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Pre-Leaving Certificate Examination, 2012

Triailscrúdú na hArdteistiméireachta, 2012

Mathematics
(Project Maths – Phase 3)

Paper 2

Higher Level

2½ hours

300 marks

For examiner	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
Total	

Instructions

There are **two** sections in this examination paper:

Section A	Concepts and Skills	150 marks	6 questions
Section B	Contexts and Applications	150 marks	2 questions

Answer **all eight** questions, as follows:

In Section A, answer:

Questions 1 to 5 and

either Question 6A **or** Question 6B.

In Section B, answer Question 7 and Question 8.

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.

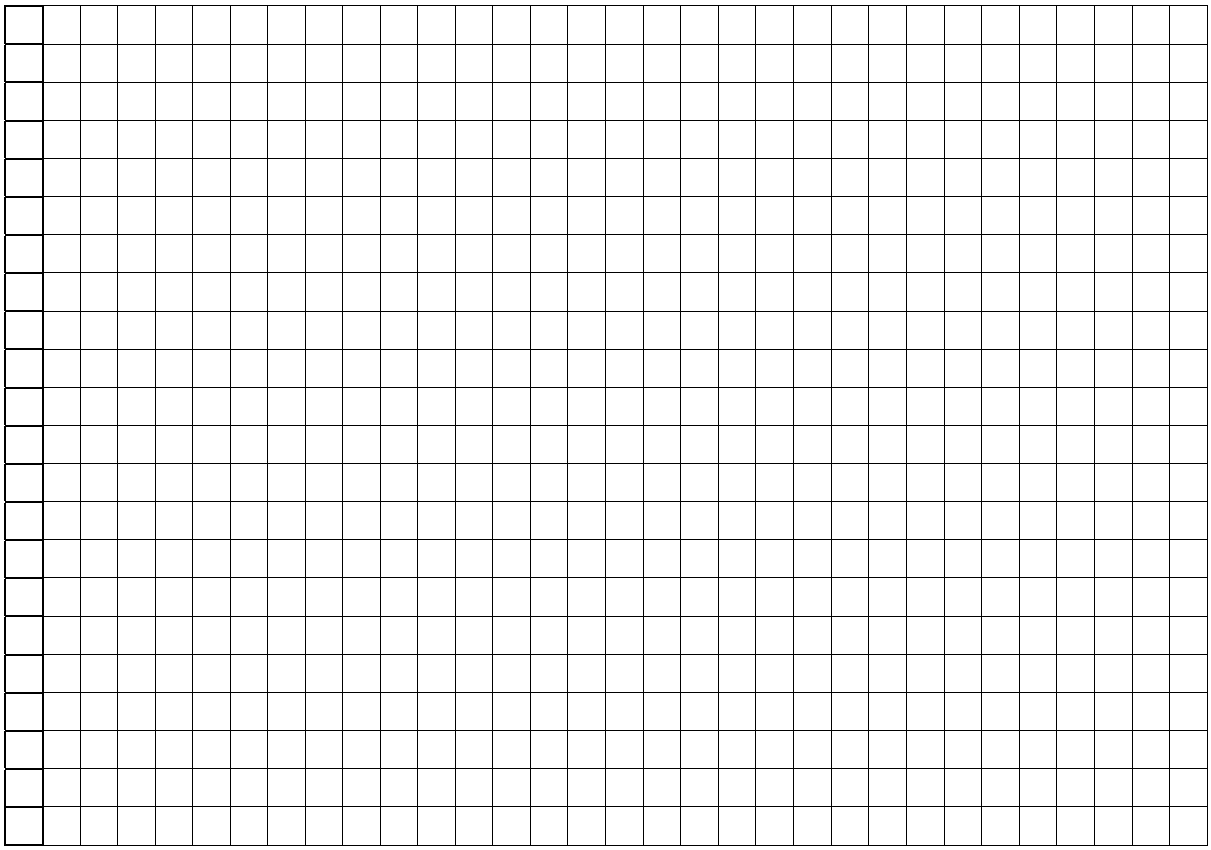
Answers should be given in simplest form, where relevant.

Section A	Concepts and Skills	150 marks

Answer **all six** questions from this section.

Question 1 **(25 marks)**

(a) In a survey it was recorded that 315 people out of 540 had at least two penalty points on their licence. How many people would you expect to have at least two penalty points if 7,500 people were surveyed?



(b) The probability of a cow producing twin calves is 0.46. If two cows are selected at random from a herd, calculate the probability that:

(i) Neither will have twins.

(ii) Only one will have twins.

Question 2 **(25 marks)**

(a) The mark X, of an exam is normally distributed with a mean of 64 and a standard deviation of 8. If 200 students sit the exam, how many students would you expect to obtain a mark between 64 and 80?

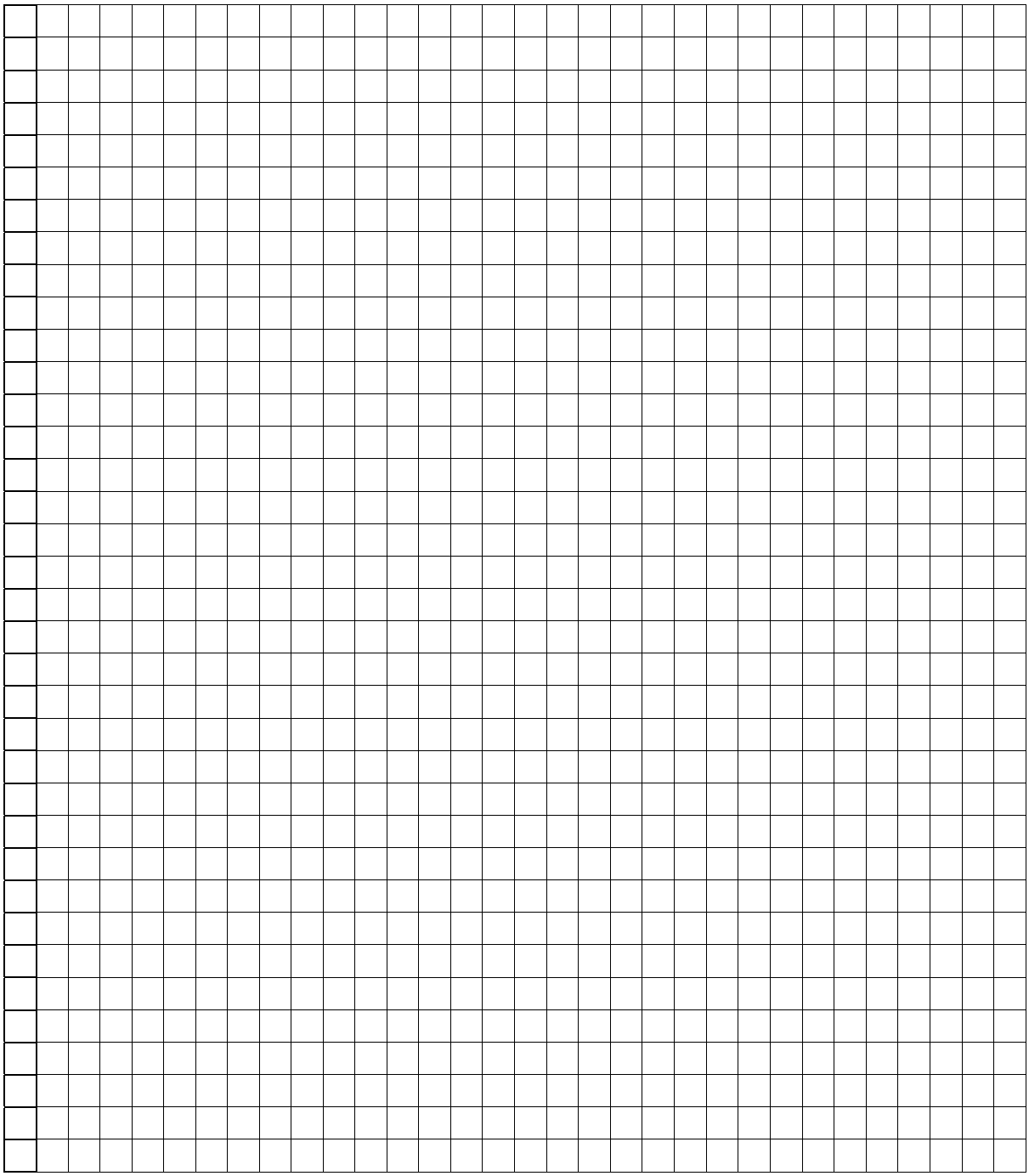
(b) Which one of the following pairs of variables is likely to have a causal relationship? Write your answer in the box.

(i) Sales of televisions and sales of DVD players.

(ii) A car's weight and its petrol consumption.

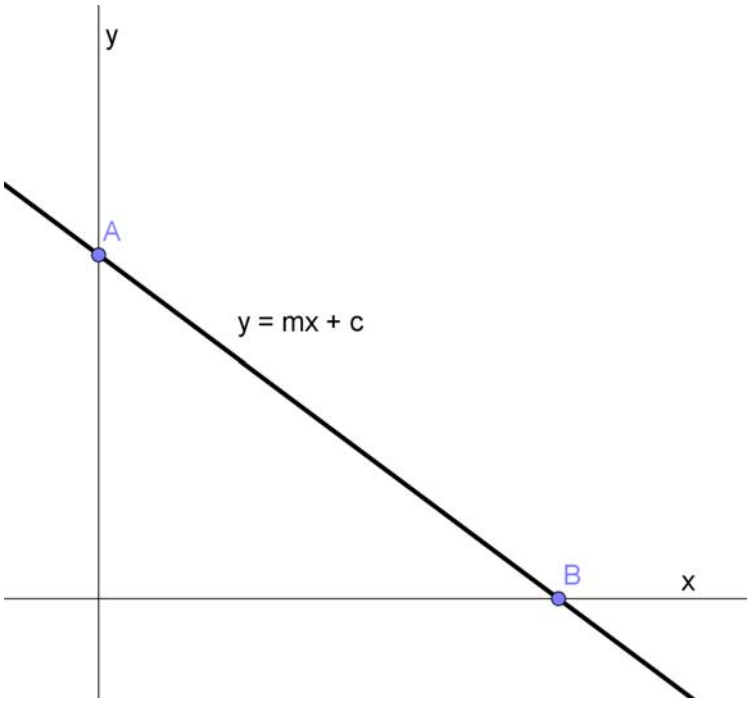
(iii) A person's height and their reading ability.

(c) The National Lottery held its first draw on the 23rd of March 1987. A contestant had to match 6 numbers from a possible 36 numbers. The lottery cost £0.50 to play per panel. In 1992, 6 extra numbers were added to the draw after a calculated scheme by a syndicate headed by Stefan Klincewicz profited by more than £300,000. By comparing the possible number of combinations, explain why the National Lottery took this action.



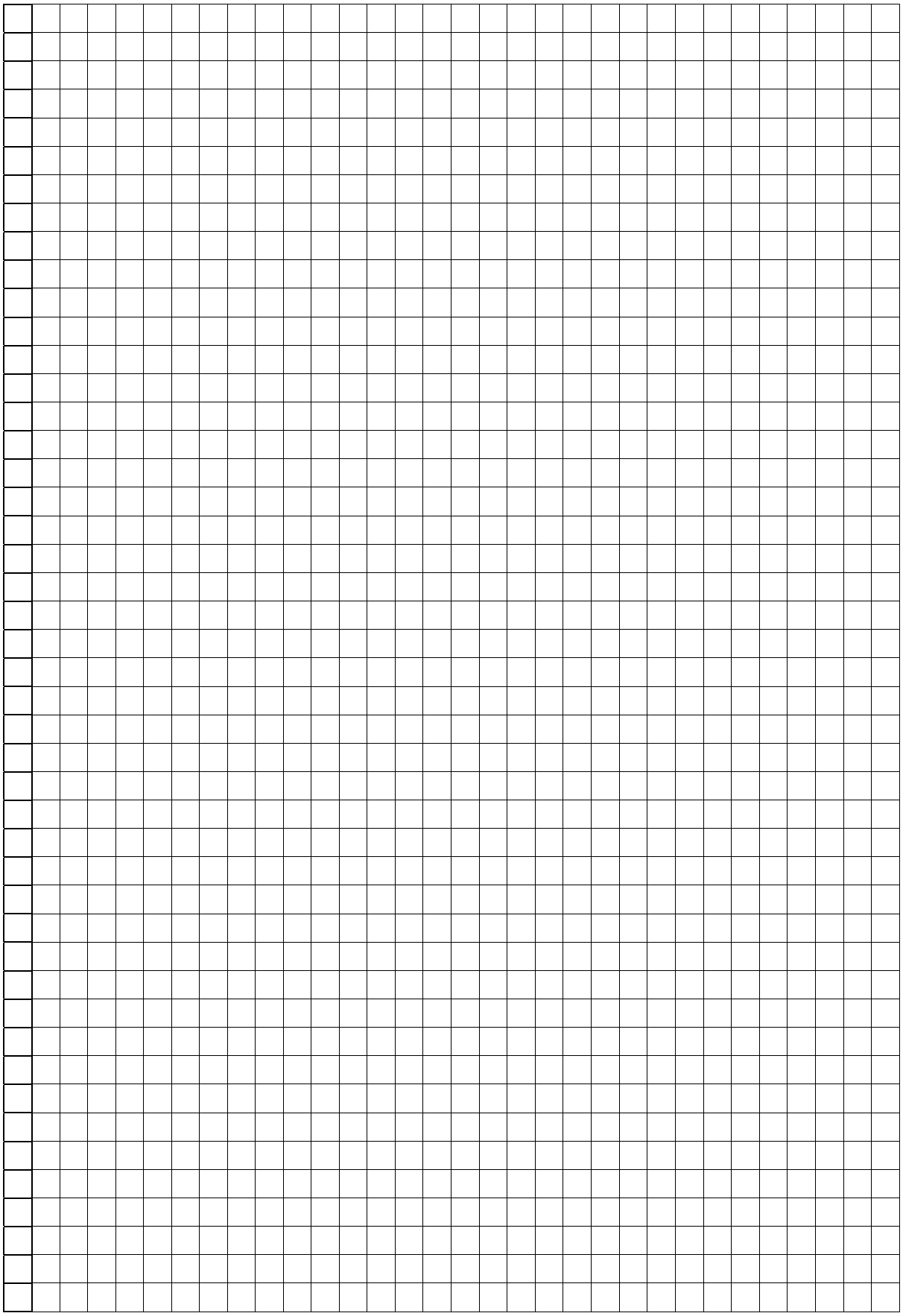
Question 3 **(25 marks)**

The line $\boldsymbol{l}: y = mx + c$ contains the point $(4,3)$ and forms a triangle of area 24 square units with the x-axis and the y-axis. The points A and B are also on the line $\boldsymbol{l}$ as shown.



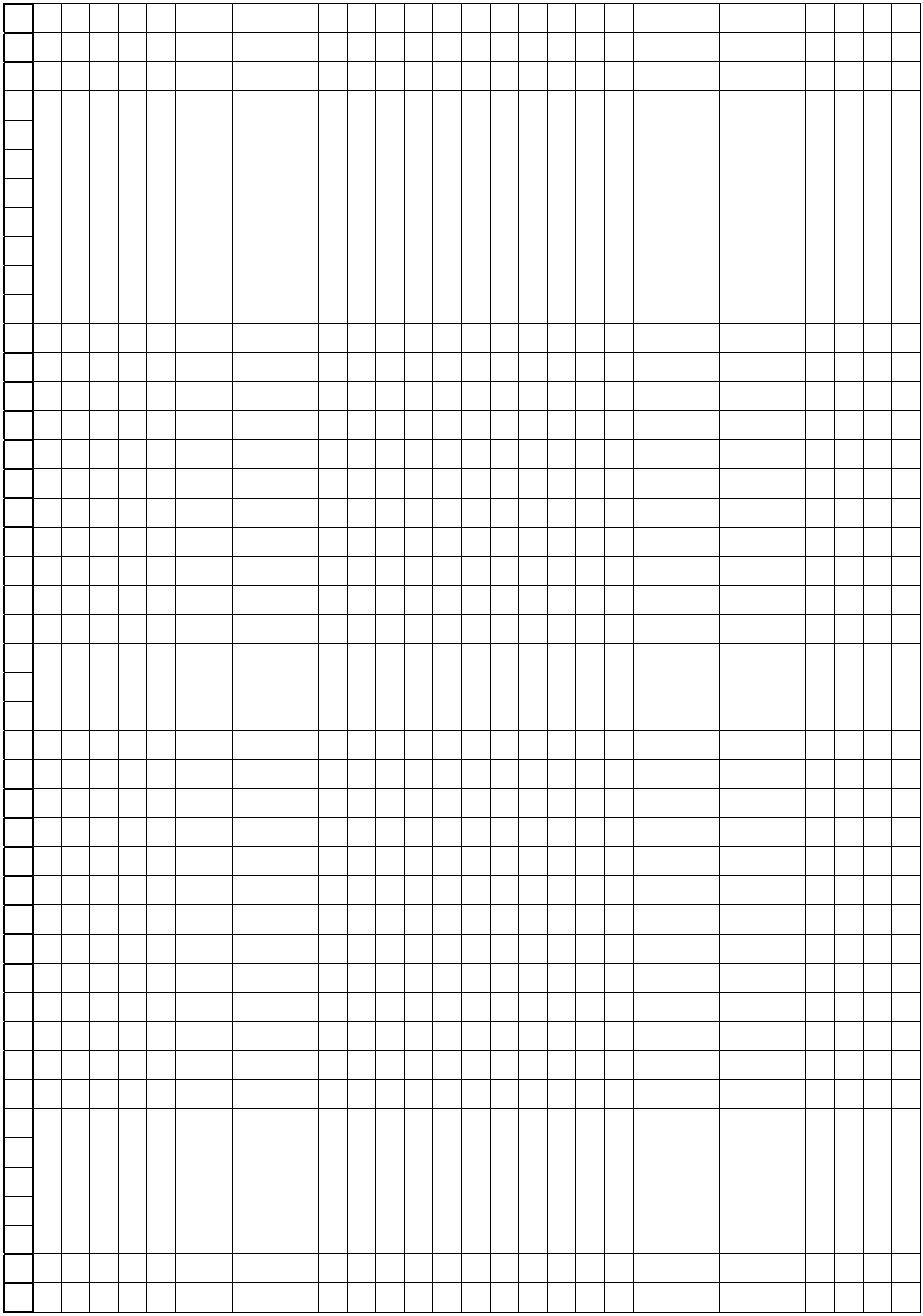
(a) Express $\boldsymbol{c}$ in terms of $\boldsymbol{m}$.

(b) Find the equation of the line ***l***.



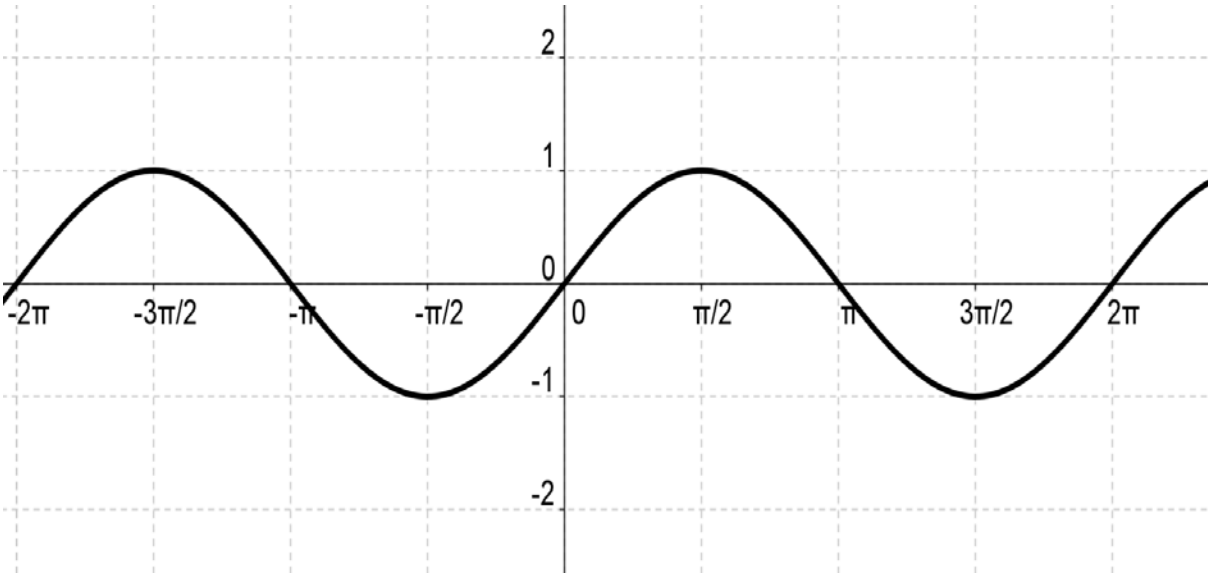
Question 4 **(25 marks)**

A circle of radius length 5 contains the point $(2,-1)$. The centre of the circle lies on the line $x+y=8$. Find the equations of the two circles which satisfy these conditions.



Question 5 **(25 marks)**

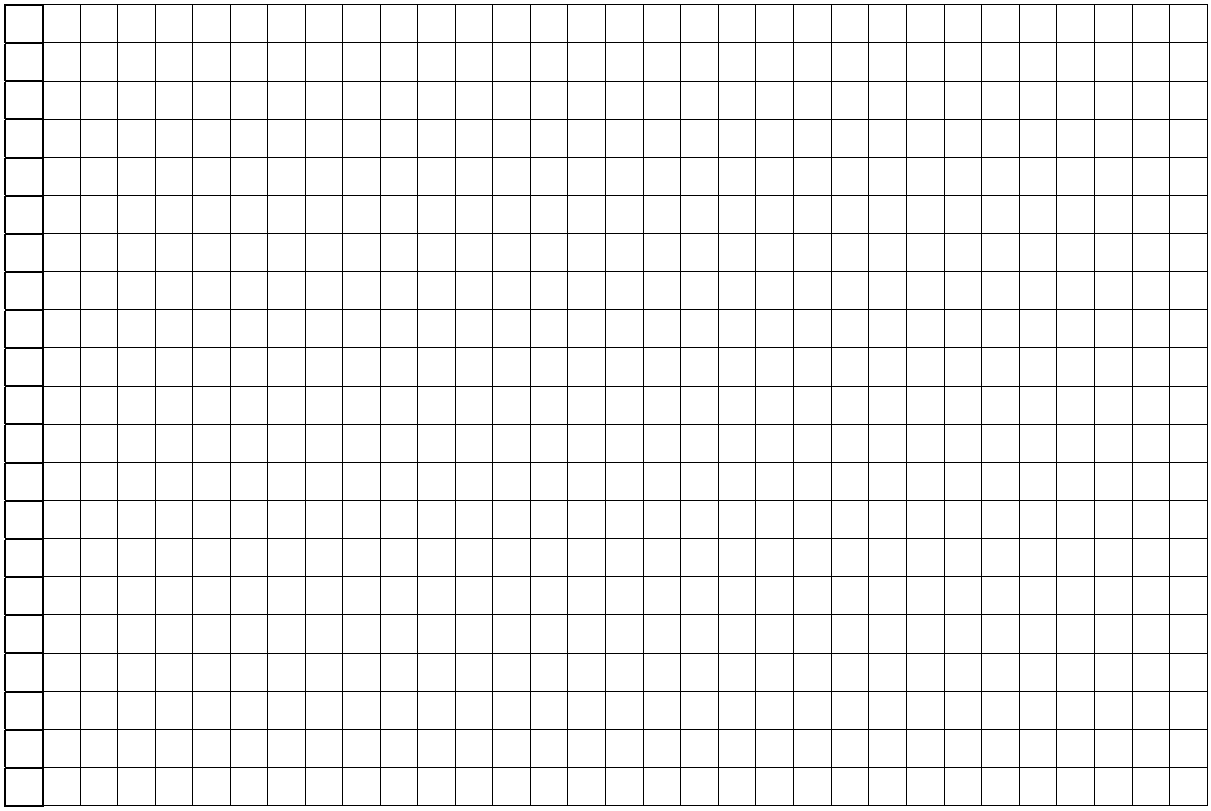
The graph of the function $f : x| \to a\sin(bx)$, where $a = 1$ and $b = 1$ is shown below.



By drawing a graph in the grid above, or otherwise, explain how the shape of the graph will be affected:

(a) if ***a*** is multiplied by a factor of ***n***, where $n \in \mathbb{N}$.

(b) if ***b*** is multiplied by a factor of ***n***, where $n \in \mathbb{N}$.

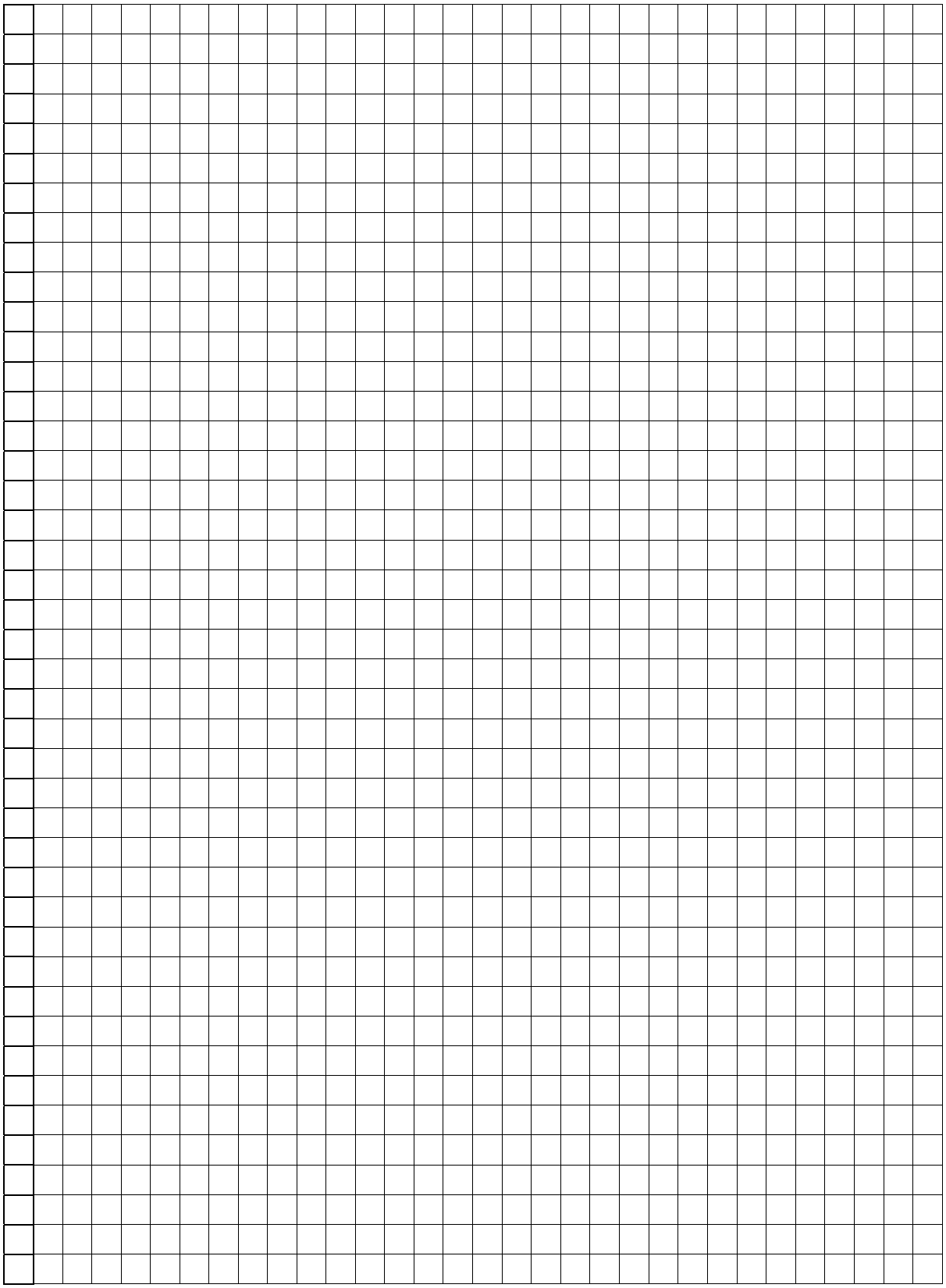


Question 6 **(25 marks)**

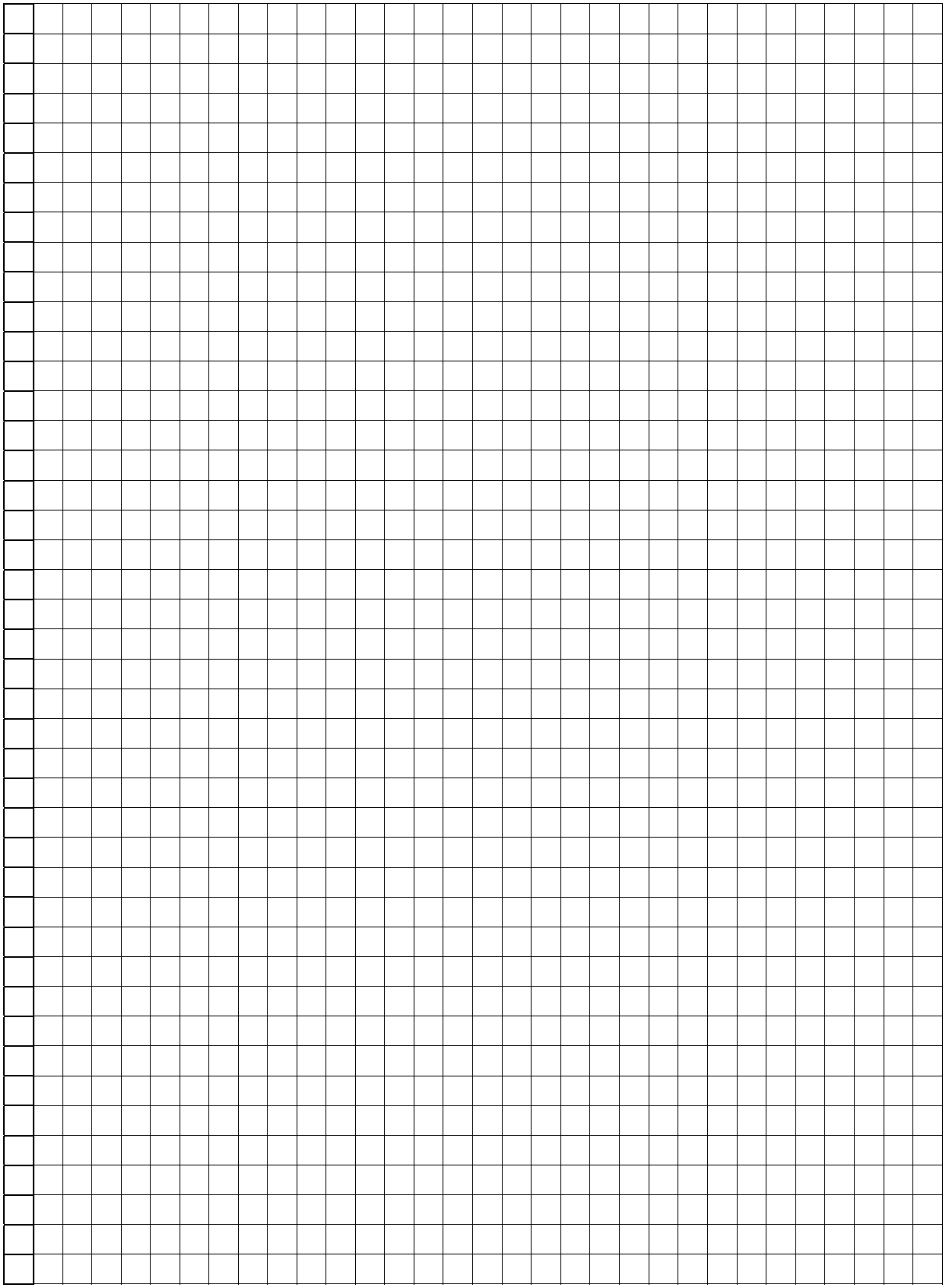
Answer **either** 6A **or** 6B

Question 6A

(a) Explain the term ***corollary***.



(b) Give an example of, and fully deduce, one corollary you have studied. Make reference to the theorem from which it originates.



OR
Question 6B

Prove that if three parallel lines cut off equal segments on some transversal line, then they will cut off equal segments on any other transversal line.

Section B	Contexts and Applications	150 marks

Answer **Question 7** and **Question 8**

Question 7 **(75 marks)**

The Road Safety Authority (RSA) tries to reduce the number of collisions and fatalities on Irish roads each year. As part of this work the RSA records statistics about road accidents.
The following table shows the number of deaths and injuries on Irish roads from 1992 to 2008.

Persons killed and injured on roads

Number

Year	Number killed	Number of injuries	Total
1992	415	10,188	**10,603**
1993	431	9,831	**10,262**
1994	404	10,229	**10,633**
1995	437	12,673	**13,110**
1996	453	13,319	**13,772**
1997	472	13,115	**13,587**
1998	458	12,773	**13,231**
1999	413	12,340	**12,753**
2000	415	12,043	**12,458**
2001	411	10,222	**10,633**
2002	376	9,206	**9,582**
2003	335	8,262	**8,597**
2004	374	7,867	**8,241**
2005	396	9,318	**9,714**
2006	365	8,575	**8,940**
2007	338	7,806	**8,144**
2008	279	9,758	**10,037**

Source: Road Safety Authority

(a) Use a suitable graphical means to display the number of fatalities on Irish roads between 1992 and 2008.

The following table shows the road casualties on Irish roads in 2008 by age group and sex.

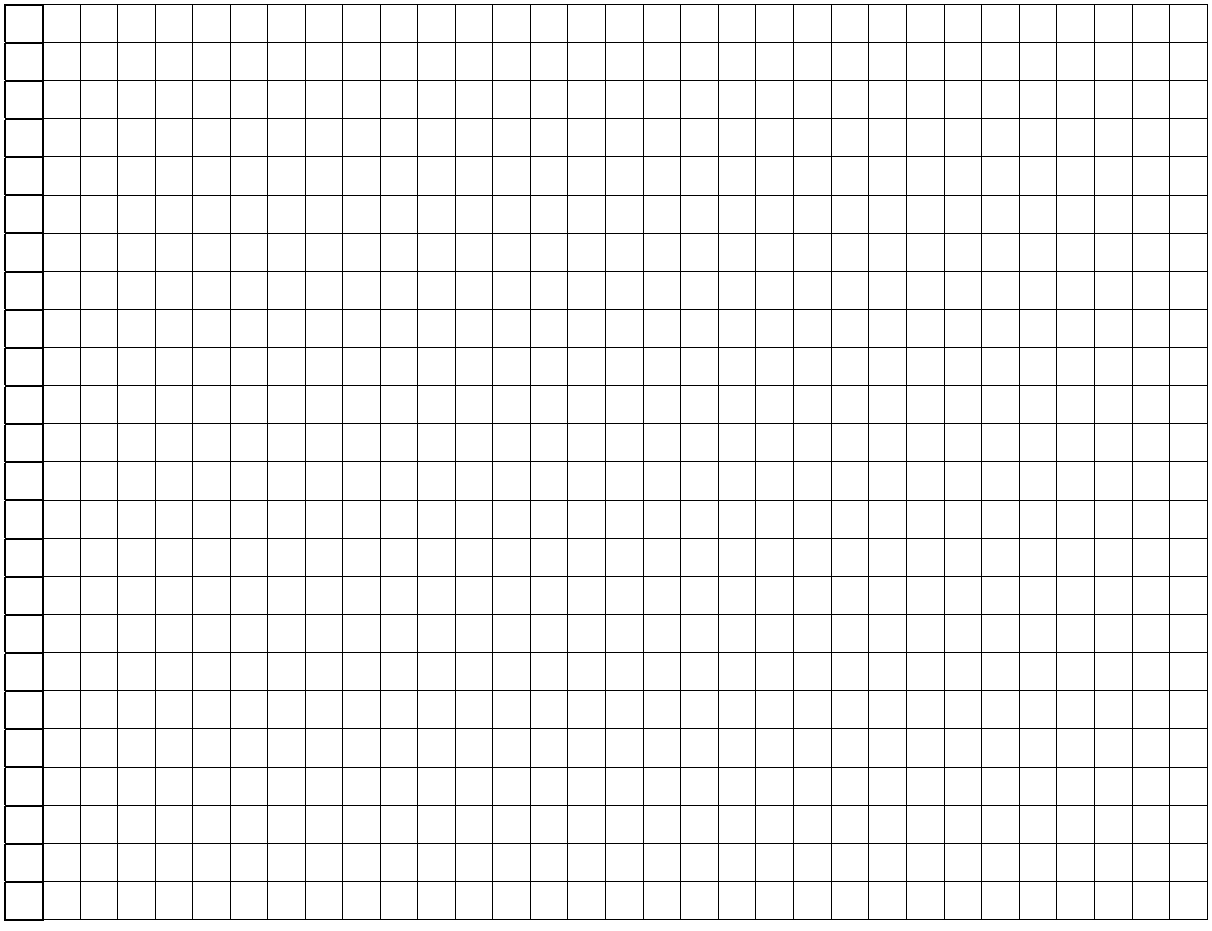
Road casulties by age and sex, 2008

Persons

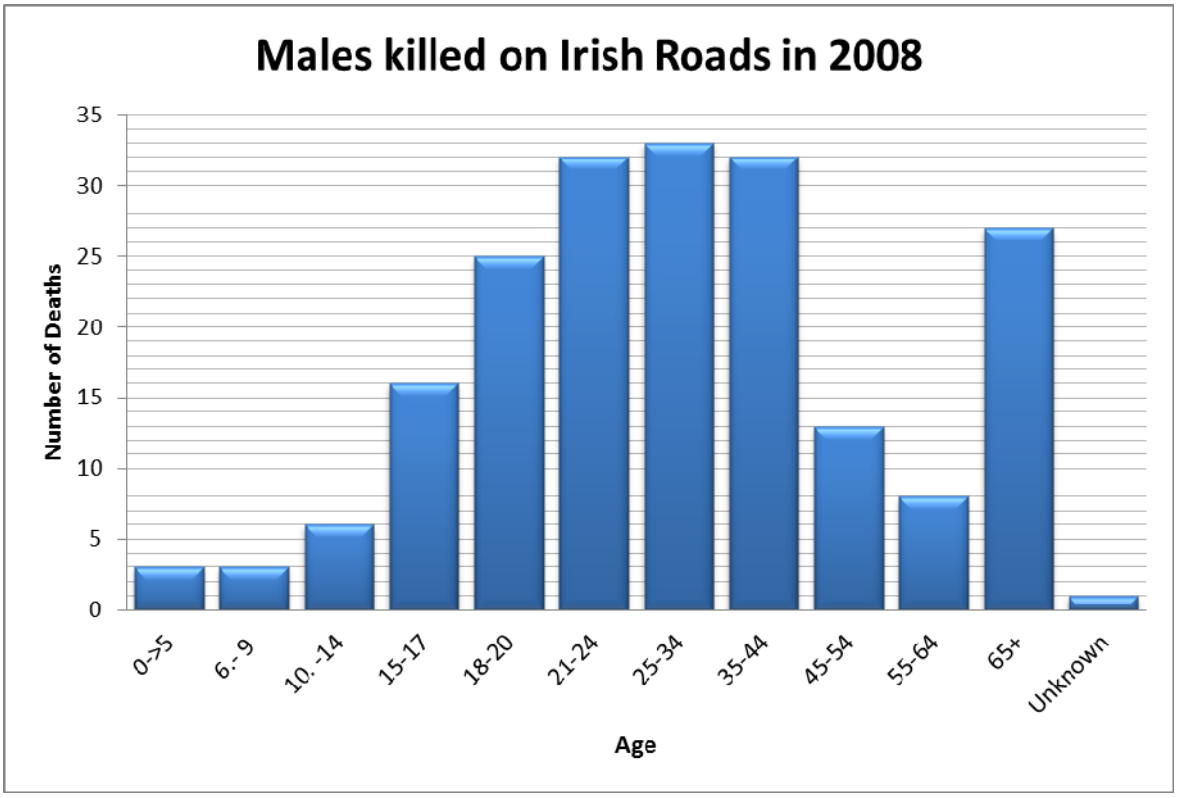
	Male			Female			Total		
Age group	**Killed**	**Injured**	**Total**	**Killed**	**Injured**	**Total**	**Killed**	**Injured**	**Total**
0-5	3	154	157	1	124	125	5	292	297
6-9	3	131	134	2	89	91	5	226	231
10-14	6	175	181	4	117	121	10	300	310
15-17	16	261	277	4	190	194	20	459	479
18-20	25	553	578	9	362	371	34	931	965
21-24	32	547	579	9	448	457	41	1,023	1,064
25-34	33	1,117	1,150	11	807	818	44	1,966	2,010
35-44	32	698	730	4	473	477	37	1,206	1,243
45-54	13	428	441	7	387	394	21	850	871
55-64	8	308	316	5	257	262	13	593	606
65 and over	27	290	317	19	298	317	47	604	651
Unknown	1	574	575	0	356	356	2	1,308	1,310
Total	**199**	**5,236**	**5,435**	**75**	**3,908**	**3,983**	**279**	**9,758**	**10,037**

Source: Road Safety Authority

(b) A student wishes to compare the figures in the table based on gender and age. Suggest the best measures and graphs for the student to use and explain your answer fully.



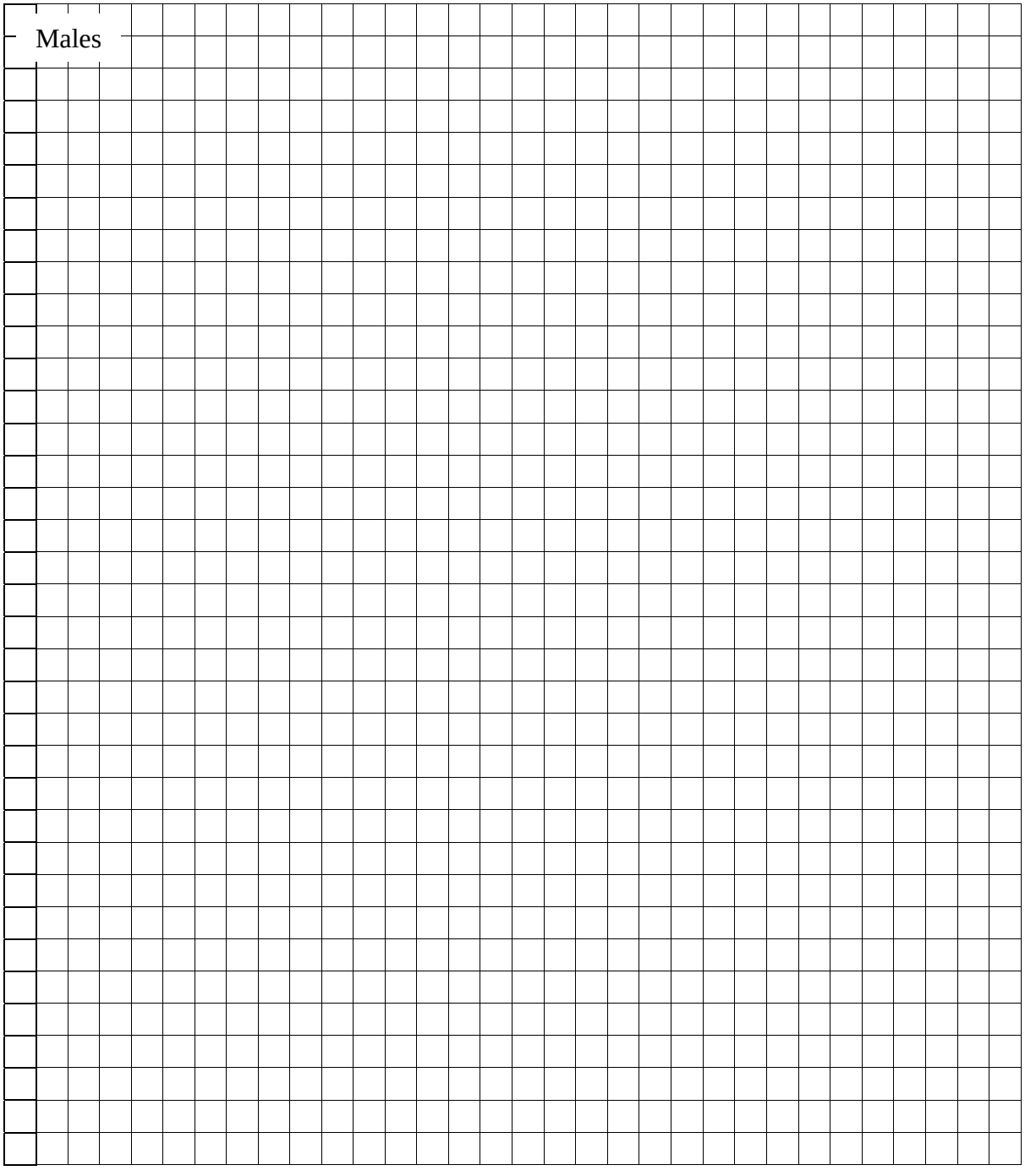
(c) A student compiled the following graph. Examine the graph and comment on the shape and mean of the distribution.

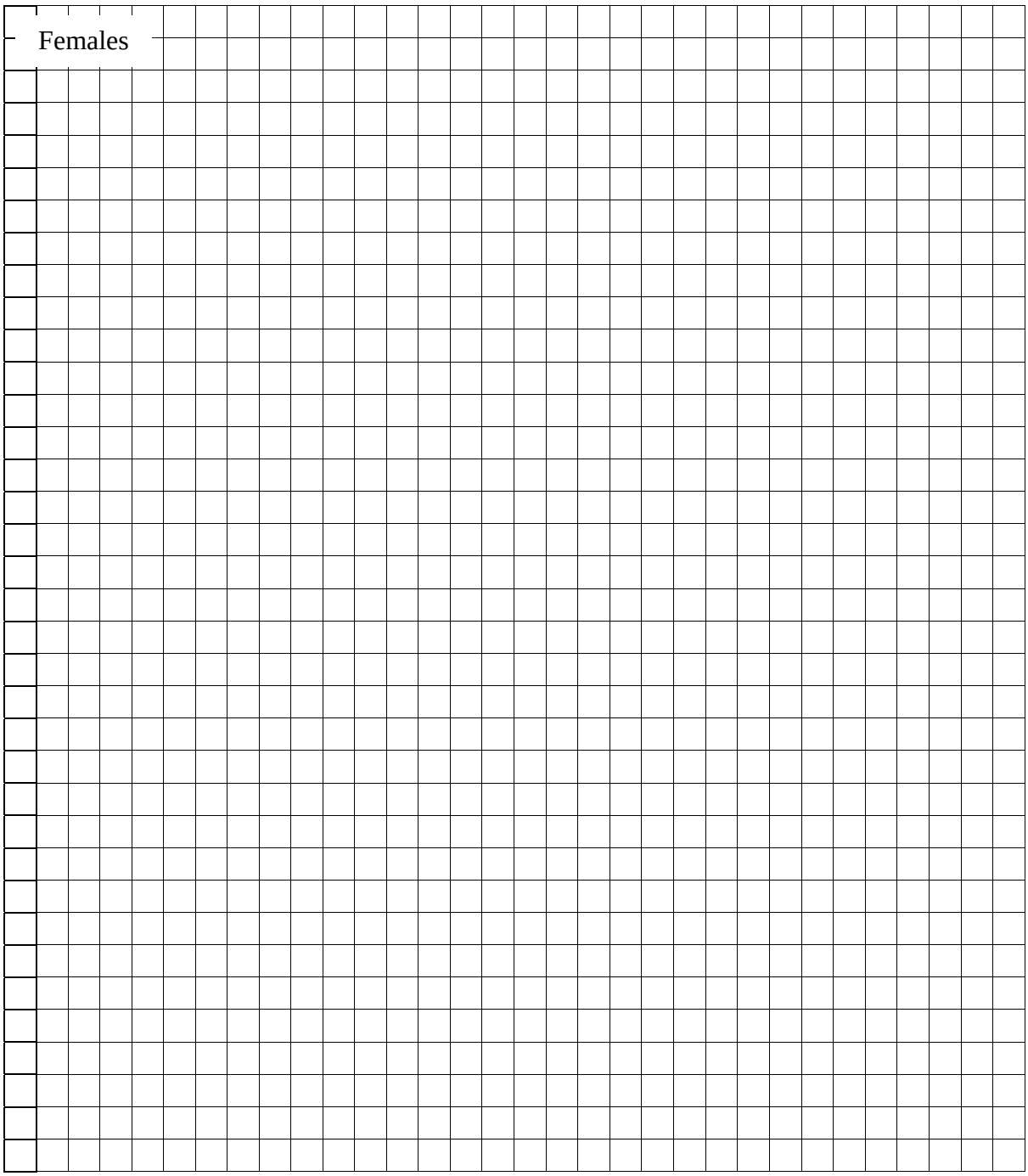


(d) A number of males and females of different ages were quoted for fully comprehensive insurance on a car of engine size 1.4l . The quotes were recorded as follows:

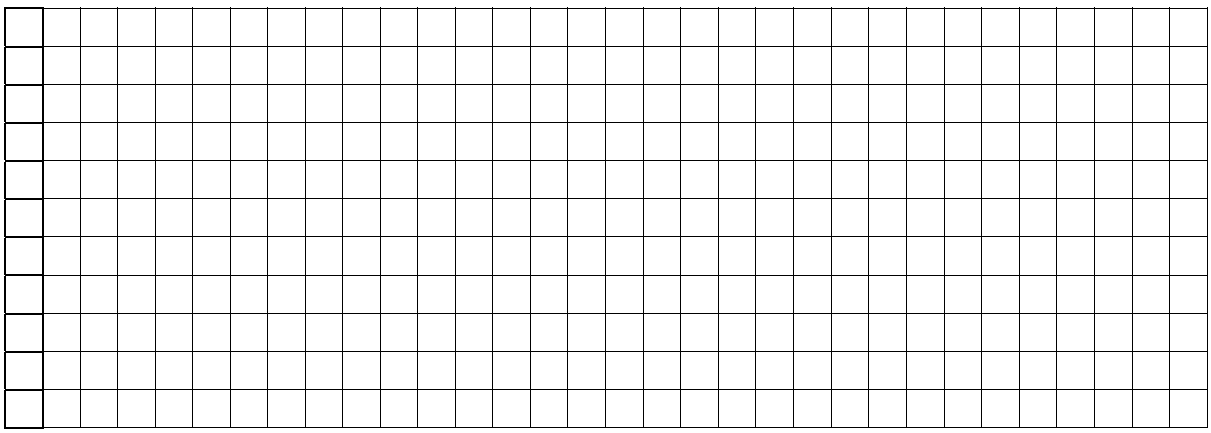
Male		Female	
Age	**Quote**	**Age**	**Quote**
19	**€2,550**	**19**	**€1,890**
27	**€1,250**	**27**	**€950**
30	**€950**	**30**	**€790**
18	**€2,850**	**19**	**€2,300**
20	**€2,490**	**20**	**€1,800**
28	**€1,060**	**28**	**€700**

(i) Draw a scatter plot for both sets of data.

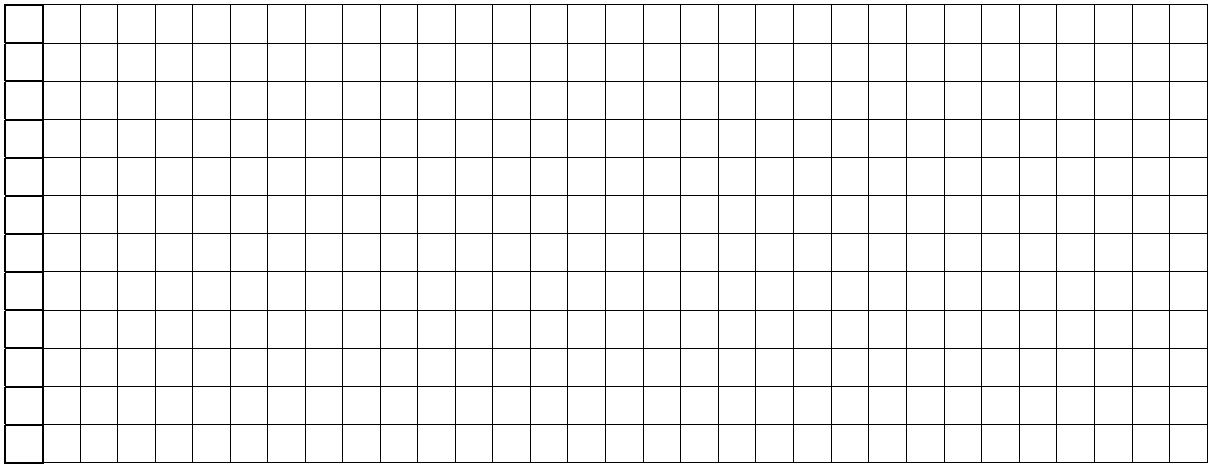




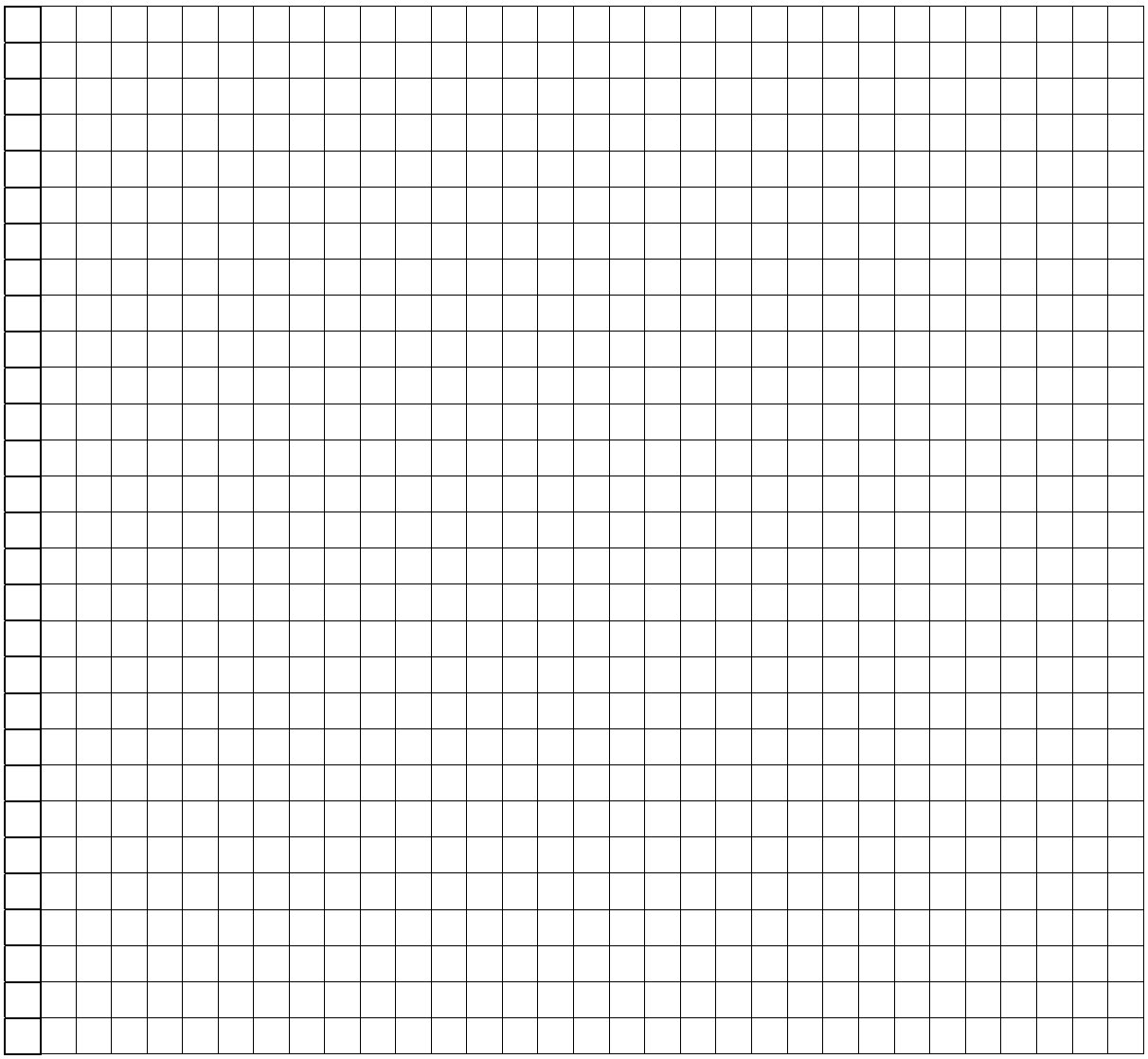
(ii) Comment on the correlation between the age and cost of insurance for both male and female drivers.



(iii) Comment on the relation between the figures released in the RSA reports on road fatalities and the cost of insurance for Irish motorists.



(e) The ages of males killed on Irish roads between the ages of 0 and 65 is assumed to be normally distributed with a mean of 28.7 years and a standard deviation of 5.8 years.
If an accident occured, resulting in the death of a male, what is the probalility that the male will be between the age of 17.1 years and 40.3 years.



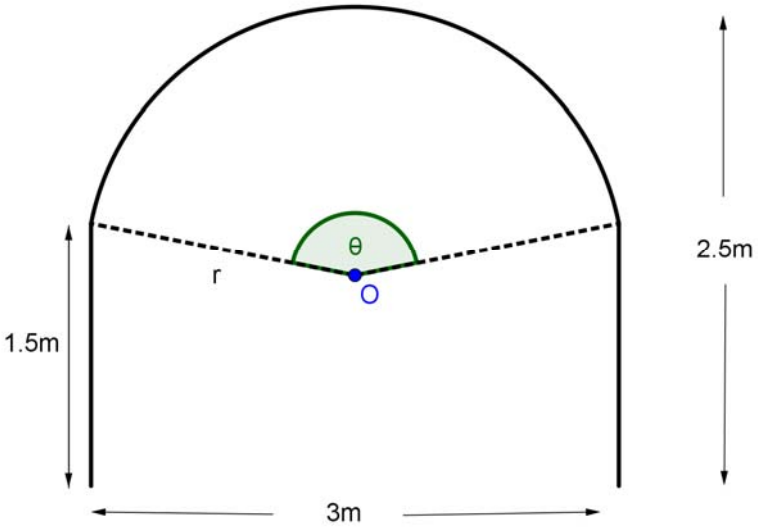
(f) Examine the following table and comment on the success or failure of the work that the RSA is carrying out in Irish society.

Road fatalities by transport mode, 2000-2010

Road User Type	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Pedestrians	85	89	86	64	70	74	73	81	49	40	41
Pedal Cyclists	10	12	18	11	11	10	9	15	13	7	3
Motor Cyclists	39	50	44	55	50	56	29	33	29	25	17
Car Users	260	230	200	172	208	222	226	171	160	146	133
PSV Users	0	0	1	0	0	6	3	1	0	1	1
Goods Vehicle	17	26	20	27	25	22	18	32	20	17	13
Other or Unknown	4	4	7	6	10	6	7	5	8	2	4
TOTAL	**415**	**411**	**376**	**335**	**374**	**396**	**365**	**338**	**279**	**238**	**212**

Question 8 **(75 marks)**

A group of Transition Year students have designed and are constructing a polytunnel as part of the Green Schools Initiative.
The tunnel is 6 m in length, divided into three equal sections. The end view for each section is shown.
Each section is joined by two horizontal bars while a single support runs along the top from the front to the back.

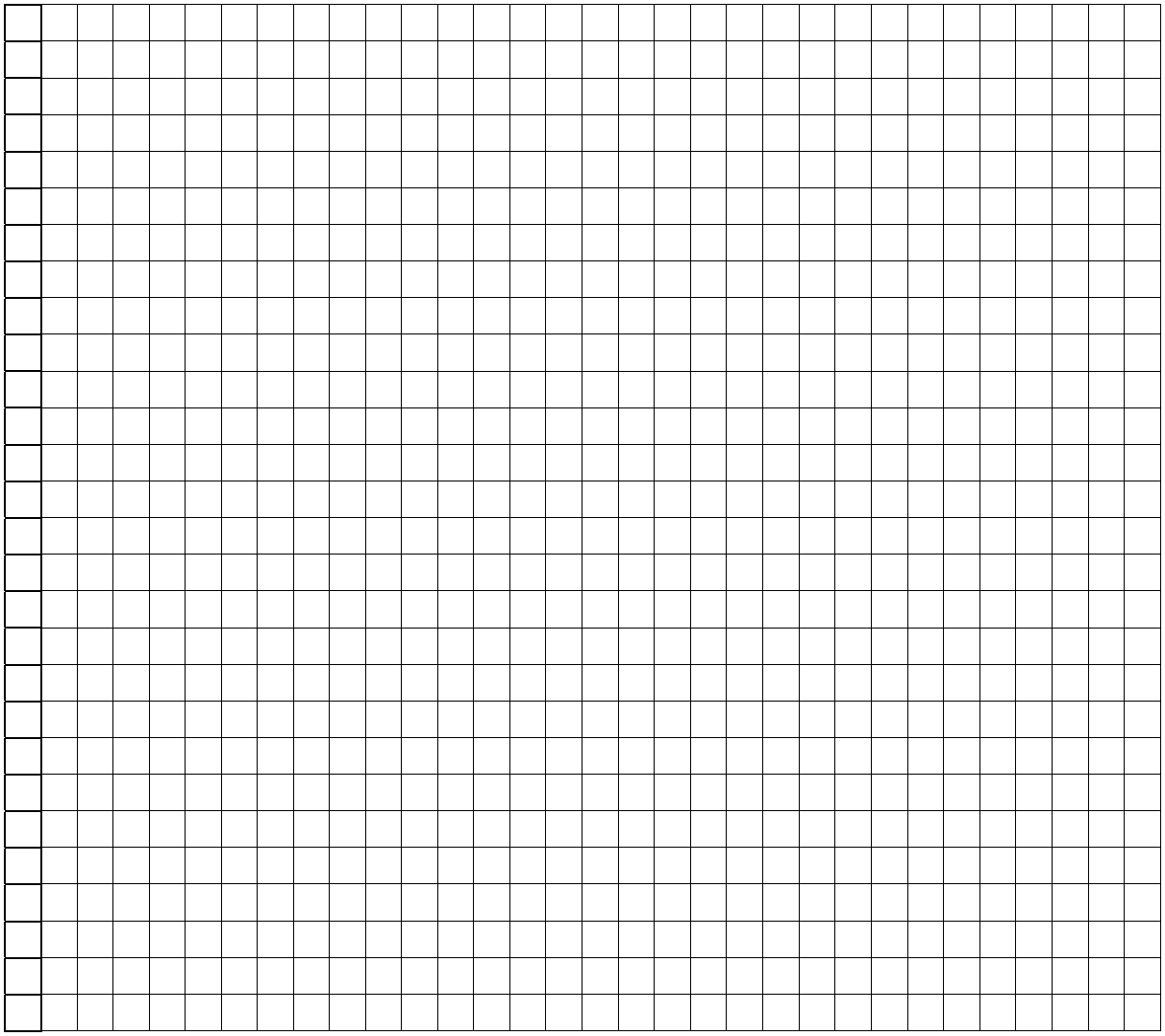


(a) Calculate the length of bar required to make the straight bars in each section of the tunnel.

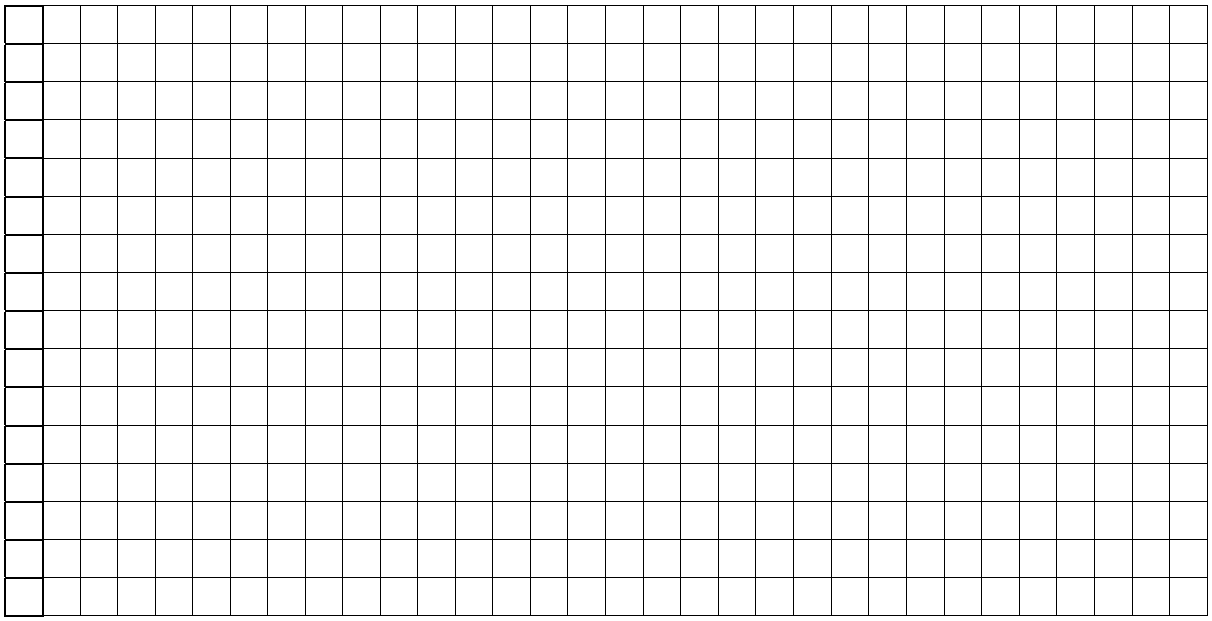
(b) The students realise they need to make the straight vertical bars 20% longer so that they can bury part of the structure in the ground. What is the extra length of bar eeded to make the straight bars?

(c) If centre of the arc is at point ***O*** calculate the radius of the arc.

(d) Calculate the angle θ correct to one decimal place.



(e) Calculate the length of the arc correct to two decimal places.



(f) If a door measuring $0.5\,\text{m} \times 1\,\text{m}$ will be placed at the front of the tunnel, calculate the amount of covering needed to fully enclose the tunnel correct to the nearest square metre.