IB MATHS AA HL · UNIT 2

Transformations of graphs: exam practice

10 questions · 29 marks · worked solutions and markschemes

Name _____ Date _____ Score / 29

- Answer every question before you look at the solutions. They start after the last question, with the marks for each line: M for method, A for accuracy, R for reasoning.
- Online, with more practice: ibmathrevision.com/hlaa/transformations-of-graphs-exam-practice

1. **2 marks · Paper 1 style · no calculator**

The graph of $y = x^3$ is translated by $\begin{pmatrix} 2 \\ -5 \end{pmatrix}$.

Write down the equation of the new graph. **[2]**

2. **2 marks · Paper 1 style · no calculator**

The graph of $y = \sqrt{x}$ is translated so that its end point moves from $(0, 0)$ to $(-3, 2)$.

Write down the equation of the new graph. **[2]**

3. **2 marks · Paper 1 style · no calculator**

The graph of $y = f(x)$ has a minimum point at $(-1, 3)$.

Find the minimum point of $y = 2f(x + 4) - 7$. **[2]**

4. **3 marks · Paper 1 style · no calculator**

Let $f(x) = x^2 + 2x$. The graph of g is obtained from the graph of f by a reflection in the y-axis followed by a translation of 3 units down.

Find $g(x)$ in the form $ax^2 + bx + c$. **[3]**

5. **3 marks · Paper 1 style · no calculator**

The graph of $y = \sin x$ is stretched horizontally by a factor of $\frac{1}{3}$ and vertically by a factor of 4.

Write down the new equation and its period. **[3]**

6. **3 marks · Paper 1 style · no calculator**

Let $f(x) = x^2 - 6x + 10$. The graph of f is translated by $\begin{pmatrix} a \\ b \end{pmatrix}$ so that its vertex is at the origin.

Find a and b. **[3]**

7. **3 marks · Paper 2 style · calculator**

The graph of $y = f(x)$ is mapped to $y = f(2x + 6)$.

Describe the two transformations in a correct order. **[3]**

8. **3 marks · Paper 1 style · no calculator**

The graph of $y = e^x$ is stretched vertically by factor 5 and then reflected in the x-axis.

(a) Write down the equation of the new graph. **[1]**

(b) Write down its y-intercept and range. **[2]**

9. **4 marks · Paper 1 style · no calculator**

The point $A(6, -4)$ lies on the graph of $y = f(x)$.

(a) Find the image of A on $y = 3f(x)$. **[1]**

(b) Find the image of A on $y = f\left(\frac{x}{2}\right)$. **[1]**

(c) Find the image of A on $y = f(3x) - 1$. **[2]**

10. **4 marks · Paper 2 style · calculator**

The graph of $y = \frac{1}{x}$ is stretched horizontally by a factor of 3 and then translated 2 units to the right.

(a) Write down the equation of the new graph. **[2]**

(b) Write down the equations of its asymptotes. **[2]**

Answers and worked solutions

Question 1 — 2 marks

Answer: $y = (x-2)^3 - 5$

$y = (x-2)^3 - 5$ **A2**

Question 2 — 2 marks

Answer: $y = \sqrt{x+3} + 2$

$y = \sqrt{x+3} + 2$ **A2**

Question 3 — 2 marks

Answer: $(-5, -1)$

$x = -1 - 4 = -5$ **A1**

$y = 2(3) - 7 = -1$ **A1**

Question 4 — 3 marks

Answer: $g(x) = x^2 - 2x - 3$

$f(-x) = x^2 - 2x$ **A1**

-3 **M1**

$g(x) = x^2 - 2x - 3$ **A1**

Question 5 — 3 marks

Answer: $y = 4\sin 3x$; period $\frac{2\pi}{3}$

$y = 4\sin 3x$ **A2**

period $\frac{2\pi}{3}$ **A1**

Question 6 — 3 marks

Answer: $a = -3$, $b = -1$

$f(x) = (x-3)^2 + 1$ $M1$**A1**

$a = -3$, $b = -1$ **A1**

Question 7 — 3 marks

Answer: translate by $\begin{pmatrix} -3 \\ 0 \end{pmatrix}$, then stretch horizontally by factor $\frac{1}{2}$

$f(2(x+3))$ **M1**

translation $\begin{pmatrix} -3 \\ 0 \end{pmatrix}$ **A1**

then horizontal stretch scale factor $\frac{1}{2}$ (about the $y-$axis) **A1**

Question 8 — 3 marks

Answer: (a) $y = -5e^x$; (b) $(0, -5)$; $y < 0$

(a)

$y = -5e^x$ **A1**

(b)

$(0, -5)$ **A1**

$y < 0$ **A1**

Question 9 — 4 marks

Answer: (a) $(6, -12)$; (b) $(12, -4)$; (c) $(2, -5)$

(a)

$(6, -12)$ **A1**

(b)

$(12, -4)$ **A1**

(c)

$x = 2$ **A1**

$(2, -5)$ **A1**

Question 10 — 4 marks

Answer: (a) $y = \frac{3}{x-2}$; (b) $x = 2$, $y = 0$

(a)

$y = \frac{3}{x}$ **A1**

$y = \frac{3}{x-2}$ **A1**

(b)

$x = 2$ **A1**

$y = 0$ **A1**

Every solution is also on ibmathrevision.com/hlaa/transformations-of-graphs-exam-practice
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