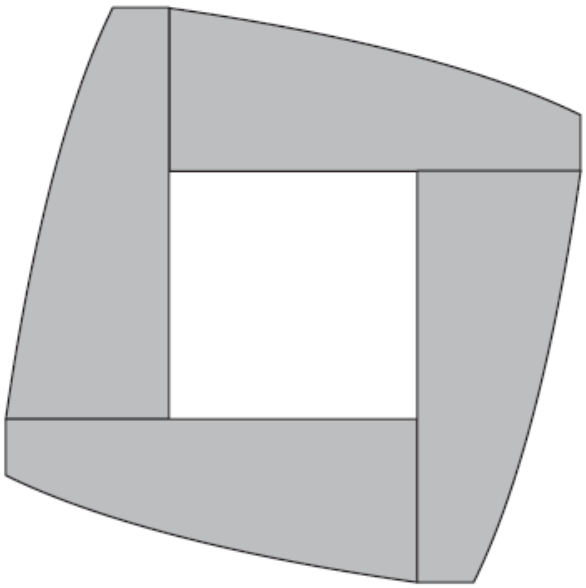
AQA – Numerical methods – A2 Mathematics P1

1. June/2020/Paper_1/No.11(b-c)

(b) Shape *B* is made from four copies of region *R* as shown in **Figure 4** below.

Figure 4



Shape *B* is cut from metal of thickness 2 mm

The metal has a density of 10.5 g/cm^3

Use the trapezium rule with **six** ordinates to calculate an approximate value of the mass of Shape *B*.

Give your answer to the nearest gram.

[5 marks]

(c) Without further calculation, give one reason why the mass found in part **(b)** may be:

(c) (i) an underestimate.

[1 mark]

(c) (ii) an overestimate.

[1 mark]

2. June/2020/Paper_1/No.14

The function f is defined by

$$f(x) = 3^x\sqrt{x} - 1 \qquad \text{where } x \geq 0$$

(a) $f(x) = 0$ has a single solution at the point $x = \alpha$

By considering a suitable change of sign, show that α lies between 0 and 1

[2 marks]

(b) (i) Show that

$$f'(x) = \frac{3^x(1 + x\ln 9)}{2\sqrt{x}}$$

[3 marks]

(b) (ii) Use the Newton–Raphson method with $x_1 = 1$ to find x_3, an approximation for α.

Give your answer to five decimal places.

[2 marks]

(b) (iii) Explain why the Newton–Raphson method fails to find α with $x_1 = 0$

[2 marks]

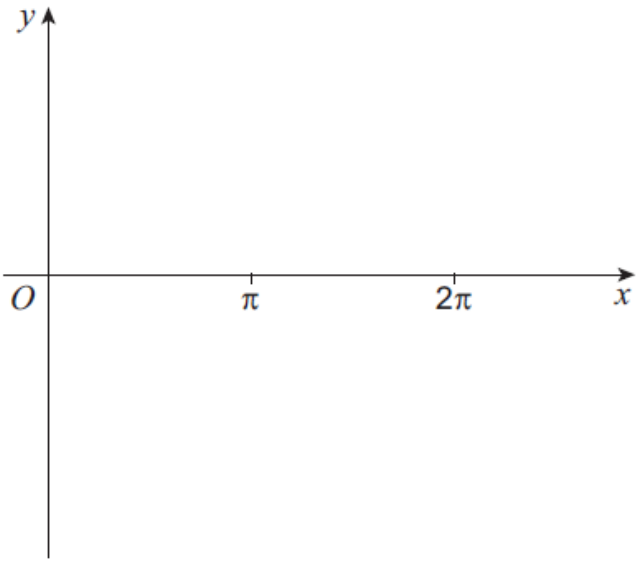
3. June/2019/Paper_1/No.7

(a) By sketching the graphs of $y = \frac{1}{x}$ and $y = \sec 2x$ on the axes below, show that the equation

$$\frac{1}{x} = \sec 2x$$

has exactly one solution for $x > 0$

[3 marks]



(b) By considering a suitable change of sign, show that the solution to the equation lies between 0.4 and 0.6

[2 marks]

(c) Show that the equation can be rearranged to give

$$x = \frac{1}{2}\cos^{-1} x$$

[2 marks]

(d) (i) Use the iterative formula

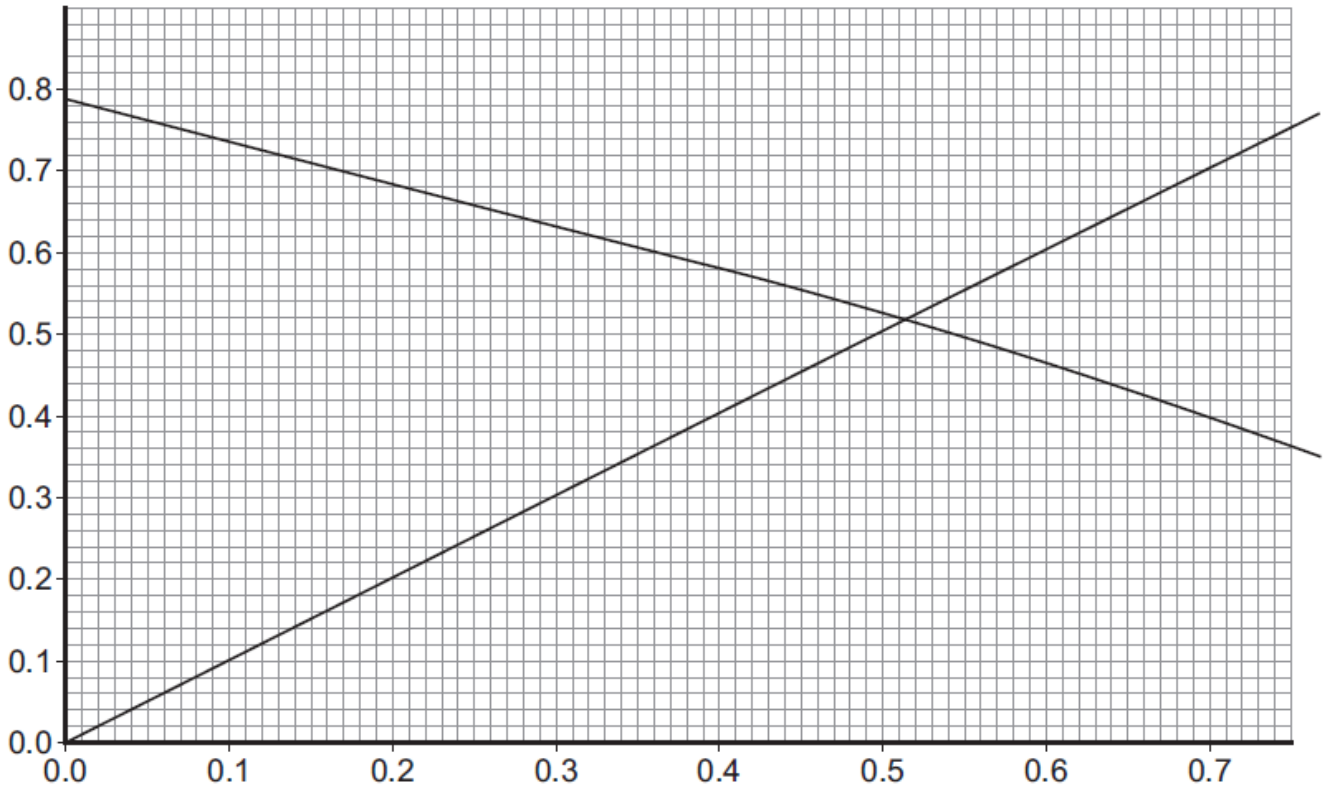
$$x_{n+1} = \frac{1}{2}\cos^{-1} x_n$$

with $x_1 = 0.4$, to find x_2, x_3 and x_4, giving your answers to four decimal places.

[2 marks]

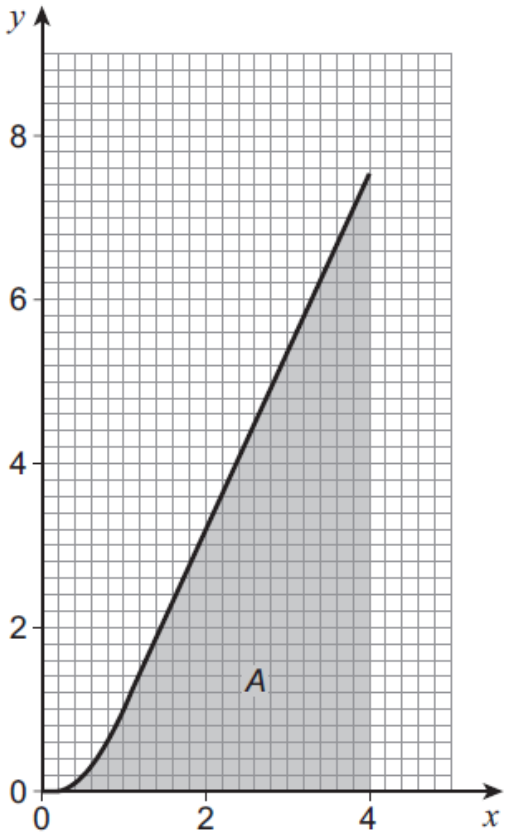
(d) (ii) On the graph below, draw a cobweb or staircase diagram to show how convergence takes place, indicating the positions of x_2, x_3 and x_4.

[2 marks]



4. June/2019/Paper_1/No.14

The graph of $y = \dfrac{2x^3}{x^2 + 1}$ is shown for $0 \leq x \leq 4$



Caroline is attempting to approximate the shaded area, A, under the curve using the trapezium rule by splitting the area into n trapezia.

(a) When $n = 4$

(a) (i) State the number of ordinates that Caroline uses.

[1 mark]

(a) (ii) Calculate the area that Caroline should obtain using this method.

Give your answer correct to two decimal places.

[3 marks]

(b) Show that the exact area of A is

$$16 - \ln 17$$

Fully justify your answer.

[5 marks]

(c) Explain what would happen to Caroline's answer to part **(a)(ii)** as $n \to \infty$

[1 mark]