Question 1:
Calculator Allowed: Yes

10. *[Maximum mark: 6]*

Find the set of values of x for which $\left|0.1x^2 - 2x + 3\right| < \log_{10} x$.

Question 2:
Calculator Allowed: Yes

3. [Maximum mark: 5]

A geometric sequence has a first term of 50 and a fourth term of 86.4.

The sum of the first n terms of the sequence is S_n.

Find the smallest value of n such that $S_n > 33\,500$.

Question 3:
Calculator Allowed: Yes

5. [Maximum mark: 9]

The sum of the first n terms of a geometric sequence is given by $S_n = \sum_{r=1}^{n} \frac{2}{3}\left(\frac{7}{8}\right)^r$.

(a) Find the first term of the sequence, u_1. [2]

(b) Find S_∞. [3]

(c) Find the least value of n such that $S_\infty - S_n < 0.001$. [4]

Question 4:
Calculator Allowed: Yes

2. [Maximum mark: 6]

On 1st January 2020, Laurie invests P in an account that pays a nominal annual interest rate of 5.5%, compounded **quarterly**.

The amount of money in Laurie's account **at the end of each year** follows a geometric sequence with common ratio, r.

(a) Find the value of r, giving your answer to four significant figures. [3]

Laurie makes no further deposits to or withdrawals from the account.

(b) Find the year in which the amount of money in Laurie's account will become double the amount she invested. [3]

Question 5:
Calculator Allowed: Yes

[Maximum mark: 7]

The function f is given by $f(x) = \dfrac{3x^2 + 10}{x^2 - 4}$, $x \in \mathbb{R}$, $x \neq 2$, $x \neq -2$.

(a) Prove that f is an even function. [2]

(b) (i) Sketch the graph $y = f(x)$.

    (ii) Write down the range of f. [5]

Question 6:
Calculator Allowed: Yes

6. [Maximum mark: 8]

(a) Prove the identity $(p + q)^3 - 3pq(p + q) \equiv p^3 + q^3$. [2]

The equation $2x^2 - 5x + 1 = 0$ has two real roots, α and β.

Consider the equation $x^2 + mx + n = 0$, where $m, n \in \mathbb{Z}$ and which has roots $\dfrac{1}{\alpha^3}$ and $\dfrac{1}{\beta^3}$.

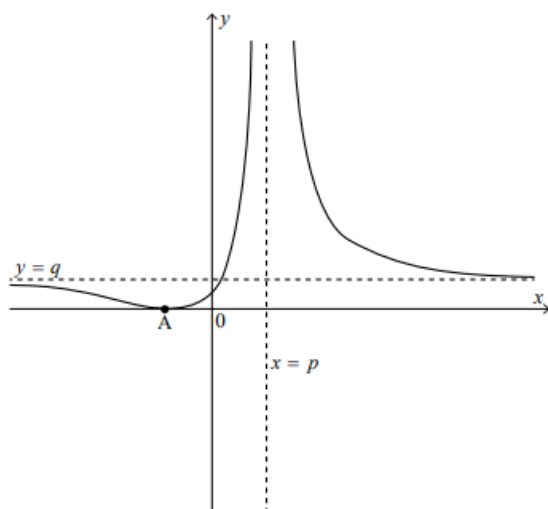(b) Without solving $2x^2 - 5x + 1 = 0$, determine the values of m and n. [6]

Question 7:
Calculator Allowed: Yes

[Maximum mark: 8]

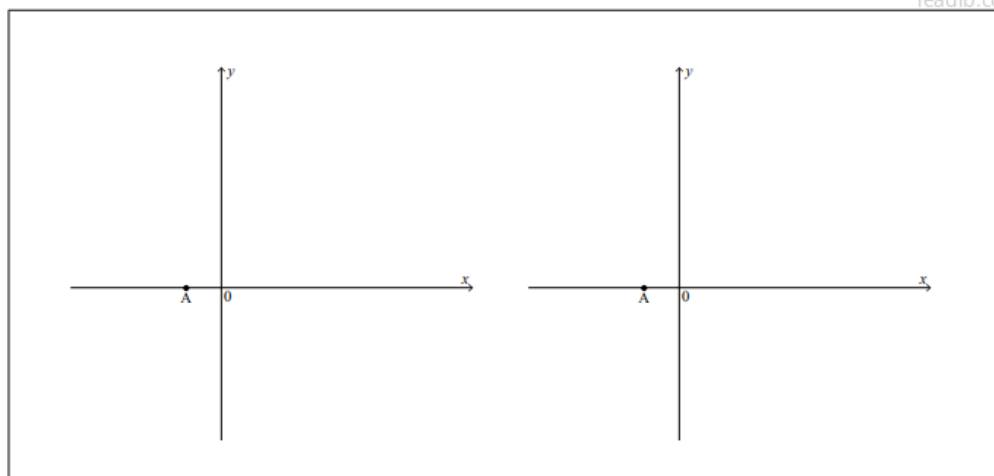Consider the function $f(x) = \dfrac{ax + 1}{bx + c}$, $x \neq -\dfrac{c}{b}$, where $a, b, c \in \mathbb{Z}$.

The following graph shows the curve $y = (f(x))^2$. It has asymptotes at $x = p$ and $y = q$ and meets the x-axis at A.

(a) On the following axes, sketch the two possible graphs of $y = f(x)$ giving the equations of any asymptotes in terms of p and q.   [4]

(b) Given that $p = \dfrac{4}{3}$, $q = \dfrac{4}{9}$ and A has coordinates $\left(-\dfrac{1}{2}, 0\right)$, determine the possible sets of values for a, b and c.   [4]
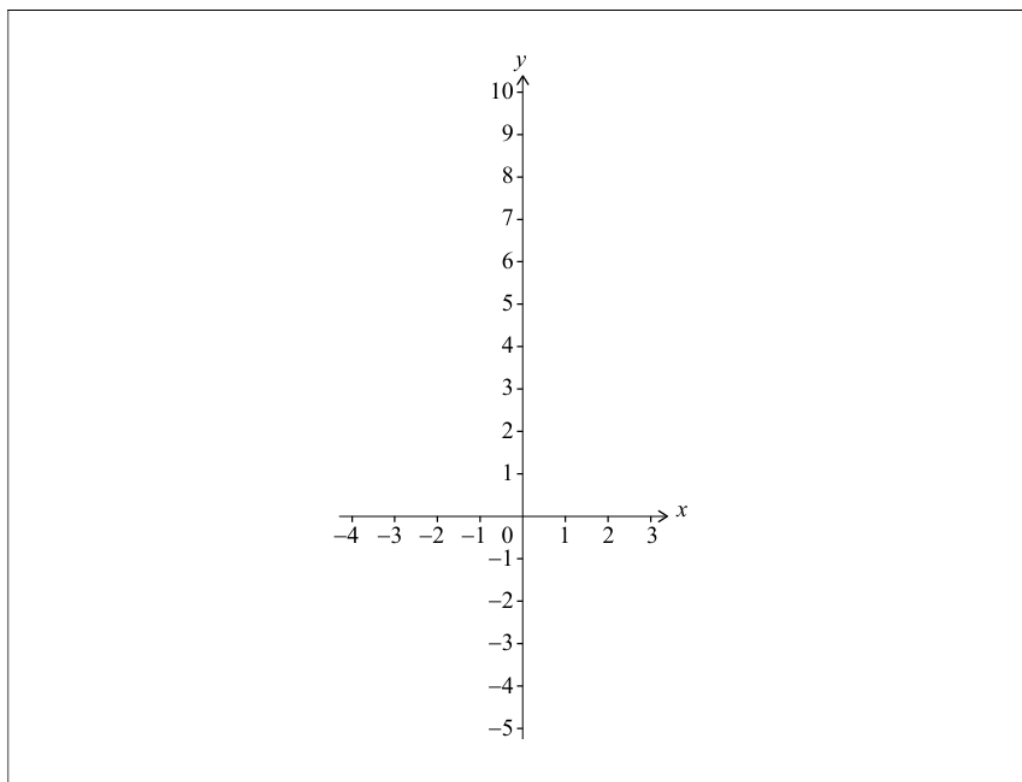
Question 8:
Calculator Allowed: Yes

2. [Maximum mark: 5]

Consider the function $f(x) = e^x - 3x - 4$.

(a) On the following axes, sketch the graph of f for $-4 \leq x \leq 3$. [3]

The function g is defined by $g(x) = e^{2x} - 6x - 7$.

(b) The graph of g is obtained from the graph of f by a horizontal stretch with scale factor k, followed by a vertical translation of c units.

Find the value of k and the value of c. [2]

Question 9:
Calculator Allowed: Yes

[Maximum mark: 5]

(a) Sketch the graph of $y = (x-5)^2 - 2|x-5| - 9$, for $0 \leq x \leq 10$. [3]

(b)   Hence, or otherwise, solve the equation $(x-5)^2 - 2|x-5| - 9 = 0$.

[2]

Question 10:
Calculator Allowed: Yes

9.   *[Maximum mark: 6]*

Let $f(x) = \dfrac{4 - x^2}{4 - \sqrt{x}}$.

(a)   State the largest possible domain for f.   *[2 marks]*

(b)   Solve the inequality $f(x) \geq 1$.   *[4 marks]*