STUDENTS ON TRACK

SUPERCARS CHAMPIONSHIP Repco

SECONDRY ANSWER BOOK

INFORMATION FOR SCHOOLS AND TEACHERS

A visit to a round of the Supercars Championship provides fantastic opportunities for students to engage with and get excited about STEM education. In an environment where they can see, hear and smell STEM in action, children can make meaningful connections between the Australian Curriculum and the action on track. This booklet has been designed to be completed by students either independently or collaboratively and can be utilised both on the day or back in the classroom.

Alignment with the Australian Curriculum Year 11 - 12	
Curriculum Area: Science	
Physics **Unit 2; Linear Motion and Waves**	• understand that Newton's Laws of Motion describe the relationship between the forces acting on an object and its motion • use science inquiry skills to design, conduct and analyse safe and effective investigations into linear motion and wave phenomena, and to communicate methods and findings • use algebraic and graphical representations to calculate, analyse and predict measurable quantities associated with linear and wave motion • evaluate, with reference to evidence, claims about motion, sound and light-related phenomena and associated technologies • communicate physics understanding using qualitative and quantitative representations in appropriate modes and genres.
Curriculum Area: Mathematics	
Shape and Measurement	Solve practical problems requiring the calculation of perimeters and areas of circles, sectors of circles, triangles, rectangles, parallelograms and composites (ACMGM018)
Applications of Trigonometry	Solve practical problems involving the trigonometry of right-angled and non-right-angled triangles, including problems involving angles of elevation and depression and the use of bearings in navigation. (ACMGM037)
Univariate data analysis and the statistical investigation process	Determine the mean and standard deviation of a dataset and use these statistics as measures of location and spread of a data distribution, being aware of their limitations. (ACMGM030) With the aid of an appropriate graphical display (chosen from dot plot, stem plot, bar chart or histogram), describe the distribution of a numerical dataset in terms of modality (uni or multimodal), shape (symmetric versus positively or negatively skewed), location and spread and outliers, and interpret this information in the context of the data (ACMGM029)
General Capabilities • Literacy • Numeracy • Critical and Creative Thinking • Personal and Social Capability	**Cross Curriculum Priorities** • Sustainability

Source: Australian Curriculum Version 9, https://v9.australiancurriculum.edu.au/

1 This data was collected from a Supercar cabin at regular intervals during a race. It shows the temperature inside the cabin.

41, 37, 45, 38, 52, 61, 37, 62, 61, 61, 57, 61, 51, 59.

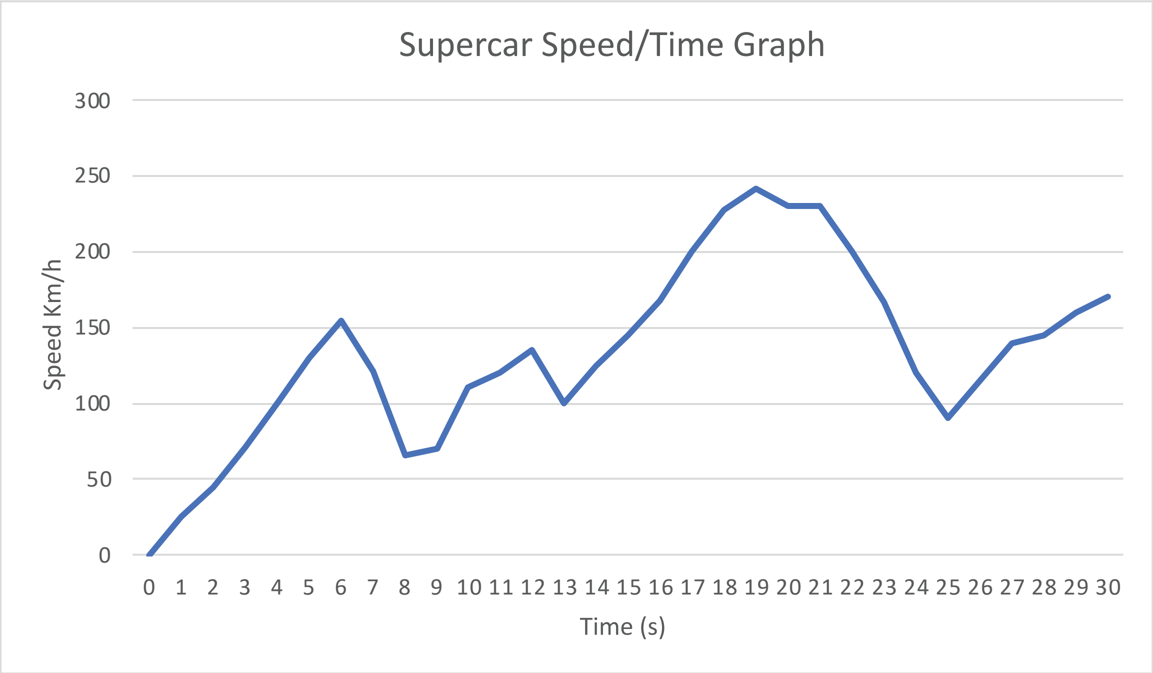
Plot this data on the stem and leaf table below, the first has been done for you. Once plotted, calculate the mean of this data set.

3	7	7	8		
4	1	5			
5	1	2	7	9	
6	1	1	1	1	2

Key 3 I 7 = 37°C

Mean = 51.64°C

Study this speed/time graph. It shows the speed of a Supercar over the first 30 seconds of a race.



2 For how many seconds was the Supercar in a state of deceleration?

In a speed/time graph, deceleration is shown as a downward trend. This graph shows the Supercar was decelerating between seconds 6-8, 12-13, 19-20, and 21-25. This means the Supercar was in a state of deceleration for a total of 8 seconds.

3 For how many seconds was the Supercar travelling at a constant speed?

A horizontal line indicates speed is constant on a speed/time graph. This graph shows the Supercar was at a constant speed between seconds 20 and 21, for a total of 1 second.

4 Newton's second law of motion states that The net force acting on an object equals the mass of an object multiplied by the acceleration. It can also be written as $F_{net} = ma$

Use this information to calculate the net force of the Supercar, with a mass of1355kg and an acceleration rate of 23.67.

Net Force
= 1355 x 23.67
= 32,072.85

5 **A)** Explain what would happen to the acceleration of the Supercar if its mass was reduced.

If the mass of the Supercar was reduced and the net force applied remained the same then its rate of acceleration would increase. It is also true that it would require a smaller net force to maintain the same rate of acceleration.

B) Explain why it is important for Supercars to have strict rules on minimum weight restrictions.

Due to the fact that mass has a significant influence on acceleration, these rules are in place to maintain fairness and parity between race teams.

6 The radius of this Supercar wheel is 336mm. Calculate the circumference and area of the wheel.

Circumference = $2\pi r$
= 2 x 3.14 x 336
=2,110.08mm

Area = πr^2
= 3.14 x 336^2
= 354,493.44

R = 336mm

7 The width of the tyre is 290mm. Use the circumference to calculate the surface area of the tyre (the part of the tyre that contacts the track)

Surface Area = circumference x 290
= 2,110.08 x 290
= 611,923.2mm^2

8 Study this diagram. Use trigonometry to find b, the height of the ramp

$\text{Cos}(20) = \frac{a}{2.6}$

Multiply both sides by 2.6

a = 2.443200814

$c^2 = a^2 + b^2$

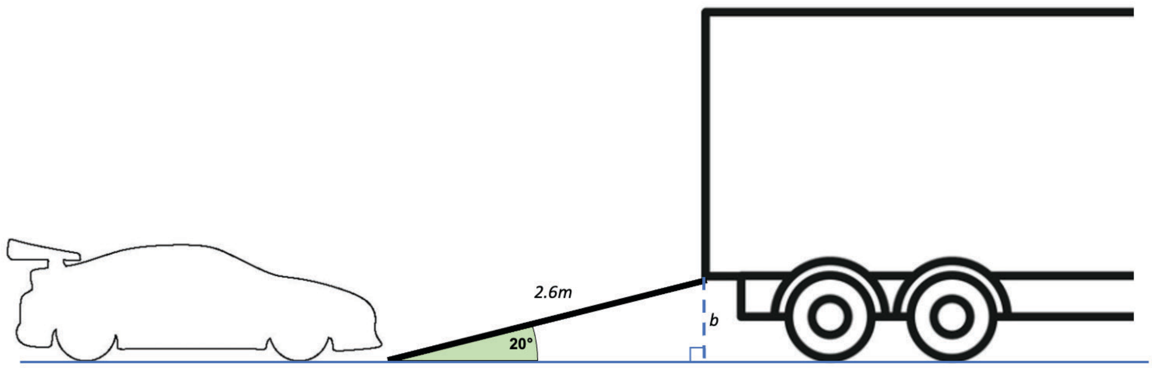
$2.6^2 = 2.443200814^2 + b^2$

$6.76 = 5.96923002177 + b^2$

$b^2 = 0.79076997823$

Apply square root on both sides

b = 0.8893m



9 Read these statements about types of energy involved in a Supercars race. Fill in the blanks to complete each statement.

1. Chemical energy is the primary source of energy in a Supercar. It is stored in the F U E L which undergoes a chemical reaction to release energy.
2. Mechanical energy is generated by the Supercar E N G I N E ' S pistons and crankshaft.
3. Electrical energy is stored in the Supercar's B A T T E R Y which is used to power the ignition and electrical systems.
4. K I N E T I C energy is the energy that results from the mechanical energy from the engine allowing the Supercar to move.
5. Thermal energy is created in the form of H E A T produced by the Supercar engine's combustion as well as friction in its moving parts.

10 The amount of Kinetic energy (E_k), measured in joules (J), an object has can be calculated with the formula $E_k = \frac{1}{2}mv^2$ where m is the mass of the object, measured in kilograms (kg) and v is the speed at which it is moving, measured in metres per second (m/s).

Use the above information to calculate the amount of Kinetic energy a Supercar with a mass of 1355kg has when travelling at 68m/s.

= .5 x 1355 x 68²

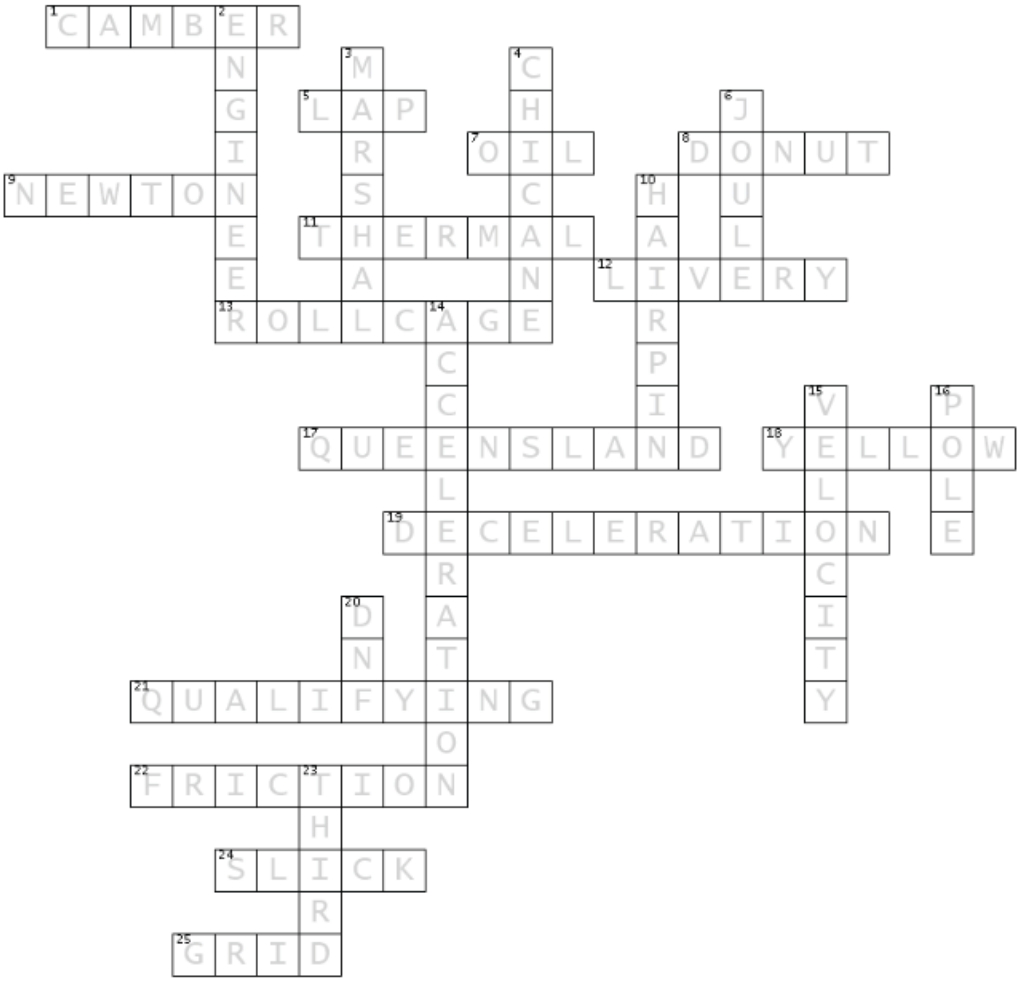
= 3,132,760J

11 Review this table outlining common design challenges encountered by Supercars teams.

Fill in your suggestions for design ideas to improve the function of systems.

Possible Issues	Design Ideas
Air resistance	Design car shape to be streamlined and low to the ground in order to move efficiently through the air.
Lack of grip on wet track	Add grooves and tread to tyres to displace water and allow the rubber of the tyre to make contact with the track.
Driver cabin overheating	Design a 'coolsuit' for drivers to wear. These suits have tiny tubes running through them that circulate cold water from a small reservoir around the suit cooling the driver.
Driver safety in event of crash	Position fuel tank farthest from possible collision points. Seat driver towards the centre of the Supercar. Install a roll cage frame around driver compartment. Fit Supercar with fire extinguisher system. Supply driver with race helmet and flameproof clothing.

SUPERCARS CROSS WORD PUZZLE!



ACROSS	DOWN
1. Angle at which corner inclines towards outside	**2.** Person skilled in working with vehicles, machinery
5. One completion of race circuit	**3.** Safety official at racetrack
7. Engine lubricant	**4.** Sharp double-bend in a racetrack
8. Sweet snack, celebratory driver manoeuvre	**6.** Measure of kinetic energy
9. Unit that forces are measured in	**10.** Sharp corner, hair accessory
11. Type of energy that produces heat	**14.** Speeding up
12. Paintjob and decals added to Supercar	**15.** Describes how fast something is moving
13. Structure of metal bars inside Supercar to enhance driver safety	**16.** Position at front of race
17. State where Townsville 500 is held	**20.** Acronym indicating driver failure to complete race
18. Colour of race flag indicating caution	**23.** For every action there is an equal and opposite reaction; Newton's _____ law
19. Slowing down	
21. Process to determine starting order	
22. Contact force between Supercar tyre and racetrack	
24. Tyre with no tread pattern maximising surface area	
25. Starting formation of race	

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