P 7

Pre-Leaving Certificate Examination, 2014

Triailscrúdú na hArdteistiméireachta, 2014

Mathematics
(Project Maths – Phase 3)

Paper 2

Higher Level

2½ hours

300 marks

Name:
School:
Address:
Class:
Teacher:

For examiner	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
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	3 questions

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

In Section A, answer

Questions 1 to 5 and

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

In Section B, answer Questions 7 to 9.

Write your answers in the spaces provided in this 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 *Formulae and Tables* booklet. 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 down the make and model of your calculator(s) here:

Section A — Concepts and Skills — 150 marks

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

Question 1 **(25 marks)**

(a) Explain the term Stratified Sampling.

(b) Explain the term Cluster Sampling.

(c) Are Stratified and Cluster Sampling random or non-random methods of sampling? Explain your answer fully.

(d) An estate agent wishes to find out the prices of the houses in a newly developing area of a city. Which type of sampling above would be most suitable to use? Explain your answer fully.

Question 2 **(25 marks)**

(a) **(i)** What is a Bernoulli Trial?

(ii) Give two characteristics of a binomial distribution.

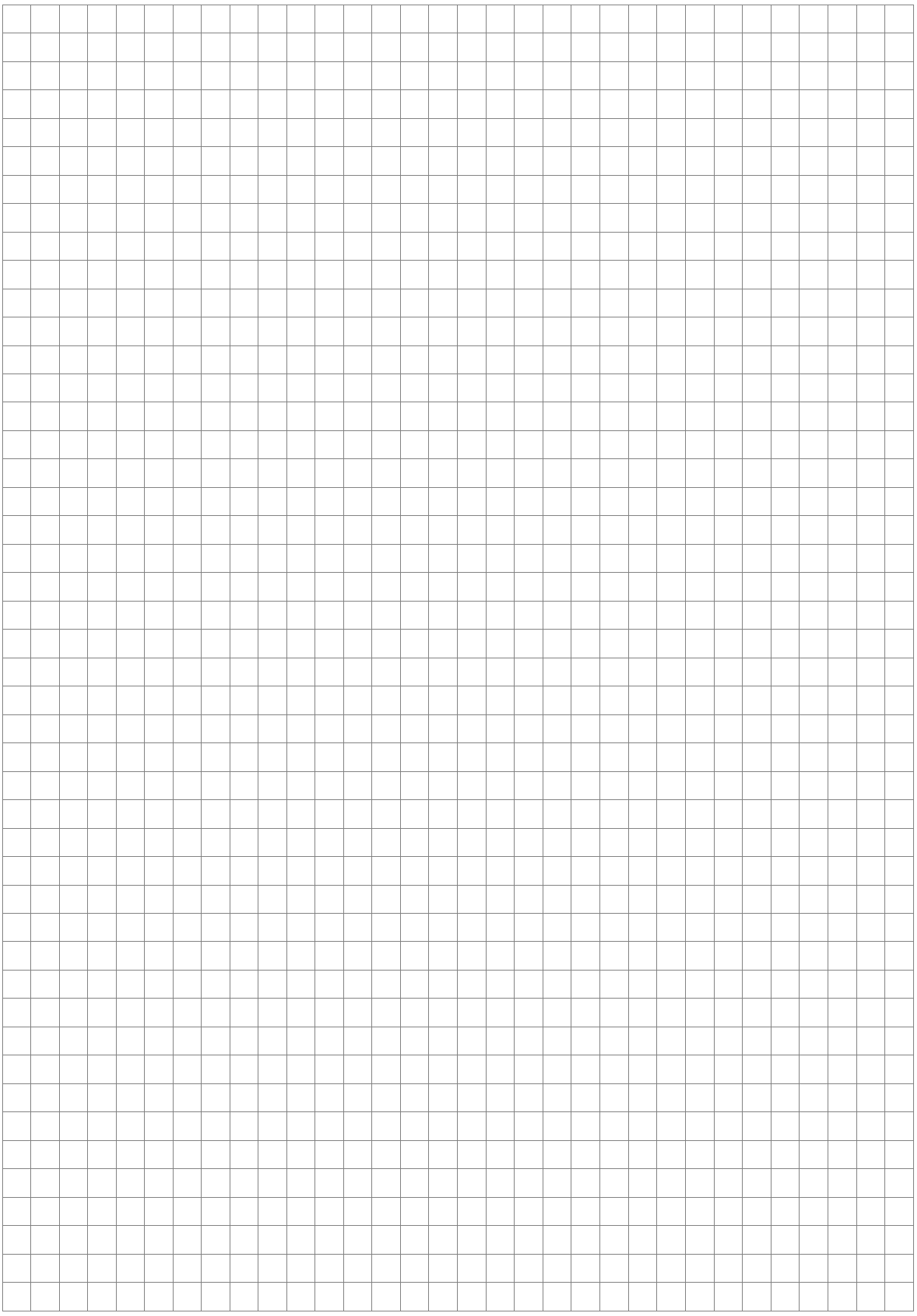
(b) At a certain Garda checkpoint one in every 10 cars has a faulty headlamp.

(i) Find the probability that the first three cars will have a faulty headlamp.

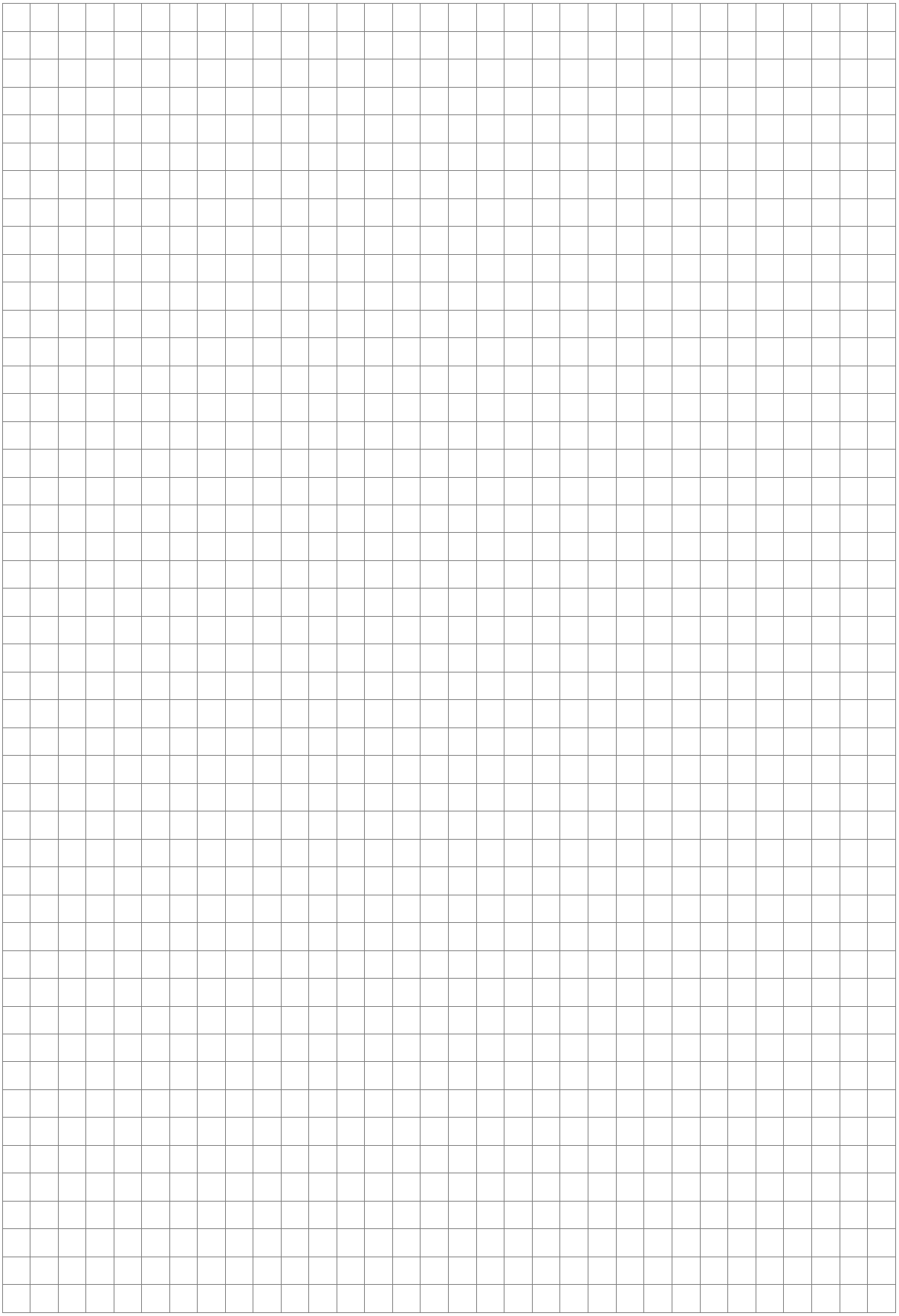
(ii) Find the probability that at least two of the first four cars stopped will have a faulty headlamp.

Question 3 **(25 marks)**

(a) Calculate the shortest distance between the line $6x+7y-10=0$ and the point $(3,6)$.



(b) Find the equations of the lines through the point $(-4,-2)$ which make an angle of $45°$ with the line $x+2y=7$.



Question 4 **(25 marks)**

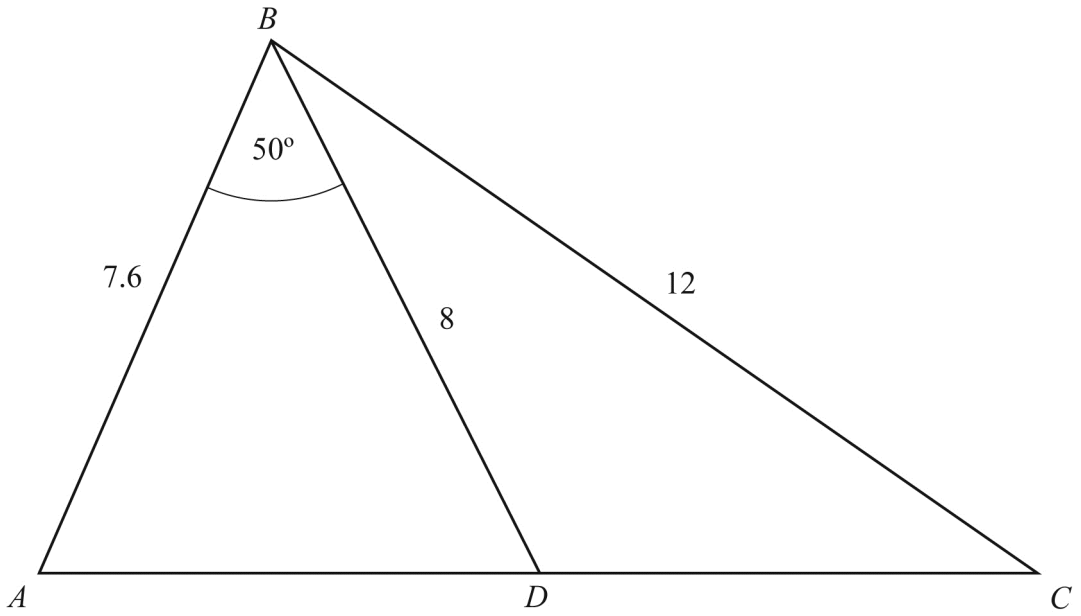
(a) Find the equation of the circle c, which passes through the points $(-1,-3)$ and $(8,-2)$ and whose centre lies on the line $4x+5y=22$.

(b) The line $5x-4y+k=0$ is a tangent to the circle c. Find two possible values for k.

Question 5 **(25 marks)**

(a) Find two values for θ, where $\sin\theta = -\frac{\sqrt{3}}{2}$ and $0° \le \theta \le 360°$.

(b) If the point D is the midpoint of $[AC]$, find $[\angle BCD]$, correct to the nearest degree.



Question 6 **(25 marks)**

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

Question 6A

A fire station is being built to service the three towns shown so that it is equidistant from the roads adjoining each town.

(a) Show, using a suitable construction, where the fire station should be built.

(b) What is the name given to the point where the fire station will be built?

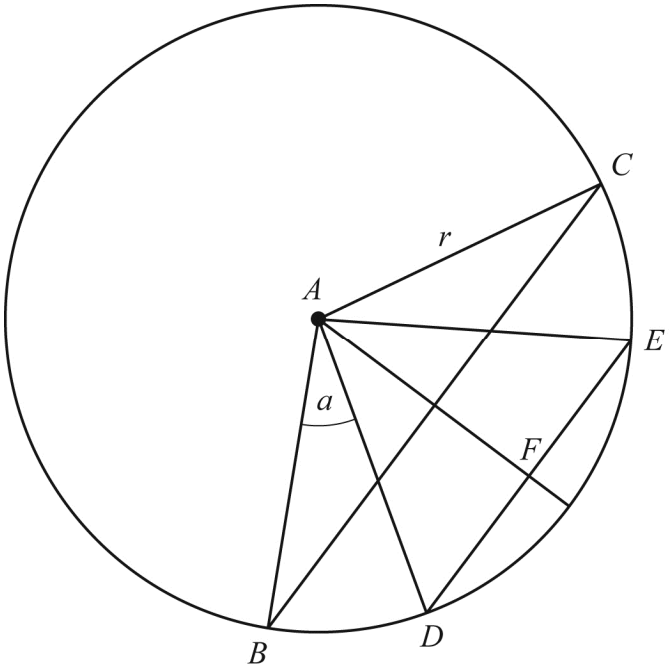
OR

Question 6B

(a) $[BC]$ and $[DE]$ are two parallel chords of a circle with centre A and radius r.

$[AF] \perp [BC]$ and $[\angle BAC] = 2[\angle DAE]$.

If the area ΔABC = area ΔADE, show that $a = \frac{\pi}{6}$ rads.



(b) Find the value of r, where $r \in \mathbb{N}$, if $|BC|^2 + |DE|^2 = 36$.

Section B — Contexts and Applications — 150 marks

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

Question 7 **(75 marks)**

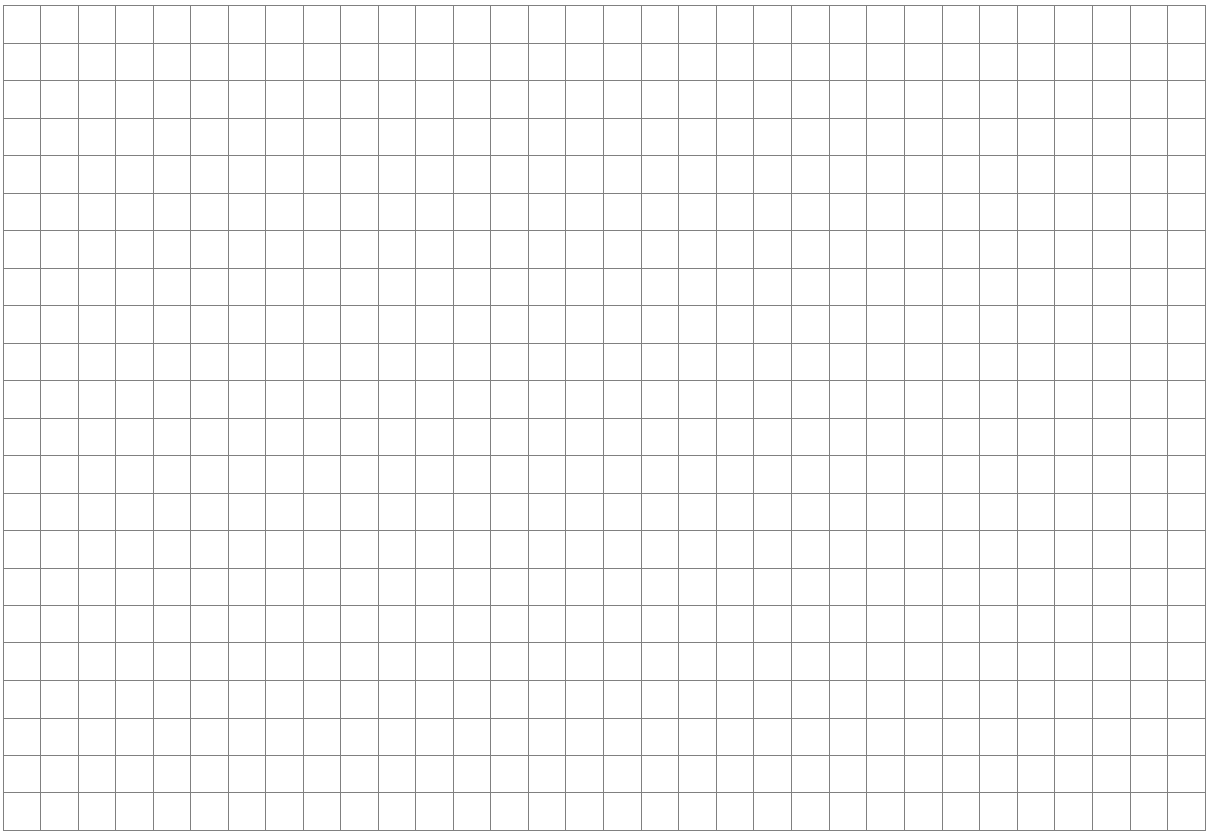
(a) Each year the Central Statistics Office, or CSO, compile vital statistics about life in Ireland. The following table from the CSO shows the number of people employed and unemployed in the Irish workforce, in thousands, from 1987 to 2011.

Table 2.1 Total number of persons in employment, unemployed and in the labour force (ILO) in thousands.

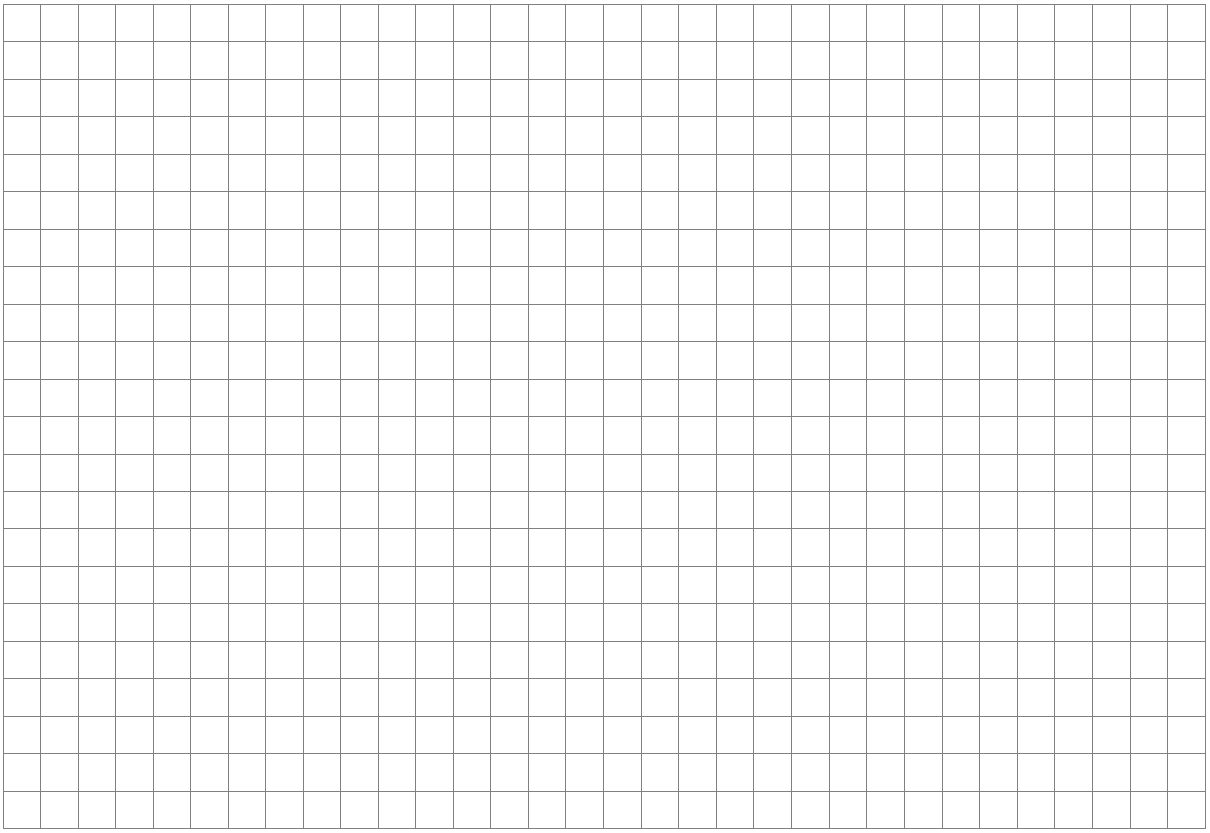
Year	In employment	Unemployed	Labour force
1987	1,110.5	226.0	1,336.5
1988	1,110.7	217.0	1,327.7
1989	1,111.0	196.8	1,307.8
1990	1,159.7	172.4	1,332.1
1991	1,155.9	198.5	1,354.4
1992	1,165.2	206.6	1,371.8
1993	1,183.1	220.1	1,403.2
1994	1,220.6	211.0	1,431.6
1995	1,281.7	177.4	1,459.2
1996	1,328.5	179.0	1,507.5
1997	1,379.9	159.0	1,539.0
1998	1,506.5	127.9	1,634.4
1999	1,607.2	102.3	1,709.5
2000	1,684.8	81.3	1,766.2
2001	1,738.4	69.7	1,808.0
2002	1,768.8	82.5	1,851.3
2003	1,800.1	87.5	1,887.5
2004	1,852.4	88.5	1.941.0
2005	1,944.6	96.9	2,041.5
2006	2,035.1	99.0	2,134.1
2007	2,136.1	107.5	2,243.6
2008	2,147.3	131.0	2,278.3
2009	1,974.0	275.0	2,248.9
2010	1,893.6	305.1	2,198.7
2011	1,861.3	317.4	2,178.7

[Source: CSO]

(i) Examining the figures in the table, discuss the trends in the unemployment figures between 1987 and 2011.



(ii) Ireland has seen a dramatic change in the employment figures since the turn of the century. Why, in your opinion, have the figures changed?

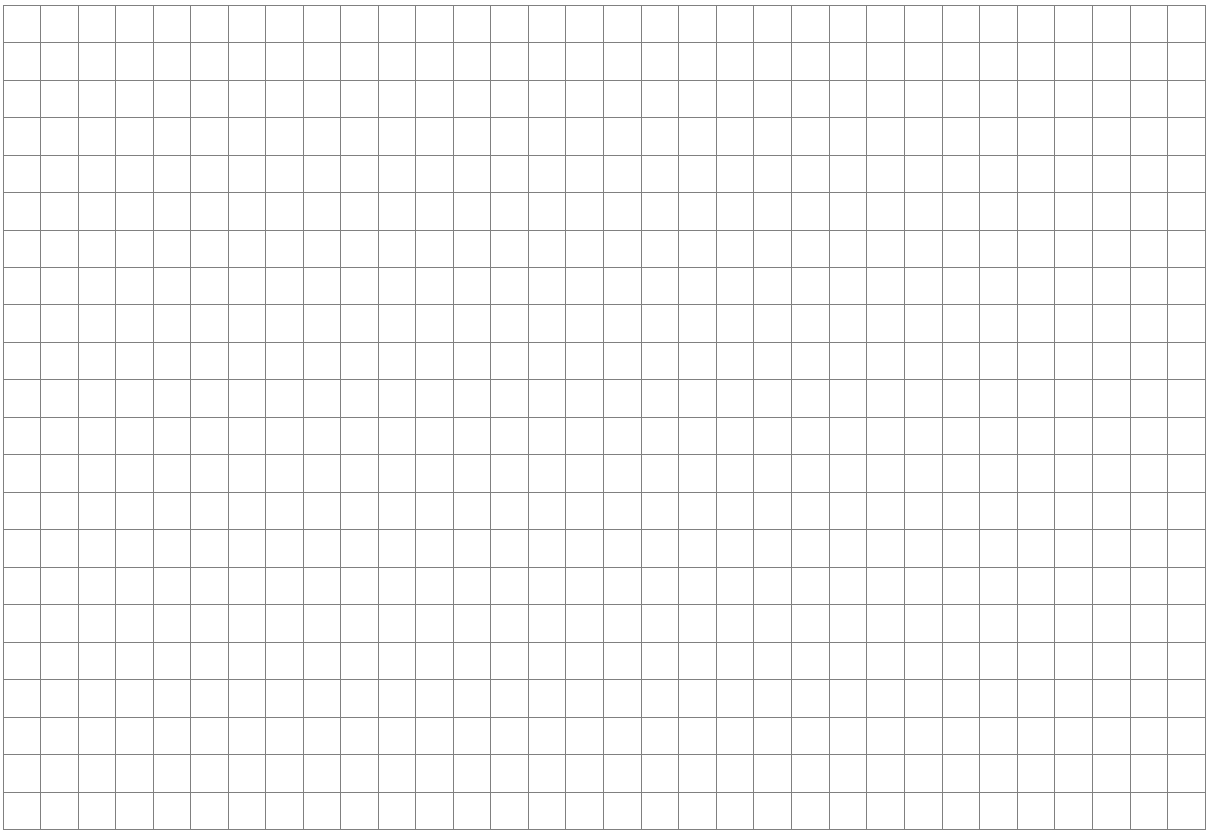


The following table shows the changes in Ireland's population from 1987 to 2011. All the figures are in thousands.

Table 2.2 Components of the annual population change, 1987 – 2011 in thousands.

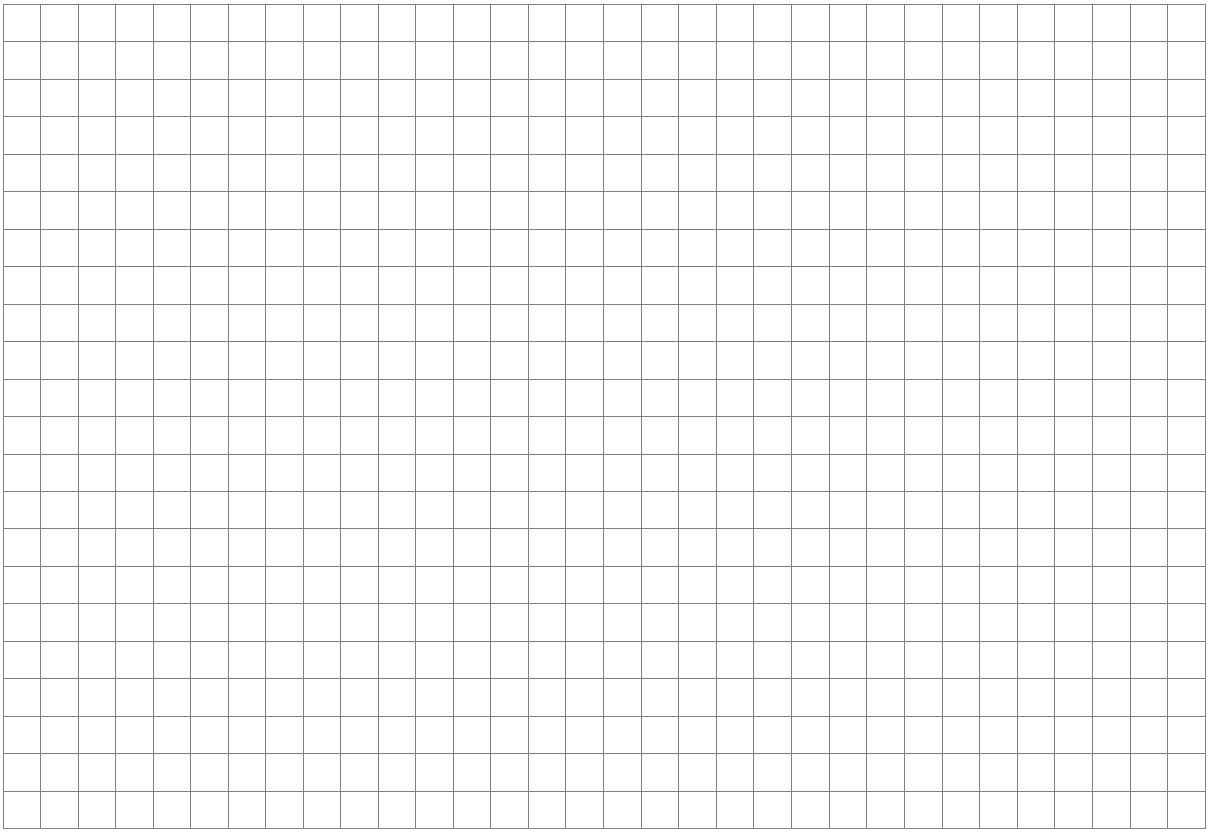
Year ending April	Births	Deaths	Natural increase	Immigrants	Emigrants	Net migration	Population change
1987	61.2	32.2	29.0	17.2	40.2	−23.0	5.9
1988	57.8	31.6	26.2	19.2	61.1	−41.9	−15.8
1989	53.6	31.0	22.6	26.7	70.6	−43.9	−21.2
1990	51.9	32.8	19.1	33.3	56.3	−22.9	−3.7
1991	53.1	31.1	22.0	33.3	35.3	−2.0	19.9
1992	52.8	31.4	21.4	40.7	33.4	7.4	28.8
1993	50.4	30.4	20.0	34.7	35.1	−0.4	19.6
1994	49.1	32.6	16.6	30.1	34.8	−4.7	11.8
1995	48.4	31.2	17.2	31.2	33.1	−1.9	15.4
1996	48.8	32.0	16.7	39.2	31.2	8.0	24.8
1997	50.7	31.7	19.0	44.5	25.3	19.2	38.2
1998	52.7	31.2	21.5	46.0	28.6	17.4	38.8
1999	53.7	32.4	21.2	48.9	31.5	17.3	38.5
2000	54.0	32.1	21.8	52.6	26.6	26.0	47.9
2001	55.1	30.2	24.8	59.0	26.2	32.8	57.7
2002	58.1	29.3	28.8	66.9	25.6	41.3	70.0
2003	60.8	28.9	31.9	60.0	29.3	30.7	62.6
2004	62.0	28.6	33.3	58.5	26.5	32.0	65.3
2005	61.4	27.9	33.5	84.6	29.4	55.1	88.6
2006	61.2	27.0	34.2	107.8	36.0	74.8	106.0
2007	65.8	27.0	38.8	109.5	42.2	67.3	106.1
2008	72.3	27.7	44.6	83.8	45.3	38.5	83.1
2009	74.5	29.4	45.1	57.3	65.1	−7.8	37.3
2010	74.1	28.2	45.9	30.8	65.3	−34.5	11.4
2011	75.1	27.4	47.7	42.3	76.4	−34.1	13.6

(iii) Discuss the trends in the Immigration/Emigration figures for the years shown.

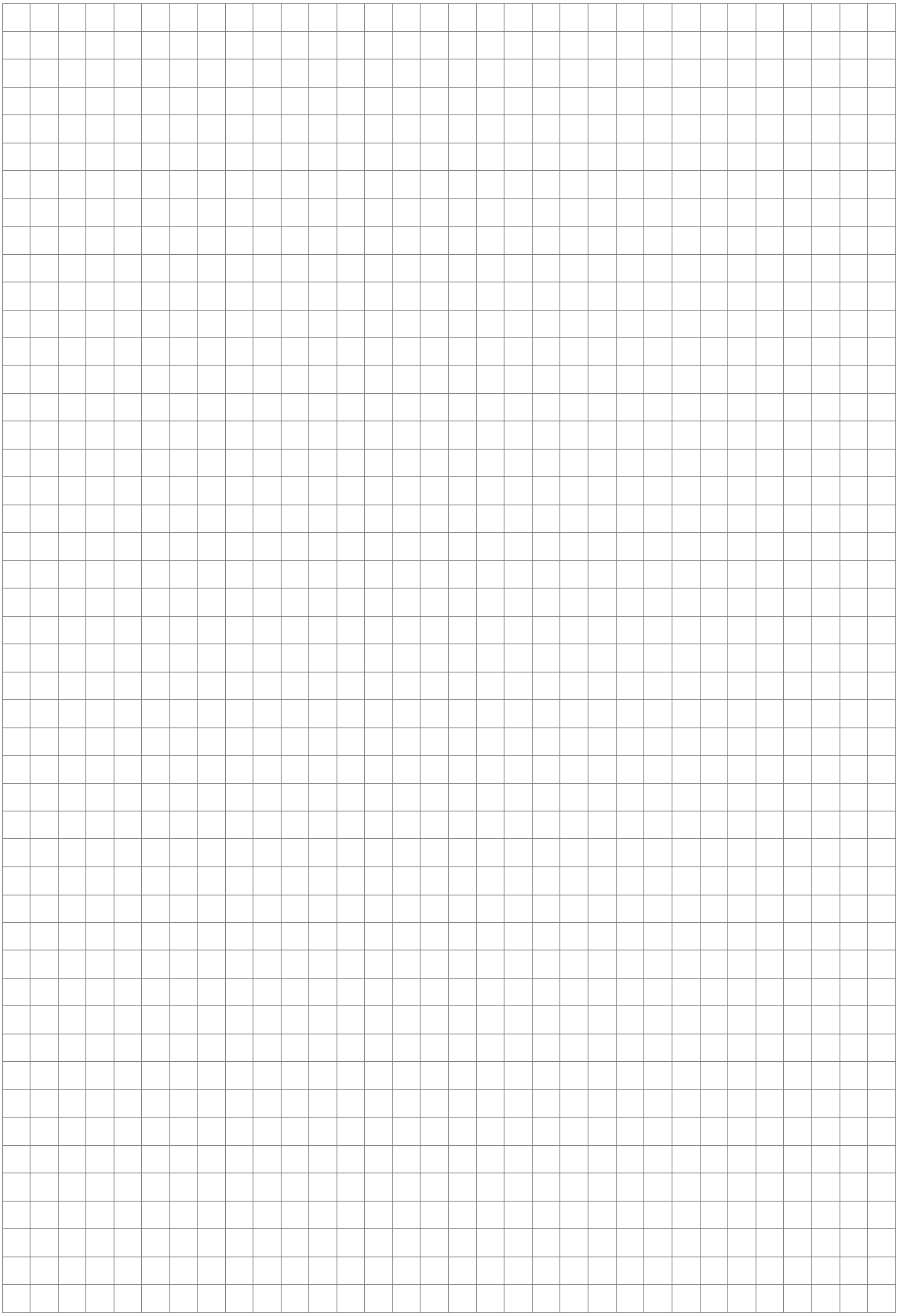


Paul states, "Recent emigration figures are affected by the lack of jobs in Ireland".

(iv) Would you agree with Paul? Explain your answer fully.



(v) Paul decides to represent the data on a suitable graph. He wants to investigate if there is a relationship between unemployment figures and emigration in Ireland. Display the data on a suitable graph.



(vi) Explain how the graph supports/does not support Paul's claim. Make reference to statistical analysis of the given data.

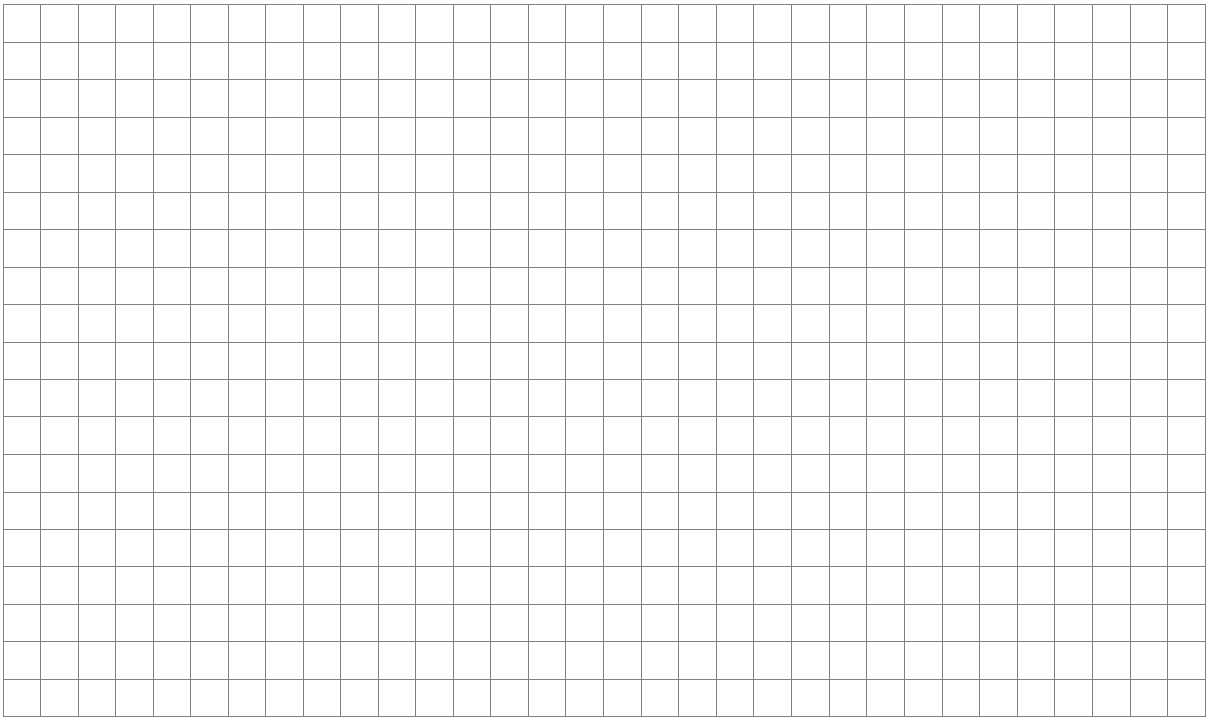
(b) **(i)** What is the relationship between the mean, mode and median of a normal distribution?

(ii) Which of the following would you expect to be normally distributed? Explain your answer fully.

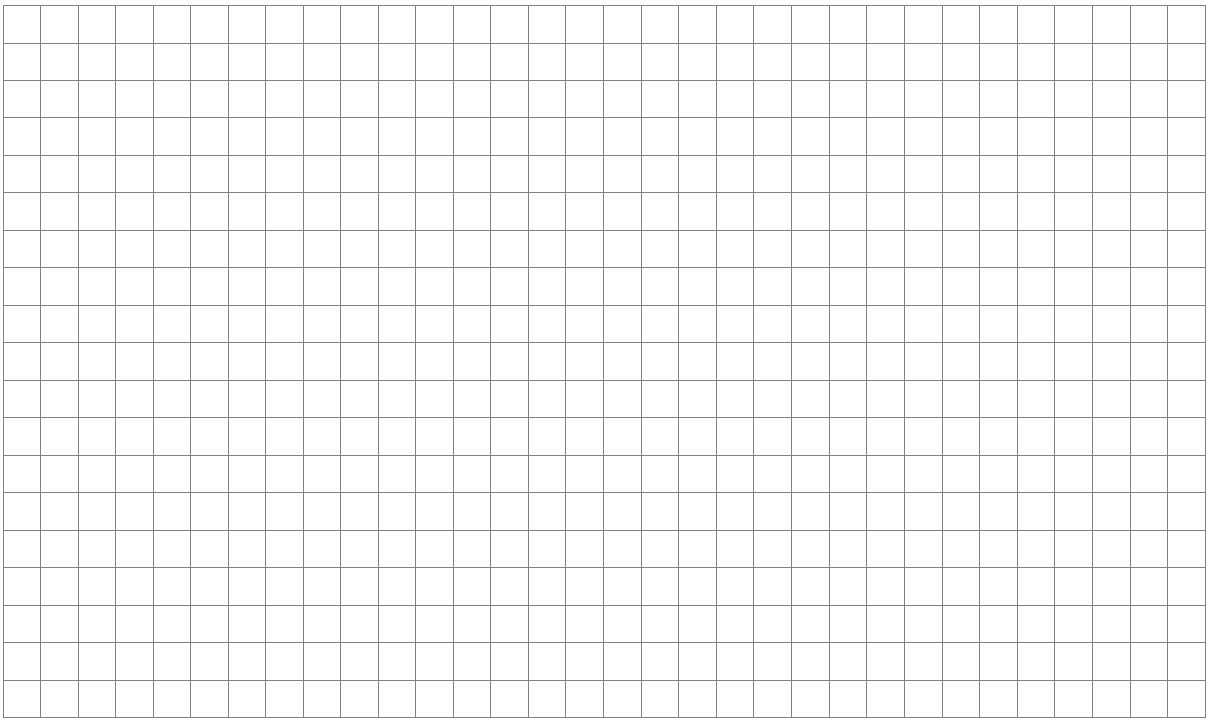
- The lifespan of a television.

OR

- The number of accidents on a stretch of M4 motorway in a year.

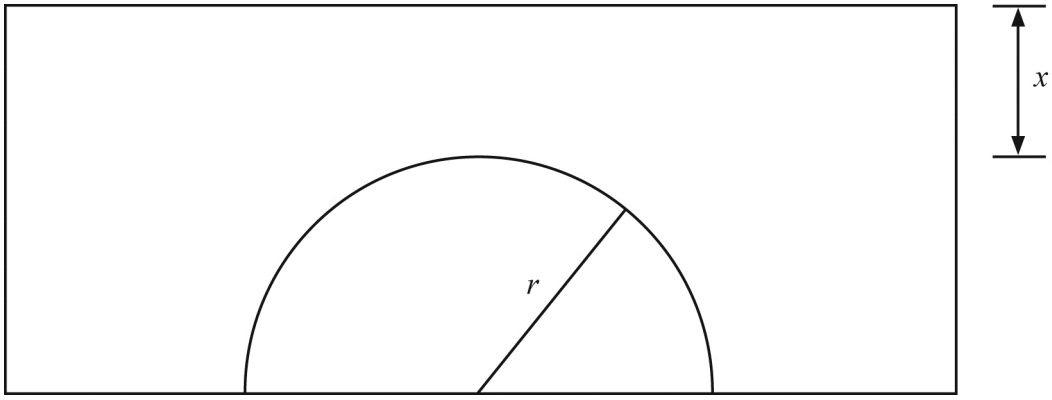


(iii) 400 samples of size 10 are taken from a production line producing jars of gravy. The mean weight of a jar is 200g, with a standard deviation of 1.5g. Calculate the limits between which you would expect 95% of the sample means to lie.



Question 8 **(40 marks)**

A rear windshield wiper has a radius of r. It cleans half the width of the windshield. The highest point of the arc of the semicircle is 60% of the height of the windshield.

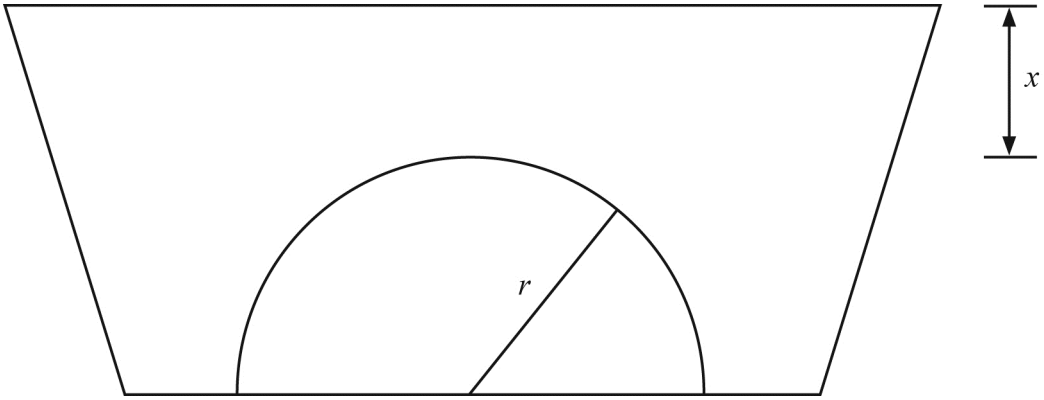


(a) Show that the distance x can be written as $\frac{2}{3}r$.

(b) Show that the total area of the windshield is $\frac{20}{3}r^2$.

(c) Show that the ratio of the area cleaned to the area unclean is $\frac{3}{40}\pi$ square units.

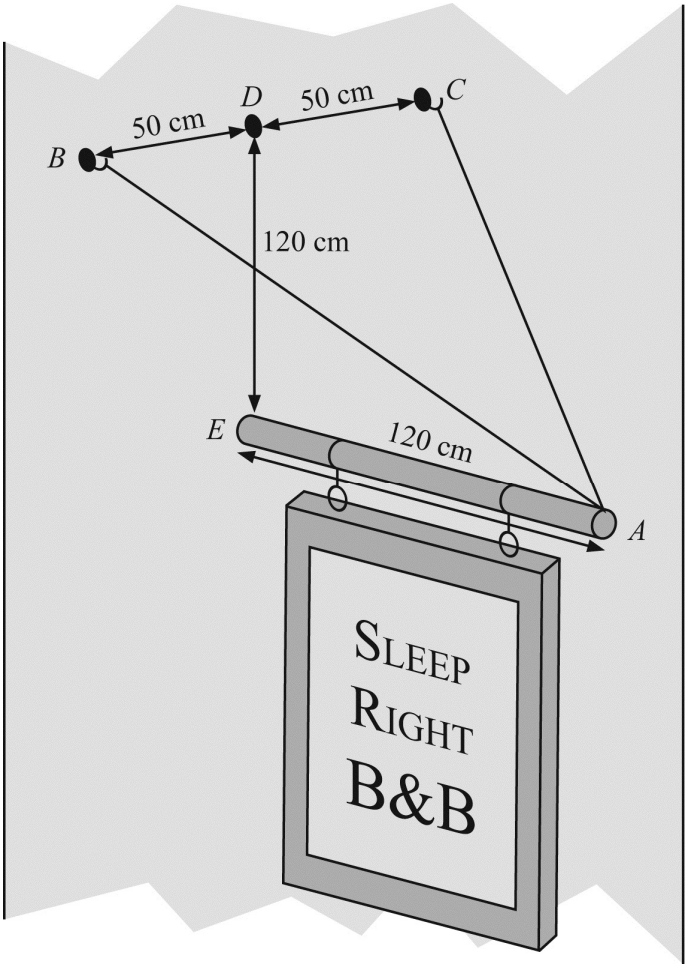
The design of the windshield is altered so that the width of the bottom of the windshield is reduced by 25% and the angle at the centre of the arc is reduced by 20%.



(d) Calculate the area of the sector cleaned in terms of r in radians.

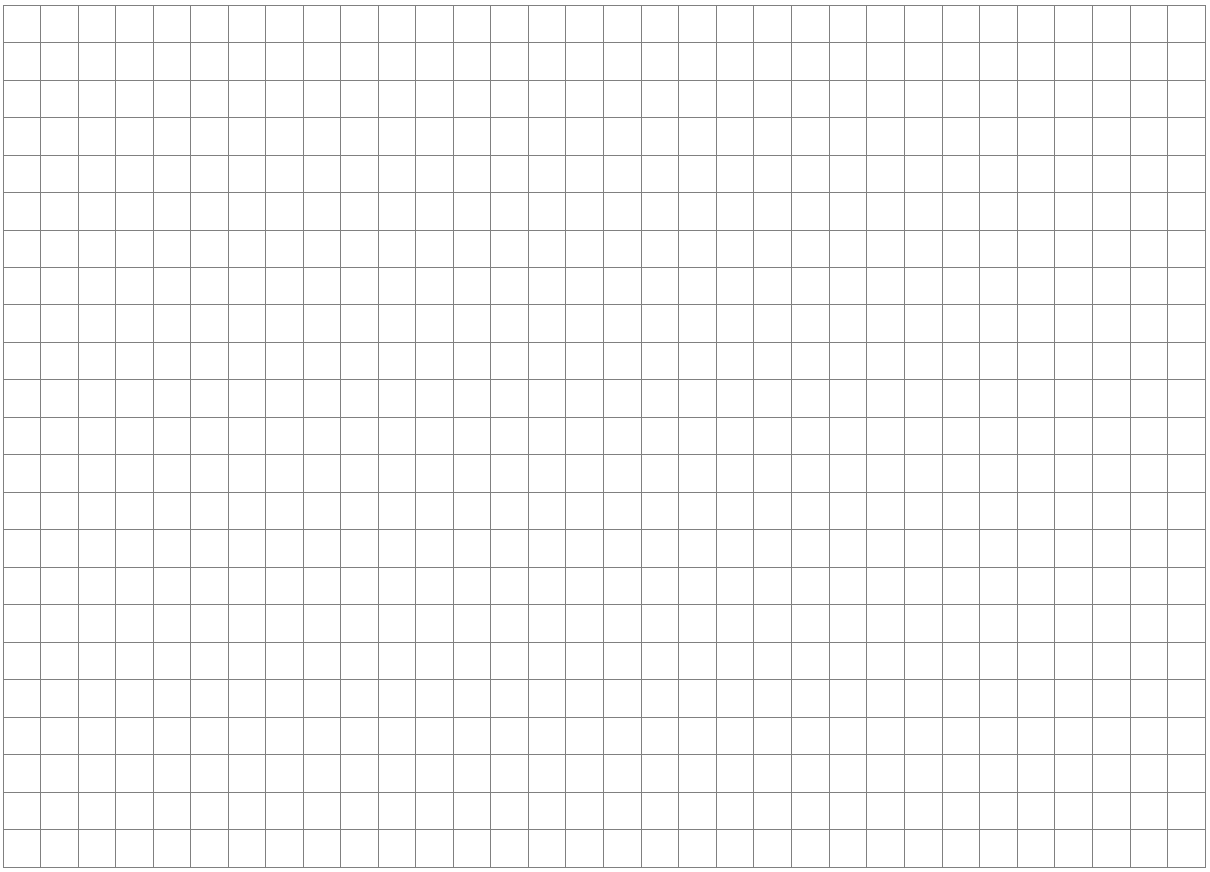
Question 9 **(35 marks)**

A sign is attached to a vertical wall at the point E. $[AE] \perp$ wall. The sign is then suspended by two wires which are attached to the wall at the points B and C as shown.



(a) Calculate the length of the wires.

(b) Calculate the angle that each wire makes with the wall.



(c) Calculate the $|\angle AEC|$, correct to two decimal places.