Contextualised task 31

The World Land Speed Record

Teaching Notes

This task focuses on the World Land Speed Record, which was set in Wales on four different occasions. Students study data and make conclusions. They choose appropriate calculations and graphs to support their analysis. Students may wish to carry out additional research, and the use of ICT would enhance the task.

Task A

Outline

Students are introduced to the history of land speed record attempts. They study a data sheet and extract necessary information in order to draw conclusions about the size of increases in the world land speed record over time.

You will need:

- Teachers' script;
- PowerPoint;
- Question sheet;
- Information sheet;
- Spreadsheet;
- Mark scheme.

Task B

Outline

Students analyse a graph showing the growth of the land speed record. They consider how improvements should be made and produce their own time series graph.

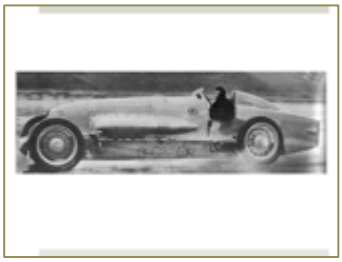
You will need:

- Questions sheet;
- Information sheet;
- Spreadsheet;
- Mark scheme.

Tasks: Teachers' script for PowerPoint presentation

The text in the right-hand boxes provides a possible script to be read to students. However, it is probably preferable to use your own words and elaboration. When questions are asked, time for discussion in pairs/groups should be provided. Ensure that students are given opportunity to explain their reasoning in response to these questions. All students need to understand the concepts in order to make progress with the task.

Slide 1		*Keep this slide on the screen until you are ready to start the presentation.*
Slide 2		This is Pendine Sands in South Wales. Pendine Sands is a 7-mile long beach with very flat and firm sand. It has been used as a venue for car races for over 100 years. Since 1924 it has been used as a venue for speed record attempts.
Slide 3		This is the first of several cars named 'Blue Bird'. On 25 September 1924, Malcolm Campbell drove it on Pendine Sands at an average speed of 146.16 miles per hour to set a new world record. The previous world land speed record, also set by a Briton, was 145.89 miles per hour. What was the percentage increase in the world record speed? *The actual difference was just 0.27 miles per hour, a percentage increase of 0.19% to two decimal places.*
Slide 4		On 21 July 1925 Malcolm Campbell increased this by another 4.71 miles per hour. What was the percentage increase in the land speed record this time? *3.22%* This photo was taken on 21 July 2015 when Blue Bird had a 90th anniversary drive on the beach. In the spring of 1926 a Welshman, John Godfrey Parry-Thomas increased the record by a further 12.68% in his car, 'Babs'. What was the new land speed record at this time? *170 miles per hour* Babs can be seen at the Pendine Museum of Speed.

Slide 5		The last time that a world land speed record was set at Pendine was in February 1927. Blue Bird II reached an average speed of 174.88 miles per hour.
Slide 6		The rules for world land speed records have developed since the very first record in 1898. For example, cars must carry out two runs in opposite directions. Why do you think this is? *e.g. so that the effect of wind is minimised* Rather than a maximum speed attained, it is their time over a fixed length that is recorded. Since 1964 the rules have also allowed jet- or rocket-propelled vehicles. The UK has a history of interest in the world land speed record. Since the outbreak of World War I, there has only been a 20-year period when someone outside of Great Britain has held the record. It was last reclaimed for the UK by Richard Noble in 1983. He drove Thrust 2 at an average speed of 634.05 miles per hour.
Slide 7		And in 1997, Thrust SSC became the first car to break the speed of sound when Andy Green (an RAF pilot with a first-class degree in Mathematics) reached an average speed of 763.04 miles per hour. This record still stands, although Richard Noble and Andy Green are aiming to set a new record with another vehicle. When Thrust SSC was being designed a 1:25 scale model was tested on a rocket sled at Pendine Sands.

Task A: Question

On 25 September 1924, Malcolm Campbell's Blue Bird reached an average speed of 146.16 m.p.h. This broke the world land speed record with an actual increase of 0.27 m.p.h. and a percentage increase of 0.19%.

On 21 July 1925 Malcolm Campbell increased this by 4.71 m.p.h. – a percentage increase of 3.22%.

In 1927 John Godfrey Parry-Thomas, driving Babs, increased the record by 12.68%, which was an actual increase of 19.13 m.p.h.

Study the data provided on the information sheet. This shows every world land speed record that has been set since 1898.

Find the lowest three actual increases in the record. Find also the lowest three percentage increases.

Repeat for the highest three actual and percentage increases.

Comment on your results.

You could use a spreadsheet to help with this task.

Task A: Information sheet

Date	Location	Driver	Vehicle	Speed	
				mph	km/h
18 December 1898	Achères, Yvelines, France	Gaston de Chasseloup-Laubat	Jeantaud Duc	57.65	92.78
17 January 1899	Achères, Yvelines, France	Camille Jenatzy	La Jamais Contente	65.792	105.882
13 April 1902	Nice, France	Léon Serpollet	Easter Egg	75.06	120.80
5 August 1902	Albis-St. Arnoult, France	William K. Vanderbilt	Mors	76.08	122.438
12 January 1904	Lake St. Clair, USA	Henry Ford	Ford 999 Racer	91.37	147.05
26 January 1906	Ormond Beach, USA	Fred Marriott	Stanley Rocket	127.66	205.44
12 July 1924	France	Ernest Eldridge	FIAT Mephistopheles	145.89	234.98
25 September 1924	Pendine Sands, UK	Malcolm Campbell	Sunbeam 350HP	146.16	235.22
21 July 1925	Pendine Sands, UK	Malcolm Campbell	Sunbeam 350HP	150.87	242.8
28 April 1926	Pendine Sands, UK	J.G. Parry-Thomas	Babs	170	273.6
4 February1927	Pendine Sands, UK	Malcolm Campbell	Blue Bird	174.88	281.44
29 March 1927	Daytona Beach, USA	Henry Segrave	Mystery (Sunbeam 1000 hp)	203.79	327.97
19 February 1928	Daytona Beach, USA	Malcolm Campbell	Blue Bird	206.956	333.048
22 April 1928	Daytona Beach, USA	Ray Keech	Triplex Special	207.552	334.007
11 March 1929	Daytona Beach, USA	Henry Segrave	Golden Arrow	231.446	372.459
5 February 1931	Verneuk Pan, South Africa	Malcolm Campbell	Blue Bird	246.09	396.025

24 February 1932	Daytona Beach, USA	Malcolm Campbell	Blue Bird	253.97	408.73
22 February 1933	Daytona Beach, USA	Malcolm Campbell	Blue Bird	272.46	438.48
7 March 1935	Daytona Beach, USA	Malcolm Campbell	Blue Bird	276.816	445.472
3 September 1935	Bonneville Salt Flats, USA	Malcolm Campbell	Blue Bird	301.129	484.598
19 November 1937	Bonneville Salt Flats, USA	George Eyston	Thunderbolt	311.42	501.16
27 August 1938	Bonneville Salt Flats, USA	George Eyston	Thunderbolt	345.4	556.012
15 September 1938	Bonneville Salt Flats, USA	John Cobb	Railton	350.2	563.566
16 September 1938	Bonneville Salt Flats, USA	George Eyston	Thunderbolt	357.5	575.314
23 August 1939	Bonneville Salt Flats, USA	John Cobb	Railton Special	369.74	595.04
16 September 1947	Bonneville Salt Flats, USA	John Cobb	Railton Mobil Special	394.196	634.397
17 July 1964	Lake Eyre, Australia	Donald Campbell	Bluebird CN7	403.10	644.96
2 October 1964	Bonneville Salt Flats, USA	Tom Green	Wingfoot Express	413.2	664.84
5 October 1964	Bonneville Salt Flats, USA	Art Arfons	Green Monster	434.03	698.35
2 November 1965	Bonneville Salt Flats, USA	Craig Breedlove	Spirit of America – Sonic 1	555.485	893.966
15 November 1965	Bonneville Salt Flats, USA	Craig Breedlove	Spirit of America – Sonic 1	600.601	966.37
23 October 1970	Bonneville Salt Flats, USA	Gary Gabelich	Blue Flame	622.407	1001.667
4 October 1983	Black Rock Desert, USA	Richard Noble	Thrust 2	633.47	1019.47
25 September 1997	Black Rock Desert, USA	Andy Green	Thrust SSC	714.144	1149.303
15 October 1997	Black Rock Desert, USA	Andy Green	Thrust SSC	763.035	1227.986

Source: https://en.wikipedia.org/wiki/Land_speed_record

Task A: Mark scheme

The information below is intended as a guide only.

Full credit

Produces fully justified figures for the lowest three actual and percentage increases:

Increase (m.p.h.)	Details
0.27	Malcolm Campbell, Sunbeam 350HP (Blue Bird), 25.09.1924
0.596	Ray Keech, Triplex Special, 22.04.1928
1.02	William K. Vanderbilt, Mors, 05.08.1902

Percentage increase	Details
0.19	Malcolm Campbell, Sunbeam 350HP (Blue Bird), 25.09.1924
0.29	Ray Keech, Triplex Special, 22.04.1928
1.36	William K. Vanderbilt, Mors, 05.08.1902

AND

Fully justified figures for the highest three actual and percentage increases:

Increase (m.p.h.)	Details
121.455	Craig Breedlove, Spirit of America – Sonic 1, 02.11.1965
80.093	Andy Green, Thrust SSC, 25.09.1997
48.891	Andy Green, Thrust SSC, 15.10.1997

Percentage increase	Details
39.72	Fred Marriott, Stanley Rocket, 26.01.1906
27.98	Craig Breedlove, Spirit of America – Sonic 1, 02.11.1965
20.10	Henry Ford, Ford 999 Racer, 12.01.1904

AND

Makes incisive comments on the results; e.g.

- When looking at the lowest increases, similar attempts appear near the end of both lists. Early in the history of breaking speed records, very small actual gains were made, and some of these were also very small percentage gains;
- When looking at the highest increases, Craig Breedlove's Spirit of America (Sonic 1) stands out in both lists (perhaps as this was about the time that rules were changed to allow jet- and rocket-propelled vehicles). Otherwise the largest percentage gains were made early on in the history of land speed records, despite the relatively small actual gains.

Partial credit

Produces correct fully justified solutions for at least nine of the twelve values

AND

Makes incisive comments on the results

OR

Produces correct fully justified solutions for all twelve values

Limited credit

Produces correct fully justified solutions for at least six values (including at least two correct percentage increases)

AND

Makes incisive comments on the results

OR

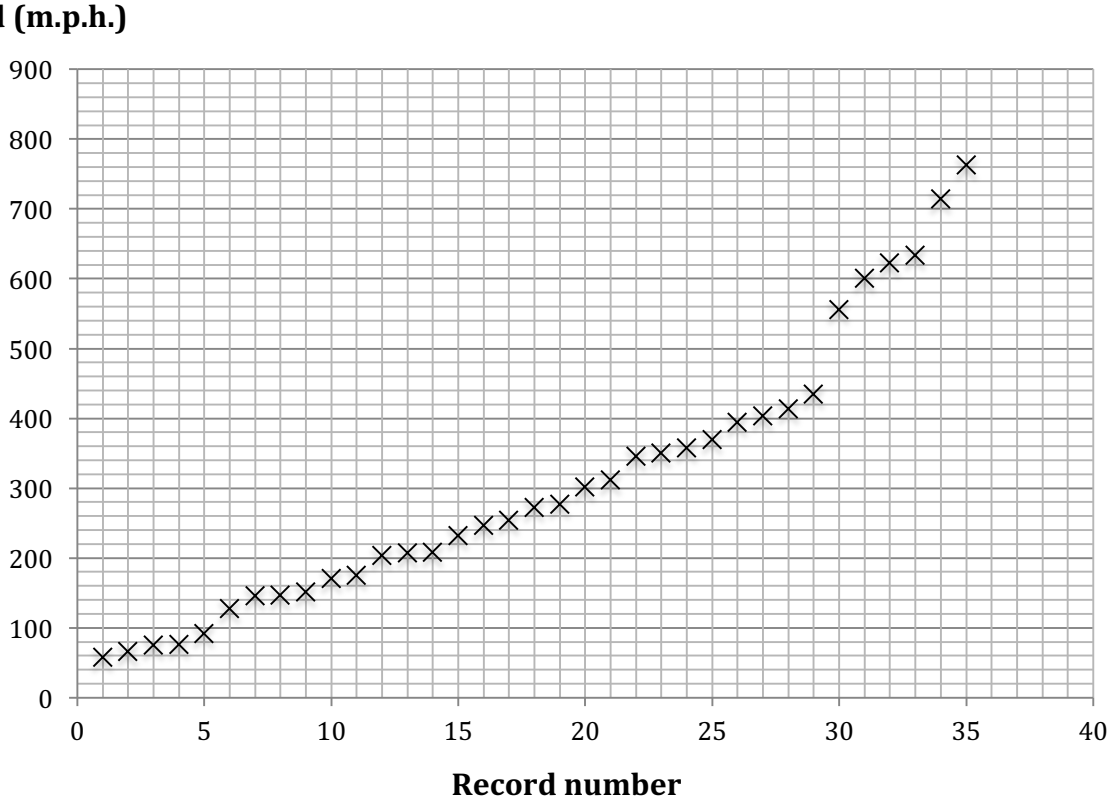
Clearly demonstrates how to find a percentage increase and round appropriately

No credit

Any other response

Task B: Question

Here is a scatter graph showing record number plotted against speed.



Describe what the graph tells you.

Is it possible to make any predictions about future land speed record attempts?

In what way is the graph misleading?

Plot a time series graph showing date against speed. Comment on your graph.

Task 2: Mark scheme

The information below is intended as a guide only.

Full credit

Makes at least three incisive comments about the graph provided, e.g.

- The rate of change of increase was fairly constant up until record number 29;
- It would be easy to place a linear line of best fit between records 1 and 29;
- The average rate of change between attempt 1 and 29 is about 13.5 m.p.h. per record;
- There have been big jumps in speed throughout the last six records.

AND

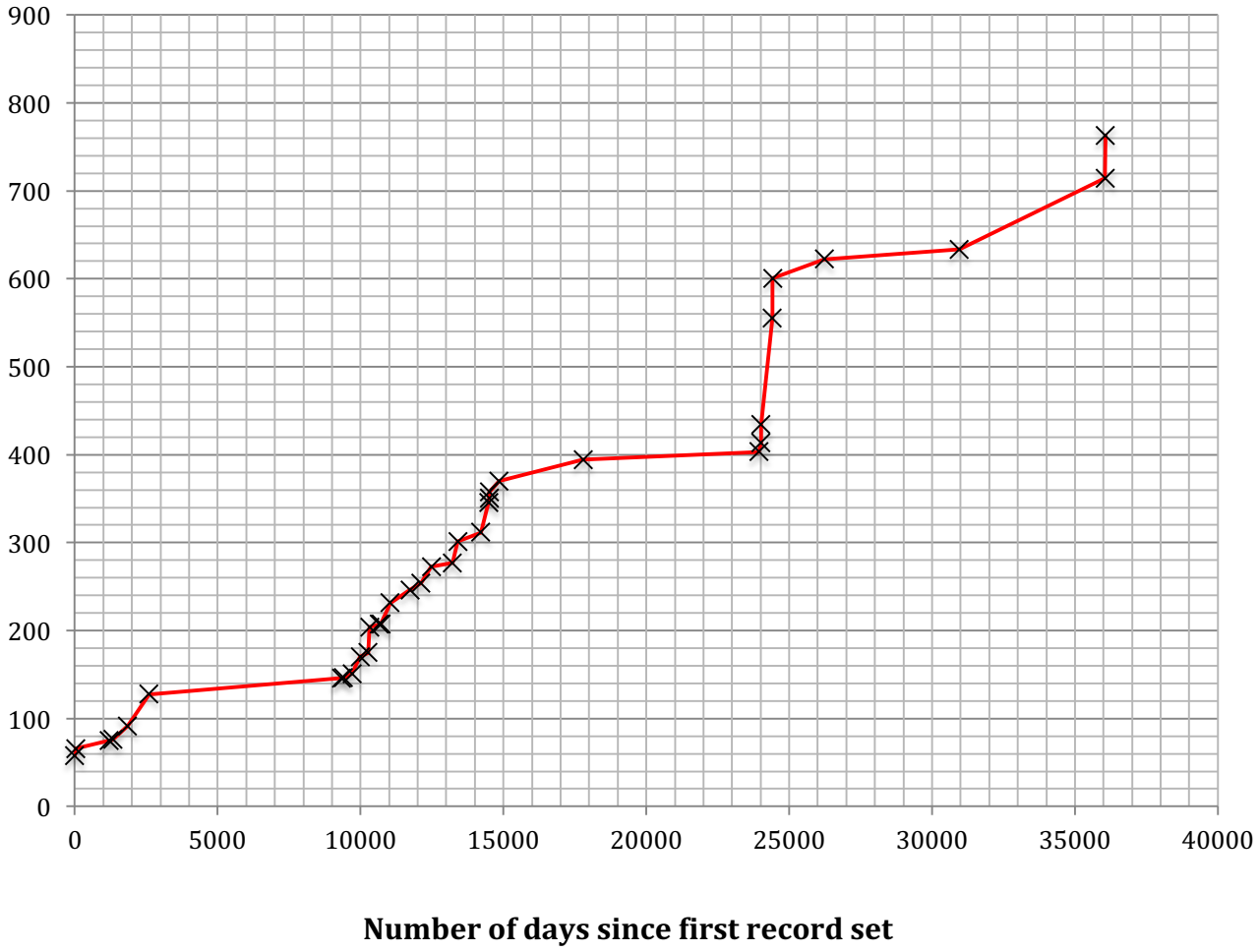
Explains that it is not possible to make sensible predictions about any future records based on this graph

AND

Identifies the fact that the record attempts were not equally spread over time

AND

Plots an accurate time series graph to show how the land speed record has changed over time. *Note that there is scope for challenging levels of numerical reasoning when plotting this graph. As the accompanying spreadsheet demonstrates, the example has been constructed by calculating an estimate for the number of days elapsed since 18.12.1898. This estimate ignores leap years and uses 365/12 (=30.41666…) days in a month. Students may find using ICT more practical than plotting on paper. There is likely to be variation in the accuracy aimed for, and students operating at a higher level may not even be satisfied with the example here.*



AND

Comments on their graph, e.g.

- The 'staircase' shape might be influenced in part by the two world wars, which each correspond to a level section on the graph;
- The period between the two world wars was the time when most attempts were made, and there was steady rise in the record throughout this period;
- The development of technology has corresponded to the gap between attempts becoming much larger – there have only been two vehicles that have set a new record in the last 45 years.

Partial credit

Creates an appropriately accurate time series graph

AND

Comments on the two graphs

Limited credit

Creates an appropriately accurate time series graph

OR

Produces appropriately incisive comments in response to the questions, but the time series graph is incomplete or inaccurate.

No credit

Any other response

Progression in reasoning			
Identify processes and connections • Identify, measure or obtain required information to complete the task	Read through the information given, and identify what might be useful information to gather next. Identify how this information might be obtained. *e.g. identify that time needs to be plotted against speed in order to produce a graph that provides more useful information*	Identify all the information that is needed to solve a problem, and how this information might be obtained. *e.g. uses the dates to establish an appropriate scale for plotting time on the horizontal axis of the time series graph*	As information is gathered, review its usefulness, and whether further information or different information is required. *e.g. makes and justifies a decision about how to deal with leap years*
Represent and communicate • Interpret graphs that describe real-life situations, including those used in the media, recognising that some graphs may be misleading	*e.g. makes correct comments about the graph provided*	*e.g. identifies what is misleading about the graph provided*	*e.g. analyses their own graph*
Review • Interpret mathematical information; draw inferences from graphs, diagrams and data, including discussion on limitations of data	*e.g. makes inferences using the graph provided*	*e.g. discusses how the provided graph should not be used to make inferences about future events*	*e.g. makes inferences using their own graph*

GCSE Content	
GCSE Mathematics – Numeracy and GCSE Mathematics	**GCSE Mathematics only**
Understanding number and place value • Rounding decimals to the nearest whole number or a given number of decimal places. Rounding numbers to a given number of significant figures. • Ordering and comparing whole numbers, decimals, fractions and percentages.	
Understanding number relationships and methods of calculation • Reading a calculator display correct to a specified number of decimal places or significant figures. • Finding a fraction or percentage of a quantity. • Expressing one number as a fraction or percentage of another.	
Solving numerical problems • Giving solutions in the context of a problem, selecting an appropriate degree of accuracy, interpreting the display on a calculator, and recognising limitations on the accuracy of data and measurements. • Rounding an answer to a reasonable degree of accuracy in the light of the context.	
Processing, representing and interpreting data • Constructing line graphs for the values of a variable at different points in time; understanding that intermediate values in a line graph may or may not have meaning. • Constructing and interpreting scatter diagrams for data on paired variables.	
Discussing results • Recognising that graphs may be misleading. Looking at data to find patterns and exceptions. • Drawing inferences and conclusions from summary measures and data representations, relating results back to the original problem. • Drawing of conclusions from scatter diagrams; using terms such as positive correlation, negative correlation, little or no correlation. Appreciating that correlation does not imply causality.	

Key
Foundation tier content is in standard text.
Intermediate tier content that is in addition to foundation tier content is in underlined text.
Higher tier content that is in addition to intermediate tier content is in **bold text**.