

Unit 1 *Mathematical Modelling*

Text Answers

1.1 Case Studies

1. The formula gives distances, 196, 388, 772.

So it is a good fit for Uranus but not for Neptune and Pluto. (It has been suggested that Neptune and Pluto were once ONE planet that split into two.)

The interpretation of $n = 3$ is the asteroids; they are found at about distance 29, and the formula gives 28.

Mercury could be included by taking the value when $n \rightarrow -\infty$, that is, 4.

2. (a) (i) -11.5°C , (ii) -4.7°C , (iii) -18.2°C

Your graph should give a value of approximately 2°C .

(b) T falls then rises

(c) For $v \approx 150$ mph

3. (a) 254 seconds

(b) The current World Record is held by the Czech athlete Jarmila Kratochvilova with a time of 1:53:28 or 113.28 seconds. This took place in 1983 and would score 1224 points!

(c) It could take the form $P = a(D - b)^c$ where D is the distance thrown or jumped and a , b and c are constants.

5.	n	$2^n - 1$	prime	$2^{n-1}(2^n - 1)$	perfect
	2	3	✓	6	✓
	3	7	✓	28	✓
	5	31	✓	496	✓
	7	127	✓	8128	×
	11	2047	✓	2 096 128	✓
	13	8191	✓	33 550 336	✓

6. (b) Yes - is will work for the last century as 2000 was a leap year but not the previous century or the next century as 1900 and 2100 are not leap years (only one in 4 centuries is a leap year).

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1.2 Using and Applying Mathematics

1. You should obtain $r \approx 5.7$ and $h \approx 9.8$ (note again that $h \approx 2 \times r$).
2. Aesthetic value is probably more important than minimising the metal used for the tin. Catering-size tins, though, where aesthetic value is perhaps not that important, are in line with $h \approx 2r$.
3. Here $A = 195$
 $n = 8$
 $L = 14$
 $R = 12.6$
giving $R \approx 14.2$
4. N is about 93 (it varies according to which 150 words are chosen) giving $R \approx 15.7$. The two values (12.6 and 15.7) are not too far apart.
5. (a) 4 (b) 5
6. (a) No (b) Yes