Mark Scheme (Results)

June 2011

GCE Core Mathematics C1 (6663) Paper 1

June 2011

Publications Code UA027654

edexcel
advancing learning, changing lives

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 √ 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

June 2011
Core Mathematics C1 6663
Mark Scheme

Question Number	Scheme	Marks
1. **(a)**	5 (or ± 5)	B1 (1)
(b)	$25^{-\frac{3}{2}} = \frac{1}{25^{\frac{3}{2}}}$ **or** $25^{\frac{3}{2}}=125$ or better	M1
	$\frac{1}{125}$ or 0.008 (or $\pm\frac{1}{125}$)	A1
		(2) **3**
	Notes	
	(a) Give B1 for 5 or ± 5 Anything else is B0 (including just –5) (b) M: Requires reciprocal OR $25^{\frac{3}{2}} = 125$ Accept $\frac{1}{5^3}$, $\frac{1}{\sqrt{15625}}$, $\frac{1}{25\times 5}$, $\frac{1}{25\sqrt{25}}$, $\frac{1}{\sqrt{25}^3}$ for M1 Correct answer with no working (or notation errors in working) scores both marks i.e. M1 A1 M1A0 for - $\frac{1}{125}$ without $+\frac{1}{125}$	

Question Number	Scheme	Marks
2. (a)	$\frac{dy}{dx} = 10x^4 - 3x^{-4}$ or $10x^4 - \frac{3}{x^4}$	M1 A1 A1 (3)
(b)	$\left(\int =\right) \frac{2x^6}{6} + 7x + \frac{x^{-2}}{-2} = \frac{x^6}{3} + 7x - \frac{x^{-2}}{2}$ $+ C$	M1 A1 A1 B1 (4) **7**

Notes

(a) M1: Attempt to differentiate $x^n \to x^{n-1}$ (for any of the 3 terms)
i.e. ax^4 or ax^{-4}, where a is any non-zero constant or
the 7 differentiated to give 0 is sufficient evidence for M1

1st A1: One correct (non-zero) term, possibly unsimplified.
2nd A1: Fully correct **simplified** answer.

(b) M1: Attempt to integrate $x^n \to x^{n+1}$
(i.e. ax^6 or ax or ax^{-2}, where a is any non-zero constant).

1st A1: Two correct terms, possibly unsimplified.
2nd A1: All three terms correct and **simplified**.

Allow correct equivalents to printed answer , e.g. $\frac{x^6}{3} + 7x - \frac{1}{2x^2}$ or $\frac{1}{3}x^6 + 7x - \frac{1}{2}x^{-2}$

Allow $\frac{1x^6}{3}$ or $7x^1$

B1: + C appearing at any stage in part (b) (independent of previous work)

Question Number	Scheme	Marks
3.	Mid-point of PQ is (4, 3)	B1
	PQ: $m = \frac{0-6}{9-(-1)}, \left(= -\frac{3}{5}\right)$	B1
	Gradient perpendicular to PQ $= -\frac{1}{m}$ $\left(= \frac{5}{3}\right)$	M1
	$y - 3 = \frac{5}{3}(x-4)$	M1
	$5x - 3y - 11 = 0$ or $3y - 5x + 11 = 0$ or multiples e.g. $10x - 6y - 22 = 0$	A1 (5)
		5

Notes

B1: correct midpoint.
B1: correct numerical expression for gradient – need not be simplified
1st M: Negative reciprocal of their numerical value for m
2nd M: Equation of a line through **their** (4, 3) with any gradient except 0 or ∞.

If the 4 and 3 are the wrong way round the 2nd M mark can still be given if a correct formula (e.g. $y - y_1 = m(x - x_1)$) is seen, otherwise M0.
If (4, 3) is substituted into $y = mx + c$ to find c, the 2nd M mark is for attempting this.

A1: Requires integer form with an = zero (see examples above)

Question Number	Scheme			Marks
4.				
	Either	Or		
	$y^2 = 4 - 4x + x^2$	$x^2 = 4 - 4y + y^2$		M1
	$4(4 - 4x + x^2) - x^2 = 11$ or $4(2-x)^2 - x^2 = 11$	$4y^2 - (4 - 4y + y^2) = 11$ or $4y^2 - (2-y)^2 = 11$		M1
	$3x^2 - 16x + 5 = 0$	$3y^2 + 4y - 15 = 0$	Correct 3 terms	A1
	$(3x-1)(x-5) = 0, \quad x =$	$(3y-5)(y+3) = 0, \quad y = ...$		M1
	$x = \frac{1}{3} \quad x = 5$	$y = \frac{5}{3} \quad y = -3$		A1
	$y = \frac{5}{3} \quad y = -3$	$x = \frac{1}{3} \quad x = 5$		M1 A1
				(7) **7**

Notes

1st M: Squaring to give 3 or 4 terms (need a middle term)

2nd M: Substitute to give quadratic in one variable (may have just two terms)

3rd M: Attempt to solve a **3 term** quadratic.

4th M: Attempt to find at least one *y* value (or *x* value). (The second variable)

This will be by substitution or by starting again.

If *y* solutions are given as *x* values, or vice-versa, penalise accuracy, so that it is possible to score M1 M1A1 M1 A0 M1 A0.

<u>“Non-algebraic” solutions:</u>

No working, and only one correct solution pair found (e.g. $x = 5$, $y = -3$):
M0 M0 A0 M1 A0 M1 A0

No working, and both correct solution pairs found, but not demonstrated:
M0 M0 A0 M1 A1 M1 A1

Both correct solution pairs found, and demonstrated: Full marks are possible (send to review)

Question Number	Scheme	Marks
5. **(a)**	$(a_2 =)\ 5k+3$	B1 (1)
(b)	$(a_3 =)\ 5(5k+3)+3$	M1
	$= 25k+18$ (*)	A1 cso (2)
(c) **(i)**	$a_4 = 5(25k+18)+3 \quad (=125k+93)$	M1
	$\sum_{r=1}^{4} a_r = k + (5k+3)+(25k+18)+(125k+93)$	M1
	$= 156k+114$	A1 ao
(ii)	$= 6(26k+19)$ (or explain each term is divisible by 6)	A1 (4) **7**
	Notes	
	(a) $5k+3$ must be seen in (a) to gain the mark (b) 1st M: Substitutes their a_2 into $5a_2+3$ - note the answer is given so working must be seen. (c) 1st M1: Substitutes their a_3 into $5a_3+3$ or uses $125k+93$ 2nd M1: for **their** sum $k+a_2+a_3+a_4$ - must see evidence of **four terms with plus signs and must not be sum of AP** 1st A1: All correct so far 2nd A1ft: Limited ft – previous answer must be divisible by 6 (eg $156k+42$) . This is dependent on second M mark in (c) Allow $\frac{156k+114}{6} = 26k+19$ without explanation. No conclusion is needed.	

Question Number	Scheme	Marks
6.		
(a)	$p=\frac{1}{2},\ q=2$ or $6x^{\frac{1}{2}},\ 3x^2$	B1, B1
		(2)
(b)	$\frac{6x^{\frac{3}{2}}}{\left(\frac{3}{2}\right)}+\frac{3x^3}{3}$ $\left(=4x^{\frac{3}{2}}+x^3\right)$	M1 A1ft
	$x=4,\ y=90$: $32+64+C=90 \Rightarrow C=-6$	M1 A1
	$y=4x^{\frac{3}{2}}+x^3+\text{"}their-6\text{"}$	A1
		(5)
		7

Notes

(a) Accept any equivalent answers, e.g. $p=0.5$, $q=4/2$

(b) 1st M: Attempt to integrate $x^n \to x^{n+1}$ (for either term)

1st A: ft their p and q, but terms need not be simplified ($+C$ not required for this mark)

2nd M: Using $x=4$ and $y=90$ to form an equation in C.

2nd A: cao

3rd A: answer as shown with simplified correct coefficients and powers – but follow through their value for C

If there is a 'restart' in part (b) it can be marked independently of part (a), but marks for part (a) cannot be scored for work seen in (b).

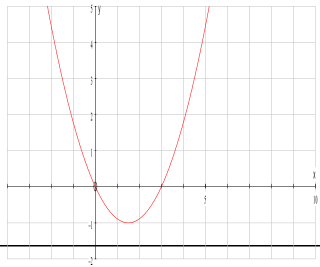
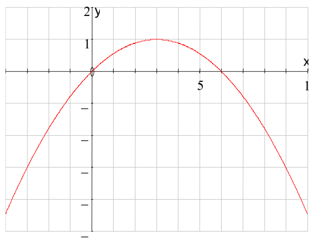
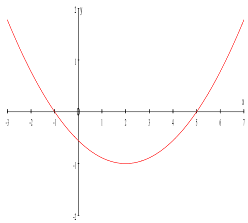
Numerator and denominator integrated separately:

First M mark **cannot** be awarded so only mark available is second M mark. So 1 out of 5 marks.

Question Number	Scheme	Marks
7. **(a)**	Discriminant: $b^2 - 4ac = (k+3)^2 - 4k$ or equivalent	M1 A1 (2)
(b)	$(k+3)^2 - 4k = k^2 + 2k + 9 = (k+1)^2 + 8$	M1 A1 (2)
(c)	For real roots, $b^2 - 4ac \geq 0$ or $b^2 - 4ac > 0$ or $(k+1)^2 + 8 > 0$ $(k+1)^2 \geq 0$ for all k, so $b^2 - 4ac > 0$**,** so roots are real for all k (or equiv.)	M1 A1 cso (2) **6**

Notes

(a) M1: attempt to find discriminant – substitution is required
If formula $b^2 - 4ac$ is seen at least 2 of a, b and c must be correct
If formula $b^2 - 4ac$ is **not** seen all 3 of a, b and c must be correct
Use of $b^2 + 4ac$ is M0
A1: correct unsimplified
(b) M1: Attempt at completion of square (see earlier notes)
A1: both correct (no ft for this mark)
(c) M1: States condition as on scheme **or** attempts to explain that their $(k+1)^2 + 8$ is greater than 0
A1: The final mark (A1cso) requires $(k+1)^2 \geq 0$ and conclusion. We will allow $(k+1)^2 > 0$ (or word positive) also allow $b^2 - 4ac \geq 0$ and conclusion.

Question Number	Scheme		Marks
8. (a)		Shape ∪ through (0, 0) (3, 0) (1.5, –1)	B1 B1 B1 (3)
(b)		Shape ∩ (0, 0) and (6, 0) (3, 1)	B1 B1 B1 (3)
(c)		Shape ∪ , <u>not</u> through (0, 0) Minimum in 4th quadrant $(-p, 0)$ and $(6-p, 0)$ $(3-p, -1)$	M1 A1 B1 B1 (4) **10**

<u>Notes</u>

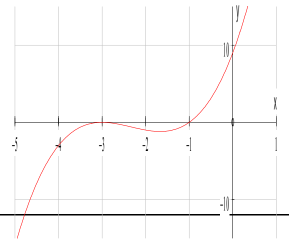
(a) B1: U shaped parabola through origin
B1: (3,0) stated or 3 labelled on x axis
B1: (1.5, -1) or equivalent e.g. (3/2, -1)

(b) B1: Cap shaped parabola in any position
B1: through origin (may not be labelled) and (6,0) stated or 6 labelled on x - axis
B1: (3,1) shown

(c) M1: U shaped parabola not through origin
A1: Minimum in 4th quadrant (depends on M mark having been given)
B1: Coordinates stated or shown on x axis
B1: Coordinates stated

Note: If values are taken for p, then it is possible to give M1A1B0B0 even if there are several attempts. (In this case all minima should be in fourth quadrant)

Question Number	Scheme	Marks
9. **(a)**	Series has 50 terms	B1
	$S=\frac{1}{2}(50)(2+100)=2550$ or $S=\frac{1}{2}(50)(4+49\times 2)=2550$	M1 A1
		(3)
(b) **(i)**	$\frac{100}{k}$	B1
(ii)	Sum: $\frac{1}{2}\left(\frac{100}{k}\right)(k+100)$ or $\frac{1}{2}\left(\frac{100}{k}\right)\left(2k+\left(\frac{100}{k}-1\right)k\right)$	M1 A1
	$=50+\frac{5000}{k}$ (*)	A1 cso
		(4)
(c)	50^{th} term $=a+(n-1)d$	
	$=(2k+1)+49"(2k+3)"$ | Or $2k+49(2k)+1+49(3)$	M1
	$=100k+148$ | $=100k+148$	A1
		(2)
		9
	Notes (a) B for seeing attempt to use $n = 50$ or $n = 50$ stated M for attempt to use $\frac{1}{2}n(a+l)$ or $\frac{1}{2}n(2a+(n-1)d)$ with $a = 2$ and values for other variables (Using $n = 100$ may earn B0 M1A0) (b) M for use of $a = k$ and $d = k$ or $l = 100$ with their value for n, could be numerical or even letter n in correct formula for sum. A1: Correct formula with $n = 100/k$ A1: NB Answer is printed – so no slips should have appeared in working (c) M for use of formula $a+49d$ with $a = 2k +1$ and with d obtained from difference of terms A1: Requires this simplified answer	

Question Number	Scheme	Marks
10. **(a)**	 Shape (cubic in this orientation) **Touching** x-axis at **–3** **Crossing** at **–1** on x-axis Intersection at **9** on y-axis	B1 B1 B1 B1 (4)
(b)	$y=(x+1)(x^2+6x+9)=x^3+7x^2+15x+9$ or equiv. (possibly unsimplified) Differentiates their polynomial correctly – may be unsimplified $\frac{dy}{dx}=3x^2+14x+15$ **(*)**	B1 M1 A1 cso (3)
(c)	At $x=-5$: $\frac{dy}{dx}=75-70+15=20$ At $x=-5$: $y=-16$ $y-("-16")="20"(x-(-5))$ or y = "20x" + c with (-5, -"16") used to find c $y=20x+84$	B1 B1 M1 A1 (4)
(d)	Parallel: $3x^2+14x+15="20"$ $(3x-1)(x+5)=0$ $x=\ldots$ $x=\frac{1}{3}$	M1 M1 A1 (3) **14**
	Notes (a) Crossing at –3 is B0. Touching at –1 is B0 (b) M: This needs to be correct differentiation here A1: Fully correct simplified answer. (c) M: If the –5 and "-16" are the wrong way round or – omitted the M mark can still be given if a correct formula is seen, (e.g. $y-y_1=m(x-x_1)$) otherwise M0. m should be numerical and not 0 or infinity and should not have involved negative reciprocal. (d) 1st M: Putting the derivative expression equal to their value for gradient 2nd M: Attempt to solve quadratic (see notes) This may be implied by correct answer.	

Further copies of this publication are available from
Edexcel Publications, Adamsway, Mansfield, Notts, NG18 4FN

Telephone 01623 467467
Fax 01623 450481
Email publication.orders@edexcel.com
Order Code UA027654 June 2011

For more information on Edexcel qualifications, please visit
www.edexcel.com/quals

Pearson Education Limited. Registered company number 872828
with its registered office at Edinburgh Gate, Harlow, Essex CM20 2JE