



AQA Qualifications

AQA Level 2 Certificate

FURTHER MATHEMATICS

Level 2 (8365)

Mark Scheme
Worksheet 10
Factor Theorem

Our specification is published on our website (www.aqa.org.uk). We will let centres know in writing about any changes to the specification. We will also publish changes on our website. The definitive version of our specification will always be the one on our website, this may differ from printed versions.

You can download this resource from our All About Maths website (<http://allaboutmaths.aqa.org.uk/>).

Copyright © 2018 AQA and its licensors. All rights reserved.

AQA retains the copyright on all its publications, including the specifications. However, registered centres for AQA are permitted to copy material from this specification booklet for their own internal use.

AQA Education (AQA) is a registered charity (number 1073334) and a company limited by guarantee registered in England and Wales (number 3644723). Our registered address is AQA, Devas Street, Manchester M15 6EX.

Glossary for Mark Schemes

These examinations are marked in such a way as to award positive achievement wherever possible. Thus, for these papers, marks are awarded under various categories.

- M** Method marks are awarded for a correct method which could lead to a correct answer.
- A** Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied.
- B** Marks awarded independent of method.
- M Dep** A method mark dependent on a previous method mark being awarded.
- B Dep** A mark that can only be awarded if a previous independent mark has been awarded.
- ft** Follow through marks. Marks awarded following a mistake in an earlier step.
- SC** Special case. Marks awarded within the scheme for a common misinterpretation which has some mathematical worth.
- oe** Or equivalent. Accept answers that are equivalent.
eg, accept 0.5 as well as $\frac{1}{2}$

10 Factor Theorem

Question	Answer	Mark	Comments
1(a)	$x(x^2 - 5x - 36)$	B1	
1(b)	$x = 0, x = -4, x = 9$	B2	B1 For two solutions
2(a)	$f(1) = 1 + 2 - 5 - 6 = -8$	B1	
	$f(-1) = -1 + 2 + 5 - 6 = 0$	B1	
2(b)	$f(2) = 8 + 8 - 10 - 6 = 0$	B1	
	$f(-2) = -8 + 8 + 10 - 6 = 4$	B1	
2(c)	$f(3) = 27 + 18 - 15 - 6 = 24$	B1	
	$f(-3) = -27 + 18 + 15 - 6 = 0$	B1	
2(d)	$(x + 1), (x - 2)$ and $(x + 3)$	B1	

Question	Answer	Mark	Comments
3(a)	$(-5)^3 + 7(-5)^2 + 2(-5) - 40$	M1	oe
	$-125 + 175 - 10 - 40 = 0$	A1	Clearly shown to = 0
3(b)	$x^3 + 7x^2 + 2x - 40$	M1	Sight of x^2 and -8 in a quadratic factor
	$\equiv (x + 5)(x^2 + kx - 8)$		
	$(x - 2)$	A1	
	$(x + 4)$	A1	
Alt 1 3(b)	Substitutes another value into the expression and tests for '= 0'	M1	
	$(x - 2)$	A1	
	$(x + 4)$	A1	
Alt 2 3(b)	Long division of polynomials getting as far as $x^2 + 2x$	M1	
	$(x - 2)$	A1	
	$(x + 4)$	A1	
3(c)	$(x =) -5, -4$ and 2	B1	
4	$(-2)^3 + 5(-2)^2 + 9(-2) + k = 0$	M1	
	$-8 + 20 - 18 + k = 0$	A1	
	$k = 6$	A1	

Question	Answer	Mark	Comments
5(a)	$(-3)^3 + (-3)^2 + (-3)a - 72 = 0$	M1	Sight of x^2 and -24 in a quadratic factor
	$-27 + 9 - 3a - 72 = 0$	A1	
	$a = -30$	A1	
5(b)	$x^3 + x^2 - 30x - 72$	M1	
	$\equiv (x + 3)(x^2 + kx - 24)$		
	$(x + 4)$	A1	
	$(x - 6)$	A1	
Alt 1 5(b)	Substitutes another value into the expression and tests for ' $= 0$ '	M1	
	$(x + 4)$	A1	
	$(x - 6)$	A1	
Alt 2 5(b)	Long division of polynomials getting as far as $x^2 - 2x$	M1	
	$(x + 4)$	A1	
	$(x - 6)$	A1	

Question	Answer	Mark	Comments
6(a)	$(x - 3)(x + 4)(x + k)$ $\equiv x^3 + ax^2 + bx + 24$ $(x - 2)$	M1 A1	or $-3 \times 4 \times k = 24$
6(b)	$(x - 3)(x + 4)(x - 2)$ $(x - 3)(x^2 + 2x - 8)$ $x^3 - x^2 - 14x + 24$ $a = -1$ and $b = -14$	M1 M1 A1 A1 ft	oe ft Their expansion
Alt 6(b)	Substitutes any two of $x = -4, x = 2$ or $x = 3$ into $x^3 + ax^2 + bx + 24$ to create simultaneous equations Any two of $-64 + 16a - 4b + 24 = 0$ or $8 + 4a + 2b + 24 = 0$ or $27 + 9a + 3b + 24 = 0$ $a = -1$ $b = -14$	M1 M1 A1 A1 ft	ft Their first solution

Question	Answer	Mark	Comments
7(a)	$(5)^3 + k(5)^2 + 9(5) - 20 = 0$	M1	
	$125 + 25k + 45 - 20 = 0$	A1	
	$k = -6$	A1	
7(b)	$x^3 - 6x^2 + 9x - 20$ $\equiv (x - 5)(x^2 + kx + 4)$	M1	Sight of x^2 and 4 in a quadratic factor
	$(x - 5)(x^2 - x + 4)$	A1	
7c	Tests ' $b^2 - 4ac$ ' for the quadratic	M1	ft Their quadratic or attempts to solve their quadratic = 0
	Shows ' $b^2 - 4ac$ ' = -15 (or < 0) and states no more linear factors	A1	States 'no solutions' to their quadratic = 0
8	Substitutes a value of x into the expression and tests for ' $= 0$ '	M1	
	Works out first linear factor $(x + 1)$, $(x + 2)$ or $(x - 9)$	A1	
	$x^3 - 6x^2 - 25x - 18$ $\equiv (x + 1)(x^2 + kx - 18)$ or $(x + 2)(x^2 + kx - 9)$ or $(x - 9)(x^2 + kx + 2)$	M1	Attempts to work out the quadratic factor Sight of x^2 and -18 in a quadratic factor or sight of x^2 and -9 in a quadratic factor or sight of x^2 and 2 in a quadratic factor
	2nd and 3rd linear factors	A1	
	-1, -2 and 9	A1	
	Alt 1 8	Substitutes a value of x into the expression and tests for ' $= 0$ '	M1
Works out first linear factor $(x + 1)$, $(x + 2)$ or $(x - 9)$	A1		
Substitutes another value into the expression and tests for ' $= 0$ '	M1		
2nd and 3rd linear factors	A1		
-1, -2 and 9	A1		

Question	Answer	Mark	Comments
Alt 2 8	Substitutes a value of x into the expression and tests for ' $= 0$ '	M1	Depending on first linear factor
	Works out first linear factor $(x + 1)$, $(x + 2)$ or $(x - 9)$	A1	
	Long division of polynomials getting as far as $x^2 - 7x$ or $x^2 - 8x$ or $x^2 + 3x$	M1	
	2nd and 3rd linear factors	A1	
	-1 , -2 and 9	A1	
9(a)	$32 - 32 - 162 + 162$	B1	
9(b)	$(x - 2)(x^4 - 81)$	M1	
	$(x - 2)(x^2 + 9)(x^2 - 9)$	M1	
	$(x - 2)(x^2 + 9)(x + 3)(x - 3)$	M1	
	2 , -3 and 3	A1	
10(a)	$3 \left(-\frac{2}{3}\right)^3 + 2 \left(-\frac{2}{3}\right)^2 - 3 \left(-\frac{2}{3}\right) - 2$	M1	Oe
	$-\frac{8}{9} + \frac{8}{9} + 2 - 2 = 0$	A1	Clearly shown to = 0
10(b)	$(3x + 2)(x^2 - 1)$	M1	
	$(3x + 2)(x + 1)(x - 1)$	A1	