood required $= 50$ cm $+ 85$ cm
$= 135$ cm

b Perimeter $P = 2(35 + 65)$ cm
$\therefore \ P = 2 \times 100$ cm
$\therefore \ P = 200$ cm
$\therefore$ Mary will need 200 cm (or 2 m) of edging.

c Area $A = \frac{1}{2}(50 \times 85)$ cm^2
$\therefore \ A = 2125$ cm^2
Mary will need 2125 cm^2 of cloth for her kite.

5 **a** **i** Area $=$ length $\times$ width
$\therefore \ A = 105$ m $\times 68$ m
$\therefore \ A = 7140$ m^2

ii Area $=$ length $\times$ width
$\therefore \ A = 16.5$ m $\times 40.3$ m
$\therefore \ A = 664.95$ m^2

iii Area $= \pi r^2$
$\therefore \ A = \pi \times 9.5^2$
$\therefore \ A \approx 284$ m^2

b The percentage $= \dfrac{\pi \times 9.5^2 \text{ m}^2}{7140 \text{ m}^2} \times 100\%$
$\approx 3.97\%$
So, the centre circle takes up 3.97% of the pitch area.

c Distance between penalty spots $=$ length of pitch $- 2 \times$ distance between penalty spot and end line
$= 105$ m $- 2 \times 11$ m
$= 83$ m
The distance between the two penalty spots is 83 m.