A1: $x^2 + y^2 - 14x + 4y = 27$

Question Number	Scheme	Marks
7 (i)	$\frac{1}{2}\{\log 4 + \log 9 + 2(\log 5 + \log 6 + \log 7 + \log 8)\}$	B1
	$= \frac{1}{2}\log(4\times 9) + \log(5\times 6\times 7\times 8) \quad = \log 10080$	M1 A1
		(3)
(ii)	$2\log_5(5-a) - \log_5(a+25) = 1$	
	$2\log_5(5-a) = \log_5(5-a)^2$ **OR** $1 = \log_5 5$	B1
	$\log_5 \frac{(5-a)^2}{(a+25)} = 1$	M1
	$a^2 - 15a - 100 = 0$	A1
	$(a-20)(a+5) = 0$	dM1
	$a = -5$	A1
		(5)
		(8 marks)

(i) Do not be concerned if the 10's completely disappear or disappear and reappear from the $\log_{10}$

B1: For writing down a correct expression for the approximate area using the trapezium rule.
The bracketing must be correct (condoning a missing trailing bracket) or implied to be correct by subsequent work. It is not implied by answers rounding to 4.0
Allow the calculation with separate trapezia. E.g.

$$\frac{1}{2}(\log 4 + \log 5) + \frac{1}{2}(\log 5 + \log 6) + \frac{1}{2}(\log 6 + \log 7) + \frac{1}{2}(\log 7 + \log 8) + \frac{1}{2}(\log 8 + \log 9)$$

M1: Attempts some correct log work seen at least once within an attempted trapezium rule.
This will usually be for a correct use of the addition law at some point but could be for $2\log 5 = \log 25$.
It cannot be scored for $\log k = 4.00 \Rightarrow k = 10^{4.00}$

A1: $\log 10080$ following the award of the M mark.
This cannot be scored by candidates who approximate the result to be 4.003…for instance and then use their
calculators to get the $\log 10080$

(ii) Do not be concerned if a different variable is used or the base 5 is omitted

B1: For $2\log_5(5-a) = \log_5(5-a)^2$ **OR** replacing 1 by $\log_5 5$

M1: Correctly combines any two terms which will usually be

$$2\log_5(5-a) - \log_5(a+25) = 1 \Rightarrow \log_5 \frac{(5-a)^2}{(a+25)} = ...$$

Alternatives exist. E.g. $2\log_5(5-a) = \log_5(a+25) + 1 \Rightarrow ... = \log_5(5a+125)$

A1: Correct 3TQ $a^2 - 15a - 100 = 0$ o.e.

dM1: Correct attempt to find at least one value of *a*. It is dependent upon previous M and having reached a quadratic equation. Apply usual rules for solving a quadratic.
Allow calculator solutions but you will need to check that they are/it is correct

A1: $a = -5$ ONLY
If $a = 20$ is written down it must be rejected

Note that a solution where the log terms are incorrectly combined can score SC 10001 as long as they reach $a = -5$ only

$$\frac{\log_5 (5-a)^2}{\log_5 (a+25)} = 1 \Rightarrow a^2 - 15a - 100 = 0 \Rightarrow a = -5$$

Question Number	Scheme	Marks
8(i)	Provides a counter example E.g. $\sqrt{2}\times\sqrt{8}=4$	B1 **(1)**
(ii)	Knows that odd numbers are of the form $2k+1,\quad (k\in\mathbb{N})$	B1
	Attempts $(2k+1)^3+3(2k+1)+2=....$	M1
	$=8k^3+12k^2+12k+6$	A1
	$=4\times\left(2k^3+3k^2+3k+1\right)+2$ Which is even but not a multiple of 4. Hence proven	A1* **(4)** **(5 marks)**

(i)

B1: Provides a counter example and shows that the statement is not always true.
The correct result must be written out showing that it is rational (that is, giving it in a rational form)
So $\sqrt{2}\times\sqrt{8}=\sqrt{16}$ is insufficient but $\frac{\pi}{2}\times\frac{6}{\pi}=\frac{6}{2}$ is acceptable

(ii)

A proof attempted by substituting odd numbers n = 1, 3, 5 etc into n^3+3n+2 will not score any marks

B1: Knows that odd numbers are of the form $2k\pm1$ using any variable apart from n
Other variations may be used, for example $2k\pm3$, $2k\pm5$, etc but will be much less common.
Note that use of $4k+1$ is flawed as it doesn't pick up all the odd numbers so on its own scores B0

M1: Attempts to expand $(2k+1)^3+3(2k+1)+2$ or $(2k-1)^3+3(2k-1)+2$ using any variable including n.
Generally, look for a minimum of $(2k+1)^3+3(2k+1)+2\rightarrow$ a cubic expression in k
As with the B mark, other variations may be used, for example $2k\pm3$ but will be much less common.
The use of $n=4k+1$ in n^3+3n+2 and expanded to a cubic form can be awarded this M mark only

A1: A correct expansion for $(2k+1)^3+3(2k+1)+2$ Allow the use of any variable including n
Look for $8k^3+12k^2+12k+6$ …
but …allow any correct expression that allows the problem to be solved e.g. $4(2k+1)\left(k^2+k+1\right)+2$
FYI the correct expansion for $(2k-1)^3+3(2k-1)+2$ is $8k^3-12k^2+12k-2$

A1*: Requires the candidate to have fully correct algebra, scored all 3 previous marks and
1) prove/show that the result is even
2) prove/show that the result is not a multiple of 4
3) give a minimal conclusion