

Time	Activity	Venue	Staff	
10:30	Arrival – Registration and Refreshments	Roscoe Foyer		
11:00	Opening Plenary - 10 mins UoM - 30 mins Dr. Rose Wagstaffe	Roscoe Theatre A	UoM	
11:40	How to use Integral and EdX		MEI	
11:55	Move to workshop rooms			
12:05	Icebreakers in Mentoring groups (+ choose session times)		Mentors (UoM)	
	Group	Tutor Groups		Room
	A	1		Roscoe 1.001
		2		Roscoe 1.003
		3		Roscoe 1.007
4		Roscoe 1.008		
B	5	Roscoe 1.009		
	6	Roscoe 1.010		
	7	Roscoe 2.10		
	8	Roscoe 3.2		
C	9	Roscoe 3.3		
	10	Roscoe 3.4		
	11	Roscoe 3.5		
	12	Roscoe 3.9		
D	13	Roscoe 4.3		
	14	Roscoe 4.4		
	15	Roscoe 4.8		
12:50	Lunch (quiet/prayer room Roscoe 2.8)	All Groups	Roscoe Foyer	
1:30	1 st Workshop		MEI	
	Workshop Name	Groups		Room
	Coordinate Geometry	A		Roscoe 2.2
	Quadratics	B		Roscoe 2.3
	Coordinate Geometry	C		Roscoe 2.4
Quadratics	D	Roscoe 2.5		
2:30	Swap workshop rooms			
2:35	2 nd Workshop		MEI	
	Workshop Name	Groups		Room
	Coordinate Geometry	B		Roscoe 2.2
	Quadratics	A		Roscoe 2.3
	Coordinate Geometry	D		Roscoe 2.4
Quadratics	C	Roscoe 2.5		
3:35	Move to main room			
3:40	Closing plenary and questions	Roscoe Theatre A	UoM	
4:15	Event End			

Emergency Information

In the event of an emergency please contact the event mobile on your lanyard or call:

University Security – 0161 306 9966

Event Mobile – 07467 339519

If you are lost or separated from your group, go to Roscoe Foyer.

mA*ths online masterclass 1

Mentor session 1

Icebreakers

This icebreaker session is a time for you to get to know your university mentor and the other people in your group.

Some of the time will be spent planning when you will be able to get help from your mentor.

During this time there will be some moments when you have little to do so the following puzzles and problems are there to give you something to think about. Talk to other people in your group while you are working on them. Share ideas.

If you come up with an answer to a problem fairly quickly, look at some of the other questions. Just remember that they are there to give you something to talk about with others in your group, particularly if you don't know what else to say to them!

Don't worry if you don't manage to find an answer to any of the puzzles or problems. This is not an examination, just an icebreaker to get you thinking before you go into the rest of the day. It is easy to forget that it is possible to enjoy solving maths problems, especially if you are used to working for tests and exams. Solving maths problems can be enjoyable particularly if you can chat about how you are trying to solve them with someone else. Mathematicians do this all the time!

Puzzle 1 – An unhelpful colleague

One of my colleagues refuses to give a straight answer to any simple question she is asked.

I recently asked her for the time and she responded:

"If you add one quarter of the time from noon until now to half the time from now until noon tomorrow, you will get the time exactly."

What was the time?

Puzzle 2 – A not-so-magic square

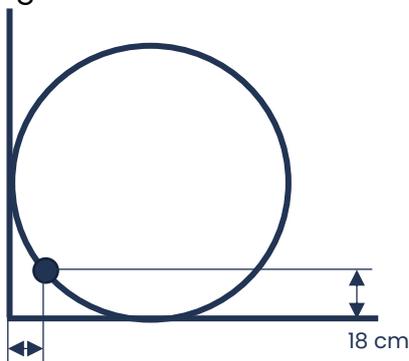
1	9	2
3	8	4
5	7	6

The digits 1 to 9 are arranged in this square so that the number in the second row (384) is twice that in the first row (192), and the number in the bottom row (576) is three times that in the top row.

Are there other ways of arranging the digits so as to produce the same result? If there are, what are they? If there aren't, why aren't there?

Puzzle 3 – How big is the table?

A circular table is pushed into the corner of a room so that it touches both walls. This is shown in the diagram below:

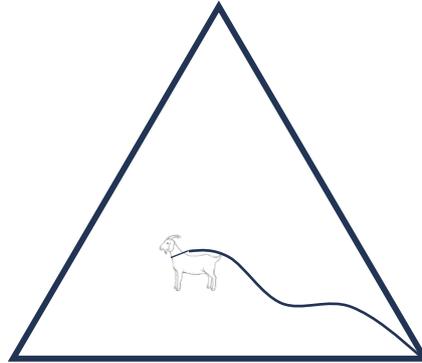


A mark on the extreme edge of the table is 18 cm from one wall and 16 cm from the other. What is the radius of the table?

Puzzle 4 – Goat on a rope

No puzzle collection is complete without a goat on a rope question.

A goat is placed in field with area 4000 m^2 . The field is in shape an equilateral triangle. The is tied by a rope to a post at one corner of the field. What length does the rope need to be if the goat is able to eat just half the grass in the field? The goat can feed right to the end of its tether.



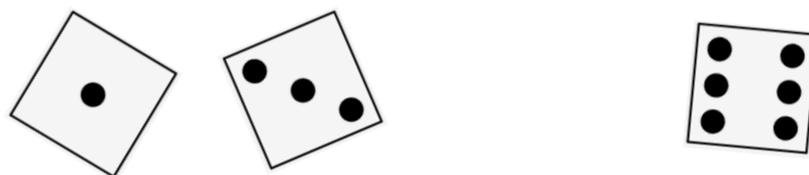
Puzzle 5 – A trick with dice

Here's a magic trick with dice I use from time to time. I ask a student to roll 3 dice but not tell me what the result is. I get the student to allocate the dice into positions 1, 2 and 3. They don't have to be in order of size.

I then ask the student to multiply the number on the first dice by 2 and then add 5 to get total A. I then get them to multiply A by 5 and add the number on the second dice to get total B. I then ask them to multiply B by 10 and add the number on the third dice to give total C.

From C I can tell them the numbers on all 3 dice.

For example the outcome



Gives the calculation $A = 1 \times 2 + 5$

$$A = 7$$

$$B = 7 \times 5 + 3$$

$$B = 38$$

$$C = 38 \times 10 + 6$$

$$C = 386$$

From knowing the answer 386, I can tell the student that they threw 1, 3 and 6.

How do I know this and how does the trick work?

Puzzle 6 – Cutting out from a cone

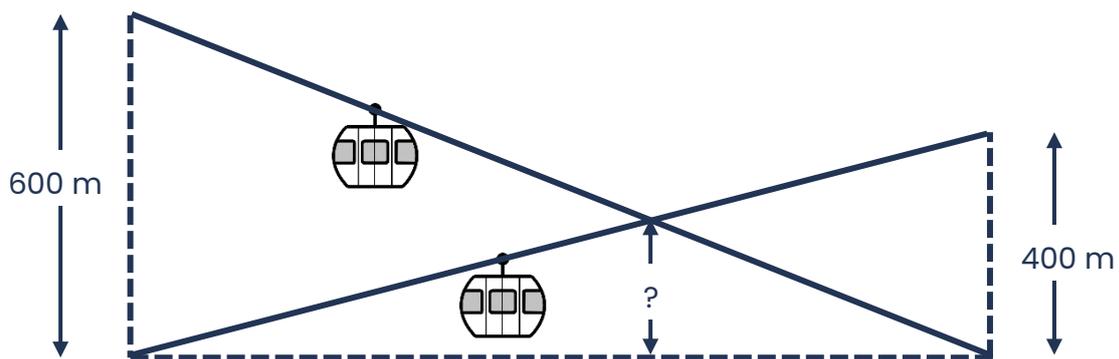
If you have a cone (let's say it's wooden). What is the largest (by volume) cylinder that could be cut from the cone? Should the cylinder be long and thin or short and fat?



Start with a cone of radius 1 unit and a height of 1 unit.

How could you find the largest cylinder for any cone?

Puzzle 7 – Cable cars



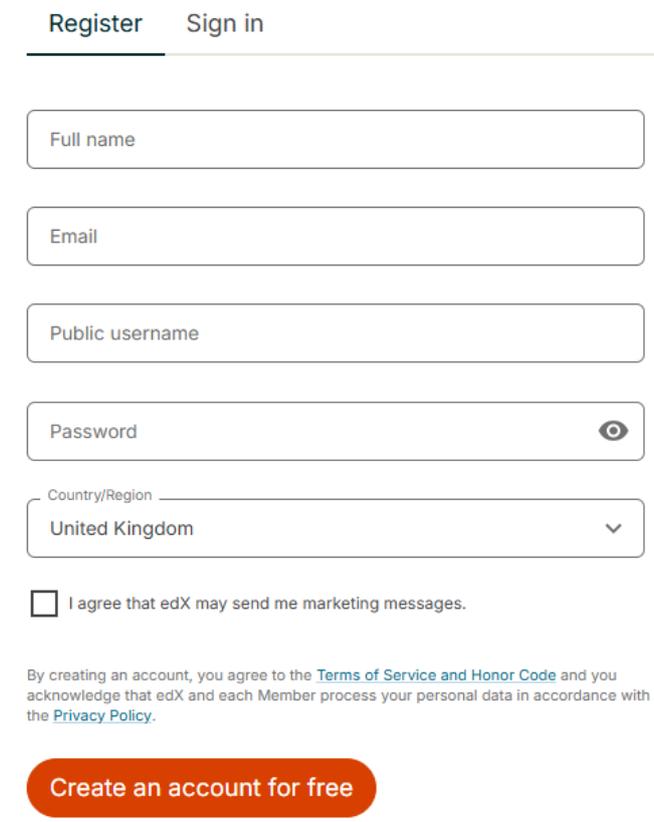
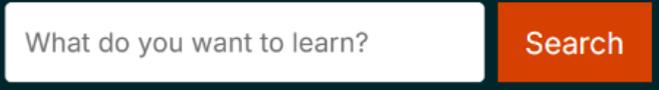
Two straight wires for cable cars are shown in the diagram. One car reaches a vertical height of 600m

and the other a vertical height of 400m as shown.

At what height do the wires cross?

mA*ths Online Programme – Masterclass 1

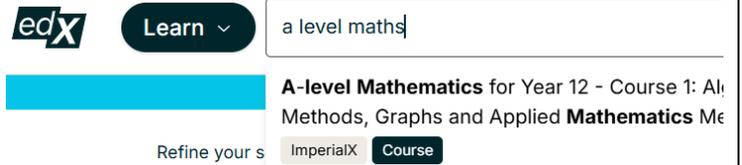
Registering with EdX

Instruction	Screenshot
<p>Go to https://www.edx.org/ From the top right-hand corner of the webpage, click on 'Register for free'.</p>	
<p>You will be asked to fill in a short form.</p> <p>Although you can sign in with a Facebook, Google+ or Microsoft account, we ask that you create a new account using the form. This will allow us to track your progress through the course.</p> <p>Fill in all of the spaces. Be very careful to use a working email and enter it carefully.</p> <p>Your <i>Public Username</i> cannot contain spaces. Use something sensible. It must be unique.</p> <p>The <i>password</i> needs both numbers (at least 1) and letters.</p> <p>Untick the marketing box if you wish, and click to '<i>Create an account for free</i>'.</p>	
<p>You will be sent an email message to verify your account. If you can't access your emails at the moment, don't worry, you can verify it when you get home – don't forget.</p>	
<p>EdX will give you the following message: Which should not come as a surprise!</p>	

The use the search feature to search for 'A Level Mathematics'.

You will actually probably see the ImperialX courses appearing

Click 'Search' to see all results.



You are looking for the course:

'A-level Further Mathematics for Year 12 – Course 1...'

Click on the course.



Click the 'Audit course' button under box on the right hand side.

On the next page, scroll past the box asking for money and click 'Audit course' again

Important: When you 'Audit' a course on edX you will still get the full experience. You will get messages asking you to pay. **Do not pay on edX.** You will get a certificate directly from Imperial College and not through edX.



 [Audit course](#)

Well done, you have registered on the course in edX.

Make sure you remember your password.



An introduction to the online platforms

mA*ths Year 12 Day 1



1

Why are we using 2 online platforms?

The online course is entirely hosted in EdX

All of the exercise and assessments are automatically marked and recorded by EdX

But...EdX does not include a classroom for mentoring sessions.



2

What each platform is used for



Hosts the online course

All the videos, reading sections, exercises and assessments are on EdX.

The day to day platform for the course.



The support platform

Your mentor's classroom. Your group forum.

Where you go to get help when you are stuck!



3

The Masterclasses



The workshops in this masterclass have more activities than you will be able to complete.

You can continue with the activities on Integral. All of today's workshops are set up for you to continue working through.

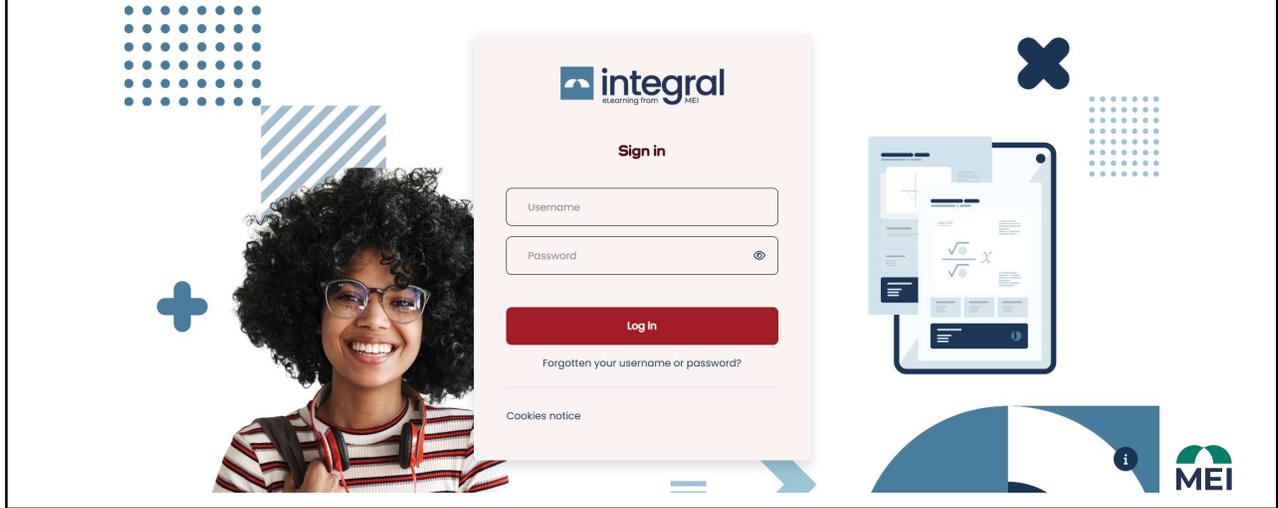
Today each workshop will start with an introduction. You will then go into your mentor groups to work through the activities.



4

Using Integral

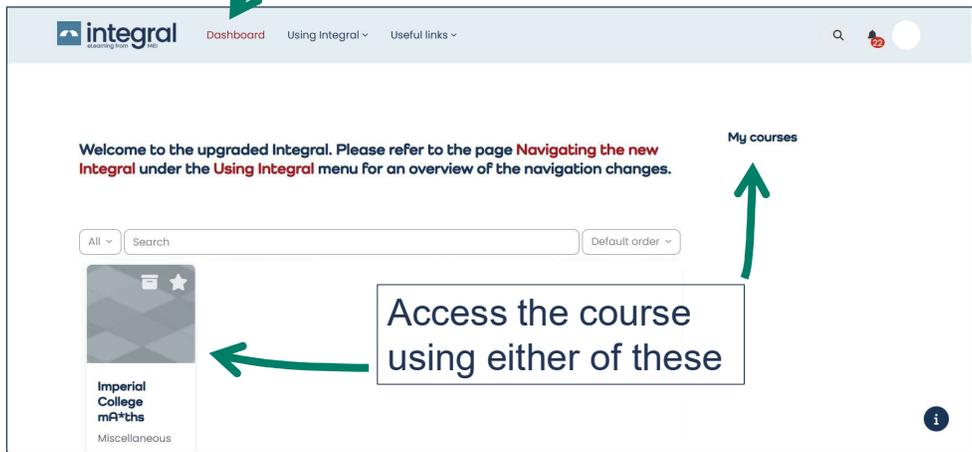
The first time you log in, you will be asked to change your password. Make sure you remember your new password when you do this.



5

Using Integral

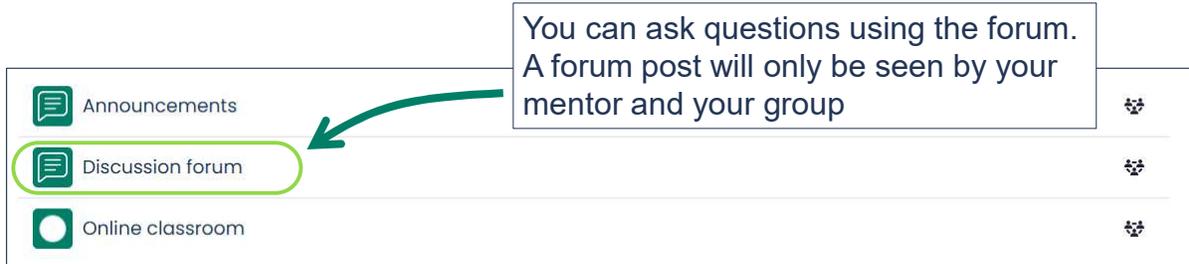
You should reach the dashboard. If you don't, click here



6

Course page

You can ask questions using the forum. A forum post will only be seen by your mentor and your group



Announcements

Discussion forum

Online classroom



7

Using Integral - forum

The forum looks like this

Forum posts are read and moderated by the course staff.

Imperial mA*ths / Discussion forum

Discussion forum

Forum Settings Advanced grading Subscriptions Reports

Search forums Add discussion topic Unsubscribe from forum

Separate groups All participants

1 2 3 4 5 »

Discussion	Group	Started by	Last post ↓	Replies	Subscribe
☆ Closing message	2322-Y12GroupL...	12 May 2025	12 May 2025	0	<input type="checkbox"/>

Click here to post a new message

Read posted messages here



8

Using Integral – posting a message

To post a message

The screenshot shows the Integral forum post editor interface. It includes a 'Subject' field at the top, a 'Message' field with a rich text editor toolbar (containing icons for undo, redo, bold, italic, link, unlink, image, video, audio, text color, background color, bulleted list, numbered list, indent, outdent, link, unlink, and table), and a 'Group' dropdown menu set to 'All participants'. At the bottom are 'Post to forum', 'Cancel', and 'Advanced' buttons. Green callout boxes with arrows point to the 'Subject' field, the message text area, the rich text editor toolbar, and the 'Post to forum' button.

You have to put a subject

Type your message here

You can enter maths using an equation editor

Click here to post it!



9

Mentor classrooms

The screenshot shows a menu with three items: 'Announcements', 'Discussion forum', and 'Online classroom'. The 'Online classroom' item is highlighted with a green rounded rectangle. A green arrow points from a callout box to this item.

You access your mentor's classroom here

A headset or even just normal headphones will make the classroom experience much better



10

Workshop materials



11

Using Integral – Workshop pages

The workshops

Workshop 1 Quadratics

-  Activity 1

-  Activity 2: Graphs of quadratic functions

-  Quadratics activity 2 pdf

-  Activity 3: Graphs of the reciprocals of quadratic functions

-  Activity 3 challenge 1

-  Activity 3 challenge 2

-  Activity 3 challenge 3



12

Registering with EdX



There are complete “from scratch” instructions in Integral.

If you have studied a course in EdX before, you will just need to add the new course to your portfolio.



13

Registering with EdX



Go to <https://www.edx.org/>

Click on

Register for free

You will be asked to fill in a short form

You can sign in with an Apple, Facebook, Google or Microsoft account, but we ask that you create a new account using the form.



14

Registering with EdX



Your Public Username cannot contain spaces. Use something sensible. It has to be unique.

The password needs both numbers (at least one) and letters.

Untick the marketing box if you wish.



15

Registering with EdX



The use the search feature to search for A Level Mathematics

Click SEARCH

You are looking for the course A Level Mathematics for Year 12 - Course 1...

Course



A-level Mathematics for Year 12 - Course 1: Algebraic Methods,...
ImperialX

🕒 7 weeks to complete
📌 Intermediate



16

Registering with EdX

Click the 'Audit course' button under box on the right-hand side.

On the next page, scroll past the box asking for money and click 'Audit course' again.

Important:

When you 'Audit' a course on edX you will still get the full experience.

Do not pay on edX. You will get a certificate directly from Imperial College and not through edX.



Starts Aug 05
Ends Sep 01

[Advance your career](#)

8,317 learners enrolled

 [Audit course](#)



17

Time to get started...

You are going to move in your mentor groups.

There are icebreaker starters to work on with your mentor and the others in the group.

Your mentor will also be checking your availability for their support sessions.



18

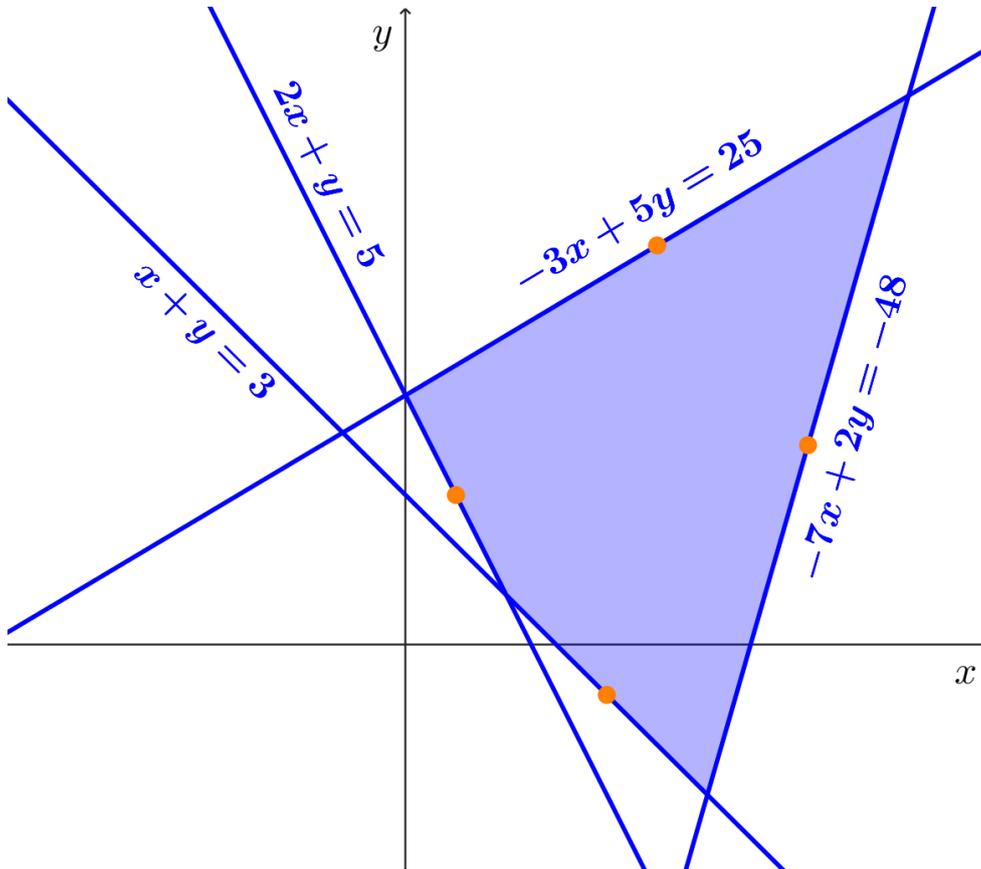
Add details of icebreaker rooms here



mA*ths online masterclass 1

Workshop A: Coordinate Geometry

Activity 1



The diagram shows a quadrilateral formed by the four lines

$x + y = 3$, $2x + y = 5$, $-7x + 2y = -48$, and $-3x + 5y = 25$.

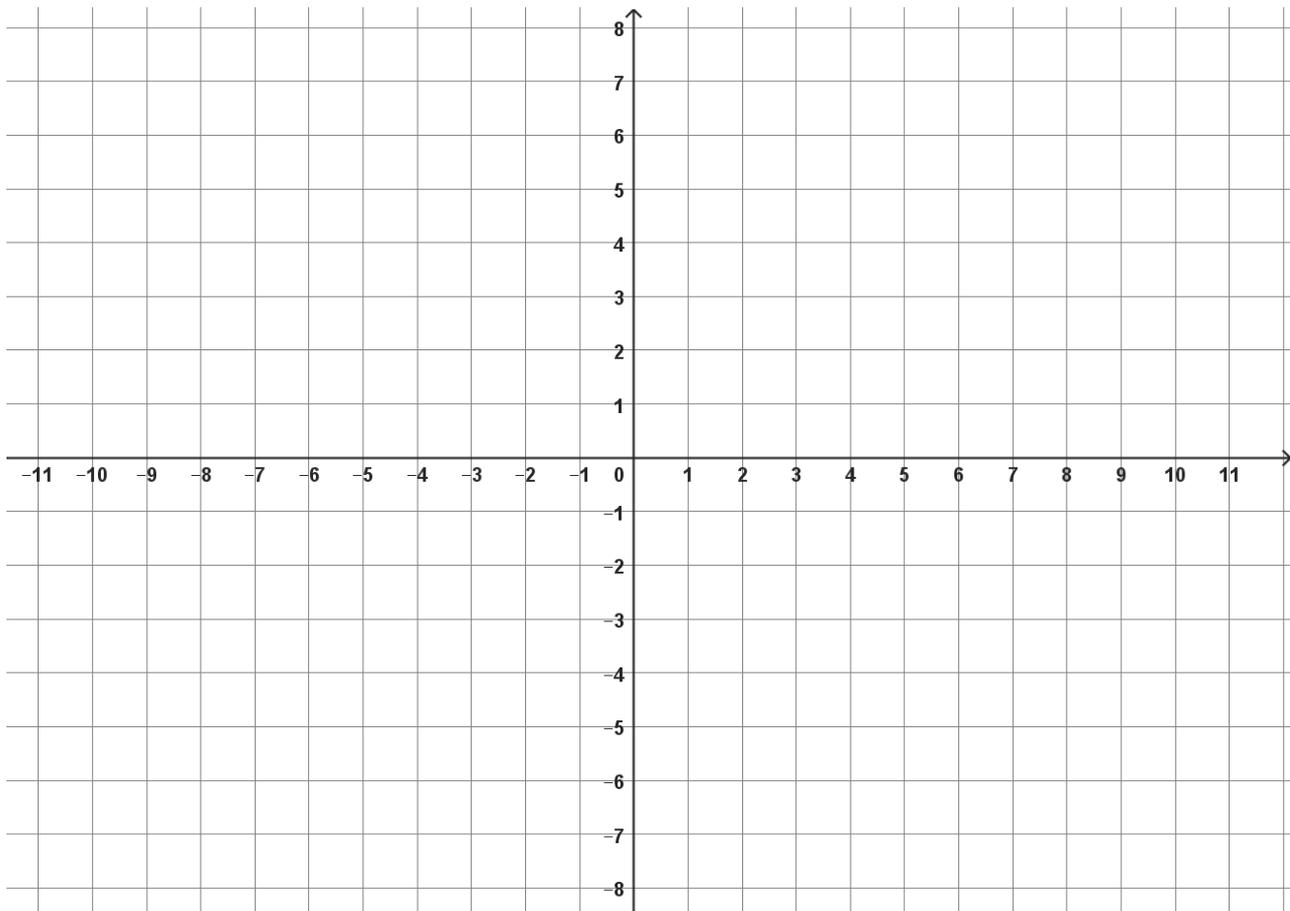
The midpoints of the edges of this quadrilateral are marked.

A new quadrilateral is formed with these midpoints as vertices.

For each edge of the new quadrilateral, calculate its length and its gradient.

- What do you notice?

Draw your own quadrilateral on the grid below



- Check whether your result still holds.
- Can you prove your result? Try to prove it.

mA*ths online masterclass 1

Workshop A: Coordinate Geometry

Activity 2

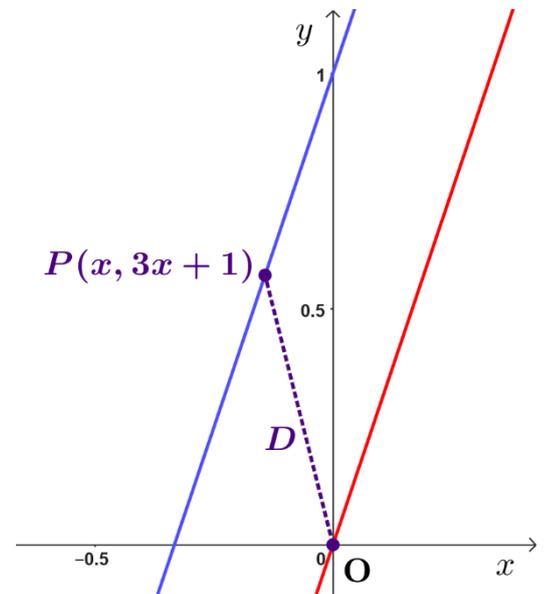
In this activity you are going to find the shortest distance from $(0,0)$ to the line $y = 3x + 1$ in three different ways. Trying all three ways is important.

Method A

OP is a line segment from the origin to a point P on the line $y = 3x + 1$.

The length of OP is D .

P can move along the line, and has coordinates $(x, 3x + 1)$.



Write down an expression for D^2 in terms of x . Simplify this expression.

Write the expression for D^2 in completed squares form.

What is the minimum value of D^2 and for what value of x does it occur?

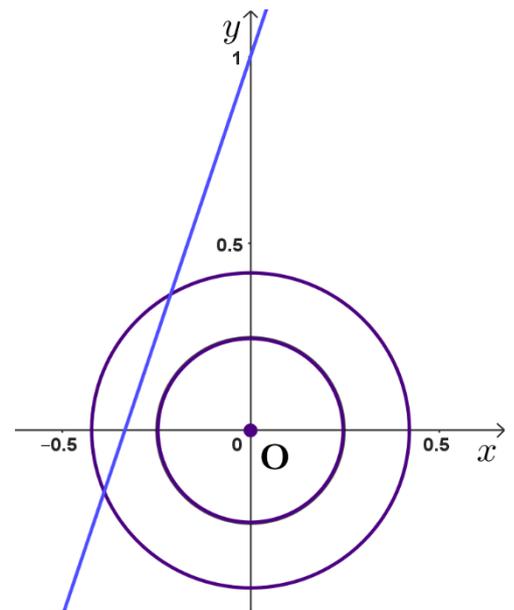
Explain how you can deduce the minimum value of D .

Method B

The diagram shows two circles, both with centre at $(0,0)$. They both have equation $x^2 + y^2 = r^2$ for different values of r .

The circle with a smaller radius does not intersect the line $y = 3x + 1$ at all.

The other circle intersects the line twice. The value of r for this circle gives the distance from $(0,0)$ to either of the points of intersection.



Explain why finding a circle for which the line $y = 3x + 1$ is a tangent helps solve our problem of finding the shortest distance from $(0,0)$ to the line $y = 3x + 1$.

Form an equation in x and r for where the circle meets the line. Simplify the equation.

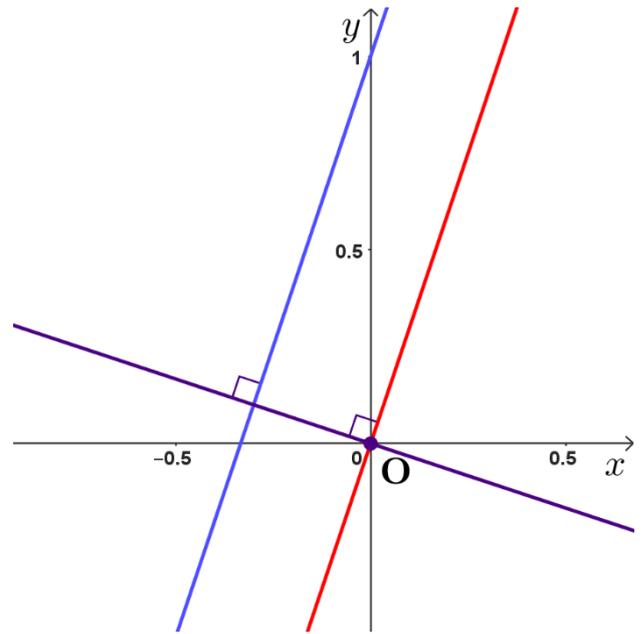
Think about the conditions for your equation to have zero, one or two roots.

Use this to find the shortest distance from $(0,0)$ to the line $y = 3x + 1$.

Method C

In this diagram a line has been added which is perpendicular to both $y = 3x$ and $y = 3x + 1$.

The line goes through $(0,0)$.



Find the gradient and the equation of this new line.

Find the point of intersection of this line and the line $y = 3x + 1$

Hence deduce the shortest distance from $(0,0)$ to the line $y = 3x + 1$.

What are the advantages and disadvantages of methods A, B and C?

Using whichever method you prefer, find the shortest distance between these pairs of lines.

- $y = 3x$ and $y = 3x + 4$
- $y = 2x$ and $y = 2x + 1$
- $y = mx$ and $y = mx + c$

Quadratics

Activity 1

Write this quadratic function in expanded form and factorised form.

$$y = 3(x - 1)^2 - 12$$

Write this quadratic function in expanded form and completed square form.

$$y = 0.5(x - 2)(x - 6)$$

Write this quadratic function in factorised form and completed square form.

$$y = 4x^2 - 4x - 3$$

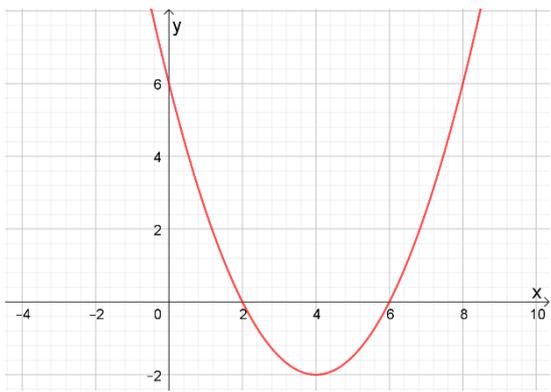
Quadratics

Activity 2

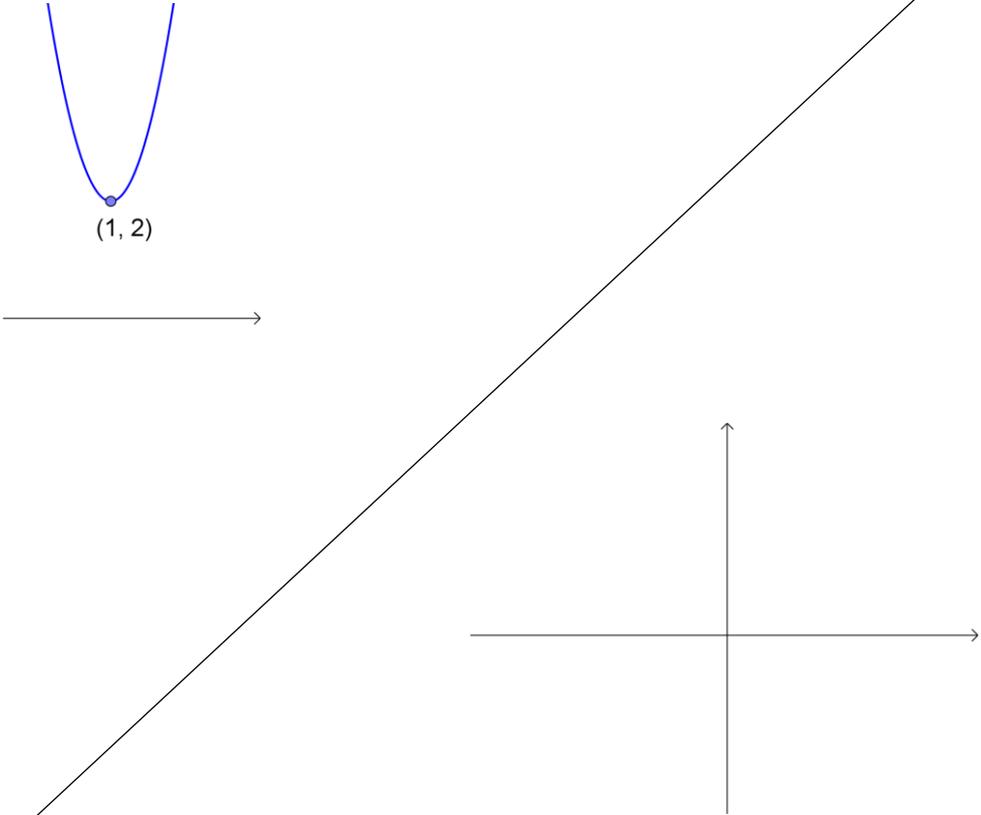
For each problem, use the clues from each form of the quadratic and the graph to give the quadratic in expanded form, factorised form and completed square form. Sketch the graph, showing the coordinates of the turning point and axis intercepts.

Below is what an answer might look like.

Use the space at the bottom of each page to show your working.

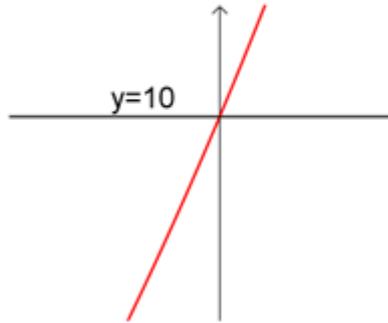
$y = ax^2 + bx + c$ $y = 0.5x^2 - 4x + 6$	
$y = f(x - g)(x - h)$ $y = 0.5(x - 2)(x - 6)$	
$y = k(x - l)^2 + m$ $y = 0.5(x - 4)^2 - 2$	

Problem 1

$y = 3x^2 + bx + c$	
$y = f(x - g)(x - h)$ Does not apply	
$y = k(x - l)^2 + m$	

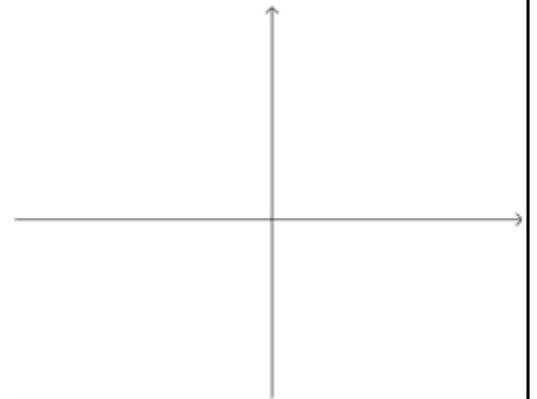
Problem 2

$$y = ax^2 + bx + c$$

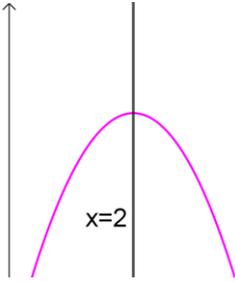
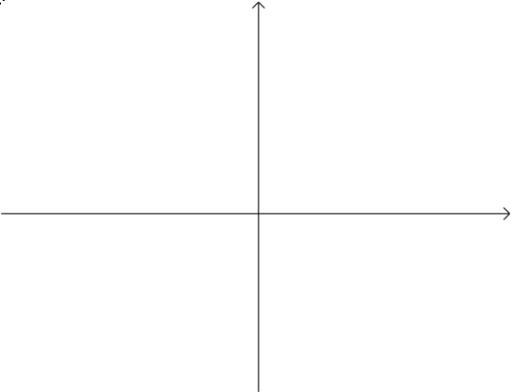


$$y = 2(x+1)(x-h)$$

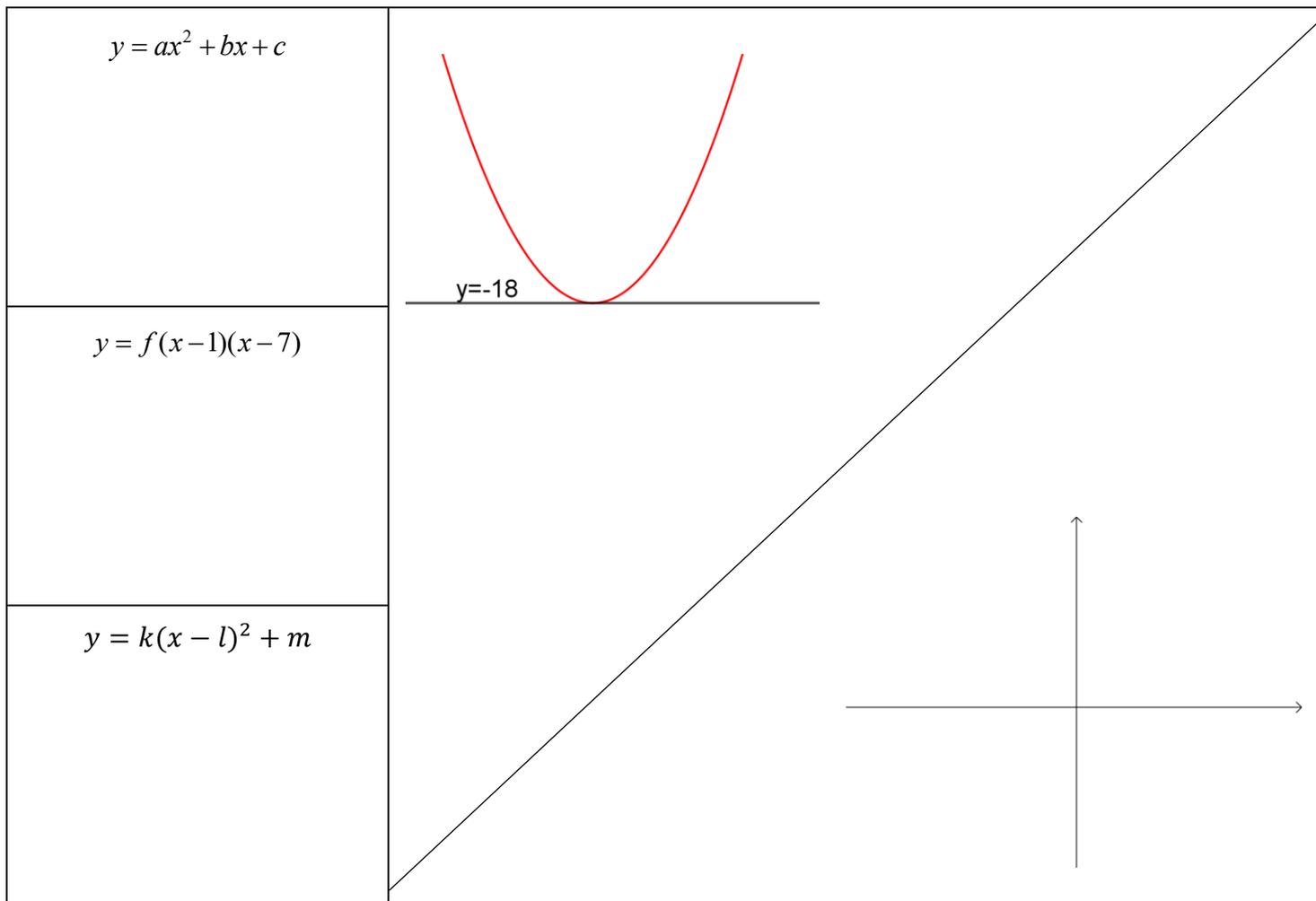
$$y = k(x-l)^2 + m$$
$$y = k(x-l)^2 + m$$



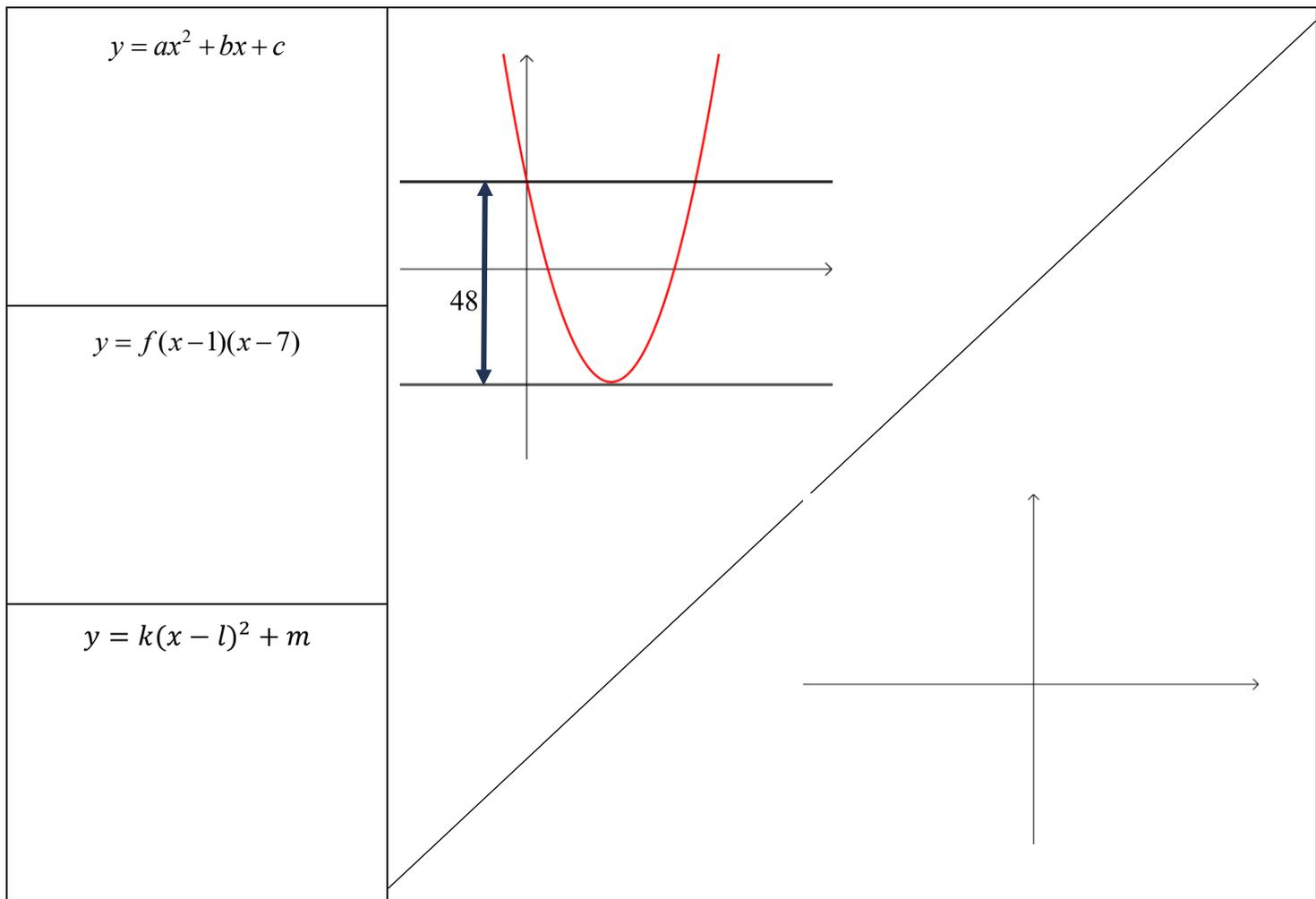
Problem 3

$y = ax^2 + 4x + 5$		
$y = f(x - g)(x - h)$		
$y = k(x - l)^2 + m$		

Problem 4



Problem 5



Problem 6

$$y = ax^2 + bx + c$$

and

$$y = 3x^2 + dx + e$$

$$y = f(x+6)(x-h)$$

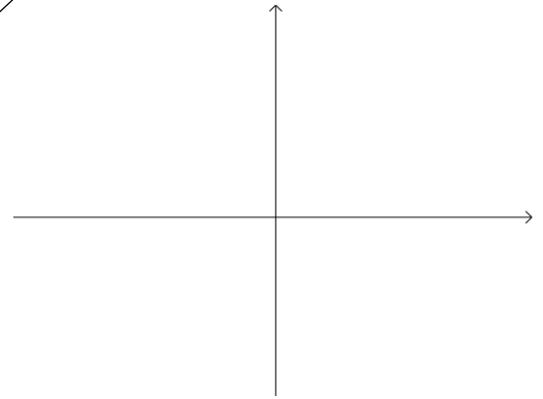
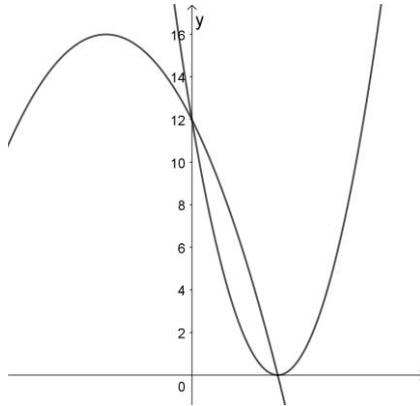
and

$$y = p(x-q)(x-r)$$

$$y = k(x-l)^2 + m$$

and

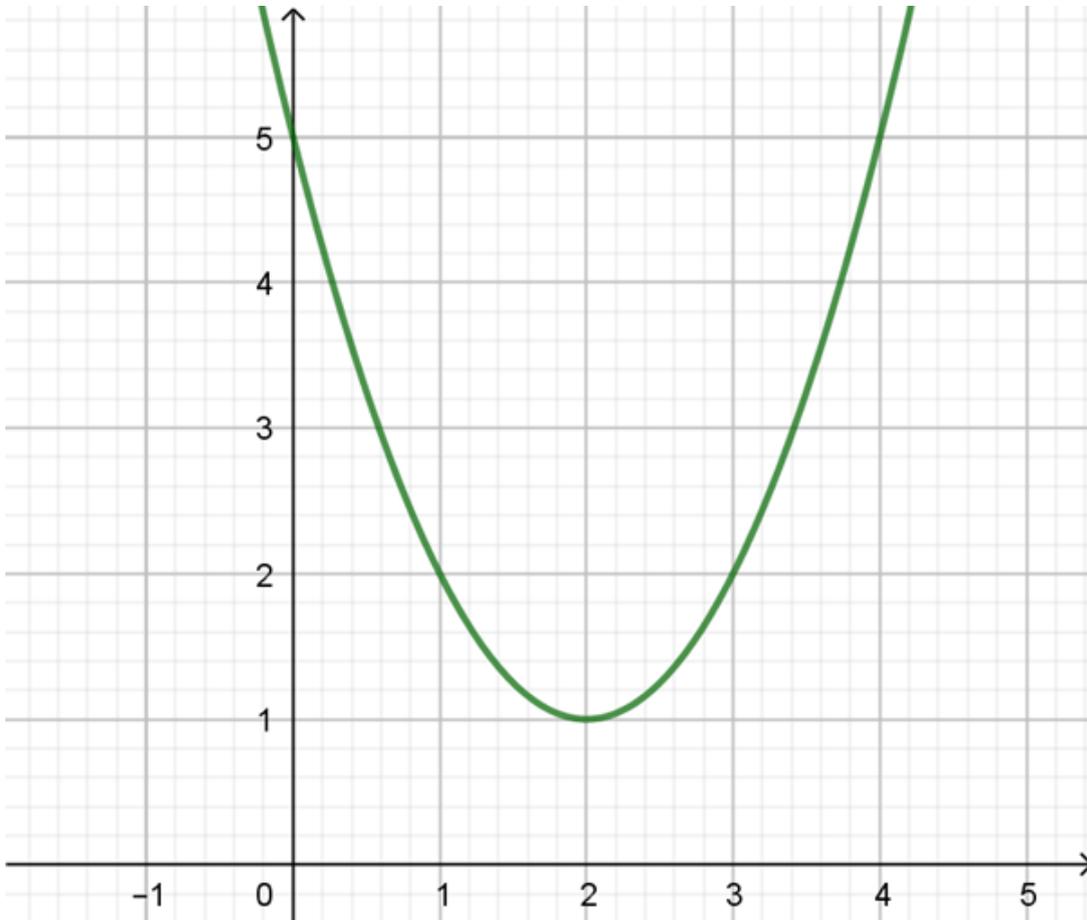
$$y = s(x-t)^2 + u$$

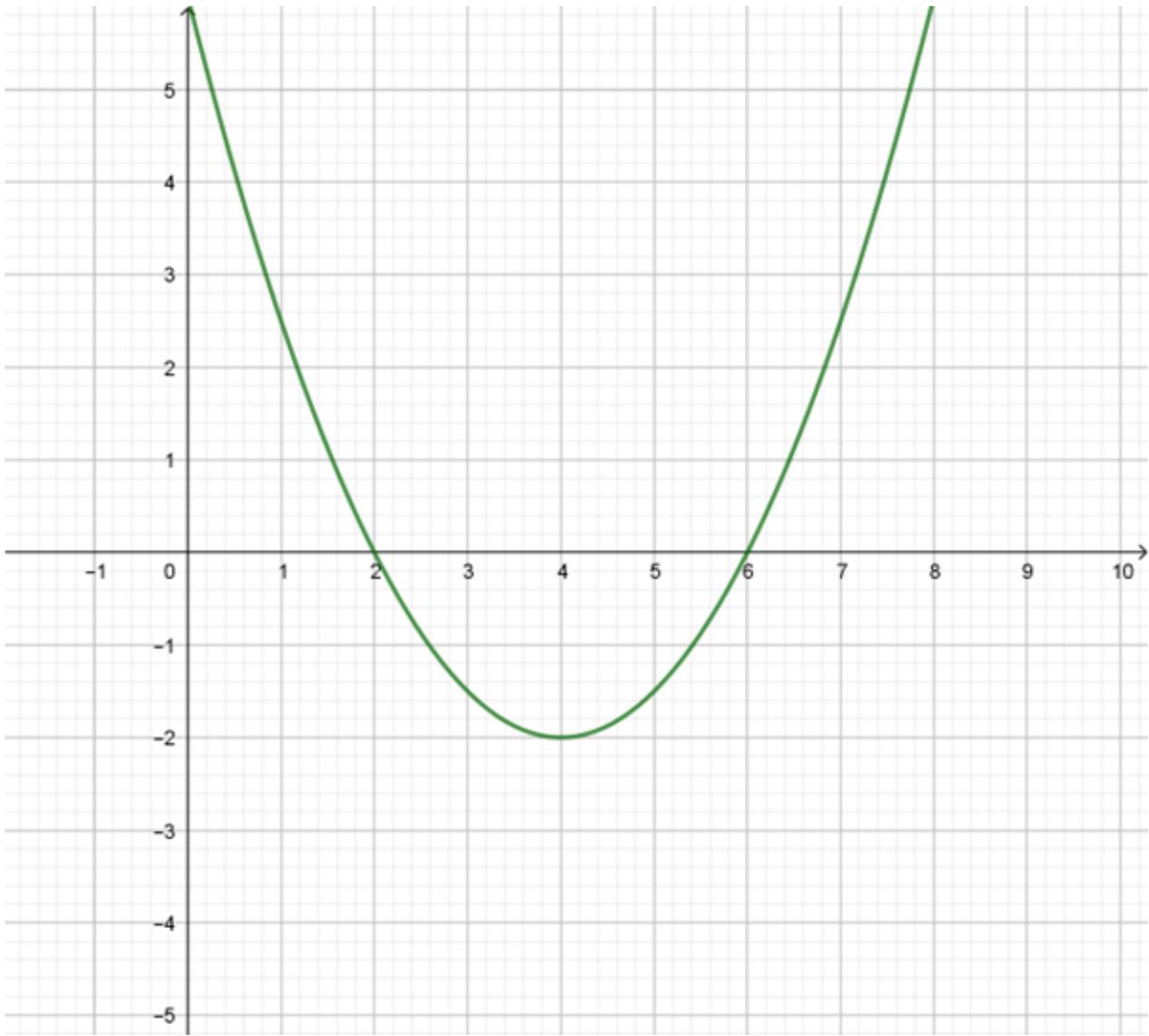


Quadratics

Activity 3

Below is the graph of a quadratic, $y = f(x)$. On the same axes, sketch the graph of $y = \frac{1}{f(x)}$. There are two examples to try.





Below are some graphs of $y = f(x)$ and $y = \frac{1}{f(x)}$, or just $y = \frac{1}{f(x)}$.

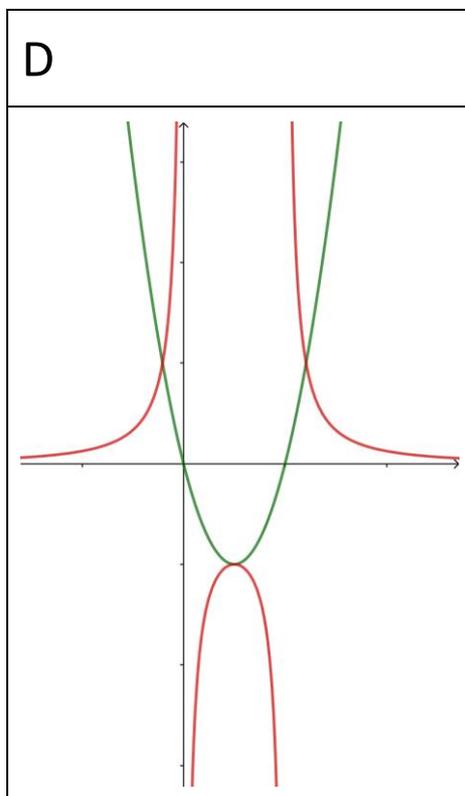
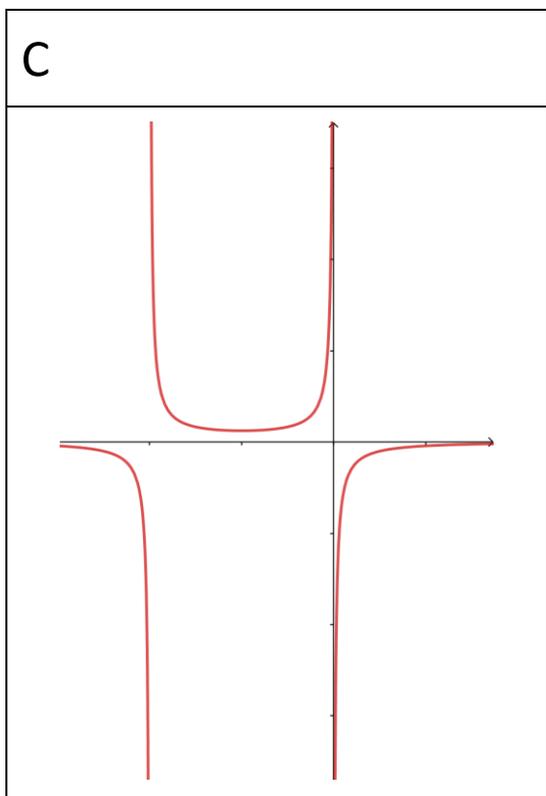
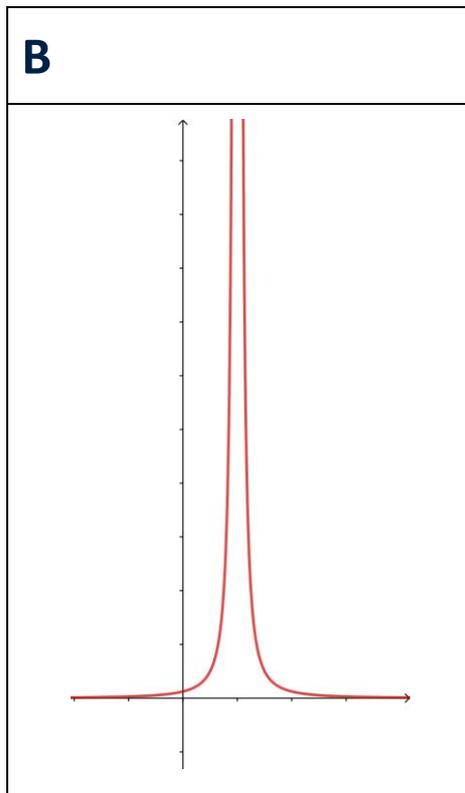
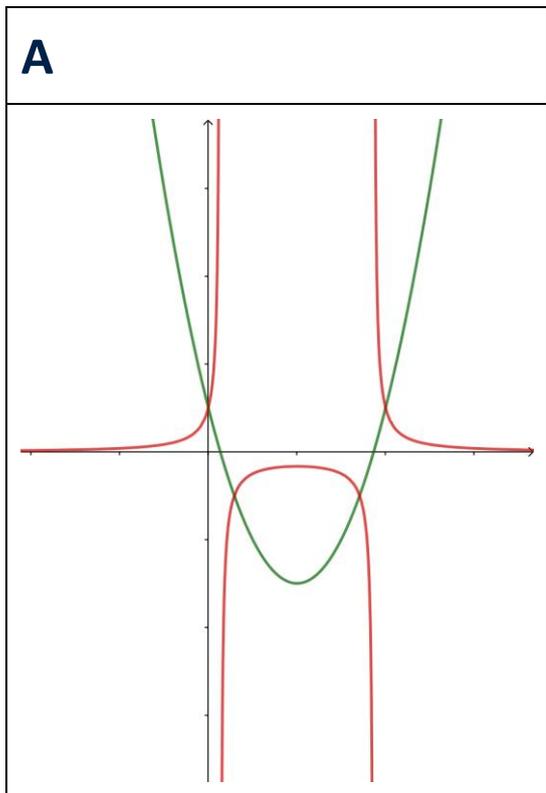
Suggest possible equations for $y = f(x)$.

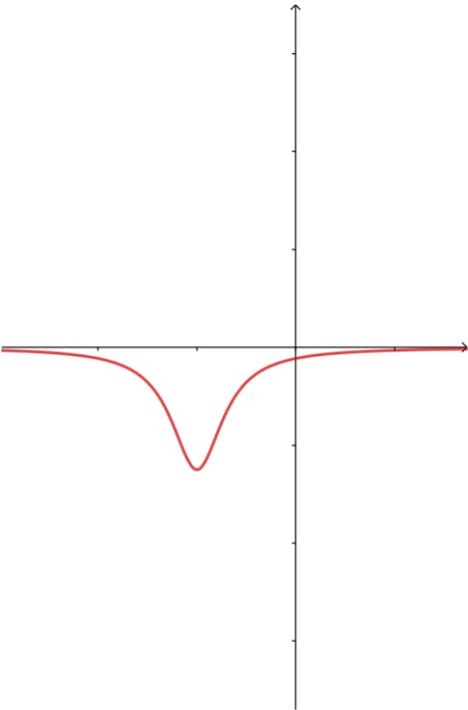
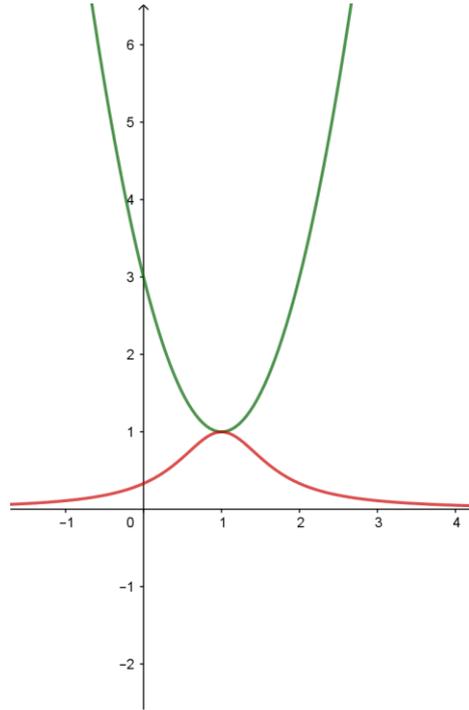
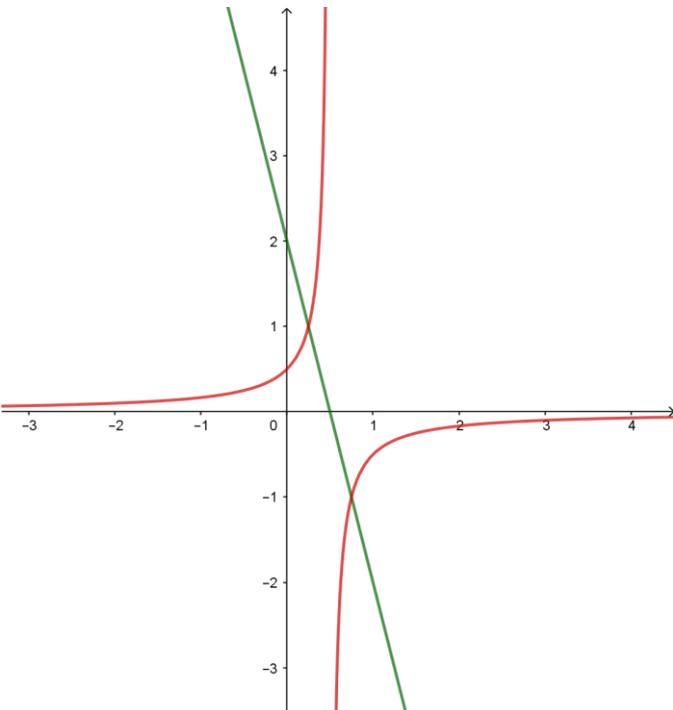
Sometimes there are unique answers and sometimes not.

Below are some graphs of $y = f(x)$ and $y = \frac{1}{f(x)}$, or just $y = \frac{1}{f(x)}$.

Suggest possible equations for $y = f(x)$.

Sometimes there are unique answers and sometimes not.



E**F****G**

For G, first take the green curve to be a straight line, i.e. a quadratic function with the coefficient of x^2 equal to 0.

What happens to the curves if the coefficient of x^2 is then changed to be

- (a) small and positive
- (b) small and negative?

H

Classify curves of the form $y = \frac{1}{ax^2 + bx + c}$ into different categories, according to constraints on a , b and c .