Maths
Leaving Certificate
Ordinary Level

Past Exam Questions
Marking Scheme on
Area and Volume

Q7 2013 Paper One Section B

Two identical cylindrical tanks, A and B, are being filled with water. At a particular time, the water in tank A is 25 cm deep and the depth of the water is increasing at a steady rate of 5 cm every 10 seconds. At the same time the water in tank B is 10 cm deep and the depth of the water is increasing at a steady rate of 7·5 cm every 10 seconds.

(a) Draw up a table showing the depth of water in each tank at 10 second intervals over two minutes, beginning at the time mentioned above.

Time (s)	0	10	20	30	40	50	60	70	80	90	100	110	120
Tank A	25	30	35	40	45	50	55	60	65	70	75	80	85
Tank B	10	17·5	25	32·5	40	47·5	55	62·5	70	77·5	85	92·5	100

(b) Each tank is 1 m in height. Find how long it takes to fill each tank.

Tank A: 2 minutes 30 seconds

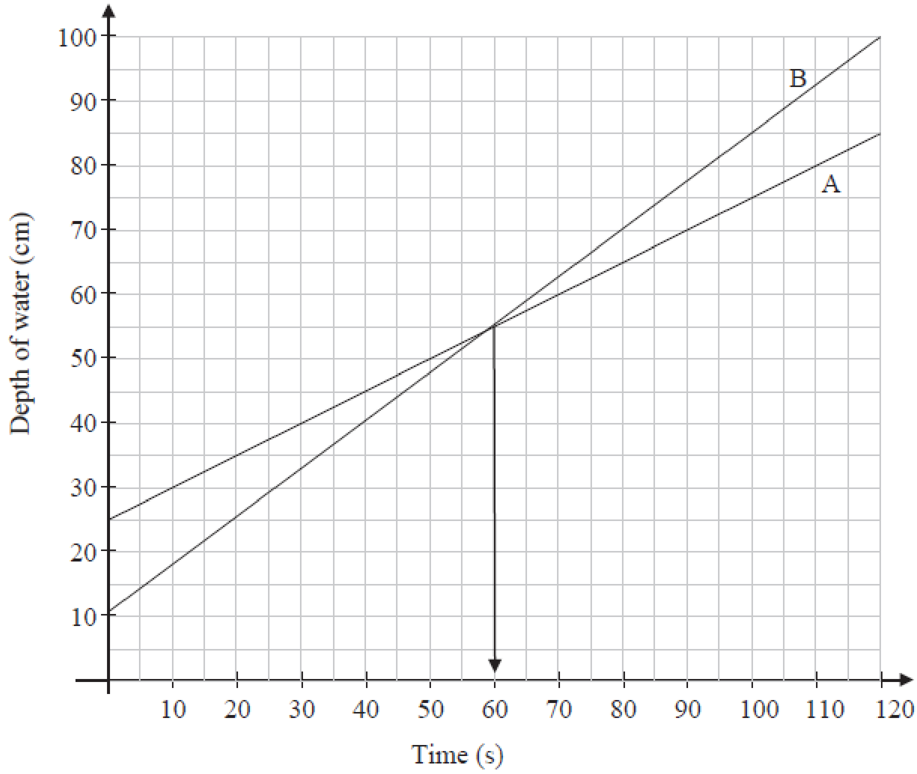
Tank B: 2 minutes

(c) For each tank, write down a formula which gives the depth of water in the tank at any given time. State clearly the meaning of any letters used in your formulas.

Tank A: $d = 25 + \frac{5}{10}t = 25 + \frac{1}{2}t$ where d is the depth in cm at time t seconds

Tank B: $d = 10 + \frac{3}{4}t$

(d) For each tank, draw the graph to represent the depth of water in the tank over the 2 minutes.



(e) Find, from your graphs, how much time passes before the depth of water is the same in each tank.

Answer: 60 seconds

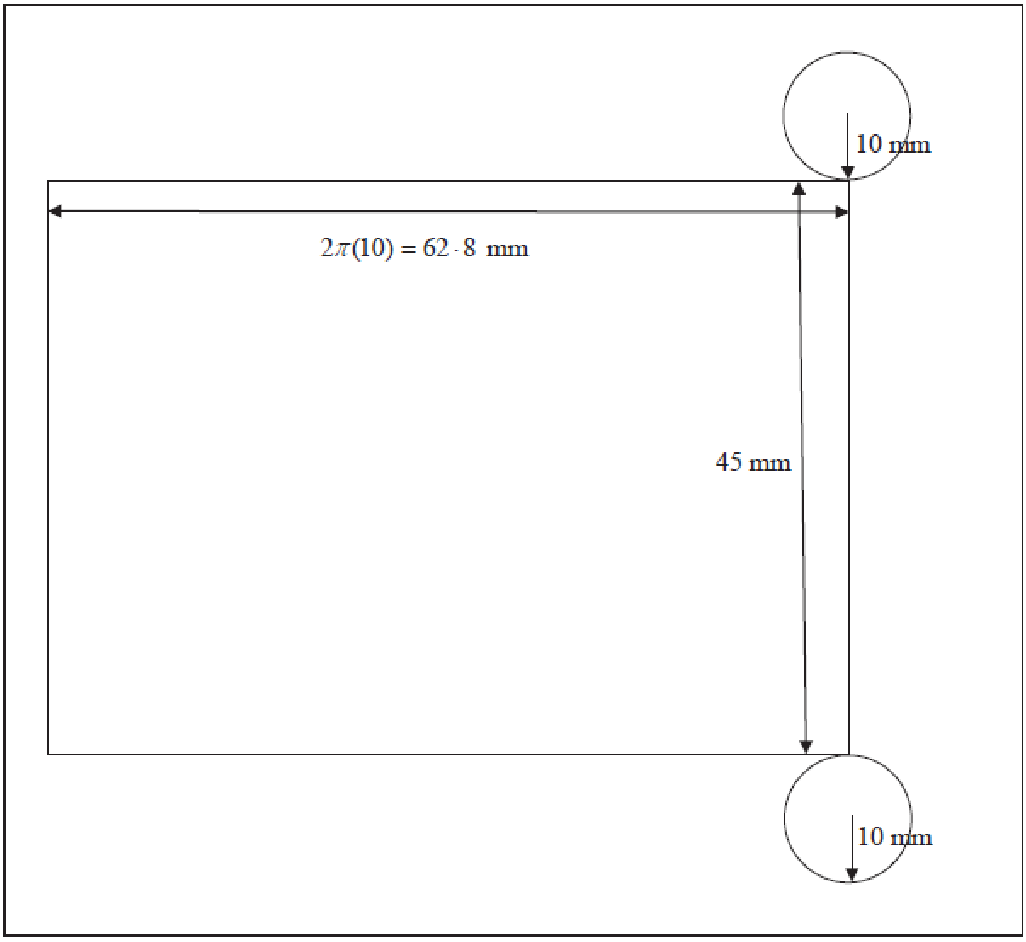
(f) Verify your answer to part **(e)** using your formulas from part **(c)**.

$d = 25 + \frac{1}{2}t = 10 + \frac{3}{4}t \Rightarrow \frac{1}{4}t = 15 \Rightarrow t = 60$ seconds

Question 5 **(25 marks)**

A solid cylinder has a radius of 10 mm and a height of 45 mm.

(a) Draw a sketch of the net of the surface of the cylinder and write its dimensions on the sketch.



(b) Calculate the volume of the cylinder. Give your answer in terms of π.

$$V = \pi r^2 h = \pi(10)^2(45) = 4500\pi \text{ mm}^3$$

(c) A sphere has the same volume as the cylinder.
Find the surface area of the sphere. Give your answer in terms of π.

$$\tfrac{4}{3}\pi r^3 = 4500\pi$$

$$\Rightarrow \quad r^3 = \frac{4500 \times 3}{4} = 3375$$

$$\Rightarrow \quad r = \sqrt[3]{3375} = 15 \text{ mm}$$

$$A = 4\pi r^2 = 4\pi(15)^2 = 900\pi \text{ mm}^2$$

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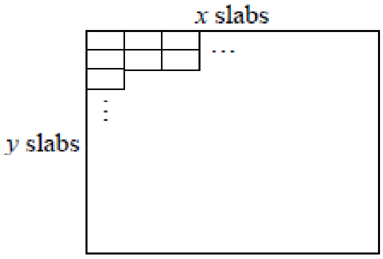
Question 9 Part b

(b) Garden paving slabs measure 40 cm by 20 cm. The slabs are to be arranged to form a rectangular paved area. There are x slabs along one side and y slabs along an adjacent side, as shown.



(i) Write the length of the perimeter, in centimetres, in terms of x and y.

$P = 2(40x + 20y)$ cm or $P = (80x + 40y)$ cm

(ii) The material being used for edging means that the perimeter is to be 64 metres. Find y in terms of x.

$P = 64\,\text{m} = 6400\,\text{cm}$

$\Rightarrow\ 80x + 40y = 6400$

$\Rightarrow\ 40y = 6400 - 80x$

$\Rightarrow\ y = 160 - 2x$

(iii) Find the value of x for which the paved area is as large as possible.

$$A = (40x)(20y)$$
$$= 800x(160 - 2x)$$
$$= 128000x - 1600x^2$$

$$\frac{dA}{dx} = 128000 - 3200x$$

Let $\frac{dA}{dx} = 0$

$\Rightarrow 128000 - 3200x = 0$

$\Rightarrow \quad x = 40$

(iv) Find the number of slabs needed to pave this maximum area.

$y = 160 - 2x = 80$

Number of slabs $= xy = 40(80)$

3200 slabs are needed.

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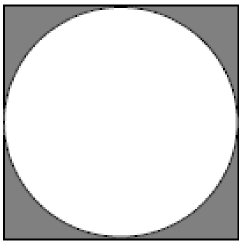
Question 5 **(25 marks)**

(a) The diagram shows a circle inscribed in a square.
The area of the square is 16 cm^2.



(i) Find the radius length of the circle.

$l^2 = 16 \Rightarrow l = 4 \Rightarrow \text{radius} = 2 \text{ cm}$

(ii) Find the area of the shaded region, in cm^2, correct to one decimal place.

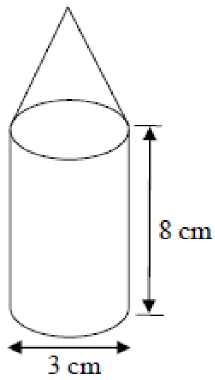
Shaded area: $16 - \pi(2)^2 = 16 - 12{\cdot}566 = 3{\cdot}433 = 3{\cdot}4 \text{ cm}^2$

(b) A solid wax candle is in the shape of a cylinder with a cone on top, as shown in the diagram.

The diameter of the base of the cylinder is 3 cm and the height of the cylinder is 8 cm.

The volume of the wax in the candle is $21\pi \text{ cm}^3$.

(i) Find the height of the candle.



Volume of cylinder = $\pi(1\cdot5)^2 8 = 18\pi$

Volume of cone $= 21\pi - 18\pi = 3\pi$

$\frac{1}{3}\pi r^2 h = 3\pi \Rightarrow \frac{1}{3}\pi(1\cdot5)^2 h = 3\pi \Rightarrow h = \frac{9}{2\cdot25} = 4$ cm

Height of candle: $8 + 4 = 12$ cm

(ii) Nine of these candles fit into a rectangular box. The base of the box is a square. Find the volume of the smallest rectangular box that the candles will fit into.

Square base $\Rightarrow$ 3 candles wide $\times$ 3 candles deep.

Dimensions of base = 3(3) $\times$ 3(3).

Area of base of box: $9 \times 9 = 81 \text{ cm}^2$

Height of box: 12 cm

Volume: $81 \times 12 = 972 \text{ cm}^3$