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Leaving Cert Maths - Paper 2
April 2020

Schedule

10-10.50	The Line (lines and quadratics)
10.50-11	BREAK... HOORAY!!!!
11-11.50	The Circle
11.50-12	BREAK... HOORAY!!!!
12-12.50	The Triangle
12.50-13.30	LUNCH... HOORAY!!!!
13.30-14.20	3-D Shapes
14.20-14.30	BREAK... HOORAY!!!!
14.30-15.20	Probability
15.20-15.30	NO BREAK... BOOOOO!!!!
	- Feedback & Survey

Rule #1: There's no such thing as a silly question
Rule #2: You must ask me lots of questions
Rule #3: Respect the abilities of every other student

Topic 1: The Line

Knowing the basics of the line is essential to being able to answer other questions on the syllabus that may crop up in the triangle or circle question. There are only a few formulas you'll need to answer all possible questions!

Slope formula	$slope, m = \frac{change\ in\ y}{change\ in\ x} = \frac{rise}{run} = \frac{y_2 - y_1}{x_2 - x_1}$ Parallel lines have equal slopes. The slopes of perpendicular lines are opposite reciprocals of each other
General Form	$Ax + By = C$
Slope Intercept Form	$y = mx + b$ where m is the slope and b is the y-intercept
Point Slope Form	$(y - y_1) = m(x - x_1)$ where m is the slope
Midpoint Formula	$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$
Distance Formula	$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

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These formulae are given to you in the log books at your exam as well, so no need to worry about learning them off.

Topic 1 - Lesson 1 ~ Finding the slope and equation of a line

Below is a typical question asked on the line.
Ans: m=5/2, 5x-2y-10=0 (2016 Q4)

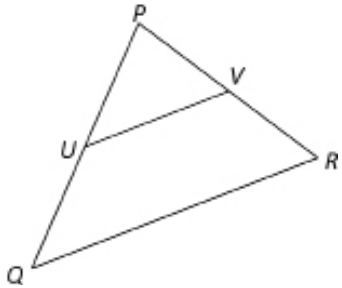
(a) The line l contains the points $A(4, 5)$ and $B(2, 0)$. Find the equation of l. Give your answer in the form $ax + by + c = 0$ where a, b, and $c \in \mathbb{Z}$.

Topic 1 - Lesson 2 ~ Finding the midpoint and distance of a line

Try the following question on the midpoint of the line.
Ans= (9,7), 2018 Q2

The points $P(7, 10)$, $Q(1, 2)$ and $R(11, 4)$ are the vertices of the triangle shown.
The point $U(4, 6)$ is the midpoint of $[PQ]$ and the point V is the midpoint of $[PR]$.

(a) Find the co-ordinates of V.

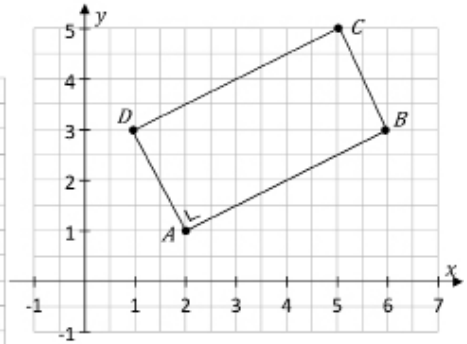


The distance of a line comes up repeatedly throughout the paper, so best to be familiar with working it out. (2017 - Q3)

1.2 Contd.

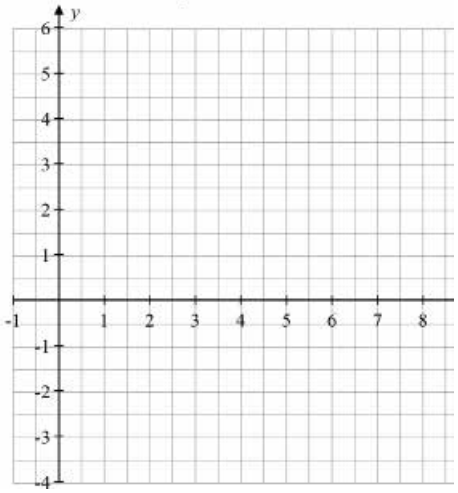
(a) The points $A(2, 1)$, $B(6, 3)$, $C(5, 5)$, and $D(1, 3)$ are the vertices of the rectangle $ABCD$ as shown.

(i) Show that $|AD| = \sqrt{5}$ units.



1.3 Sketching Lines

When sketching a line all you need is two points. If you have an equation of a line, the easiest two points to find are when x=0 and when y=0. So plugging in x=0 in to the equation of the line will give a y value. And pluuging in y=0 will give a new x value. With these two points, you have your line! (2016 - Q4)



1.4 Intersection of Lines

To know when two lines intersect, use your knowledge of simultaneous equations to find values for x and y. Try for the lines 5x-2y-10=0 and x+2y=8.

Ans = (3,2.5) - 2016 Q4

The Circle

Topic 2 - Lesson 1 ~ Equation of a circle

The General Form of the equation of a circle with centre (-g,-f)

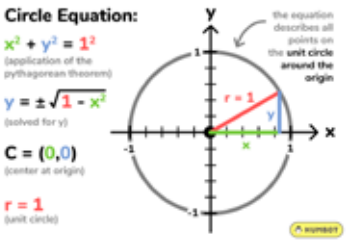
$$x^2 + y^2 + 2gx + 2fy + c = 0$$

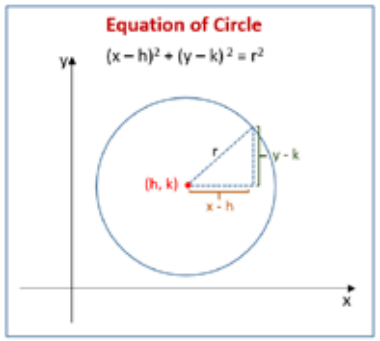
The equation of the unit circle is

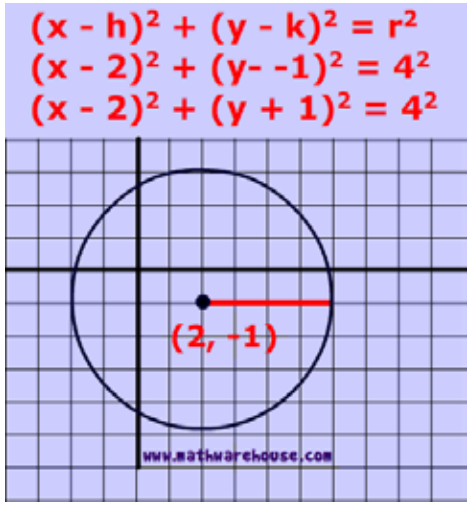
$$x^2 + y^2 = 1$$

The equation of a circle with centre (h,k) is

$$(x - h)^2 + (y-k)^2 = r^2$$







Topic 2.1 Contd.

(a) The circle c has centre $(0, 0)$ and radius 5 units. Write down the equation of c.

Equation of c: _____

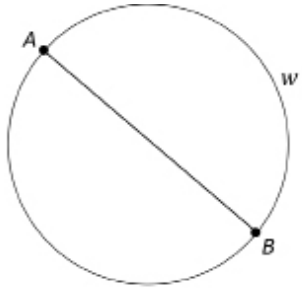
2017 -Q2

(a) The circle c has centre $(2, -3)$ and a radius of 4 cm. Write down the equation of c.

2016 - Q3

Questions on the circle may be asked that simply cover questions from the Line in Topic 1 earlier. Take the following (2018 - Q2)

The points $A(1, 8)$ and $B(9, 0)$ are the end-points of a diameter of the circle w, as shown in the diagram.



(a) Find the co-ordinates of the centre of w.

(b) Find the length of the radius of w. Give your answer in the form $p\sqrt{q}$, where $p, q \in \mathbb{N}$.

(c) Hence write down the equation of the circle w.

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Topic 2 - Lesson 2 ~ Equation of Tangent to the Curve

A tangent is a line. Therefore to find the equation of a line we need its slope and a point on the line. When a line is a tangent to a curve, at the point where they meet both the line and the curve have the same slope. If we have the point where they meet then we have the two pieces of information we need to find the equation in the form

$$y-y_1 = m(x-x_1)$$

Using the circle from the example above, try the following

(d) Find the equation of the line that is a tangent to the circle w at A. Give your answer in the form $ax + by + c = 0$, where $a, b,$ and $c \in \mathbb{Z}$.

The Sector

Topic 3 - Lesson 1 ~ Area

There really are very few questions that can come up on the sector. Usually you will either be asked to find its area or surface area or to calculate the length of its arc etc.

AREA OF A SECTOR:

$$A = \frac{1}{2}r^2\theta \quad \text{or} \quad A = \frac{x}{360}\pi r^2$$

where r *is the length of the radius*, θ *is the angle of the sector*

r *is the length of the radius*, x *is the angle of the sector*

ARC LENGTH:

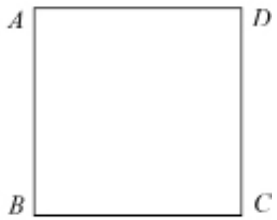
$$l = \frac{x}{360}2\pi r \qquad l = r\theta$$

$$l = \frac{x}{360}\pi d$$

* Note that the Area of the Segment = Area of Sector - Area of Triangle

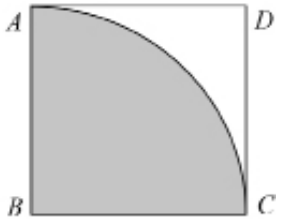
Try the following questions (2014 - Q5)

(a) The square $ABCD$ has an area of 81 cm^2. Find $|AD|$.

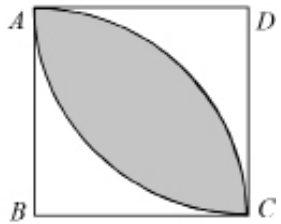


(b) A sector of a circle, centre B and radius $|BC|$, is drawn inside $ABCD$ as shown by the shaded region.

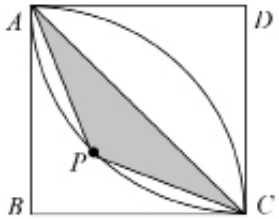
(i) Find the area of the sector, correct to one decimal place.



(ii) A second sector of a circle, centre D and radius $|DA|$, is drawn. Find the area of the shaded region (the overlap of the two sectors), correct to one decimal place.



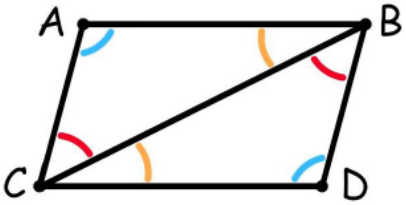
(c) The point P is on the arc of the sector DAC, as shown. The triangle APC is isosceles. Find the area of the triangle APC, correct to one decimal place.



(The Parallelogram - Briefly)

Line AB || Line CD

Line AC || Line BD



$\angle ABC \equiv \angle BCD$ Line AB ≡ Line CD

$\angle ACB \equiv \angle CBD$ Line AC ≡ Line BD

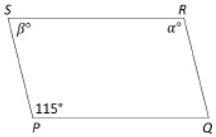
Line BC ≡ Line BC $\angle BAC \equiv \angle CDB$

$\triangle ABC \equiv \triangle DCB$

(b) The diagram shows a parallelogram with vertices P, Q, R, and S.
$|\angle SPQ| = 115°$, $|\angle QRS| = \alpha°$ and $|\angle RSP| = \beta°$.

(i) Write down the value of α and the value of β.

$\alpha =$ _____ $\beta =$ _____

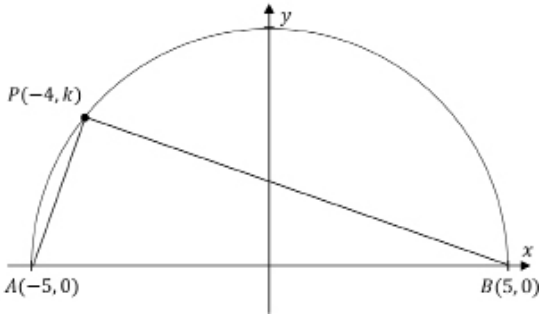


The Triangle

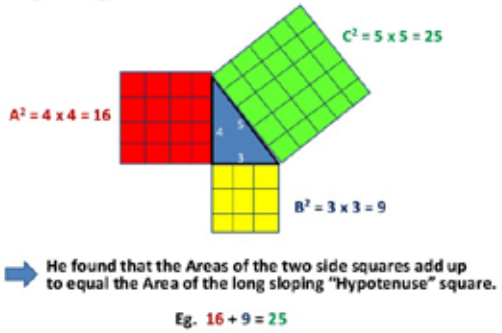
Topic 4 - Lesson 1 ~ Area

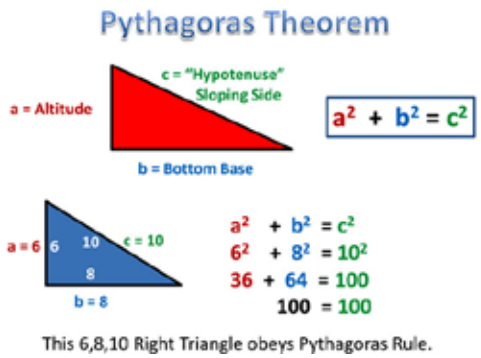
To get the area of a triangle we need half the length of its base and the triangle's height. Usually we measure the height of the triangle when the hypotenuse (longest side) is lying down flat, and we measure up to the apex. Often questions on are come up in an applied way as below (2017 - Q2)

(c) Find the area of the region which is inside the semi-circle but outside the triangle ABP.
Give your answer, in square units, correct to 2 decimal places.

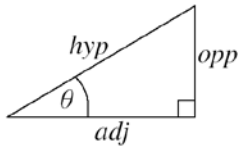


Topic 4 - Lesson 2 ~ Pythagoras' Theorem & Trigonometric Ratios
(***for Right-Angled Triangles Only***)





Trigonometric Ratios



$$\sin(\theta) = \frac{opp}{hyp}$$

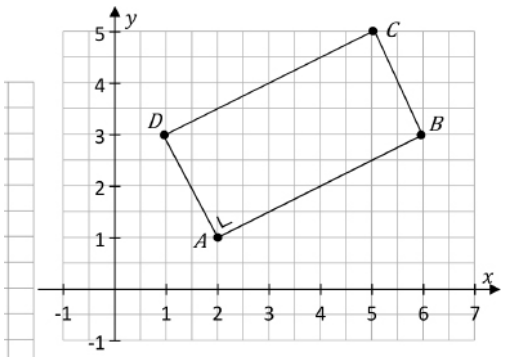
$$\cos(\theta) = \frac{adj}{hyp}$$

$$\tan(\theta) = \frac{opp}{adj}$$

I always remembered this with..

Silly Old Harry
Caught A Herring
Trawling Off America

Now try the following question which combines the line, circle and triangle principles we've learned so far (2017 - Q3)



Find the angle ABD

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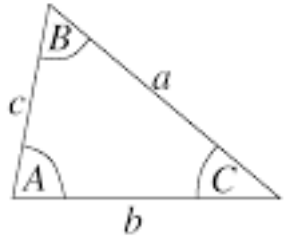
Topic 4 - Lesson 3 - Sin and Cosine Rule

(***Applied to non Right-Angled Triangles generally***)



Sine Rule

$$\frac{a}{\sin(A)} = \frac{b}{\sin(B)} = \frac{c}{\sin(C)}$$ (for finding sides)

or

$$\frac{\sin(A)}{a} = \frac{\sin(B)}{b} = \frac{\sin(C)}{c}$$ (for finding angles)

Cosine Rule

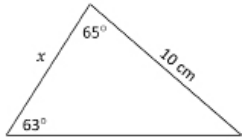
$$a^2 = b^2 + c^2 - 2bc\cos(A)$$ (for finding sides)

or

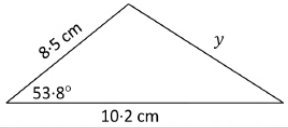
$$\cos(A) = \frac{b^2 + c^2 - a^2}{2bc}$$ (for finding angles)

Using these rules, we generally can find any side or angle if we have three other measurements - some combination of sides and angles. The Sin Rule may not always be possible to apply directly if we don't have 2 angles given. Try the following questions (2017 - Q6)

(a) Find the distance x in the diagram below (not to scale).
Give your answer correct to 2 decimal places.

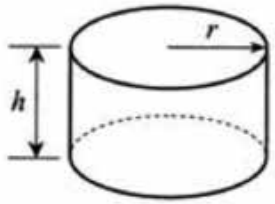


(b) Find the distance y in the diagram below (not to scale).
Give your answer correct to 2 decimal places.



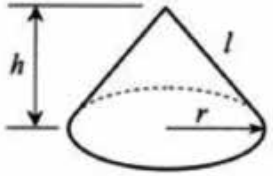
3-D Shapes - The Sphere/Cone/Cylinder

Topic 5 - Lesson 1 - Area and Surface Area



$A = 2\pi rh$

$V = \pi r^2 h$



$A = \pi rl$

$V = \frac{1}{3}\pi r^2 h$

$A = 4\pi r^2$

$V = \frac{4}{3}\pi r^3$

Note: The letter A here represents the curved surface area and does not include the flat circles at the top and/or bottom of the cylinder and cone.

(a) **(i)** Find the volume of a solid sphere of radius 0·3 cm.
Give your answer in cm^3, correct to 3 decimal places.

(ii) The sphere is made of pure gold. Each cm^3 of pure gold weighs 19·3 grams.
Find the number of grams of pure gold in the sphere.
Give your answer correct to 2 decimal places.

(iii) It is known that there are approximately $6{\cdot}02 \times 10^{23}$ atoms in 197 grams of pure gold.
Find the number of atoms of pure gold in the sphere.
Give your answer in the form $a \times 10^n$, where $1 \leq a < 10, n \in \mathbb{N}$,
and where a is correct to 2 significant figures.

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Probability

Topic 6 - Lesson 1

A question on probability comes up each year without fail. It can seem tricky at first, but really there are only a few principles to get your head around, and you've covered yourself for the exam.

Probability

Test for Independence

$P(A) = P(A \mid B)$

Addition Rule

$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

Multiplication Rule of All Events

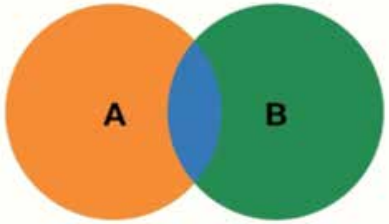
$P(A \text{ and } B) = P(A) \cdot P(B \mid A)$

Multiplication Rule for Independent Events

$P(A \text{ and } B) = P(A) \cdot P(B)$

Conditional Probability

$P(A \mid B) = P(A \text{ and } B) / P(B)$



Try the following question (2017 - Q1)

Random Selection Rule: $\dfrac{\text{desired population}}{\text{entire population}}$

Question 1 **(25 marks)**

According to the Central Statistics Office (CSO) there were 65 909 babies born in Ireland in 2015. Of these 32 290 were girls.

(a) **(i)** How many boys were born in Ireland in 2015?

(ii) Find the probability that a baby picked at random from those born in Ireland in 2015 is a boy. Give your answer correct to 2 decimal places.

(b) Eight babies were born in Limerick's Maternity Hospital on 1 May 2015.

(i) Use your answer to **part (a)(ii)** to find the probability that the first three babies born were boys. Give your answer correct to 4 decimal places.

(ii) Find the probability that the third birth was the first girl born in the hospital that day. Give your answer correct to 4 decimal places.

(c) The table below shows the probability of being born on a particular day of the week.

(i) Complete the table.

Day	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Probability	0·14		0·15	0·18	0·15	0·12	0·1

(ii) In a particular week 1300 babies were born.
Find the number of babies expected to be born on the Tuesday of that week.

Arrangments - with arrangements, you need to note that the overall total may be decreasing by one as you take one out of a total.

Notes

Try the following question (2018 - Q3)

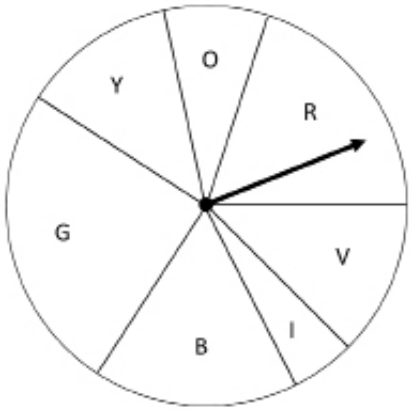
(a) **(i)** Find the number of different arrangements that can be made using **all** the letters of the word RAINBOW. Each letter is used only once.

(ii) Find the number of different 3-letter arrangements that can be made using the letters of the word RAINBOW. Each letter is used at most once.

(b) A game, called *Rainbow*, uses an unbiased circular spinner.
The spinner has seven sectors coloured red (R), orange (O), yellow (Y), green (G), blue (B), indigo (I), and violet (V) as shown below.
The table below shows the angle of each sector.
It also shows the cash prize that a player wins if the spinner stops in that sector.

Colour	Angle	Probability	Prize
Red	72°		€20
Orange	30°		€60
Yellow	45°	$\frac{1}{8}$	€24
Green	90°		€8
Blue	60°		€42
Indigo	18°		€90
Violet	45°		€48

Spinner



(i) Complete the "Probability" column of the table which shows the probability of the spinner coming to rest in each sector after one spin.

(ii) Find the **expected value** of the prize that a player wins if they play *Rainbow*.