Topic Test: Further Applications of Area and Volume
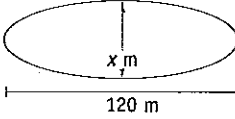
Remember: these are HSC-type questions.
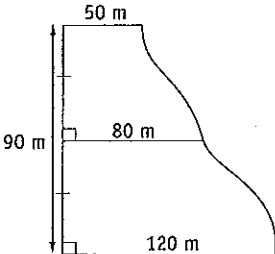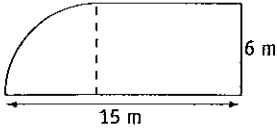
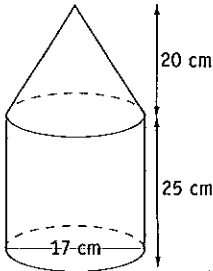## Part A   (Suggested time: 15 minutes)

**Choose the correct answer (A, B, C or D)
for each question.**   One mark each
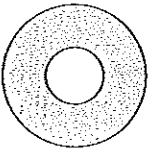
1 The surface area of a sphere with diameter 8 cm is closest to:
A 201 cm²   B 268 cm²
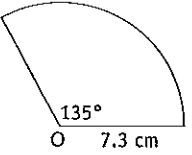C 804 cm²   D 2147 cm²

2 The area of the ellipse is 7540 m², to the nearest square metre. What is the value of x?

A 20   B 40
C 60   D 80

3 Use Simpson's rule to approximate the area shown in the diagram.

A 3750 m²
B 7350 m²
C 1.47 ha
D 1.96 ha

4 Find the area (to the nearest square metre) of the figure, which is made up of a rectangle and quadrant.
A 118 m²
B 100 m²
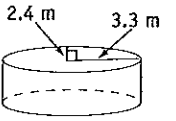C 82 m²
D there is not enough information to find the area

5 This shape is made up of a cylinder and cone. What is the volume to the nearest cubic centimetre?
A 4161 cm³
B 28 751 cm³
C 7188 cm³
D 10 214 cm³

6 The shaded area is between two circles with common centre. The diameter of the smaller circle is 4 m, while the radius of the larger circle is 8 m. Find the shaded area, giving the answer to the nearest square metre.
A 197 m²   B 51 m²
C 151 m²   D 188 m²

7 The diagram shows a sector of a circle, centre O. The area of the sector, in square centimetres correct to one decimal place, is:
A 62.8 cm²   B 17.2 cm²
C 125.6 cm²   D 41.9 cm²

8 Donna measures the radius of a sphere to be 9 cm. If the actual radius is 9.6 cm, by approximately how much is Donna's calculation of the volume too small?
A 0.9 cm³   B 4.5 cm³
C 140 cm³   D 652 cm³

9 The area of a quadrant is 272 m², to the nearest square metre. What is its approximate radius?
A 4.7 m   B 18.6 m
C 13.2 m   D 21 m

10 A hole in the ground is 2 metres deep and has an elliptical cross-section as shown in the diagram. If the ground was level before the hole was dug, approximately what amount of earth has been removed?
A 16 m³   B 50 m³
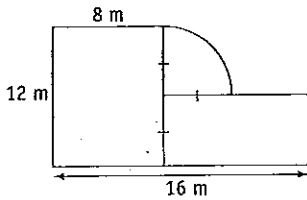C 63 m³   D 200 m³

Part B

Show all working.   **15 marks**

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11 The diagram shows the floor of a shed and part of a driveway that needs to be concreted.


a   Explain why the total area to be concreted is 172 m², to the nearest square metre.   **2 marks**

b   Find the total cost of the concrete required if it is to be laid to a depth of 15 cm and it costs $200 per cubic metre.   **2 marks**

**12** The figure in the diagram consists of a triangle and semi-circle.
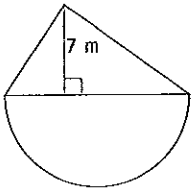
If the area of the triangle is 56 m², find the area of the figure.   **3 marks**

13 An artificial lake has a constant vertical cross-section as shown in the diagram.
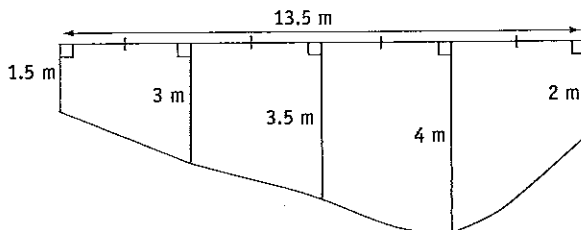
a   Use Simpson's rule to approximate the area of the cross-section.   **2 marks**

b   If the lake is 25 m long, find the volume of water in the lake. Give the answer in megalitres, to one decimal place. (1 m³ = 1000 L)   **2 marks**

14 On a farm, a silo is used for storing grain bought to feed cattle. The silo is made up of a cylinder and cone as shown in the diagram.
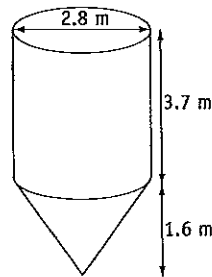
a   Find the volume of the silo.   **2 marks**

b   If the grain is transferred from the silo to a set of eight feed bins, each with volume 0.56 m³, how many times can the set of feed bins be filled from a full silo.   **2 marks**

Solutions

Topic Test p135

1 Diameter is 8 cm. $\therefore r = 4$

$A = 4\pi r^2$
$= 4 \times \pi \times 4^2$
$= 201.061\,9298\ldots$

The surface area is 201 cm^2, to the nearest square centimetre.

2 $a = \dfrac{120}{2}$
$= 60$

$b = \dfrac{x}{2}$

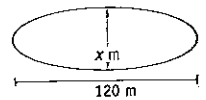$A = \pi ab$

$7540 = \pi \times 60 \times \dfrac{x}{2}$

$7540 = 30\pi x$

$x = 7540 \div 30\pi$
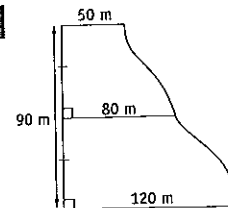$= 80.001\,884\,73\ldots$

$x = 80$

(Diagram: ellipse labelled x m high and 120 m wide, corners A, D)

3

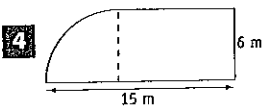*(Diagram: land shape with 50 m, 80 m, 90 m, 120 m measurements)*

$h = 90 \div 2$
$= 45$

$A \approx \dfrac{h}{3}(d_f + 4d_m + d_l)$

$= \dfrac{45}{3}(50 + 4 \times 80 + 120)$

$= 7350$

The area of the land is approximately 7350 m^2.

4

Radius of quadrant = width of rectangle
$$= 6\,m$$
Length of rectangle $= 15\,m - 6\,m$
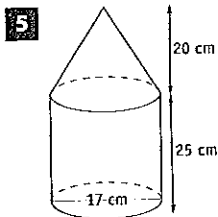$$= 9\,m$$

$$A = lb + \frac{1}{4}\pi r^2$$
$$= 9\times6 + \frac{1}{4}\times\pi\times6^2$$
$$= 82.274\,333\,88\,\dots$$
$$= 82 \quad\text{(nearest unit)}$$
The area of the figure, to the nearest
square metre, is $82\,m^2$. **C**

5

$r = 8.5$

$$V = \pi r^2 H + \frac{1}{3}\pi r^2 h$$
$$= \pi\times8.5^2\times25 + \frac{1}{3}\times\pi\times8.5^2\times20$$
$$= 7187.702\,192\,\dots$$
$$= 7188 \quad\text{(nearest unit)}$$
The volume is $7188\,cm^3$, to the nearest
cubic centimetre. **C**

6

$$A = \pi(R^2 - r^2)$$
$$= \pi\times(8^2 - 2^2)$$
$$= 188.495\,5592\,\dots$$
$$= 188 \quad\text{(nearest unit)}$$
The shaded area is $188\,m^2$,
to the nearest square metre. **D**

7

$$A = \frac{\theta}{360}\pi r^2$$
$$= \frac{135}{360}\times\pi\times7.3^2$$
$$= 62.780\,802\,19\,\dots$$
$$= 62.8 \quad\text{(1 d.p.)}$$
The area of the sector is $62.8\,cm^2$,
correct to one decimal place. **A**

8 $V = \frac{4}{3}\pi r^3$

If $r = 9$, $V = \frac{4}{3}\times\pi\times9^3$
$$= 3053.628\,059\,\dots$$
$$= 3054 \quad\text{(nearest unit)}$$

If $r = 9.6$, $V = \frac{4}{3}\times\pi\times9.6^3$
$$= 3705.973\,491\,\dots$$
$$= 3706 \quad\text{(nearest unit)}$$
Difference $= 3706 - 3054$
$$= 652$$
The volume is approximately
$652\,cm^3$ too small. **D**

9

$$A = \frac{1}{4}\pi r^2$$
$$272 = \frac{1}{4}\times\pi\times r^2$$
$$r^2 = 272 \div \left(\frac{1}{4}\times\pi\right)$$
$$= 346.321\,1562\,\dots$$
$$r = \sqrt{346.321\,1562\,\dots} \quad (r > 0)$$
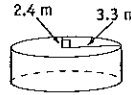$$= 18.609\,705\,97\,\dots$$
The radius is approximately 18.6 m. **B**
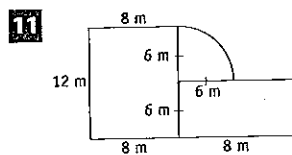
10

$$V = Ah$$
$$= \pi\times3.3\times2.4\times2$$
$$= 49.762\,827\,63\,\dots$$
$$= 50 \quad\text{(nearest unit)}$$
The amount of earth removed
is approximately $50\,m^3$. **B**

11

a Total area
$$= \text{area of 2 rectangles} + \text{area of quadrant}$$
$$A = 12\times8 + 8\times6 + \frac{1}{4}\times\pi\times6^2$$
$$= 172.2743339\dots$$
$$= 172 \quad\text{(nearest unit)}$$
The area to be concreted is $172\,m^2$,
to the nearest square metre.

b Volume $= 172\,m^2 \times 0.15\,m$
$$= 25.8\,m^3$$
Cost $= 25.8 \times \$200$
$$= \$5160$$

12 Triangle:

$$A = \frac{1}{2}bh$$
$$56 = \frac{1}{2}\times b\times7$$
$$56 = 3.5b$$
$$b = 16 \quad [56 \div 3.5]$$
Diameter of semi-circle is 16 m.
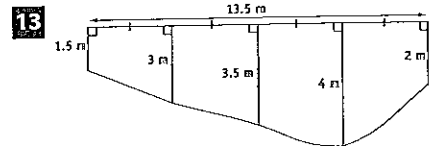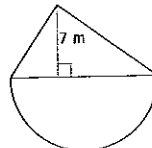$$r = 8$$
Semi-circle:
$$A = \frac{1}{2}\pi r^2$$
$$= \frac{1}{2}\times\pi\times8^2$$
$$= 100.530\,9649\,\dots$$
$$= 100.5 \quad\text{(1 d.p.)}$$
Total area $\approx 56\,m^2 + 100.5\,m^2$
$$= 156.5\,m^2$$

13

a $h = 13.5 \div 4$
$$= 3.375$$
$$A \approx \frac{h}{3}(d_f + 4d_m + d_l) + \frac{h}{3}(d_f + 4d_m + d_l)$$
$$= \frac{3.375}{3}\times(1.5 + 4\times3 + 3.5) + \frac{3.375}{3}(3.5 + 4\times4 + 2)$$
$$= 43.3125$$
The approximate area of the
cross-section is $43.3125\,m^2$.

b $V = Ah$
$$= 43.3125 \times 25$$
$$= 1082.8125$$
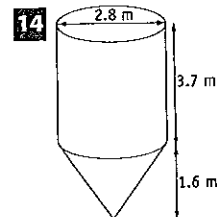The volume is approximately
$1082.8125\,m^3$.
Volume in litres
$$= 1082.8125 \times 1000\,L$$
$$= 1\,082\,812.5\,L$$
$$= 1.082\,8125\,ML$$
The approximate volume is
1.1 ML, to one decimal place.

14

a $r = 1.4$
$$V = \pi r^2 H + \frac{1}{3}\pi r^2 h$$
$$= \pi\times1.4^2\times3.7 + \frac{1}{3}\times\pi\times1.4^2\times1.6$$
$$= 26.066\,841\,44\,\dots$$
$$= 26.1 \quad\text{(1 d.p.)}$$
The volume of the silo is $26.1\,m^3$,
to one decimal place.

b Eight feed bins:
$$V = 8 \times 0.56$$
$$= 4.48$$
The volume of the eight bins
is $4.48\,m^3$.
Number of times filled
$$= 26.0668\,\dots \div 4.48$$
$$= 5.818\,491\,394\,\dots$$
The bins can be filled five times
from the silo.