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GCSE MATHEMATICS • ALGEBRA

Functions

Worked Solutions

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • No calculator

Full worked solutions for the free Functions worksheet, GCSE and iGCSE Maths



Tap a section to jump straight to it

Full worked solutions for every question on the Functions worksheet, in the same order and with the same question numbers.

How to mark your work. Tick each step you got right, not just the final answer. In the exam, method marks are given for correct working even when the final answer is wrong. If you lost marks, find the *first* line where your working is different from ours. That is the thing to fix.

In Section E: **M** = method mark, **P** = process mark, **A** = accuracy mark, **B** = independent mark, **C** = communication mark.

Question sheet

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A**Your turn answers**

Compare each line of your working with the solution.

FOUNDATION

A1 Forwards: $(11 - 5) \times 2 = 12$ Backwards: $30 \div 2 + 5 = 20$

A2 $g(2) = 10 - 6 = 4$ $g(-2) = 10 + 6 = 16$

A3 $\frac{12}{1}, \frac{12}{2}, \dots: 12, 6, 4, 3, 2$

HIGHER

A4 $gf(x) = g(2x) = (2x)^2 - 1 = 4x^2 - 1$

A5 $y = \frac{x+3}{2}$, so $2y = x+3$ and $x = 2y - 3$ $f^{-1}(x) = 2x - 3$

A6 $-f(x)$ reflects in the x -axis: $(-1, -4)$ $f(-x)$ reflects in the y -axis: $(1, 4)$

A7 $fg(x) = x^2 - 1 = 8$, so $x^2 = 9$ $x = 3$ or $x = -3$

B**Fluency solutions**One mark for each correct part. The notes in *italics* explain why each sequence was chosen.**FOUNDATION**

B1 (a) 10 (b) -5 (c) $(13+2) \div 3 = 5$ (d) $(-8+2) \div 3 = -2$ *Backwards: reverse each step and the order.*

B2 (a) 3 (b) $5+6 = 11$ (c) 4 (d) $5 - 2x = -9$, $2x = 14$: $x = 7$

B3 (a) 5 (b) 5 (c) -4 (d) $x^2 = 16$: $x = 4$ or $x = -4$ *x and $-x$ give the same output here.*



B4 (a) $8 - 2 = 6$ (b) $-8 + 2 = -6$ (c) 2 (d) -3

B5 P: $y = x^2 - 1$ Q: $y = x^3$ R: $y = \frac{1}{x}$ A U shape; an S shape through O; two separate curves.

B6 (a) $2(x+3)$ (b) $2x+3$ (c) $2x+6$ is always 3 more than $2x+3$, so **never** (d) $\frac{x-3}{2}$

HIGHER

B7 (a) $f(2) = 5$ (b) $g(4) = 8$ (c) $2x+3$ (d) $2(x+3) = 2x+6$ The order matters.

B8 (a) $x-7$ (b) $\frac{x}{5}$ (c) $\frac{x+4}{3}$ (d) $y = 2(x-1)$, $x = \frac{y}{2} + 1$: $\frac{x}{2} + 1$

B9 (a) up 4: $(3, 2)$ (b) right 2: $(5, -2)$ (c) reflect in the x -axis: $(3, 2)$ (d) reflect in the y -axis: $(-3, -2)$

B10 (a) 8 (b) 1 (c) $\frac{1}{2}$ (d) $32 = 2^5$: $x = 5$

C

Reasoning solutions

Your wording can be different. Check that your reason makes the same point.

FOUNDATION

C1 Tom multiplied by 3 before squaring. Square first: $(-2)^2 = 4$, then $3 \times 4 = 12$

C2 The steps must also be undone in reverse order: subtract 1 first, then divide by 4

C3 $\frac{1}{0}$ is not defined, so there is no point at $x = 0$. $\frac{1}{x}$ is never 0, because 1 divided by any number is not 0, so the graph never meets the x -axis.

C4 Machine A: $2(x+5) = 2x+10$. Machine B: $2x+10$. They are the same expression, so they always agree.



HIGHER

C5 $fg(x) = x^2 + 1$ but $gf(x) = (x+1)^2 = x^2 + 2x + 1$. For example, when $x = 1$ they give 2 and 4

C6 $\frac{1}{f(x)}$ is the reciprocal, not the inverse. Solve $y = 2x + 6$ for x :

$$f^{-1}(x) = \frac{x-6}{2}$$

C7 $f^{-1}(x) = 3x - 4$ $f(f^{-1}(x)) = \frac{(3x-4)+4}{3} = \frac{3x}{3} = x$

as required

C8 (a) $(x-3)^2 + 1$

(b) $y = (x-3)^2 + 1$, so $x-3 = \sqrt{y-1}$ (the positive root, since $x \geq 3$)

$$f^{-1}(x) = 3 + \sqrt{x-1}$$

Without $x \geq 3$, two inputs give each output, so f would have no inverse.

D

Problem solving solutions

There is often more than one correct method. Any complete, correct method scores full marks.

FOUNDATION

D1 Reverse: $(10.90 - 2.50) \div 1.20 = 8.40 \div 1.20 = 7$ km

D2 $3x - 5 = 2(x+1)$ $3x - 5 = 2x + 2$ $x = 7$ output 16

D3 $x^2 + 1 = 5x - 3$ $x^2 - 5x + 4 = 0$ $(x-1)(x-4) = 0$ $x = 1$ or $x = 4$

D4 (a) $3 = \frac{12}{a}$, so $a = 4$ $b = \frac{12}{4} = 3$

(b) The factor pairs of 12: (1, 12), (2, 6), (3, 4), (4, 3), (6, 2), (12, 1) 6 points

HIGHER

D5 $f^{-1}(x) = \frac{x-1}{2}$ $2a+1 = \frac{a-1}{2}$ $4a+2 = a-1$ $a = -1$

D6 (a) left 2: $(-3, 4)$ (b) reflect in the x -axis: $(-1, -4)$ (c) (0, 3) moves down 3: $(0, 0)$



D7 (a) $f(3x - 2) = 3(3x - 2) - 2 = 9x - 8$ (b) $9x - 8 = x$ $x = 1$

D8 $2^x \times 2^{x+1} = 2^{2x+1}$ $128 = 2^7$ $2x + 1 = 7$ $x = 3$

E

Exam practice solutions

Marks are shown on the right of each line.

FOUNDATION

Foundation and Higher crossover

E1 (a) 11 B1

(b) $(20 + 4) \div 3 = 8$ B1

E2 (a) $2 \times 16 - 3 = 29$ B1

(b) $2 - 3 = -1$ B1

(c) $2x^2 = 18$: $x = 3$ or $x = -3$ B1

E3 Graph 1: C Graph 2: D Graph 3: A Graph 4: B B2

E4 (a) $5(x + 2)$ B1

(b) $5x + 10 = x$ M1

$x = -2.5$ A1

E5 y: $-2, 2, 0, -2, 2$ B3

B2 for 4 correct, B1 for 2 or 3 correct

E6 $f(2) + 12 = 13 + 12 = 25$ M1

$3x + 7 = 25$: $x = 6$ A1

HIGHER

E7 (a) $f(9) = 19$ B1

(b) $(2x + 1)^2$ M1

$4x^2 + 4x + 1$ A1



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E8 $y = \frac{3x-2}{5}$, so $5y = 3x - 2$ M1

$x = \frac{5y+2}{3}$ M1

$f^{-1}(x) = \frac{5x+2}{3}$

A1

E9 (a) $(2, 2)$ B1

(b) $(6, -1)$ B1

(c) $(2, 1)$ B1

(d) $(-2, -1)$ B1

E10 (a) $y = 3x - 1$, so $x = \frac{y+1}{3}$ M1

$f^{-1}(x) = \frac{x+1}{3}$

A1

(b) $\frac{x+1}{3} = \frac{2}{x}$ M1

$x^2 + x - 6 = 0$, $(x+3)(x-2) = 0$ M1

$x = 2$ or $x = -3$ A1

