Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Certificate Examination 2011

Mathematics
(Project Maths – Phase 1)

Paper 2

Higher Level

Monday 13 June Morning 9:30 – 12:00

300 marks

Examination number

Centre stamp

Running total	

For examiner			
Question	Mark	Question	Mark
1		11	
2		12	
3		13	
4		14	
5		15	
6			
7			
8			
9			
10		Total	

Grade

Instructions

There are fifteen questions on this examination paper.

Answer **all** questions.

Questions do not necessarily carry equal marks. To help you manage your time during this examination, a maximum time for each question is suggested. If you remain within these times, you should have about 10 minutes left to review your work.

Write your answers in the spaces provided in this booklet. There is space for extra work at the back of the booklet. You may also ask the superintendent for more paper. Label any extra work clearly with the question number and part.

The superintendent will give you a copy of the booklet of *Formulae and Tables*. You must return it at the end of the examination. You are not allowed to bring your own copy into the examination.

Marks will be lost if all necessary work is not clearly shown.

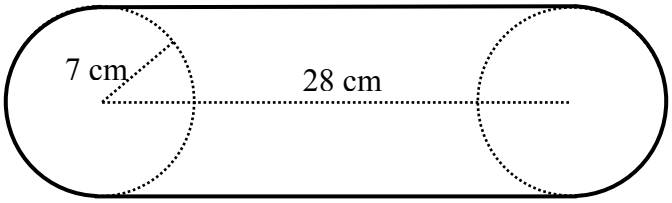
Answers should include the appropriate units of measurement, where relevant.

Answers should be given in simplest form, where relevant.

Write the make and model of your calculator(s) here:

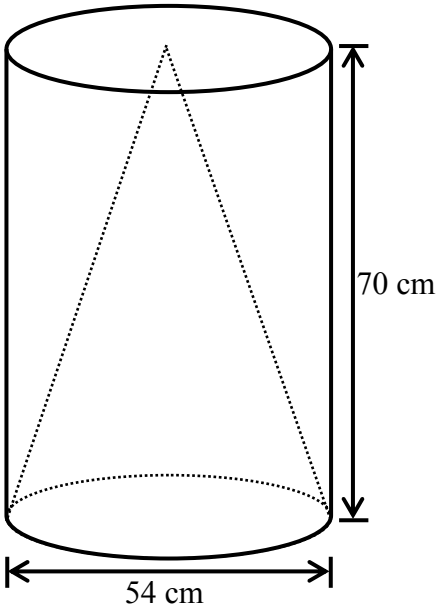
Question 1 **(Suggested maximum time: 20 minutes)**

(a) The diagram shows two pulley wheels of equal size, connected by a drive belt. The radius of each wheel is 7 cm and the distance between the centres is 28 cm.



✍ Calculate the length of the belt. Give your answer correct to the nearest whole number.

(b) The diagram shows a solid cylinder of diameter 54 cm and of height 70 cm. A cone, of the same diameter and height as the cylinder, is cut from inside the cylinder.



(i) ✍ Calculate the volume of the cylinder. Give your answer in terms of π.

(ii) ✍ Calculate the volume of the cone. Give your answer in terms of π.

(iii) ✍ What fraction of the cylinder remains after the cone is removed?

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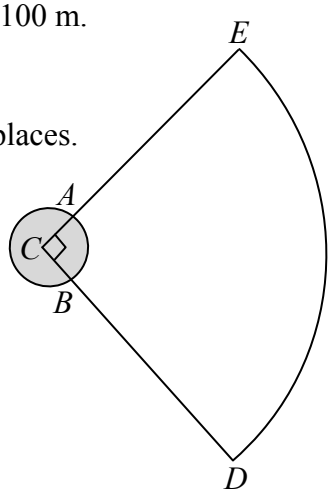
(c) The diagram, not to scale, represents a shot-put zone in an athletics stadium. The area of *CDE* is a quarter of the area of a disc of centre *C* and of radius 100 m.



(i) ✍ Calculate the area of *CDE*, correct to two decimal places.

The shot-put zone consists of a throwing zone and a landing zone. The throwing zone (shaded) is a disc of centre *C* and of radius 1 m.

(ii) ✍ Calculate the area of the throwing zone, correct to two decimal places.

The landing zone is the unshaded area *ABDE*, which is part of *CDE*.

(iii) ✍ Calculate the total area of the shot-put zone, correct to two decimal places.

Question 2 **(Suggested maximum time: 10 minutes)**

The percentage distribution of blood groups in the Irish population is given in the table below. The table also gives information about which types of blood can be safely used when people need to be given blood during an operation.

Blood Group	Percentage in Irish population	Blood groups to which transfusions can be safely given.	Blood groups from which transfusions can be safely received.
O-	8	All	O-
O+	47	O+, AB+, A+, B+	O+ and O-
A-	5	A-, A+, AB+, AB-	A- and O-
A+	26	A+ and AB+	A+, O-, O+, A-
B-	2	B-, B+, AB-, AB+	B- and O-
B+	9	B+ and AB+	B+, B-, O-, O+
AB-	1	AB- and AB+	AB-, O-, A-, B-
AB+	2	AB+	all

Source: Irish Blood Transfusion Service

(a) If an Irish person is chosen at random, what is the probability that that person will have blood group AB-?

(b) Mary has blood group B-. If a person is chosen at random from the population, what is the probability that Mary could safely receive blood from that person?

(c) Aaron has blood group O+ and donates blood. What is the probability that his blood can be given to a person randomly chosen from the population?

(d) The *Irish Blood Transfusion Service* recently asked that people with blood group O- should give blood as regularly as possible. Give a reason why this might be the case.

Question 3 **(Suggested maximum time: 10 minutes)**

The colour of 500 cars that pass a particular set of traffic lights during a two hour period is recorded by a group of students.

Colour	Frequency	Relative frequency	Daily frequency (Part **(e)** below)
Red	70		
Blue	100		
Yellow	45		
White	55		
Black			
Silver	140		
Total	500		

(a) Calculate the number of black cars and write it into the table.

(b) Calculate the relative frequency of each colour and write these into the table.

(c) Suggest a method to check that your relative frequency calculations are correct. Perform this check.

Method

Check

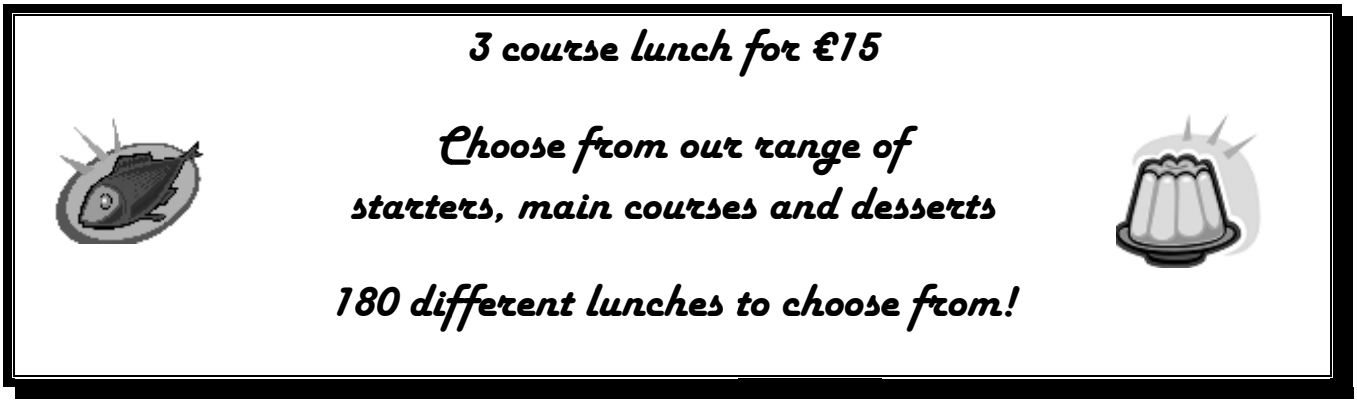
(d) What is the probability that the next car to pass the lights is red?

(e) Use the information to estimate the frequency of each colour if 2400 cars pass the lights in a full day. Write this information into the table.

(f) The data collected by the students is not a random sample of the cars passing throughout the day. Do you think that this makes your estimates in **(e)** above unreliable? Give a reason for your answer.

Question 4 **(Suggested maximum time: 5 minutes)**

A restaurant advertises its lunch menu using the sign below.



(a) The menu has a choice of five starters and nine main courses. How many items must appear on the dessert menu to justify the above claim of 180 different lunches?

(b) On a particular day one of the starters and one of the main courses is not available. How many different three course lunches is it possible to have on that day?

Question 5 **(Suggested maximum time: 10 minutes)**

The table below shows the distances travelled by seven paper airplanes after they were thrown.

Airplane	A	B	C	D	E	F	G
Distance (cm)	188	200	250	30	380	330	302

(a) Find the median of the data. Median = _____

(b) Find the mean of the data.

(c) Airplane D is thrown again and the distance it travels is measured and recorded in place of the original measurement. The median of the data remains unchanged and the mean is now equal to the median. How far did airplane D travel the second time?

(d) What is the minimum distance that airplane D would need to have travelled in order for the median to have changed?

Question 6 **(Suggested maximum time: 5 minutes)**

Data on the type of broadband connection used by enterprises in Ireland for 2008 and 2009 is contained in the table below.

	2008	2009
	%	%
Broadband connection	84	84
By type of connection		
DSL (<2Mb/S)	31	29
DSL (>2Mb/S)	41	45
Other fixed connection	31	20
Mobile broadband	24	27

Source: Central Statistics Office

(a) Display the data in a way that allows you to compare the data for the two years.

(b) Identify any trends that you think are shown by the data.

Question 7 **(Suggested maximum time: 10 minutes)**

John's third-year Physical Education class did a fitness test. The number of sit-ups that each student did in one minute is recorded below:

59	48	27	53	36	29	52	46	45	37	49	51
33	45	38	52	40	51	37	44	47	45	60	41

The students practiced this exercise for the next three weeks and then repeated the test in the same order. The data for the second test are as follows:

61	52	33	51	39	40	50	49	46	37	59	49
38	48	39	58	44	52	38	44	49	51	62	44

(a) Represent the data from the two tests on a back-to-back stem-and-leaf diagram.

Test 2		Test 1
	2	
	3	
	4	
	5	
	6	
		Key:

(b) How many students are in the class? _____

(c) What is the *range* of sit-ups for the class? Test 1 _____ Test 2_____

(d) Based on the data and the diagram, do you think that practice improves the ability to do sit-ups? Give a reason for your answer.

(e) John did 41 sit-ups in Test 1 and 44 in Test 2. How did his performance compare with that of the rest of the class?

Question 8 **(Suggested maximum time: 10 minutes)**

There are 24 students in a class. On a Friday each student present in class is asked for the number of days they had been absent that week. The results are recorded in the table below.

Number of days absent	None	One	Two	Three	Four	Five
Number of students	9	2	3	4	1	0

(a) How many students were absent on that Friday? _____

(b) On the following Monday all of the students were present in class and the table was updated to include the entire class. Which number from the above table could not have changed? Give a reason for your answer.

(c) The total number of days that were missed during the week will depend on the answers given by the students who were absent on Friday. Complete the tables below to show how the largest possible and smallest possible number of days missed would arise.

Smallest possible number of days missed						
Number of days absent	None	One	Two	Three	Four	Five
Number of students						

Largest possible number of days missed						
Number of days absent	None	One	Two	Three	Four	Five
Number of students						

(d) Cathal decides to draw a pie chart of the actual data collected on Monday. He calculates the number of degrees for each sector of the pie chart. Use this data to calculate the mean number of absences per pupil for the previous week correct to one place of decimals.

Number of days absent	None	One	Two	Three	Four	Five
Number of students						
Number of degrees	135°	30°	75°	60°	45°	15°

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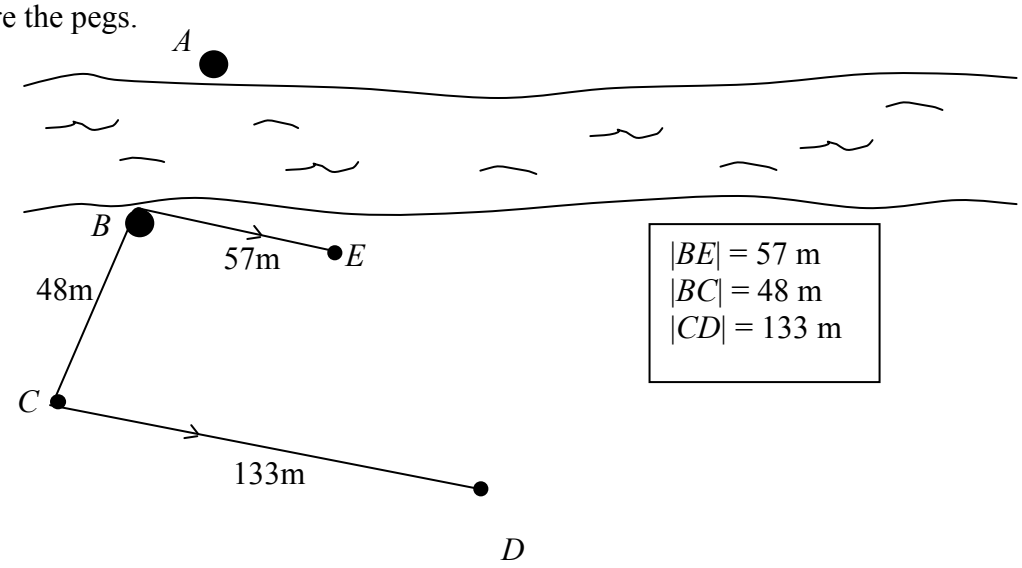
Question 9 **(Suggested maximum time: 10 minutes)**

A group of students were trying to find the distance between two trees on opposite sides of a river using pegs, a measuring tape and a large amount of string. They align the pegs in a particular way, take several measurements and sketch this diagram. On the diagram, A and B are the trees and C, D and E are the pegs.



(a) In what way must the pegs and the trees be aligned if the students are to use these measurements to calculate $|AB|$.

(b) Calculate the distance between the trees.

(c) Another group of students repeats the activity. They have a similar diagram but different measurements. Their measurements are $|BE| = 40$ m and $|BC| = 9$ m. Based on the value of $|AB|$ that the first group got, what measurement will this second group have for $|CD|$.

(d) Suggest how the group of students might have ensured that [*BE*] was parallel to [*CD*].

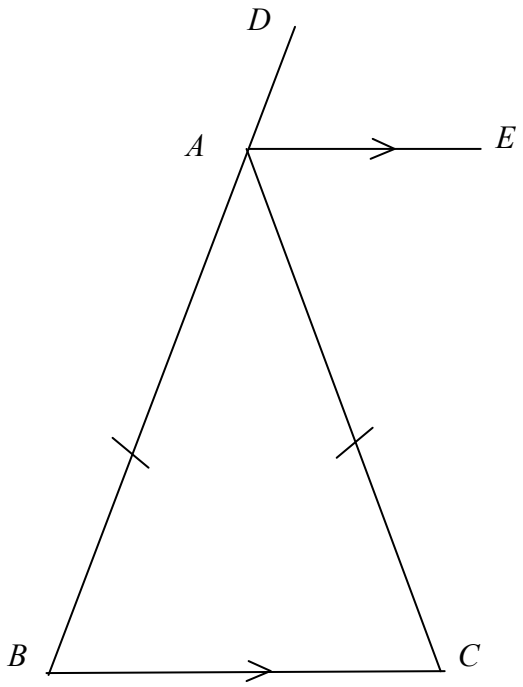
Question 10 **(Suggested maximum time: 5 minutes)**

(a) Draw a shape below which has exactly three axes of symmetry. Show the axes on the diagram.

(b) Draw a shape below which has exactly four axes of symmetry. Show the axes on the diagram.

Question 11 **(Suggested maximum time: 5 minutes)**

ABC is an isosceles triangle with $|AB| = |AC|$.
$[BA]$ is produces to D.
AE is parallel to BC.

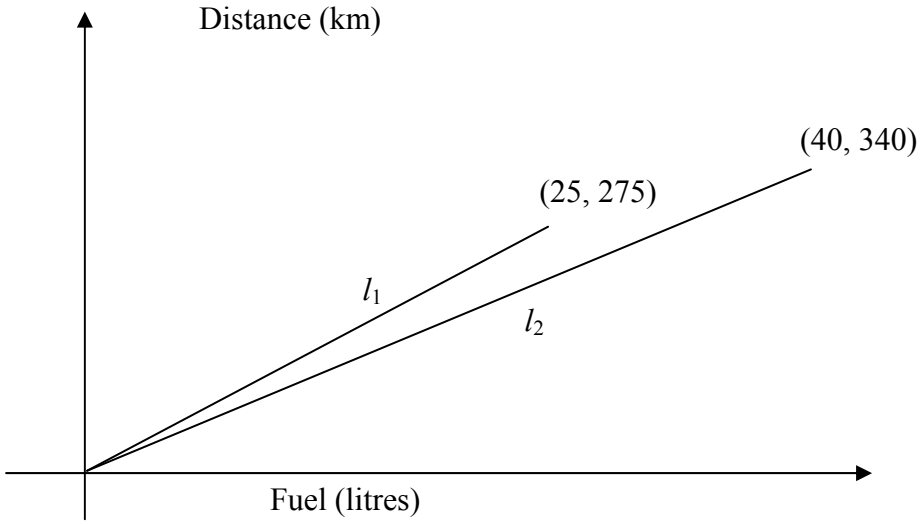


(a) Prove that $[AE$ bisects $\angle DAC$.

(b) Would the result in part **(a)** still apply if $|AB|$ and $|AC|$ were not equal?
Give a reason for your answer.

Question 12 **(Suggested maximum time: 5 minutes)**

The graphs below show the relationship between distances travelled and fuel consumption for John's car. The segments l_1 and l_2 represent the fuel consumption at steady speeds of 60 km/h and100 km/h respectively.



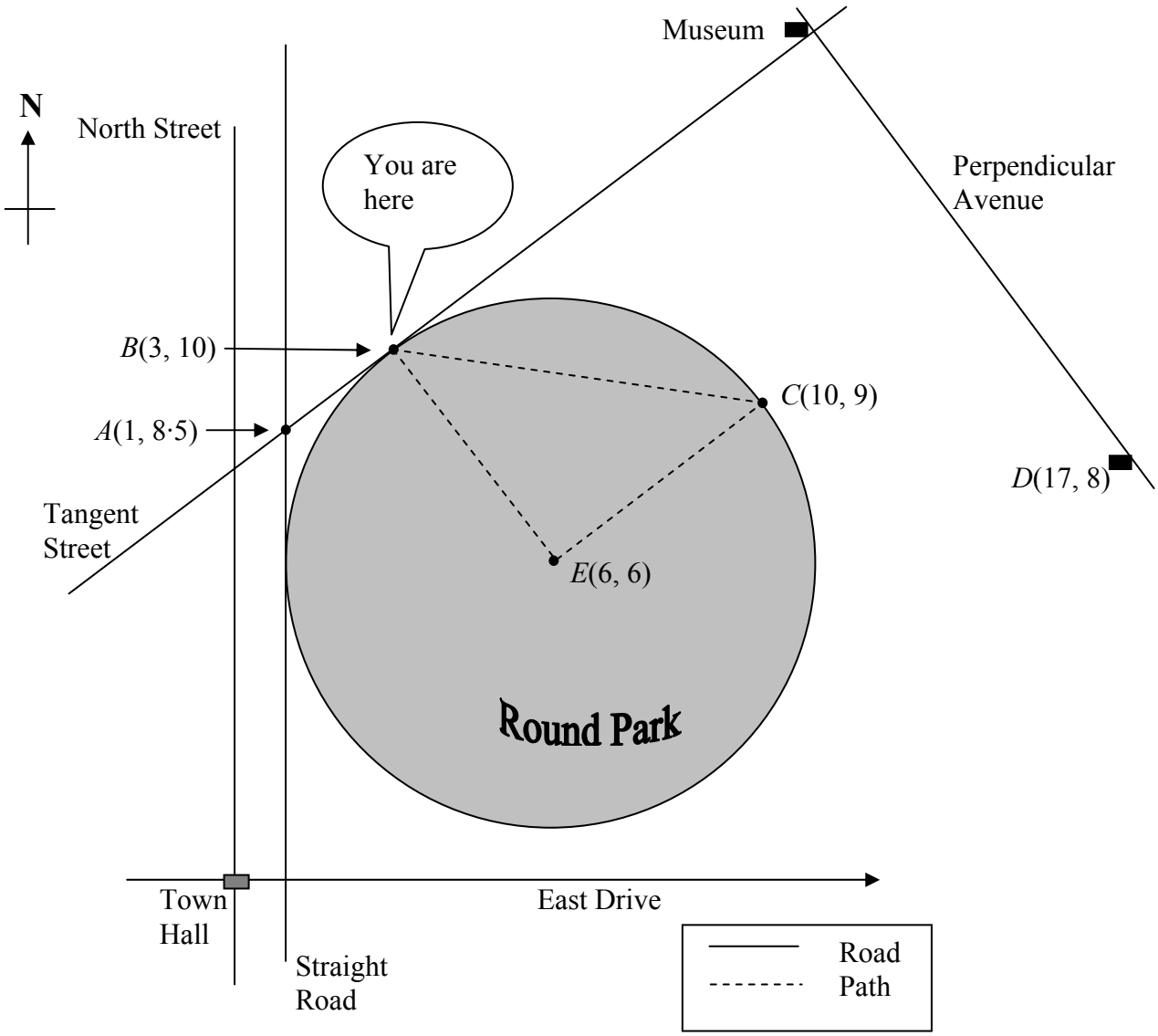
(a) Find the slopes of l_1 and l_2.

(b) What do these slopes tell you about the fuel consumption of the car at these speeds?

(c) Fuel costs 149·9 cent per litre. John drives a distance of 200 km at a steady speed. How much cheaper is the journey at 60 km/h than at 100 km/h?

Question 13 **(Suggested maximum time: 15 minutes)**

The map below shows part of a town containing a park and some streets. Distances are measured (in kilometres) horizontally and vertically from the Town Hall and shown in co-ordinate form.



(a) How long is the path from $B(3, 10)$ to $C(10, 9)$? Give your answer correct to three significant figures.

(b) $E(6, 6)$ is the centre of Round Park. How much shorter is it to walk directly from B to C rather than take the path to E and then on to C? Give your answer correct to the nearest km.

(c) The points $A(1, 8{\cdot}5)$ and $B(3, 10)$ are on Tangent Street. Find the equation of Tangent Street.

(d) Perpendicular Avenue is perpendicular to Tangent Street and passes through $D(17, 8)$. Find its equation.

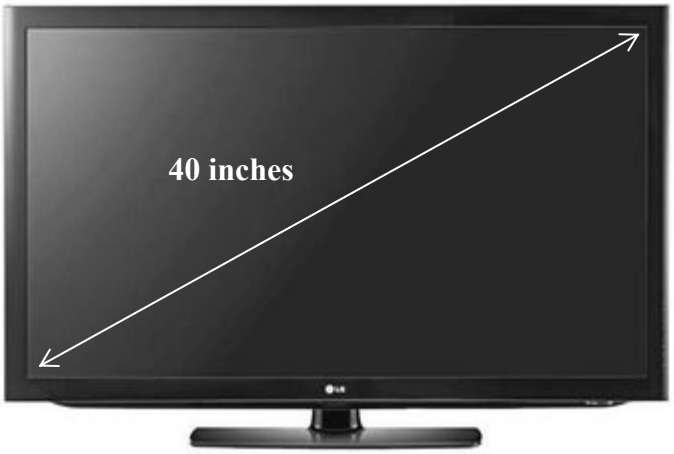
(e) The museum is located at the intersection of Tangent Street and Perpendicular Avenue. Find the co-ordinates of the museum.

(f) John is at the Town Hall and wants to get to the museum. Give one possible route he might take and calculate the total distance he must travel if he takes that route.

Question 14 **(Suggested maximum time: 10 minutes)**

Mary is thinking of buying a new television. The television is advertised as having a "40 inch" screen. This refers to the diagonal measurement of the screen. The *aspect ratio* of a television screen is the ratio of its width to its height. For this television, the aspect ratio is 16:9 (sixteen units wide for every nine units in height).

(a) Convert 40 inches to centimetres if 1 inch = 2·54 cm.



(b) Find the width and the height of the screen, in centimetres. Give your answers correct to the nearest cm.

(c) A different 40 inch television screen has an aspect ratio of 4:3. Which of the two television screens has the greatest area, and by how much?

Question 15 **(Suggested maximum time: 10 minutes)**

A group of students wish to calculate the height of the Millennium Spire in Dublin. The spire stands on flat level ground. Maria, who is 1·72 m tall, looks up at the top of the spire using a clinometer and records an angle of elevation of 60˚. Her feet are 70 m from the base of the spire. Ultan measures the circumference of the base of the spire as 7·07 m.

Photo by *Doyler79.* Wikipedia Commons. Licence: CC-SA

(a) Explain how Ultan's measurement will be used in the calculation of the height of the Spire.

(b) Draw a suitable diagram and calculate the height of the spire, to the nearest metre, using the measurements obtained by the students.

You may use this page for extra work

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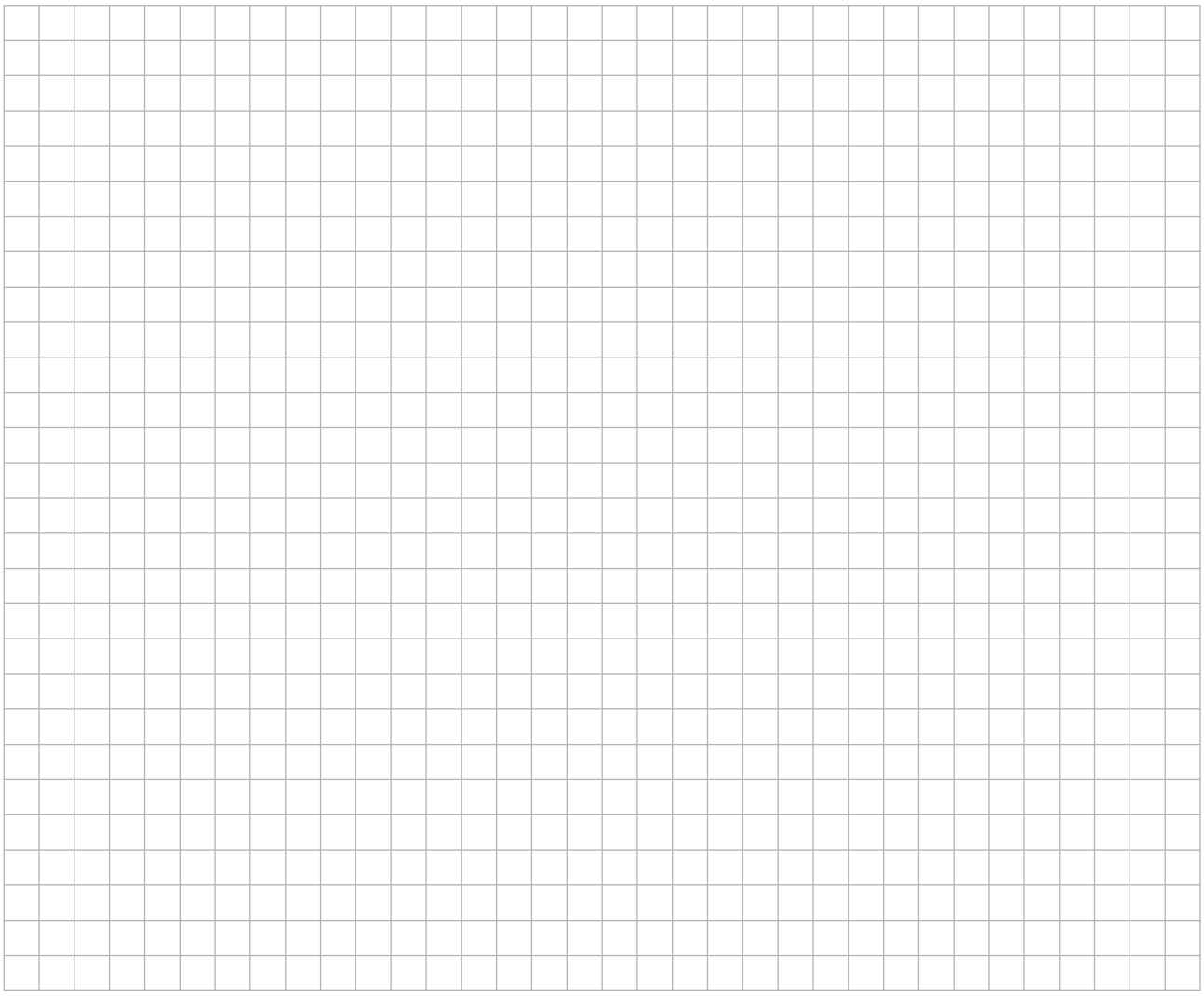

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