

MATHEMATICS IN CAREERS

Investigation - Collision

Key career focus for this investigation: Engineer and design

Related career areas: Auto mechanics



THINKING ABOUT CAREERS

- Brainstorm information technology professions you can think of where maths is frequently used. Use <https://joboutlook.gov.au> to explore engineering related career pathways that include use of mathematics. *How is maths used in these scenarios? What maths is used in these scenarios?*
- This task focuses on how maths is used in Engineering through investigating a scenario to avoid a collision.
- Explore careers such as mechanical engineering to discover how maths is used in these. For a more extensive list of careers related to this task, with a maths / science focus, refer to the table at the end of the task and explore the maths used in these jobs.

MATHEMATICS IN EVERYDAY LIFE AND CAREERS

Mathematical focus for this investigation

- Solving simple equations arising from formulas
- Re-arranging expressions to make a specified variable the subject
- Calculate speed, time, and distance
- Represent word problems with simple linear equations and solving them to answer questions.
- Comparing and analysing data to draw conclusions
- Kinetics (physics)
- A formula is a mathematical relationship expressed in variables.
- Many people use formulas every day to calculate unknown values.
- Formulas can be used to calculate or convert different values such as Celsius degrees to Fahrenheit or currency exchange rates.

Brainstorm and share scenarios where this mathematics may be used in engineering to solve problems.

MATHEMATICAL INVESTIGATION COLLISON

TEACHER INFORMATION

LINKS TO VICTORIAN CURRICULUM

Mathematics links to Victorian Curriculum Level 10	Application to work and life
<p>Patterns and algebra Substitute values into formulas to determine an unknown and re-arrange formulas to solve for a particular term. (VCMNA333)</p> <p>Linear and non-linear relationships Solve problems involving linear equations, including those derived from formulas (VCMNA335)</p>	<p>Scientists model relationships comparing different scenarios. The relationship may be linear other. They represent word problems with simple linear equations and solving them to answer questions.</p>

PROFICIENCY FOCUS: VICTORIAN CURRICULUM

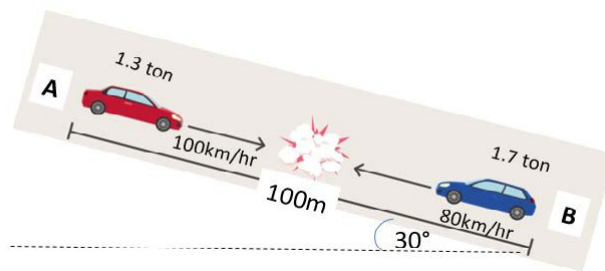
This investigation focuses on: Fluency, Understanding, Problem Solving		
<p>Fluency describes students developing skills in choosing appropriate procedures, carrying out procedures flexibly, accurately, efficiently and appropriately, and recalling factual knowledge and concepts readily.</p> <p>This investigation focuses on:</p> <ul style="list-style-type: none"> Solving simple equations arising from formulas. Re-arranging expressions to make a specified variable the subject. Representing word problems, including those involving fractions, as equations and solving them to answer the question. 	<p>Understanding refers to students building a robust knowledge of adaptable and transferable mathematical concepts and structures.</p> <p>This investigation focuses on:</p> <ul style="list-style-type: none"> Describe their mathematical thinking. Interpret mathematical information. 	<p>Problem Solving is the ability of students to make choices, interpret, formulate, model and investigate situation, select and use technological functions and communicate solutions effectively.</p> <p>This investigation focuses on:</p> <ul style="list-style-type: none"> Students applying their existing strategies to seek solutions

MATHEMATICAL INVESTIGATION COLLISON

STUDENT INVESTIGATION WITH TEACHER GUIDE

INVESTIGATION BACKGROUND

As an engineer working for Ford, you are required to simulate various scenarios. From the scenario you have been given below, investigate the point of collision of the two vehicles and after working through the various parts analyse how realistic this situation is?



YOUR INVESTIGATION

As Future Ford Driver Assist Technologies (DAT) engineers, your task is to compare 3 vehicles and rank them in terms of their safety for vulnerable road users. You are then to provide a recommendation of what you would do to improve the performance of the vehicle in terms of VRU protection.

PART 1

Determine the point of collision of vehicle A and B.

Assumptions:

- Reaction time of vehicle A: 1s, vehicle B: 1.5s
- 2D elastic collision
- Average mechanically applied pre-collision deceleration rate of vehicle A: 7m/s^2 , vehicle B: 6.5m/s^2

NOTE: $1000\text{m} = 1\text{km}$

VEHICLE A:

Velocity = $100\text{km/hr} = 100\,000\text{m} / 60\text{min} = 10\,000\text{m} / 6\text{min} = 10\,000\text{m} / 360\text{secs} = 1000\text{m} / 36\text{secs}$

100m would take 3.6 secs

VEHICLE B:

Velocity = $80\text{km/hr} = 80\,000\text{m} / 60\text{min} = 8000\text{m} / 6\text{min} = 8000\text{m} / 360\text{secs} = 800\text{m} / 36\text{secs}$

100m would take 4.5 secs

PART 2

Determine the velocity of each vehicle after the collision, ignoring gravitational potential energy.

PART 3

Imagine a perfect scenario where these 2 vehicles 'touch' but do not collide, what would be the average mechanically applied break force of each vehicle?

MATHEMATICAL INVESTIGATION COLLISON

ADDITIONAL INFORMATION - FORMULAE

Velocity

$$v = u + at$$

v = final velocity, u = initial velocity, a = acceleration, t = time

Momentum

$$p = mv$$

p = momentum, m = mass, v = velocity

Kinetic energy

$$KE = \frac{1}{2}mv^2$$

KE = kinetic energy, m = mass, v = velocity

Force

$$F = ma$$

F = force, m = mass, a = acceleration

EXTENSION OR ADVANCED INVESTIGATION - EXTENDING PROMPTS

Brainstorming question: determine three other factors affecting the safety of the passengers in real world scenario and explain their effects.

Further investigation:

- How realistic is this situation?
- Investigate what is the steepest road in the world.
- How does the scenario you have been presented with compare with this?



MATHEMATICAL INVESTIGATION COLLISON

CAREERS RELATED TO THIS INVESTIGATION

Refer to the student investigation, it provides:

- An extensive table of careers related to this investigation
- Further career references

CAREERS ACTIVITIES

Refer to the student investigation, it provides:

- A table of the top 10 rated jobs of 2021. This data comes from careercast.com. Have students investigate the jobs specific to this investigation.

INDUSTRY PARTNER

This project was produced collaboratively between The Mathematical Association of Victoria (MAV) and FORD

Ford Motor Company of Australia Pty Limited is a subsidiary of Ford Motor Company, founded in Geelong, Victoria, in 1925. The company designs, engineers, and imports award-winning and best-selling cars, SUVs and trucks, including Puma, Escape, Everest, Focus, Fiesta ST, Ranger, Ranger Raptor, Mustang, Mustang Mach 1 and Transit commercial vans.

Australia is a key product development hub for Ford, with the company investing more than \$2.5 billion in research and development in Australia between 2016-20. More than \$500 million is expected to be invested in our Australian operations in 2021.

Ford is Australia's largest automotive employer, with a team of over 2,500 engineers, designers, technical, automotive and other specialists working at four locations across Victoria. Australia-based engineers and designers lead the development of award-winning vehicles sold in more than 180 markets globally, such as the Ford Ranger pickup and Ford Everest SUV.

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