Question	Scheme	Marks	AOs
13(a)	$\log_{10} b = 0.0054 \Rightarrow b = 10^{0.0054}$ **or** $\log_{10} a = 0.81 \Rightarrow a = 10^{0.81}$	M1	3.1a
	$b = 1.01$ **or** $a = 6.46$	A1	1.1b
	$\log_{10} b = 0.0054 \Rightarrow b = 10^{0.0054}$ **and** $\log_{10} a = 0.81 \Rightarrow a = 10^{0.81}$	M1	2.1
	$b = 1.013$ **and** $a = 6.457$	A1	1.1b
		(4)	
(b)(i)	e.g. The world population **in billions** in 2004	B1ft	3.2a
(ii)	b = 1.013 represents the scale factor of the yearly increase in the world population	B1ft	3.2a
		(2)	
(c)	$P = 6.457...(1.013...)^{26}$ or e.g. $\log P = 0.81 + 26 \times 0.0054 \Rightarrow P = ...$	M1	3.4
	awrt 9 billion	A1	2.2b
		(2)	
(d)	Not reliable since the data used for the model covered the years 2004 – 2007 and it would not be sensible to assume that the model still holds in 2030	B1	3.2b
		(1)	
			(9 marks)

Notes

(a) Must be using base 10 in (a). Ignore any units associated with a and b in part (a).

M1: Correct strategy to get a numerical expression or value for a **or** b e.g. $a = 10^{0.81}$ **or** $b = 10^{0.0054}$. This may be implied by a = awrt 6.46 or b = awrt 1.01 if no incorrect work is seen.

A1: Correct value for a or b. Allow 3 sf for **this mark** so allow a = awrt 6.46 or b = awrt 1.01.
May be seen embedded in their formula.

M1: Correct strategy to get a numerical expression or value for a **and** b e.g. $a = 10^{0.81}$ **and** $b = 10^{0.0054}$. This may be implied by a = awrt 6.46 and b = awrt 1.01 if no incorrect work is seen.

A1: Correct values. This requires a = awrt 6.457 and b = awrt 1.013 for this mark.
May be seen embedded in their formula.
Isw once correct answers are seen.

Special case: Constants the wrong way round:

$a = 1.013$ **and** $b = 6.457$ with or without working scores M1A1M1A0 unless the equation is formed correctly in which case the final A mark can be recovered.

Note that having found the value of a, it is possible to find b by substituting e.g. t = 1 as follows:

$$a = 10^{0.81} = 6.457 \quad t = 1 \Rightarrow P = ab \Rightarrow b = \frac{P}{a}$$

$$t = 1 \Rightarrow \log_{10} P = 0.0054 + 0.81 = 0.8154 \Rightarrow P = 10^{0.8154} \Rightarrow b = \frac{P}{a} = \frac{10^{0.8154}}{6.457} = 1.013$$

Note that a misread of 0.0054 as 0.054 is quite common and may score 1110 as it does not simplify the question.

(b)(i) Follow through their *a*.

B1ft: Correct interpretation for *a* but must reference "billions".

Allow equivalent alternatives e.g.

- The original/initial population **in billions**
- The population in 2004 was "6.46" **billion**

(b)(ii) Follow through their *b*.

B1ft: Correct interpretation for *b* but must reference "each year" or e.g. "yearly" oe

Allow equivalent alternatives e.g.

- The proportional increase/change in each year.
- The population will rise by "1.3%" each year. Must follow their value for *b*.
- The rate/factor at which the population is rising/increasing/changing per annum.
- "1.013" is the multiplier representing the year on year increase.

Do **not** accept

- The amount it is rising
- How much it is rising
- The rate the population increases
- The percentage increase each year
- The rate of increase in billions annually

If they are not labelled (b)(i) and (b)(ii) mark in the order given but accept any way round as long as clearly labelled '' *a* is..... '' and ''*b* is .....''

(c)

M1: Substitutes $t = 25$ or 26 or 27 into their model to find a value for P

Must be using **their** *a* and *b* correctly in $P = ab^t$

May be implied by sight of "9" or 9 billion if no incorrect working is seen.

A1: Correct value including units (allow awrt 9 billion) **from a correct model but condone incorrect/premature rounding or truncating in an otherwise correct model that leads to the correct value of awrt 9 billion.**

Allow e.g. awrt 9 000 000 000 or e.g. awrt 9×10^9

Just awrt 9 without the "billions" is A0

(d)

B1: The response must refer to the fact that the answer is unreliable together with a reference to the fact that the data used for the model is a long way from 2030

Examples:

- Not good as 2030 is a long way from 2004 – 2007
- Unreliable as based on old data
- Questionable as it has been extrapolated over a long time
- Not reliable due to how far out we have extrapolated
- By the time 2030 arrives it will be unreliable

But not e.g.

- Unreliable, extrapolation
- Not good as outside the range
- Not good as the population rises 101.3% each year
- Disease may happen
- Reliable as based on old data