Mark Scheme (Results)

January 2012

International GCSE Mathematics
(4PM0) Paper 02

January 2012

Publications Code UG030471

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.
- **Types of mark**
  - o M marks: method marks
  - o A marks: accuracy marks. Can only be awarded if the relevant method mark(s) has (have) been gained.
  - o B marks: unconditional accuracy marks (independent of M marks)
- **Abbreviations**
  - o cao – correct answer only
  - o ft – follow through
  - o isw – ignore subsequent working
  - o SC - special case
  - o oe – or equivalent (and appropriate)
  - o dep – dependent
  - o indep – independent
  - o eeoo – each error or omission
- **No working**

  If no working is shown then correct answers may score full marks

  If no working is shown then incorrect (even though nearly correct) answers score no marks.
- **With working**

If there is a wrong answer indicated always check the working and award any marks appropriate from the mark scheme.

If it is clear from the working that the “correct” answer has been obtained from incorrect working, award 0 marks.

Any case of suspected misread which does not significantly simplify the question loses two A (or B) marks on that question, but can gain all the M marks. Mark all work on follow through but enter A0 (or B0) for the first two A or B marks gained.

If working is crossed out and still legible, then it should be given any appropriate marks, as long as it has not been replaced by alternative work.

If there are multiple attempts shown, then all attempts should be marked and the highest score on a single attempt should be awarded.

- **Follow through marks**

  Follow through marks which involve a single stage calculation can be awarded without working since you can check the answer yourself, but if ambiguous do not award.

  Follow through marks which involve more than one stage of calculation can only be awarded on sight of the relevant working, even if it appears obvious that there is only one way you could get the answer given.

- **Ignoring subsequent work**

  It is appropriate to ignore subsequent work when the additional work does not change the answer in a way that is inappropriate for the question: eg. incorrect cancelling of a fraction that would otherwise be correct.

  It is not appropriate to ignore subsequent work when the additional work essentially shows that the candidate did not understand the demand of the question.

- **Linear equations**

  Full marks can be gained if the solution alone is given, or otherwise unambiguously indicated in working (without contradiction elsewhere). Where the correct solution only is shown substituted, but not identified as the solution, the accuracy mark is lost but any method marks can be awarded.

- **Parts of questions**

  Unless allowed by the mark scheme, the marks allocated to one part of the question CANNOT be awarded in another

January 2012 International GCSE Mathematics (4PM0) Paper 02 Mark Scheme

Question	Scheme	Marks
1	(a) $x_R = \frac{4\times 2+10\times 1}{3}$, $y_R = \frac{6\times 2-3\times 1}{3}$ $\overrightarrow{OR} = 6\mathbf{i}+3\mathbf{j}$ (b) $\frac{9}{4}\text{Area } \Delta SRQ = \text{area } \Delta ORQ$ $3\text{Area } \Delta ORQ = \text{area } \Delta OPQ$ $\frac{9}{4}\times 3\text{Area } \Delta SRQ = \text{area } \Delta OPQ$ $\lambda = \frac{27}{4}$ oe (exact)	M1 (either) A1 (both) M1 M1 M1 A1
2	(a) $VA^2 = 12^2+5^2$, $VA = 13$ cm (b) P is the mid-point of AB Identify the required angle $VP^2 = 13^2 - 2.5^2$ ALT $PX^2 = 5^2 - 2.5^2$ $\sin\theta = \frac{12}{\sqrt{13^2-2.5^2}}$ ALT $\tan\theta = \frac{12}{\sqrt{5^2-2.5^2}}$ $\theta = 70.2°$	M1,A1 B1 M1 M1 A1
3	$x+7 = 3+6x-x^2$ $x^2-5x+4=0$ $(x-1)(x-4)=0$ $x=1$ $y=8$ $x=4$ $y=11$ points are $(1,8)$ $(4,11)$	M1 A1 M1dep A1 A1

Question	Scheme	Marks
4	(a) $\frac{1}{2}r^2\theta = 15 \qquad \frac{1}{2}r^2 \times 1.2 = 15$	M1
	$r = \sqrt{\frac{30}{1.2}} = 5\,\text{cm}$	A1
	(b) $r\theta = 5 \times 1.2 = 6$ cm	M1A1ft
	(c) Area of $\Delta = \frac{1}{2} \times 5^2 \times \sin 1.2$	M1
	Area of segment $= 15 - \frac{1}{2} \times 5^2 \times \sin 1.2, = 3.35\ \text{cm}^2$	M1,A1
	(Calculator in degree mode gives 14.7 - allow M marks if this is seen w/o working.)	
5	(a)	
	$(1+3x)^{\frac{1}{5}} = 1 + \frac{1}{5} \times 3x + \frac{\frac{1}{5}\times\left(-\frac{4}{5}\right)}{2!} \times (3x)^2 + \frac{\frac{1}{5}\times\left(-\frac{4}{5}\right)\times\left(-\frac{9}{5}\right)}{3!} \times (3x)^3 + \ldots$	M1
	$= 1 + \frac{3}{5}x, -\frac{18}{25}x^2, +\frac{162}{125}x^3, +\ldots$	A1,A1,A1
	(b)	
	$\left(1-\frac{3}{8}\right)^{\frac{1}{5}} = \left(\frac{5}{8}\right)^{\frac{1}{5}} = \left(\frac{20}{32}\right)^{\frac{1}{5}} = \frac{1}{2} \times \sqrt[5]{20}$	M1A1
	$\left(1-\frac{3}{8}\right)^{\frac{1}{5}} = 1 + \frac{3}{5} \times \left(-\frac{1}{8}\right) - \frac{18}{25} \times \left(-\frac{1}{8}\right)^2 + \frac{162}{125} \times \left(-\frac{1}{8}\right)^3$	M1
	$(= 0.91121875\ldots\ldots)$	
	$\sqrt[5]{20} = 2 \times 0.91121875.. = 1.82244$ (Give A1 for awrt this)	A1
	(c)	
	Series is only convergent for $\lvert x \rvert < \frac{1}{3}$ $\quad\therefore$ not convergent when $x = 1$	B1

Question Number	Scheme	Marks
6	(a)	
	At time t, vol $=\frac{1}{3}\pi\left(h\tan 30\right)^2 h, =\frac{1}{9}\pi h^3$	M1,A1
	$t=0$ vol $=\frac{1000\pi}{9}$	B1
	$\frac{1000\pi}{9}-2t=\frac{1}{9}\pi h^3$	M1
	$h^3=1000-\frac{18t}{\pi}$	
	$h=\sqrt[3]{\left(1000-\frac{18}{\pi}t\right)}$ *	M1A1
	(b)	
	$A=\pi r^2=\pi\left(h\tan 30\right)^2=\frac{\pi h^2}{3}$	B1
	$\frac{dA}{dh}=\frac{2\pi h}{3}$	B1
	$\frac{dA}{dt}=\frac{dA}{dh}\times\frac{dh}{dt}=\frac{2\pi h}{3}\times\frac{dh}{dt}$	M1
	$h=\left(1000-\frac{18t}{\pi}\right)^{\frac{1}{3}}$	
	$\frac{dh}{dt}=\frac{1}{3}\left(1000-\frac{18t}{\pi}\right)^{-\frac{2}{3}}\times-\frac{18}{\pi}$	M1
	$\frac{dA}{dt}=-\frac{2\pi}{3}\times\left(1000-\frac{18t}{\pi}\right)^{\frac{1}{3}}\times\frac{1}{3}\left(1000-\frac{18t}{\pi}\right)^{-\frac{2}{3}}\times\left(-\frac{18}{\pi}\right)$	
	$t=15\qquad \frac{dA}{dt}=-\frac{2\pi}{3}\times\frac{1}{3}\times\frac{18}{\pi}\times\frac{1}{\left(1000-\frac{18\times 15}{\pi}\right)^{\frac{1}{3}}}$	M1
	$=-0.412\quad \text{cm}^2/\text{s}$	A1

Question Number	Scheme	Marks
7	(a)	
	Grad $AB = \dfrac{8-5}{7-3} = \dfrac{3}{4}$	M1A1
	Grad $AC = \dfrac{1-5}{6-3} = -\dfrac{4}{3}$	A1
	$\dfrac{3}{4} \times -\dfrac{4}{3} = -1$	A1 cso
	$(\therefore AB \perp AC)$	
	(b)	
	Eqn AC: $y-5 = -\dfrac{4}{3}(x-3)$	M1A1ft
	$3y+4x-27=0$ (o.e. but must be integers)	A1
	(c) D is $(12,-7)$	B1B1
	(d)	
	Length $AD = \sqrt{\left((12-3)^2+(-7-5)^2\right)}$, $=15$	M1,A1
	Length $AB = \sqrt{\left((7-3)^2+(8-5)^2\right)}$, $=5$	A1
	Area $\Delta ABD = \dfrac{1}{2} \times 15 \times 5 = 37\dfrac{1}{2}$ sq.units	A1ft

Question Number	Scheme	Marks
8	(a)	
	$\tan(A+B)=\dfrac{\sin(A+B)}{\cos(A+B)}=\dfrac{\sin A\cos B+\cos A\sin B}{\cos A\cos B-\sin A\sin B}$	M1
	$=\dfrac{\dfrac{\sin A\cos B}{\cos A\cos B}+\dfrac{\cos A\sin B}{\cos A\cos B}}{\dfrac{\cos A\cos B}{\cos A\cos B}-\dfrac{\sin A\sin B}{\cos A\cos B}}$	M1
	$\dfrac{\tan A+\tan B}{1-\tan A\tan B}$ *	A1
	(b)	
	$\tan 2\theta=\dfrac{2\tan\theta}{1-\tan^2\theta}$	B1
	(c)	
	$\tan 3\theta=\dfrac{\tan 2\theta+\tan\theta}{1-\tan 2\theta\tan\theta}$	M1
	$=\dfrac{\dfrac{2\tan\theta}{1-\tan^2\theta}+\tan\theta}{1-\dfrac{2\tan\theta}{1-\tan^2\theta}\times\tan\theta}$	M1
	$=\dfrac{2\tan\theta+\tan\theta-\tan^3\theta}{1-3\tan^2\theta}=\dfrac{3\tan\theta-\tan^3\theta}{1-3\tan^2\theta}$ *	M1A1
	(d)	
	$-1+3\tan^2\theta=3\tan\theta-\tan^3\theta$	
	$\tan^3\theta+3\tan^2\theta-3\tan\theta-1=0$ *	B1
	(e)	
	$(\tan\theta-1)(\tan^2\theta+4\tan\theta+1)=0$	M1
	$(\tan\theta=1)\qquad \tan\theta=\dfrac{-4\pm\sqrt{16-4}}{2}$	M1
	$\tan\theta=-2\pm\sqrt{3}$	A1A1

Question Number	Scheme	Marks
9	(a)	
	$y = \int \left(x^3 - 3x^2 - x + 3 \right) dx$	
	$y = \frac{1}{4}x^4 - x^3 - \frac{1}{2}x^2 + 3x \quad (+c)$	M1A1
	Through $(0,4) \Rightarrow c = 4$	
	$y = \frac{1}{4}x^4 - x^3 - \frac{1}{2}x^2 + 3x + 4$	B1
	(b)	
	$\frac{dy}{dx} = f'(x) = x^3 - 3x^2 - x + 3$	
	$f'(-1) = -1 - 3 + 1 + 3 = 0$	M1A1
	$f'(3) = 27 - 27 - 3 + 3 = 0$	A1
	(or divide/factorise, $(x+1)(x-3)(x-1) = 0$)	(M1,A1A1)
	$\frac{d^2y}{dx^2} = 3x^2 - 6x - 1$	M1
	$x = -1 \quad \frac{d^2y}{dx^2} = 3 + 6 - 1 > 0 \quad \therefore$ min at $x = -1$	A1
	$x = 3 \quad \frac{d^2y}{dx^2} = 27 - 18 - 1 > 0 \quad \therefore$ min at $x = 3$	A1
	(c)	
	(i) $f'(x) = (x+1)(x-3)(x-1) = 0 \qquad f'(1) = 0$	M1
	$y = \frac{1}{4} - 1 - \frac{1}{2} + 3 + 4 = 5\frac{3}{4}$	A1
	(ii) $x = 1 \quad \frac{d^2y}{dx^2} = 3 - 6 - 1 < 0 \quad \therefore$ max.	A1
	(d) Increasing for $-1 < x < 1$, and $x > 3$	B1,B1

Question Number	Scheme	Marks
10	(a) $a+ar^2=104$	M1 (either)
	$ar+ar^2=24$	A1 (both)
	$\frac{1+r^2}{r+r^2}=\frac{13}{3}$	
	$3+3r^2=13r+13r^2 \qquad 10r^2+13r-3=0$	
	$(5r-1)(2r+3)=0 \qquad r=\frac{1}{5} \qquad \left(r=-\frac{3}{2}\right)$	M1A1
	(b) $r=\frac{1}{5} \qquad a\left(1+\frac{1}{25}\right)=104$	M1
	$a=\frac{25}{26}\times104=100$	A1
	$S=\frac{100}{1-\frac{1}{5}}=125$	M1A1
	(c) $r'=-\frac{3}{2}$	B1
	(d) $a'\left(1+\frac{9}{4}\right)=104, \quad a'=\frac{4}{13}\times104=32$	M1A1
	$\frac{32\left(1-\left(-\frac{3}{2}\right)^n\right)}{1+\frac{3}{2}}=125$	M1
	$-\left(-\frac{3}{2}\right)^n=\frac{561}{64}$	A1
	solve $\left(\frac{3}{2}\right)^n=\frac{561}{64} \qquad n=\frac{\log\left(\frac{561}{64}\right)}{\log\left(\frac{3}{2}\right)}=5.35...$	M1 (log or ln)
	n must be odd $\quad \therefore n=7$	A1

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 UG030741 January 2012

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

Llywodraeth Cynulliad Cymru
Welsh Assembly Government

Rewarding Learning