P1 Graphs and Transformations: exam questions

10 questions · 28 marks · full mark schemes

Name _____ Date _____ Score / 28

- Sketching cubics, quartics and reciprocals; transformations of graphs (translations, stretches, reflections); function notation.
- Try every question before you look at the mark schemes. They start after the questions: M marks for method, A marks for accuracy, B marks for a correct result on its own.
- Online, with more practice: alevelmathrevision.com/alevel-frontend/units/p1/graphs-transformations-questions

1. **2 marks · warm-up**

State the equations of the asymptotes for the graph of $y = \frac{6}{x^2}$. Also, state the range of y.

2. **2 marks · warm-up**

Given $f(x) = \frac{1}{x}$, state the equations of the asymptotes for the graph of $y = f(x - 4) + 2$.

3. **2 marks · standard**

A curve has the equation $y = f(x)$. Describe fully the single geometric transformation that maps the graph of $y = f(x)$ onto the graph of $y = f(x + 6)$.

4. 2 marks · standard

If $f(x) = 2x^2 + x$, find the equation for $y = f(2x)$ in its simplest form.

5. 3 marks · standard

The graph of $y = \frac{k}{x^2}$ passes through the point $(2, 5)$. Find the value of k and state the value of y when $x = -2$.

6. 4 marks · standard

Find the exact coordinates of the points of intersection of the curves $y = \frac{12}{x}$ and $y = x - 4$.

7. 3 marks · harder

Show that the curve $y = (x - 3)(x^2 + x + 2)$ crosses the x-axis at exactly one point.

8. 3 marks · harder

The curve $y = x^2 - 4x$ is transformed to the curve $y = 5(x^2 - 4x)$. Find the coordinates of the turning point of the new curve.

9. 3 marks · harder

The curve $y = \frac{1}{x}$ is translated by the vector $\begin{pmatrix} 3 \\ -2 \end{pmatrix}$. Write down the equation of the new curve.

10. 4 marks · harder

Show that the line $y = 2x - 7$ does not intersect the curve $y = x^2 - 3x + 5$.

Answers and worked solutions

Question 1 — 2 marks

1. M1 for identifying the asymptotes as the axes: $x = 0$ and $y = 0$.
2. A1 for stating the range is $y > 0$.

Question 2 — 2 marks

1. M1 for recognising the translation by the vector $\begin{pmatrix} 4 \\ 2 \end{pmatrix}$.
2. A1 for stating the asymptotes are $x = 4$ and $y = 2$.

Question 3 — 2 marks

1. M1 for identifying the transformation as a translation.
2. A1 for specifying it is a translation by the vector $\begin{pmatrix} -6 \\ 0 \end{pmatrix}$ (or 6 units to the left).

Question 4 — 2 marks

1. M1 for substituting $2x$ into the expression: $2(2x)^2 + (2x)$.
2. A1 for expanding and simplifying to get $y = 8x^2 + 2x$.

Question 5 — 3 marks

1. M1 for substituting the coordinates into the equation: $5 = \frac{k}{2^2}$.
2. A1 for finding $k = 20$.
3. A1 for calculating $y = \frac{20}{(-2)^2} = 5$ (or recognising the symmetry of the graph).

Question 6 — 4 marks

1. M1 for equating the functions: $\frac{12}{x} = x - 4$.
2. M1 for multiplying by x and rearranging into a quadratic: $x^2 - 4x - 12 = 0$.
3. M1 for solving the quadratic: $(x - 6)(x + 2) = 0 \implies x = 6$ or $x = -2$.
4. A1 for substituting back to find the full coordinates: $(6, 2)$ and $(-2, -6)$.

Question 7 — 3 marks

1. M1 for setting $y = 0$ and identifying the root $x = 3$.
2. M1 for considering the quadratic factor $x^2 + x + 2 = 0$ and checking its discriminant: $b^2 - 4ac = 1^2 - 4(1)(2) = -7$.
3. A1 for concluding that since the discriminant is negative ($-7 < 0$), the quadratic has no real roots, so $x = 3$ is the only point where the curve crosses the x-axis.

Question 8 — 3 marks

1. M1 for finding the turning point of the original curve by completing the square or differentiation: $y = (x - 2)^2 - 4$, so turning point is $(2, -4)$.
2. M1 for applying the vertical stretch of scale factor 5 to the y-coordinate.
3. A1 for the new turning point coordinates $(2, -20)$.

Question 9 — 3 marks

1. M1 for replacing x with $x - 3$ to represent the horizontal translation.
2. M1 for subtracting 2 from the entire function to represent the vertical translation.
3. A1 for the correct equation $y = \frac{1}{x-3} - 2$.

Question 10 — 4 marks

1. M1 for equating the line and the curve: $x^2 - 3x + 5 = 2x - 7$.
2. M1 for rearranging into a quadratic equation: $x^2 - 5x + 12 = 0$.
3. M1 for calculating the discriminant: $b^2 - 4ac = (-5)^2 - 4(1)(12) = 25 - 48 = -23$.
4. A1 for concluding that since the discriminant is less than zero, there are no real roots, and thus no points of intersection.

More graphs and transformations practice with instant feedback: alevelmathrevision.com/alevel-frontend/units/p1/graphs-transformations-questions

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