



3.13H Substitution: Higher Tier Practice

EDEXCEL Edexcel 1MA1 · Calculator allowed · about 65 minutes

Total Marks

Name: _____ Date: ____ / ____ / ____

Answer ALL questions. Show all your working.

- 1 Evaluate the expression $3x^2 - 2x + 5$ when $x = -1$.

(Total for Question 1 is 1 mark)

- 2 Given $f(t) = 2t^3 - t^2 + 4$ and $t = 0.5$, find $f(t)$. Give your answer as a decimal.

(Total for Question 2 is 1 mark)

- 3 Substitute $x = 3$ and $y = -2$ into the expression $5x - 2y$ and simplify.

(Total for Question 3 is 2 marks)

- 4 A formula for the area A of an isosceles triangle is $A = (1/2)bh$ where b is the base and h is the height. A triangle has $b = 8x$ and $h = x + 3$. Write an expression for A in terms of x and simplify fully.

(Total for Question 4 is 3 marks)

- 5 The temperature T in degrees C is given by $T = 20 - 5k$, where k is a constant. If $k = (2p - 1)/4$ and $p = 5$, find T .

(Total for Question 5 is 3 marks)

- 6 Let $g(x) = 4 - 3x$. Find x such that $g(x) = 13$. Show your working.

(Total for Question 6 is 4 marks)

- 7 $H(p) = p^2 - 6p + 8$. Given $p = 3 + 2t$, expand $H(p)$ fully in terms of t and simplify.

(Total for Question 7 is 5 marks)

- 8 Show that if $f(x) = ax + b$ and $g(x) = 2x - 5$, then the composite function $f(g(x))$ equals 2.5 when $x = 3$, given $a = 2$ and $b = 0.5$. You must show substitution and evaluation.

(Total for Question 8 is 6 marks)

- 9** A scientist models mass m (in kg) by $m = c r^2$ where c is a constant and r is the radius in metres. Given $c = 0.75$ and $r = 2k + 1$ where $k = 2$, find m and give your answer in the form a/b or simplified fraction where appropriate.

(Total for Question 9 is 8 marks)

- 10** Given the expression $E = (2x + 1)/(x - 1)$. Show that $E = 5$ when $x = 2$. Then find the value of x (if any) for which $E = 2$. You must show all algebraic steps.

(Total for Question 10 is 7 marks)

Mark scheme · 3.13H Substitution: Higher Tier Practice

Question 1

- **B1** $3(-1)^2 - 2(-1) + 5 = 3 + 2 + 5 = 10$ cao
- **Answer: 10**

Question 2

- **B1** $2(0.5)^3 - (0.5)^2 + 4 = 2(0.125) - 0.25 + 4 = 0.25 - 0.25 + 4 = 4.0$ cao
- **Answer: 4.0**

Question 3

- **M1** substitute values: $5 \cdot 3 - 2 \cdot (-2)$ or equivalent
- **A1** 19 cao
- **Answer: 19**

Question 4

- **M1** substitute $A = (1/2) \cdot 8x \cdot (x+3)$ or show $(1/2) \cdot 8x \cdot (x+3)$
- **M1** simplify $(1/2) \cdot 8x \cdot (x+3)$ to $4x(x+3)$ or show distribution step
- **A1** $4x^2 + 12x$ cao
- **Answer: $4x^2 + 12x$**

Question 5

- **M1** substitute p into k: $k = (2 \cdot 5 - 1)/4 = (10 - 1)/4 = 9/4$
- **M1** substitute k into T: $T = 20 - 5 \cdot (9/4)$ or $20 - 45/4$
- **A1** $35/4$ or 8.75 cao
- **Answer: $35/4$ or 8.75**

Question 6

- **M1** set $4 - 3x = 13$ and rearrange to linear form
- **M1** subtract 4: $-3x = 9$
- **M1** divide both sides by -3 to get $x = -3$
- **A1** $x = -3$ cao
- **Answer: $x = -3$**

Question 7

- **M1** substitute $p = 3+2t$ into $p^2 - 6p + 8$
- **M1** expand $(3+2t)^2 = 9 + 12t + 4t^2$
- **M1** expand $-6(3+2t) = -18 - 12t$
- **M1** collect terms correctly
- **A1** $4t^2 - 1$ cao
- **Answer: $4t^2 - 1$**

Question 8

- **M1** state $g(x)=2x-5$ and substitute into f: $f(g(x)) = a(2x-5)+b$
- **M1** substitute $a=2$ and $b=0.5$ to get $2(2x-5)+0.5$
- **M1** simplify to $4x - 10 + 0.5 = 4x - 9.5$
- **M1** substitute $x=3$ to evaluate: $4 \cdot 3 - 9.5$
- **M1** calculate $12 - 9.5 = 2.5$
- **A1** state final evaluation equals 2.5 cao, confirming the given target value
- **Answer: 2.5**

Question 9

- **M1** substitute $k = 2$ into $r = 2k + 1$ to get $r = 5$
- **M1** state $m = c r^2$ and substitute r : $m = 0.75 * 5^2$
- **M1** compute $r^2 = 25$
- **M1** compute $0.75 * 25 = 18.75$
- **M1** convert 0.75 to fraction $3/4$ and show $3/4 * 25$
- **M1** compute fraction $3/4 * 25 = 75/4$
- **M1** simplify fraction if needed and include units
- **A1** $75/4$ kg cao
- **Answer: $75/4$ kg or 18.75 kg**

Question 10

- **M1** substitute $x = 2$: $(2*2 + 1)/(2 - 1) = (4 + 1)/1$
- **M1** calculate numerator and denominator to show $5/1 = 5$
- **M1** for $E = 2$, multiply both sides by $(x - 1)$: $2x + 1 = 2(x - 1)$
- **M1** expand and rearrange to show contradiction: $2x + 1 = 2x - 2$ gives $1 = -2$
- **B1** state domain restriction $x \neq 1$ or note that $x = 1$ would make denominator zero
- **M1** deduce from $1 = -2$ that no solution exists
- **A1** conclude there is no value of x satisfying $E = 2$, cao
- **Answer: $E = 5$ when $x = 2$. There is no solution for $E = 2$ (contradiction $1 = -2$), with $x \neq 1$ noted.**