Secondary Curriculum Guide

Our team of mathematicians and education professionals are dedicated to producing outstanding curriculum content to help you deliver exceptional learning outcomes.

Key Stage 3

Directed Numbers

Outcome

Students are able to add and subtract positive and negative integers.

Lesson

Discuss where negative numbers are used in everyday life. Use temperature as an example and open the **Temperature Spheres** interactive. Use the model and thermometer to demonstrate adding positive and negative integers.

Use the **Mysterious Dr Thermos** questions in the **Directed Numbers** eBook.

Ask students to complete the activity **Adding Integers: Positive, Negative or Zero.**

Questioning

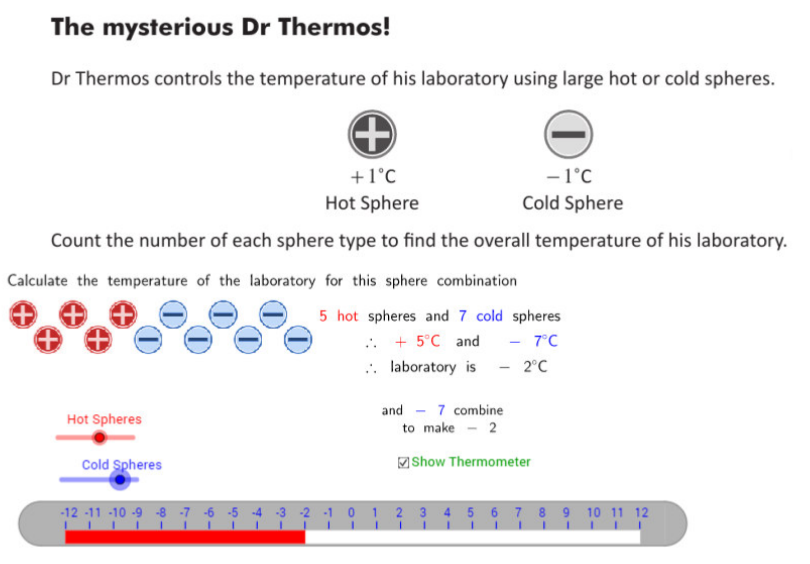
How would you calculate the difference in temperatures?

Does the sign/magnitude of the numbers matter to the sign of the answer?

What about when we multiply/divide?

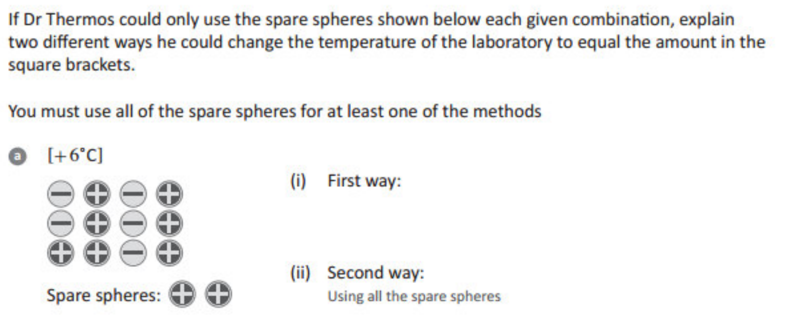
Interactive: Temperature Spheres

Reasoning



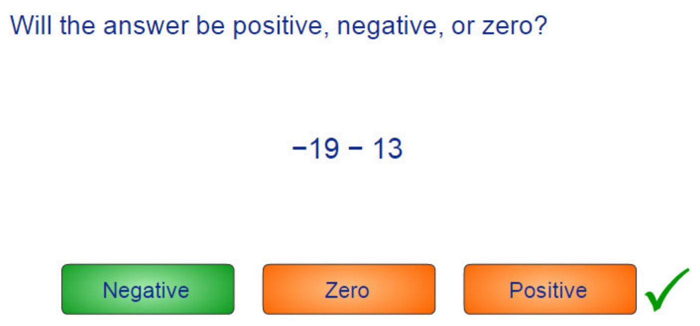
eBook: Directed Numbers

Problem Solving



Activity: Adding Integers: Positive, Negative or Zero

Fluency



Mathletics

Key Stage 3

Fractions and Decimals

Outcome

Students are able to multiply fractions and decimals.

Lesson

Begin with the **Random Squares** interactive and see how many equivalent fractions your students can find.

Use the **Overlap Multiplication** interactive to demonstrate multiplying fractions. Ask students to use the model to answer the word problems from the **Fractions** eBook.

Now ask students to apply the same concept to multiplying decimals in the activity **Multiply Decimals 1**.

Questioning

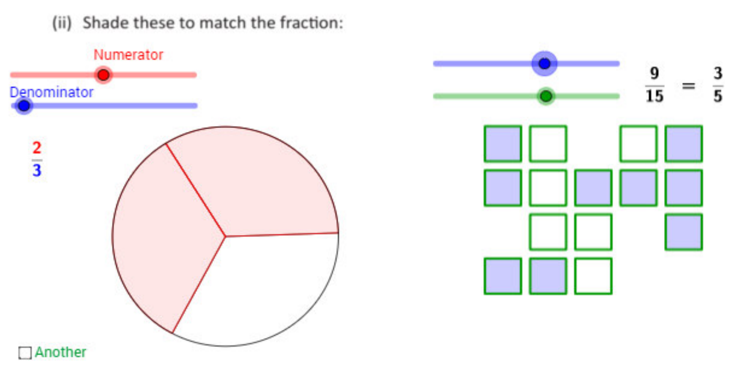
If two fractions are equivalent, will the numerators/denominators always be a multiple of each other?

Does this approach work when multiplying improper fractions?

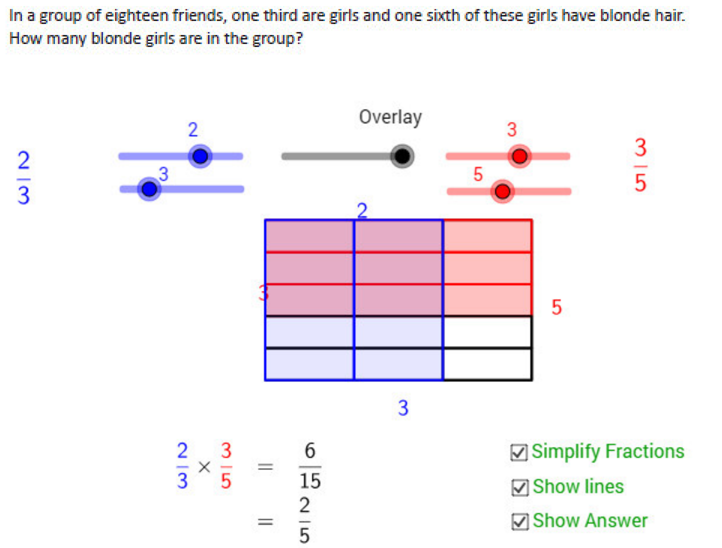
How could this model be used with percentages?

What does 'of' mean as a mathematical operation?

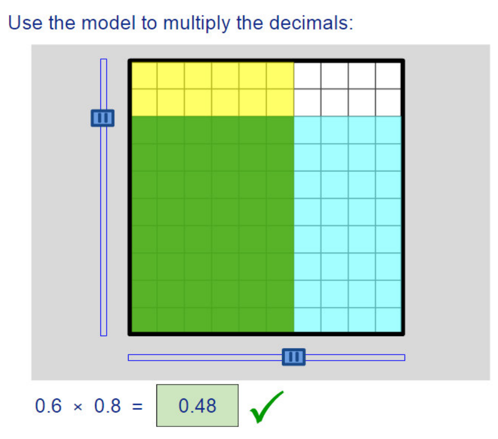
Interactive: Random Squares — Reasoning



Interactive: Overlap Multiplication — Problem Solving



Activity: Multiplying Decimals 1 — Fluency



Key Stage 3

Sequences

Outcome

Students can deduce expressions to calculate the nth term of a linear sequence.

Lesson

Ask students to construct a table to record the number of matchsticks used to form each diagram in the **Matchsticks Patterns** interactive. Predict how many matchsticks will be in the 10^{th} and 25^{th} diagrams. Derive the rule for the number of matchsticks in the nth diagram.

Answer the word problems in the **Algebra Basics** eBook.

Ask students to complete the activity **Linear Expressions for the Nth Term.** Some questions will require students to rearrange the expression for the nth term.

Questioning

True or false? If I know the 10^{th} term of a sequence, I can multiply it by 10 to find the 100^{th} term.

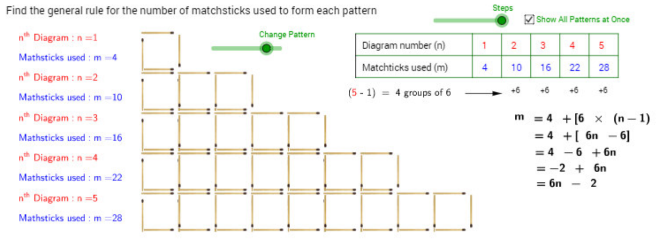
Can you extend the sequence back beyond the first term?

Try plotting your sequence on a graph. What do you notice?

The difference between two numbers in a sequence is 3. Will the expression for the nth term include 3n?

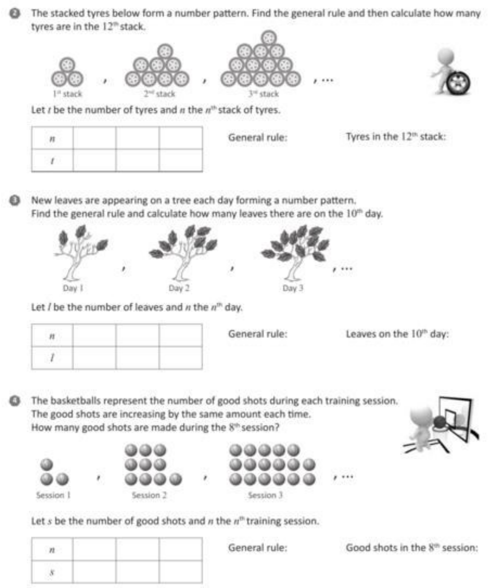
Interactive: Matchstick Patterns

Reasoning



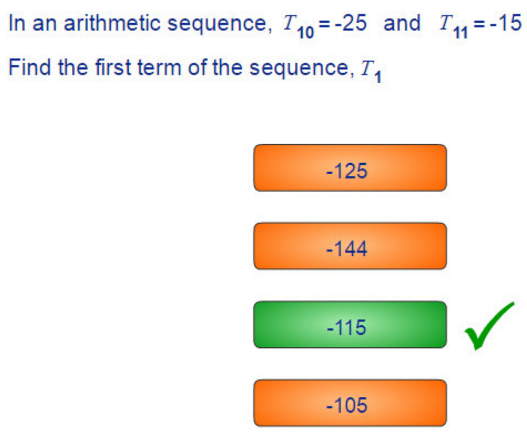
eBook: Algebra Basics

Problem Solving



Linear Expressions for the Nth Term

Fluency



Mathletics

Key Stage 3

Interior Angles

Outcome

Students are able to geometrically prove the sum of the interior angles of a quadrilateral is 360° and apply this fact to find missing angles.

Lesson

Ask students to open the interactive **Quadrilateral Angle Sums** and see what they discover about the angles in a triangle and quadrilateral.

Allow students to move the quadrilateral to check that it can always be split into two triangles.

Ask student to complete the activity **Angle Sum of a Quadrilateral** and questions in the **Angles and Polygons** eBook.

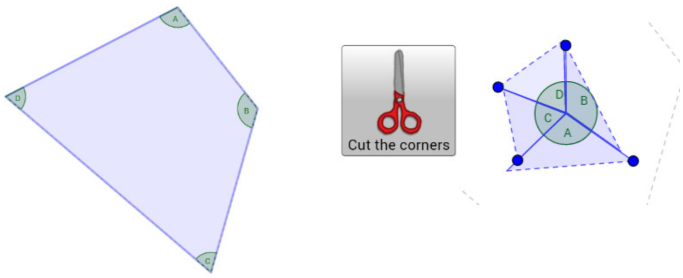
Questioning

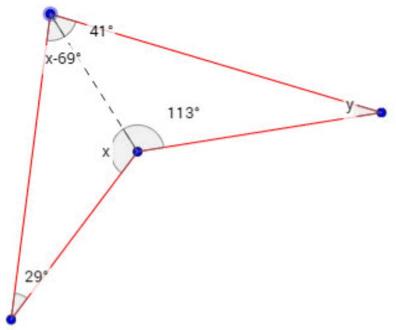
Could this method by used to prove the sum of the interior angles of other polygons?

Is there a general rule for calculating the sum of the interior angles of a polygon with n sides?

Interactive: Quadrilateral Angle Sums

Reasoning

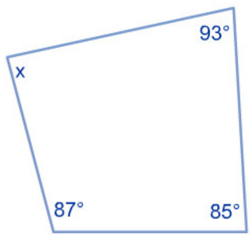




Angle Sum of a Quadrilateral

Fluency

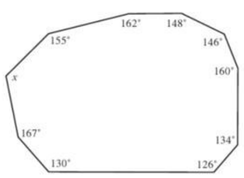
Calculate the value of x.



x = 95 °

eBook: Angles and Polygons

Problem Solving



5. Answer these questions about the following polygon:

a. How many sides does this polygon have?

b. What is the sum of the interior angles of this polygon?

c. Find the size of x.

Mathletics

Key Stage 3

Pythagoras' Theorem

Outcome

Students are able to prove Pythagoras' Theorem geometrically and apply the theorem to find the lengths of sides on a right-angled triangle.

Lesson

Introduce Pythagoras' Theorem with a visual representation. Ask students to prove the theorem using the interactive **Pythagoras Jigsaw**.

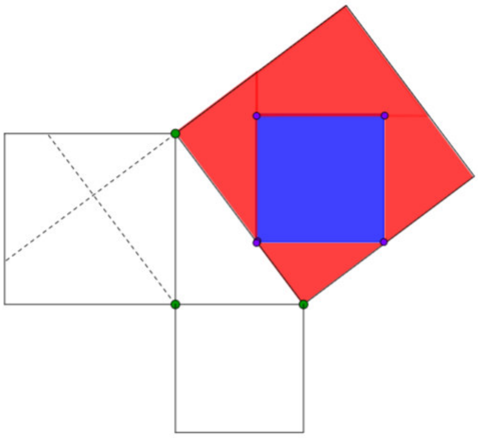
Students then apply the theorem in questions from the **Pythagoras' Theorem** eBook and activity to find unknown sides. They also identify if a triangle will be right-angled given the lengths of the three sides in the activity **Pythagorean Triads**.

Questioning

Is Pythagoras' Theorem true for triangles that are not right-angled? Can you prove your answer?

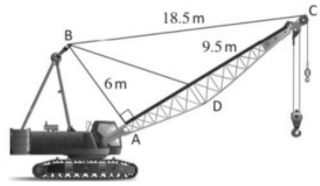
Where do you see right-angled triangles in everyday life?

Interactive: Pythagoras Jigsaw — Reasoning



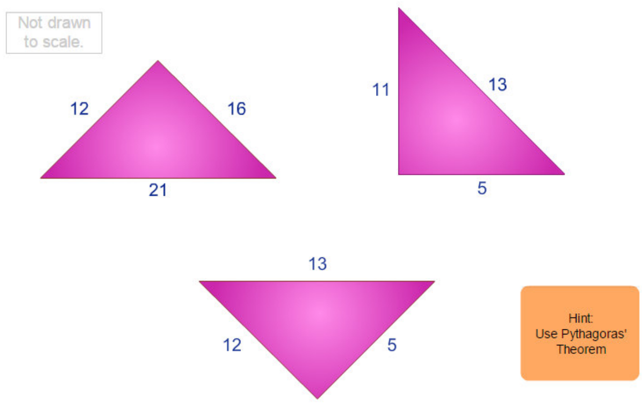
eBook: Pythagoras' Theorem — Problem Solving

8 Calculate the length of the cable support BD on the crane picture below if CD = 9.5 m, AB = 6 m and BC = 18.5 m.



Activity: Pythagorean Triads — Fluency

Which of the following is a right angled triangle?



Mathletics

Key Stage 4

Straight Lines

Outcome

Students are able to write the equation of a straight line passing through any two points.

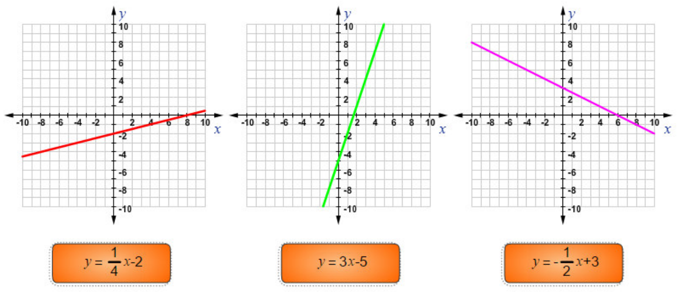
Lesson

Complete the activity **Which Straight** as a class, asking students to hold up their answers on a mini whiteboard.

Activity: Which Straight Line?

Fluency

Match the equations to the graphs.

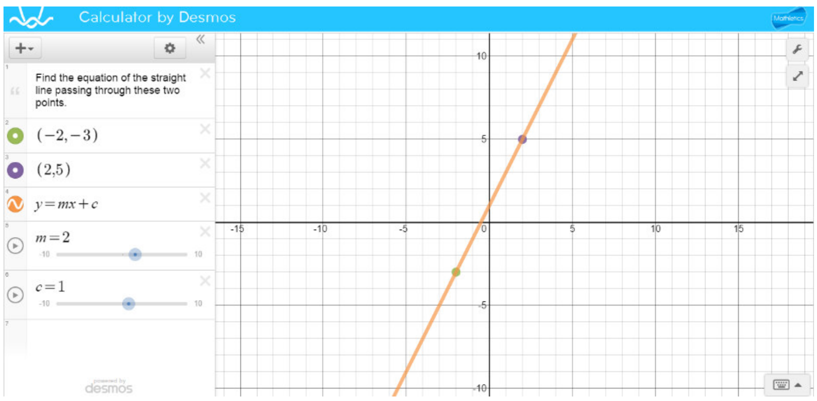


Ask students to type *y* = *mx* + *c* into the **Graphical Calculator.** Give students two points on the Cartesian plane and ask them to use their sliders for *m* and *c* to find the equation of the line that passes through the points.

Watch the video **Equation of a Straight Line** and open the interactive. Select two points and ask students to work out the equation of the line that passes through them. Ask students to explain their workings and then use the interactive to check the answer.

Graphical Calculator

Reasoning



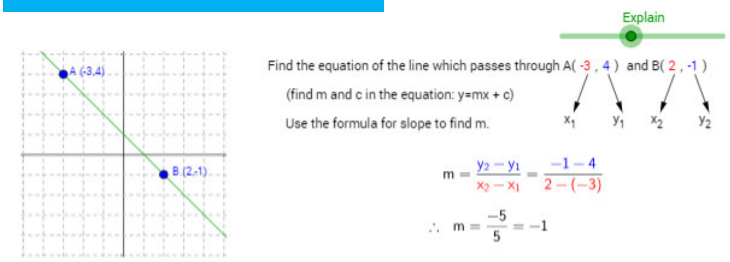
Questioning

What happens to the line as we increase/decrease *m* ?
What happens to the line as we increase/decrease *c* ?

What would the equation of the line be if the *x*-co-ordinates of the two points are the same?

Interactive: Equation of a Straight Line

Problem Solving



Mathletics

Key Stage 4

Quadratic Roots

Outcome

Students are able to identify the roots of quadratic equations and know the conditions for no/one/two real roots.

Lesson

Type the general quadratic equation into the **Graphical Calculator** and use the sliders to see that the coefficients impact how many times the graph intercepts the *x*-axis. Use the quadratic formula to derive the conditions on discriminant required for no/one/two real roots.

Ask students to complete the activity **Nature of Solutions of Quadratics**. Students should not calculate the roots but look at the discriminant to calculate the number of real roots.

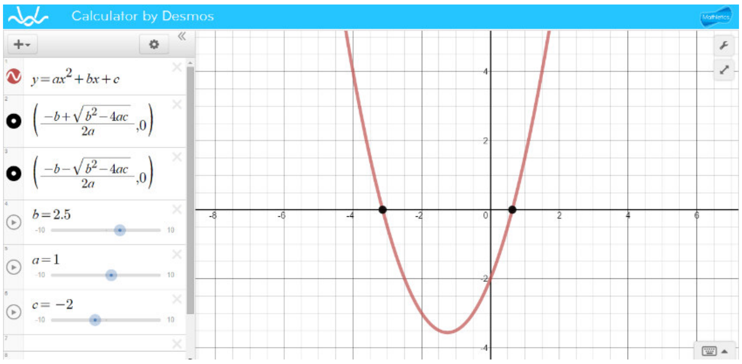
Answer questions in the **Quadratic Equations** eBook. Students will have to consider the situation in the question when determining which solution(s) to give.

Questioning

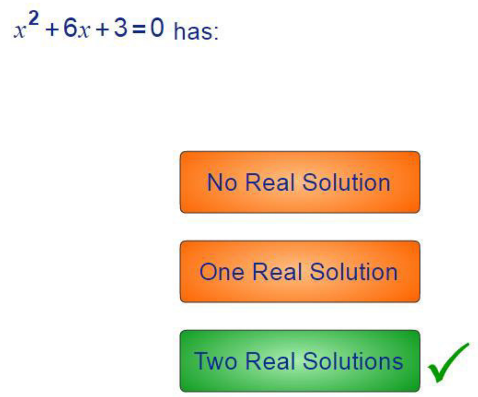
Does the square root of a negative number exist?

Why do we call these *real* roots?

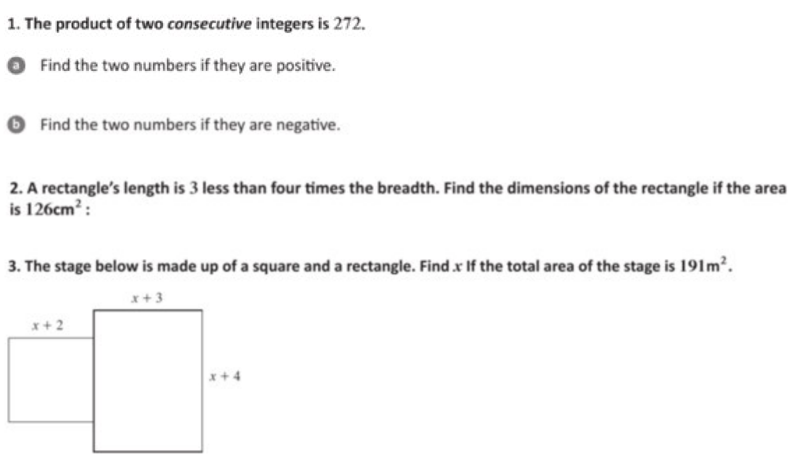
Graphical Calculator | Reasoning



Nature of Solution of Quadratics | Fluency



eBook: Quadratic Equations | Problem Solving



1. The product of two *consecutive* integers is 272.

(a) Find the two numbers if they are positive.

(b) Find the two numbers if they are negative.

2. A rectangle's length is 3 less than four times the breadth. Find the dimensions of the rectangle if the area is 126cm^2:

3. The stage below is made up of a square and a rectangle. Find x if the total area of the stage is 191m^2.

Mathletics

Key Stage 4

Graphing Linear Inequalities

Outcome

Students are able to graph and solve linear inequalities.

Lesson

Project the interactive **Co-ordinate Pairs** and choose four points. Ask students to find an inequality that includes only two of points.

Ask students to complete the activity **Linear Regions**.

Play **Where's My Point?** with your students by asking them to use the **Graphical Calculator** to graph your description of your chosen point e.g.

1. The co-ordinates are integers.
2. The *y*-co-ordinate is bigger than the *x*-co-ordinate.
3. The sum of the co-rdinates is less than 6.
4. The *x*-co-ordinate is greater than or equal to 2.

Answer: (2,3)

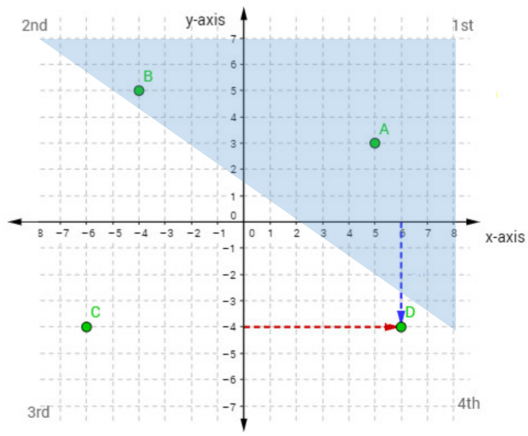
Questioning

Can you solve this algebraically?

Create your own Where's My Point? puzzle for your classmate.

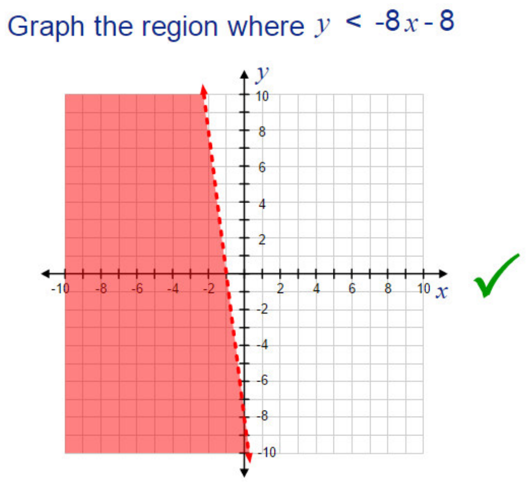
Interactive: Co-ordinate Pairs

Reasoning



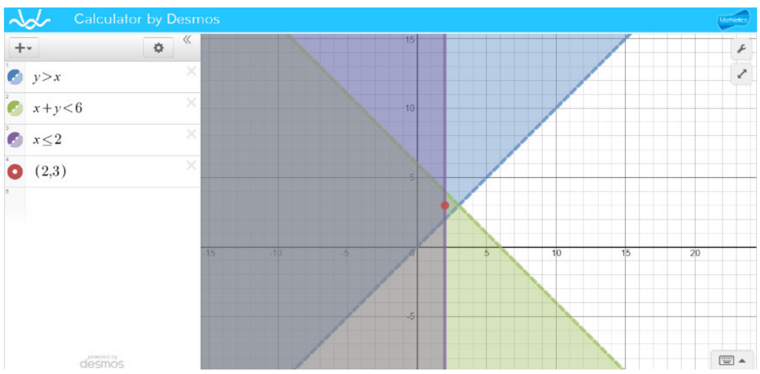
Linear Regions

Fluency



Graphical Calculator

Problem Solving



Circle Theorems

Key Stage 4

Outcome

Students are able to prove and apply the circle theorems.

Lesson

Recap circle vocabulary with your class: centre, radius, diameter, circumference, chord, major/minor sector, major/minor segment, arc, tangent.

Use the interactives in the eBook **Chords and Angles** to demonstrate the circle theorems and their proofs.

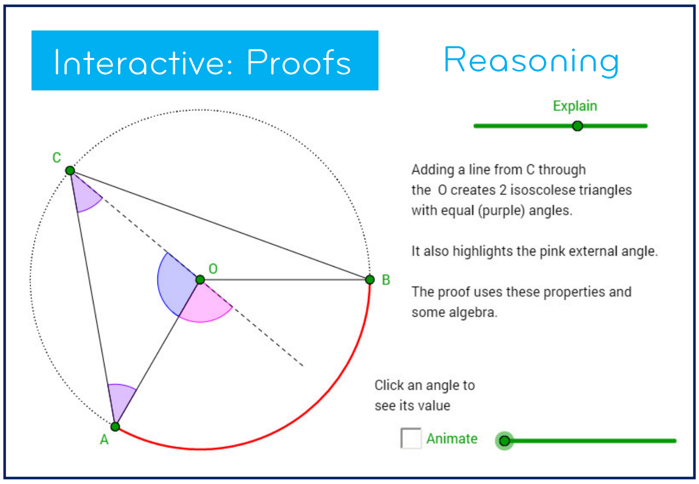
Ask students to complete the activity **Circle Theorems**. Students will need to calculate the answer and select the theorem they have used.

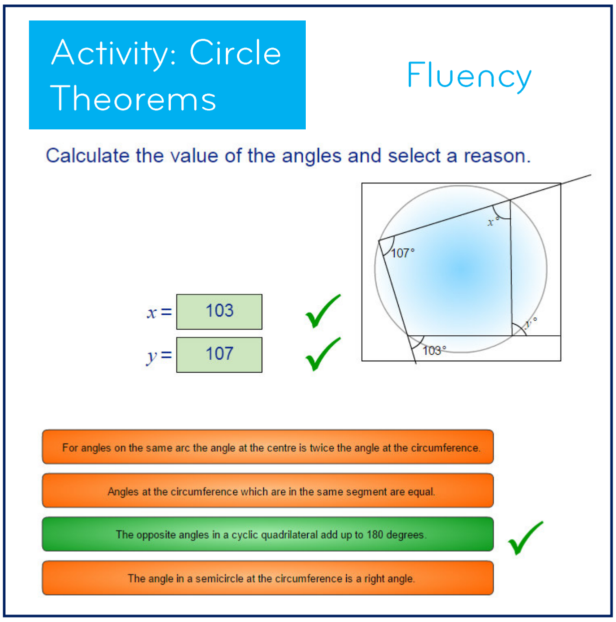
Answer exam-style questions in the eBook **Chords and Angles**. These will require students to apply multiple theorems in one question.

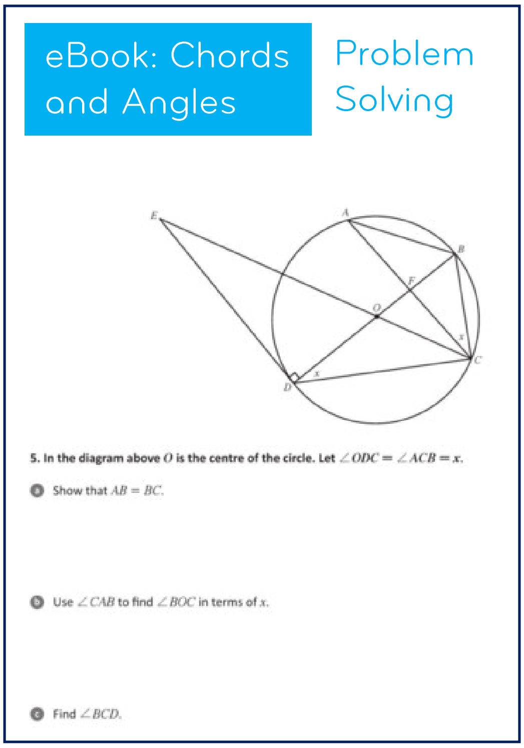
Questioning

Do you already know any relationships between these circle terms?

Can you derive any of the theorems from one of the other theorems?







Mathletics

Key Stage 5

Graphing Circles

Outcome

Students understand and use the co-ordinate geometry of the circle including using the equation of a circle.

Lesson

Use the interactive **General Equation of a Circle** to derive the equation of a circle using Pythagoras.

Ask students to complete the activity **Graphing Circles** to familiarise themselves with identifying the centre and radius of circle from the equation, and recognising the corresponding graph.

Give students exam-style questions from the eBook **Circle Graphs**, where they will use their understanding of the equation of a circle along with other known geometric properties to solve problems.

Questioning

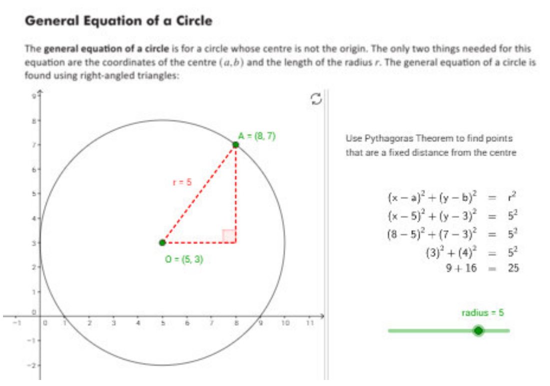
Can you calculate the area of circle from its equation?

Could r be negative?

Give students two co-ordinates A and B. Ask them to find the equation of the circle given the points A and B lie on the circle and the line AB passes through the centre.

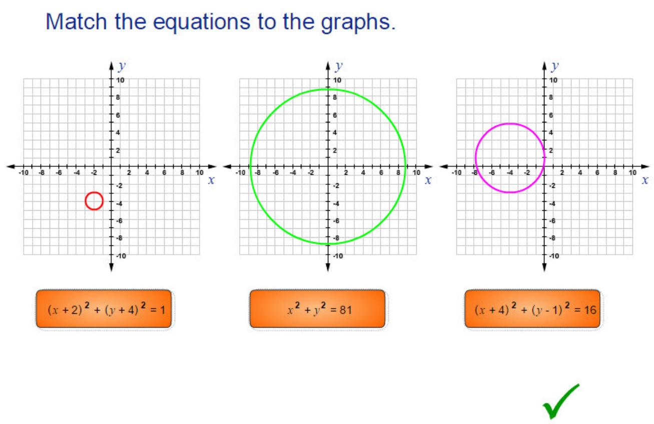
Interactive: General Equation of a Circle

Reasoning



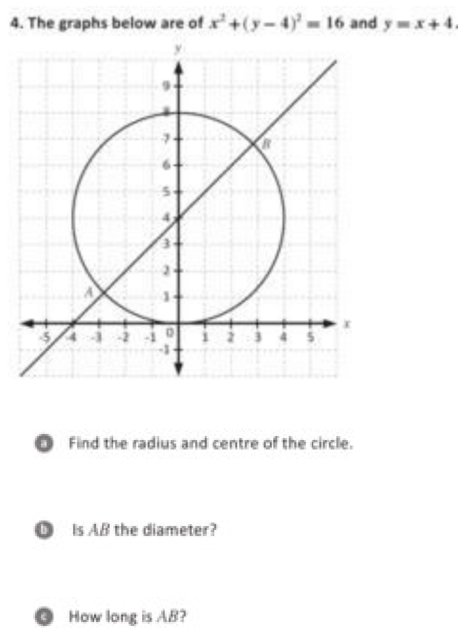
Activity: Graphing Circles

Fluency



eBook: Circle Graphs

Problem Solving



Mathletics

Key Stage 5

Transformation of Functions

Outcome

Students understand the effect of transformations on functions and can sketch their associated graphs.

Lesson

Ask students to open to the **Graphical Calculator** and define a function of their choice. Now ask them to type f(x) + a and explore the impact on the graph as they use the slider to vary a. Repeat for f(x + a), f(ax) and af(x).

Ask students to complete the activity **Symmetries of Graphs 1**.

Answer exam-style questions from the eBook **Curve Sketching**. Students will need to consider combinations of transformations.

Questioning

Can you explain in words the effect of each transformation?

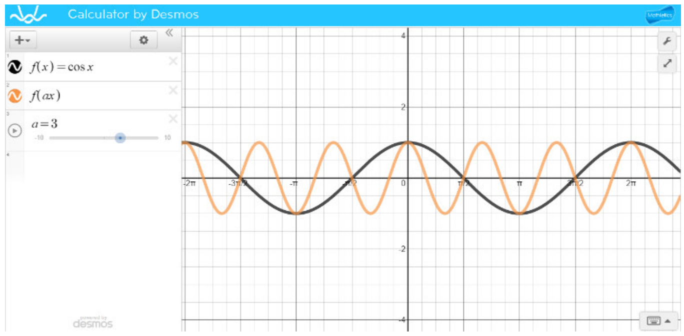
What about when a is negative?

Are the any combinations of different transformations that result in the graph not moving?

Does the order in which you apply the transformations impact the result?

Graphical Calculator

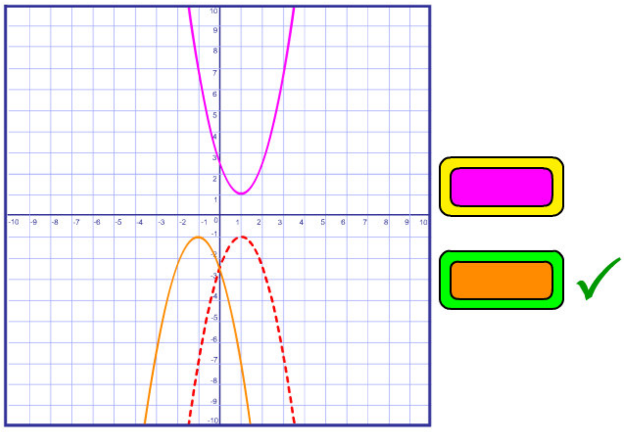
Reasoning



Activity: Symmetries of Graphs 1

Fluency

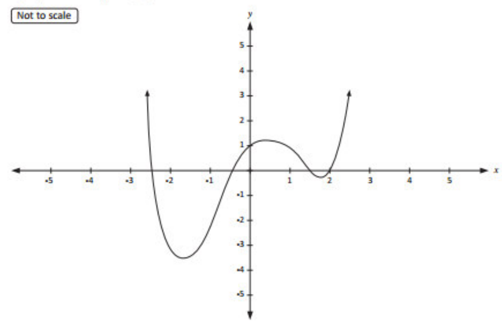
On the following graph, P(x) is represented by a dashed line:



Identify which graph represents P(-x).

eBook: Curve Sketching

Problem Solving



5. The graph below is of $y = P(x)$.

Not to scale

a On the same set of axes, sketch the graph of $y = P(x+2)+1$.

b On the same set of axes, sketch the graph of $y = 2P(x)-1$.

c On the same set of axes, sketch the graph of $y = 2P(x-1)$.

d On the same set of axes, sketch the graph of $y = P(-x)$.

Mathletics

Key Stage 5

Differentiation

Outcome

Students understand the derivative of f(x) as the gradient of the tangent to the graph of y = f(x) at (x,y) and differentiate x^n for rational n.

Lesson

Open the **Graphical Calculator** and ask students to calculate the gradient of $y = x^2$ at x = 1, 2, 3, 4 and 5 by using $y = mx + c$ and sliders. Record the results in a table and ask students if they spot a relationship between x and the gradient. Repeat the exercise or split into groups to look at x^3 and x^4, and derive the rule for x^n.

Use the interactive **Exponent Derivatives** to examine the definition of derivative and derive the rule $\frac{d}{dx}ax^n = nax^{n-1}$ using the binomial theorem.

Ask students to complete the activity **Differentiation 1**.

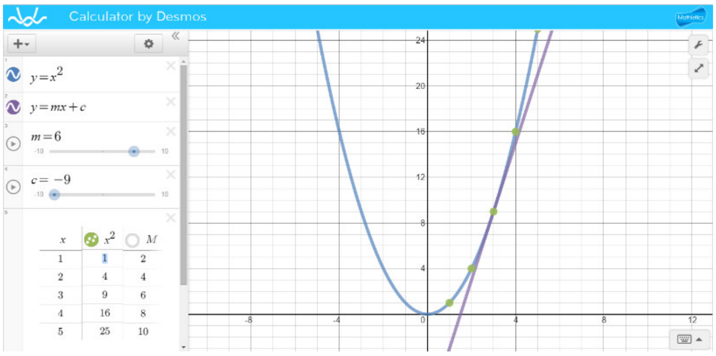
Questioning

What is the derivative of a constant?

Is the derivative of the sum/difference the same as the sum/difference of the derivatives?

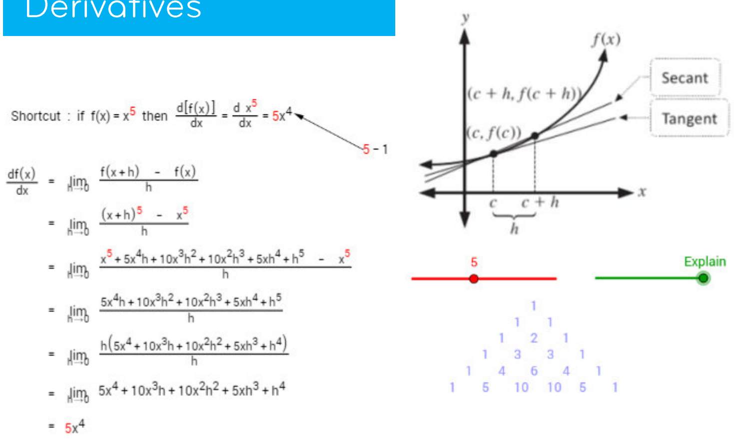
Graphical Calculator

Problem Solving



Interactive: Exponent Derivatives

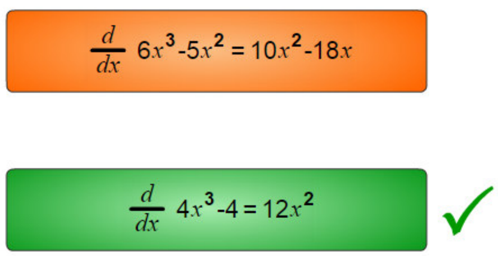
Reasoning



Activity: Differentiation 1

Fluency

Which of the following is correct?



Mathletics

Arithmetic Series

Key Stage 5

Outcome

Students understand arithmetic series and can use the sum to n terms to solve problems.

Lesson

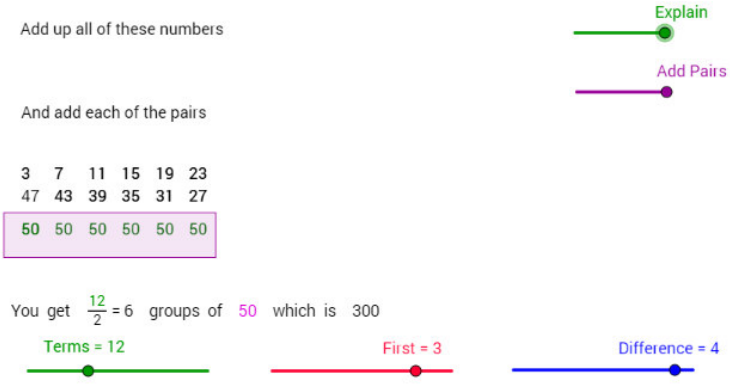
Use the interactive **Sum of Arithmetic Sequences** to explore summing different arithmetic sequences. Extend to using the same approach for summing a generic arithmetic sequence to n terms using the related interactive.

Apply this rule by asking students to complete the activity **Sum: Arithmetic Progressions**.

Answer word problems from the eBook **Sequences & Series: Arithmetic** for real-life applications.

Interactive: Sum of Arithmetic Sequences

Reasoning



Sum: Arithmetic Progressions

Fluency

An arithmetic series is given by $1, 6, 11, \ldots, 96$ Calculate S_{20} given $T_{20} = 96$.

485 | 970 ✓

980 | 1940

Questioning

Can you still use the formula for the sum of n terms if n is odd? Why?

Can any term in the sequence be greater than the sum of the sequence?

eBook: Sequences & Series: Arithmetic

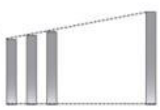
Problem Solving

58. Paula is training for a 4 km swimming race by swimming each week for 30 weeks. She swims 200 m in the first week, and each week after that she swims 200 m more than the previous week, until she reaches 4 km in a week. She then continues to swim 4 km each week.

- a How far does Paula swim in the fourth week?
- b In which week does she first swim 4 km?
- c What is the total distance Paula swims in 30 weeks?

59. The temperature in a cool room was taken at regular intervals after it was turned on, and the readings in degrees Celsius were $25^\circ, 24.1^\circ, 23.2^\circ, \ldots$. Assume that these readings are in arithmetic progression. If the final reading taken was equal to -9.2°, how many readings were taken altogether?

60. A tall fence has the shape of a trapezium and has planks arranged as shown. The difference between the lengths of adjacent planks is a constant and so the lengths of the planks form an arithmetic sequence. The shortest plank is 180 cm in length and the longest string is 250 cm. The sum of the lengths of the planks is 774 m



- a Find the number of planks.
- b Find the difference in length between adjacent planks.

Mathletics