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Mark Scheme (Pre-Standardisation)

January 2012

GCE Core Mathematics C1 6663

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

EDEXCEL GCE MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

- **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
- **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
- **B** marks are unconditional accuracy marks (independent of M marks)
- Marks should not be subdivided.

3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes and can be used if you are using the annotation facility on ePEN.

- bod – benefit of doubt
- ft – follow through
- the symbol $\surd$ will be used for correct ft
- cao – correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC: special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- dp decimal places
- sf significant figures
- * The answer is printed on the paper
- ⌐ The second mark is dependent on gaining the first mark

4. All A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected. If you are using the annotation facility on ePEN, indicate this action by 'MR' in the body of the script.

6. If a candidate makes more than one attempt at any question:
    - If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
    - If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

7. Ignore wrong working or incorrect statements following a correct answer.

8. Marks for each question are scored by clicking in the marking grids that appear below each student response on ePEN. The maximum mark allocation for each question/part question(item) is set out in the marking grid and you should allocate a score of '0' or '1' for each mark, or "trait", as shown:

	0	1
aM		●
aA	●	
bM1		●
bA1	●	
bB	●	
bM2		●
bA2		●

9. Be careful when scoring a response that is either all correct or all incorrect. It is very easy to click down the '0' column when it was meant to be '1' and all correct.

General Principals for Core Mathematics Marking

(But note that specific mark schemes may sometimes override these general principles).

Method mark for solving 3 term quadratic:

1. Factorisation

$(x^2 + bx + c) = (x + p)(x + q)$, where $|pq| = |c|$, leading to x = …

$(ax^2 + bx + c) = (mx + p)(nx + q)$, where $|pq| = |c|$ and $|mn| = |a|$, leading to x = …

2. Formula

Attempt to use correct formula (with values for *a*, *b* and *c*).

3. Completing the square

Solving $x^2 + bx + c = 0$: $(x \pm p)^2 \pm q \pm c$, $p \neq 0$, $q \neq 0$, leading to x = …

Method marks for differentiation and integration:

1. Differentiation

Power of at least one term decreased by 1. ($x^n \rightarrow x^{n-1}$)

2. Integration

Power of at least one term increased by 1. ($x^n \rightarrow x^{n+1}$)

Use of a formula

Where a method involves using a formula that has been learnt, the advice given in recent examiners' reports is that the formula should be quoted first.
Normal marking procedure is as follows:
Method mark for quoting a correct formula and attempting to use it, even if there are mistakes in the substitution of values.
Where the formula is not quoted, the method mark can be gained by implication from correct working with values, but may be lost if there is any mistake in the working.

Exact answers

Examiners' reports have emphasised that where, for example, an exact answer is asked for, or working with surds is clearly required, marks will normally be lost if the candidate resorts to using rounded decimals.

Answers without working

The rubric says that these may not gain full credit. Individual mark schemes will give details of what happens in particular cases. General policy is that if it could be done "in your head", detailed working would not be required. Most candidates do show working, but there are occasional awkward cases and if the mark scheme does not cover this, please contact your team leader for advice.

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Mark Scheme

Question	Scheme	Marks
1. **(a)**	$4x^3 + 3x^{-\frac{1}{2}}$	M1A1A1 (3)
(b)	$\frac{x^5}{5} + 4x^{\frac{3}{2}} + C$	M1A1A1 (3) **6 marks**
	Notes	
(a)	M1 for $x^n \rightarrow x^{n-1}$ 1st A1 for $4x^3$ or $3x^{-\frac{1}{2}}$ (ignore a + c for this mark) 2nd A1 for both $4x^3$ and $3x^{-\frac{1}{2}}$ and no +c	
(b)	M1 for $x^n \rightarrow x^{n+1}$ 1st A1 for $\frac{x^5}{5}$ or $\frac{6x^{\frac{3}{2}}}{\frac{3}{2}}$ (or better) 2nd A1 for fully correct and simplified answer with +C	

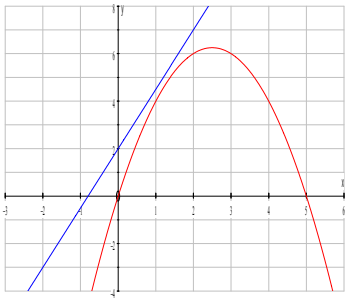
Question	Scheme	Marks
2. (a)	$\sqrt{32} = 4\sqrt{2}$ or $\sqrt{18} = 3\sqrt{2}$	B1
	$\left(\sqrt{32} + \sqrt{18} =\right)\ \underline{7\sqrt{2}}$	B1 (2)
(b)	$\times \frac{3-\sqrt{2}}{3-\sqrt{2}}$ seen	M1
	$\left[\frac{\sqrt{32}+\sqrt{18}}{3+\sqrt{2}} \times \frac{3-\sqrt{2}}{3-\sqrt{2}} = \right] \frac{3a\sqrt{2} - a\sqrt{2}\times\sqrt{2}}{[9-2]}$ (or better)	dM1
	$= \underline{3\sqrt{2}, -2}$	A1, A1 (4)
ALT	$(b\sqrt{2}+c)(3+\sqrt{2}) = 7\sqrt{2}$ leading to: $3b + c = 7, \quad 3c + 2b = 0$	M1
	e.g. $3(7 - 3b) + 2b = 0$ (o.e.)	dM1
		6 marks

	Notes
(a)	1st B1 for either surd simplified
	2nd B1 for $7\sqrt{2}$ or accept $a = 2$. Answer only scores B1B1
(b)	1st M1 for an attempt to multiply by $\frac{3-\sqrt{2}}{3-\sqrt{2}}$. Condone poor use of brackets
	2nd dM1 for an attempt to multiply out their numerator leading to an expression with $\sqrt{2}$ s Follow through their a. Ignore denominator. Allow use of letter a. Dependent on 1st M1
	1st A1 for $3\sqrt{2}$ or accept $b = 3$
	2nd A1 for -2 or accept $c = -2$
ALT	**Simultaneous Equations**
	1st M1 for $(b\sqrt{2}+c)(3+\sqrt{2}) = 7\sqrt{2}$ and forming 2 simultaneous equations
	2nd dM1 for solving their simultaneous equations: reducing to a linear equation in one variable

Question		Scheme	Marks
3.	**(a)**	$5x > 20$ $\underline{\boldsymbol{x > 4}}$	M1 A1 (2)
	(b)	$x^2 - 4x - 12 = 0$ $(x+2)(x-6)\,[=0]$ $x = 6,\ -2$ $x < -2\ ,\ x > 6$	 M1 A1 M1, A1ft (4) **6 marks**
		Notes	
	(a)	M1 for reducing to the form $px > q$ with one of p or q correct A1 $x > 4$ only	
	(b)	1st M1 for multiplying out and attempting to solve a 3TQ with at least $4x$ or 12 1st A1 for 6 and -2 seen. Allow $x > 6$, $x > -2$ etc to score this mark 2nd M1 for choosing the "outside region" for their critical values. Do mot award simply for a diagram or table – they must have chosen their "outside" regions 2nd A1ft follow through their 2 distinct critical values. Allow "," "or" or a "blank" between answers. $-2 > x > 6$ scores M1A0 i.e. loses the final A1 Use of ≤ instead of < (or ≥ instead of >) loses the final A mark.	

Question	Scheme	Marks
4. (a)	$(x_2 =)\ a + 5$	B1 (1)
(b)	$(x_3) = a"(a+5)"+5$	M1
	$= a^2 + 5a + 5$ **(*)**	A1cso (2)
(c)	$41 = a^2 + 5a + 5 \Rightarrow a^2 + 5a - 36(= 0)$	M1
	$(a + 9)(a - 4) = 0$	M1
	$a = 4$ or -9	A1 (3)
		6 marks

	Notes
(a)	B1 accept $a1 + 5$ or $1\times a + 5$ (etc)
(b)	M1 must see a(their x_2) + 5
	A1cso must have seen $a(a + 5) + 5$ and no incorrect working seen
(c)	1st M1 for forming a suitable equation and attempting to reduce to 3TQ. Accept for example $a^2 + 5a + 46(= 0)$
	2nd M1 Attempting to solve their relevant 3TQ
	A1 for both 4 and -9 seen

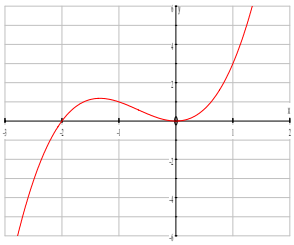
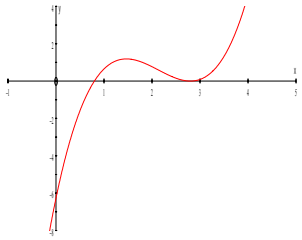
Question	Scheme	Marks
5. (a)	$x(5-x)=\frac{1}{2}(5x+4)$ (o.e.)	M1
	$2x^2-5x+4(=0)$	A1
	$b^2-4ac=(-5)^2-4\times2\times4$	M1
	$=25-32$ <0, so no roots <u>or</u> no intersections	A1 (4)
(b)	 Curve: ∩ shape and passing through (0, 0) ∩ shape and passing through (5, 0) Line : +ve gradient and no intersections with *C*. If no *C* drawn score B0 Line passing through (0, 2) and (- 0.8, 0) marked on axes	B1 B1 B1 B1 (4)
		8 marks

	Notes
(a)	1st M1 for forming a suitable equation in one variable 1st A1 for a correct equation. Condone missing "= 0" 2nd M1 for an attempt to evaluate discriminant for their 3TQ. Correct formula quoted and some correct substitution or a correct expression 2nd A1 for 25 – 32 (or better) <u>and</u> a comment indicating no roots or no intersections
(b)	1st B1 for correct shape and passing through origin. Can be assumed if it passes through the intersection of axes 2nd B1 for correct shape and 5 marked on *x*-axis 3rd B1 for a line of positive gradient that (if extended) has no intersection with *C* (possibly extended) 4th B1 for line passing through - 0.8 on *x*-axis and 2 on *y*-axis

Question	Scheme	Marks
6. (a)	$m = \frac{2}{3}$	B1 (1)
(b)	B: (0, 4)	B1
	Gradient: $\frac{-1}{m} = -\frac{3}{2}$	M1
	$y - 4 = -\frac{3x}{2}$ or equiv. e.g. $\left(y = -\frac{3x}{2} + 4, \quad 3x + 2y - 8 = 0\right)$	A1 (3)
(c)	A: $(-6, 0)$	B1
	C: $\frac{3x}{2} = 4 \quad \Rightarrow \quad x = \frac{8}{3}$	B1ft
	Area: Using $\frac{1}{2}(x_C - x_A)y_B$	M1
	$= \frac{1}{2}\left(\frac{8}{3} + 6\right)4 = \frac{52}{3} \ \left(= 17\frac{1}{3}\right)$	A1 (4)
ALT	$BC = \frac{4}{6}\sqrt{52}$ (from similar triangles) (or possibly using C)	2nd B1ft
	Area: Using $\frac{1}{2}(AB \times AC)$ N.B. $AB = \sqrt{6^2 + 4^2} = \sqrt{52}$	M1
	$= \frac{1}{2} \times \sqrt{52} \times \left(\frac{2}{3}\sqrt{52}\right) = \frac{52}{3} \ \left(= 17\frac{1}{3}\right)$	A1
		8 marks

	Notes
(a)	B1 for $\frac{2}{3}$ seen
(b)	B1 for coordinates of B. Accept 4 marked on y-axis M1 for use of perpendicular gradient rule. Follow through their value for m A1 for a correct equation (any form, need not be simplified)
(c)	1st B1 for the coordinates of A. Accept – 6 marked on x-axis 2nd B1ft for the coordinates of C. Accept $x = \frac{8}{3}$ marked on x-axis. Follow through from l_2 M1 for an expression for the area of the triangle. Ft their 4, - 6 and $\frac{8}{3}$ A1 for $\frac{52}{3}$ or exact equivalent seen
ALT	2nd B1ft If they use this approach award this mark for C (if seen)

Question	Scheme	Marks
7.	$\left[\mathrm{f}(x)=\right]\frac{3x^3}{3}-\frac{3x^2}{2}+5x\left[+c\right]$ or $\left\{x^3-\frac{3}{2}x^2+5x(+c)\right\}$	M1A1
	$10 = 8 - 6 + 10 + c$	M1
	$c = -2$	A1
	$\mathrm{f}(1) = 1-\frac{3}{2}+5 \quad "-2" = \underline{\frac{5}{2}}$ (o.e.)	A1ft (5)
		5 marks
	Notes	
	1st M1 for attempt to integrate $x^n \rightarrow x^{n+1}$ 1st A1 all correct, possibly unsimplified. Ignore $+c$ here. 2nd M1 for using $x = 2$ and f(2) = 10 to form a linear equation in c 2nd A1 for $c = -2$ 3rd A1ft for $\frac{9}{2}+c$ Follow through their c	

Question	Scheme	Marks
8. (a)	$[\, y = x^3 + 2x^2 \,]$ so $\dfrac{dy}{dx} = 3x^2 + 4x$	M1A1 (2)
(b)	 Shape  Touching x-axis at origin Through and not touching at -2 on x-axis	B1 B1 B1 (3)
(c)	At $x = -2$: $\dfrac{dy}{dx} = 3(-2)^2 + 4(-2) = 4$ At $x = 0$: $\dfrac{dy}{dx} = 0$ (Both values correct)	M1 A1 (2)
(d)	 Horizontal translation (touches x-axis still) $k-2$ and k marked on x-axis $k^2(2-k)$ (o.e) marked on y-axis	M1 B1 B1 (3)
		10 marks

	Notes
(a)	M1 for multiplying out and then some attempt to differentiate $x^n \to x^{n-1}$ Do not award for $2x(x+2)$ or $2x(1+2)$ etc A1 for both terms correct
(b)	1st B1 for correct shape (anywhere) 2nd B1 for graph touching at origin (not crossing or ending) 3rd B1 for graph passing through -2 on x axis and -2 marked on axis
(c)	M1 for attempt at $y'(0)$ or $y'(-2)$ Follow through their 0 or – 2 and their $y'(x)$ A1 for both correct answers
(d)	M1 for a horizontal translation of their (b). Should still touch x - axis 1st B1 for k and $k-2$ on the x-axis. Curve should pass through $k-2$ and touch at k 2nd B1 for a correct intercept on negative y-axis in terms of k.

Question	Scheme	Marks
9. (a)	$S_{10} = \frac{10}{2}\left[2P + 9 \times 2T\right]$	M1
	e.g. $\left\{5[2P + 18T] \text{ or } 10[P + 9T]\right\}$ = (£) $(10P + 90T)$ **(*)**	A1cso (2)
(b)	Scheme 2: $S_{10} = \frac{10}{2}\left[2(P + 1800) + 9T\right] = \left\{10P + 18000 + 45T\right\}$	M1
	$10P + 90T = 10P + 18000 + 45T$	M1
	$90T = 18000 + 45T$	A1
	$T = 400$	A1 (4)
(c)	Scheme 2, Year 10 salary: $a + (n-1)d = (P + 1800) + 9T$	B1
	$P + 1800 +$ "3600" $= 29850$	M1
	$P =$ (£) 24450	A1 (3)
		9 marks

	Notes
(a)	M1 for identifying $a = P$, $d = 2T$ and attempt at S_{10}. Using $n = 10$ and one of a or d correct. A1cso for simplifying to given answer. No incorrect working seen.
(b)	1st M1 for attempting S_{10} for scheme 2 (condone missing (…) brackets) 2nd M1 for forming an equation using the two sums. Follow through their expressions 1st A1 for a correct linear equation in T only 2nd A1 for $T = 400$
(c)	M1 for forming an equation using 29850 and using their value of T A1 for 24450 seen

Question	Scheme	Marks
10. (a)	$\left(\frac{1}{2}, 0\right)$	B1 (1)
(b)	$\frac{dy}{dx} = x^{-2}$	M1A1
	At $x = \frac{1}{2}$, $\frac{dy}{dx} = \left(\frac{1}{2}\right)^{-2} = 4$ (= m)	A1
	Gradient of normal $= -\frac{1}{m}$ $\left(= -\frac{1}{4}\right)$	M1
	Equation of normal: $y - 0 = -\frac{1}{4}\left(x - \frac{1}{2}\right)$	M1
	$2x + 8y - 1 = 0$ **(*)**	A1cso (6)
(c)	$2 - \frac{1}{x} = -\frac{1}{4}x + \frac{1}{8}$	M1
	$[= 2x^2 + 15x - 8 = 0]$	
	$(2x-1)(x+8) = 0$ leading to $x = \ldots$	M1
	$x = \left[-\frac{1}{2}\right]$ or -8	A1
	$y = \frac{17}{8}$	A1ft (4)
		11 marks

	Notes
(a)	B1 accept $x = \frac{1}{2}$ if evidence that $y = 0$ has been used
(b)	1st M1 for kx^{-2} even if the '2' is not differentiated to zero. 1st A1 for x^{-2} (o.e.) only 2nd A1 for using $x = 0.5$ to get $m = 4$ 2nd M1 for using the perpendicular gradient rule on their m 3rd M1 for using their changed gradient and coordinates of their A to find equation of line 3rd A1cso for reaching printed answer with no incorrect working seen. Accept $2x + 8y = 1$ or equivalent equations with $2x$ and $8y$
(c)	1st M1 for attempt to form a suitable equation. Condone poor use of brackets etc. 2nd M1 for simplifying their equation to a 3TQ and attempting to solve 1st A1 for $x = -8$ (ignore a second value) 2nd A1ft for $y = \frac{17}{8}$ Follow through their x value in $y = 2 - \frac{1}{x}$ only provided answer is > 0

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