Pearson Edexcel

Teaching and Learning

Activity 2 Mark scheme

Question Number	Scheme	Marks
3. (i)	$(x-4)^2 \geqslant 2x-9 \Rightarrow x^2-10x+25 \ldots 0$ $\Rightarrow (x-5)^2 \ldots 0$ Explains that "square numbers are greater than or equal to zero" hence (as $x \in \mathbb{R}$), $\Rightarrow (x-4)^2 \geqslant 2x-9$ *	M1 A1 A1* **(3)**
(ii)	Shows that it is not true for a value of n Eg. When $n=3$, $2^n+1=8+1=9$ × Not prime	B1 **(1)** **(4 marks)**

Notes

(i) A proof starting with the given statement

M1 Attempts to expand $(x-4)^2$ and work from form $(x-4)^2 \ldots 2x-9$ to form a 3TQ on one side of an equation or an inequality

A1 Achieves both $x^2-10x+25$ and $(x-5)^2$. Allow $(x-5)^2$ written as $(x-5)(x-5)$

A1* For a correct proof. Eg

"square numbers are **greater than or equal** to zero", hence (as $x \in \mathbb{R}$), $(x-5)^2 \geqslant 0$

$\Rightarrow (x-4)^2 \geqslant 2x-9$

This requires (1) Correct algebra throughout, (2) a correct explanation concerning square numbers and (3) a reference back to the original statement

Answers via b^2-4ac are unlikely to be correct. Whilst it is true that there is only one root and therefore it touches the x-axis, it does not show that it is always positive. The explanation could involve a sketch of $y=(x-5)^2$ but it must be accurate with a minimum on the +ve x axis with some statement alluding to why this shows $(x-5)^2 \geqslant 0$

....

Approaches via odd and even numbers will usually not score anything. They would need to proceed using the main scheme via $(2m-4)^2 \geqslant 4m-9$ and $(2m-1-4)^2 \geqslant 2(2m-1)-9$

....

Alt to (i) via contradiction

Proof by contradiction is acceptable and marks in a similar way

M1 For setting up the contradiction

'Assume that there is an x such that $(x-4)^2 < 2x-9 \Rightarrow x^2-10x+25 \ldots 0$

A1 $\Rightarrow (x-5)^2 \ldots 0$ or $(x-5)(x-5) \ldots 0$

A1* This is not true as square numbers are always greater than or equal to 0, hence $(x-4)^2 \geqslant 2x-9$

....

Alt to part (i) States $(x-5)^2 \geqslant 0$

$\Rightarrow x^2-10x+25 \geqslant 0$

$\Rightarrow x^2-8x-16 \geqslant 2x-9$

$\Rightarrow (x-4)^2 \geqslant 2x-9$

Question Number	Scheme	Marks
M1	States $(x-5)^2 \geqslant 0$ and attempts to expand. There is no explanation required here	
A1	Rearranges to reach $x^2 - 8x - 16 \geqslant 2x - 9$	
A1*	Reaches the given answer $(x-4)^2 \geqslant 2x - 9$ with no errors	
(ii)		
B1	Shows that it is not true for a value of n This requires a calculation (and value found) with a minimal statement that it is not true Eg. '$2^6 + 1 = 65$ which is not prime' or '$2^5 + 1 = 33$ ×' Condone sloppily expressed proofs. Eg. ' $2^7 + 1 = \frac{129}{3} = 43$ which is not prime' Condone implied proofs where candidates write $2^5 + 1 = 33$ which has a factor of 11 If there are lots of calculations mark positively. Only one value is required to be found (with the relevant statement) to score the B1 The calculation cannot be incorrect. Eg. $2^3 + 1 = 10$ which is not prime	

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Question Number	Please read notes for 8(i) before looking at scheme		Marks
8.(i)	$8^{2x+1}=6 \Rightarrow 2x+1=\log_8 6$ M1	$2^{6x+3}=6$	
	$\Rightarrow 2x+1=\dfrac{\log_2 6}{\log_2 8}$ A1	$\Rightarrow (6x+3)\log_2 2=\log_2 6$ M1 A1	
	$\Rightarrow 2x+1=\dfrac{\log_2 2+\log_2 3}{3}$ M1	$\Rightarrow (6x+3)=\log_2 2+\log_2 3$ M1	
	$\Rightarrow x=\dfrac{\log_2 3}{6}-\dfrac{1}{3}$ A1	$\Rightarrow x=\dfrac{\log_2 3}{6}-\dfrac{1}{3}$ A1	
			(4)
(ii)	$\log_5(7-2y)=2\log_5(y+1)-1$	$2\log_5(y+1)-\log_5(7-2y)=1$	
	$\log_5(7-2y)=\log_5(y+1)^2-1$	$\log_5(y+1)^2-\log_5(7-2y)=1$	M1
	$\log_5(7-2y)=\log_5(y+1)^2-\log_5 5$	$\log_5\dfrac{(y+1)^2}{(7-2y)}=1$	dM1
	$(7-2y)=\dfrac{(y+1)^2}{5}$	$\dfrac{(y+1)^2}{(7-2y)}=5$	A1
	$y^2+12y-34=0 \Rightarrow y=$	$y^2+12y-34=0 \Rightarrow y=$	ddM1
	$y=-6+\sqrt{70}$ oe only		A1
			(5)
			(9 marks)

Notes

There are many different ways to attempt this but essentially can be marked in a similar way.

If index work is used marks are not scored until the log work is seen

Eg 1: $8^{2x+1}=6 \Rightarrow 8^{2x}\times 8=6 \Rightarrow 8^{2x}=\dfrac{3}{4}$.

1ST M1 is scored for $2x=\log_8\dfrac{3}{4}$ and then 1ST A1 for $2x=\dfrac{\log_2\frac{3}{4}}{\log_2 8}$

but BOTH of these marks would be scored for $2x\log_2 8=\log_2\dfrac{3}{4}$

2nd M1 would then be awarded for $\log_2\dfrac{3}{4}=\log_2 3-\log_2 4$ which may be implied by $\log_2 3-2$

Two more examples where the candidate initially uses index work.

$8^{2x+1}=6 \Rightarrow 2^{3(2x+1)}=6$	$8^{2x+1}=6 \Rightarrow 64^x=\dfrac{3}{4}$
$3(2x+1)=\log_2 6$ is M1 A1	$\Rightarrow x=\log_{64}\dfrac{3}{4}$ is M1
as it is a correct linear equation in x involving a log 2 term	But $\Rightarrow x\log_2 64=\log_2\dfrac{3}{4}$ is M1 A1

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(ii)

M1 Attempts a correct log law. This may include

$2\log_5(y+1) \to \log_5(y+1)^2 \qquad 1 \to \log_5 5$

You may award this following incorrect work. Eg

$1 = 2\log_5(y+1) - \log_5(7-2y) \Rightarrow 1 = \log_5 2(y+1) - \log_5(7-2y) \Rightarrow 1 = \log_5 \frac{2(y+1)}{(7-2y)}$

dM1 Uses two correct log laws. It may not be awarded following errors (see above)

It is awarded for $2\log_5(y+1) - 1 = \log_5 \frac{(y+1)^2}{5}$, $2\log_5(y+1) - \log_5(7-2y) = \log_5 \frac{(y+1)^2}{(7-2y)}$

$1 + \log_5(7-2y) = \log_5 5(7-2y)$ or $2\log_5(y+1) - 1 = \log_5(y+1)^2 - \log_5 5$

A1 A correct equation in 'y' not involving logs

ddM1 A correct attempt at finding at least one value of y from a 3TQ in y

All previous M's must have been awarded. It can be awarded for decimal answer(s), 2.4 and −
14.4

A1 $y = -6 + \sqrt{70}$ or exact equivalent only.

It cannot be the decimal equivalent but award if the candidate chooses 2.4 following the exact answer. If $y = -6 \pm \sqrt{70}$ then the final A mark is withheld

Special case:

Candidates who write

$$\log_5(y+1)^2 - \log_5(7-2y) = 1 \Rightarrow \frac{\log_5(y+1)^2}{\log_5(7-2y)} = 1 \Rightarrow \frac{(y+1)^2}{(7-2y)} = 5$$

can score M1 dM0 A0 ddM1 A1 if they find the correct answer.

International GCSE Question 5

5		120 ÷ (3 + 5) (= 15)		6	M1	M2 for
		‘15’ × 3 (= 45) **or** ‘15’ × 5 (= 75)			M1	$\frac{3}{8} \times 120 (= 45)$ **or** $\frac{5}{8} \times 120 (= 75)$ oe
		‘45’ ÷ 3 (= 15) **or** ‘45’ ÷ 3 × 2 (= 30)			M1	
		‘75’ × $\frac{16}{25}$ (= 48) **or** ‘75’ × $\frac{9}{25}$ (= 27)			M1	
		E.g. (‘45’ ÷ 3 × 2) + (‘75’ × $\frac{9}{25}$) oe **or** ‘27’ + ‘30’ **or** (‘75’ – ‘48’) + (‘45’ – ‘15’)			M1 for a complete method	
			57		A1	
						Total 6 marks