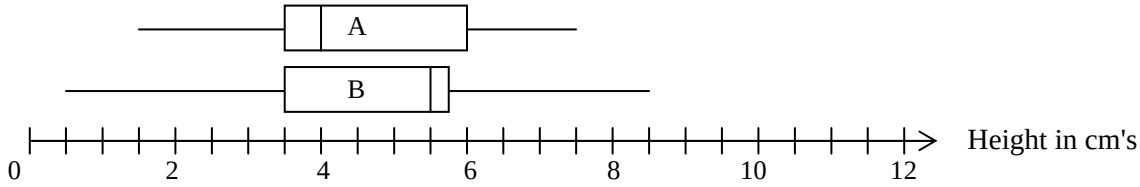
DO NOT WRITE ON THIS PAPER	**TIME** 2 hours	*Paper 4 of 5 from ZigZag Education*
Sample GCSE Examination Paper **Higher Tier Calculator Paper**	Standard Equipment: lined or squared paper, pen, pencil, ruler. Additional Equipment: graph paper, pair of compasses, plain paper. Notes: squared paper useful for Q7 & Q10.	

1. 200 plant seeds were divided into 2 groups. Group A and group B.
Group A were grown in field A. Group B were grown in field B.
The box and whisker plot of the heights of the plants is shown below.



a) Comment on one statistical feature that is the same between the two groups.

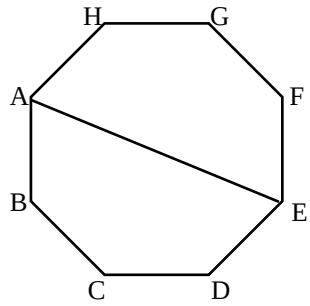
The plants are sold. The plants achieve a selling price dependent on how tall they are.
The taller plants get more money. The plants sell for £3 per cm in height.
The farmer can only sell the plants from one of the fields.

b) Which plants, from field A or B, do you think the farmer should sell? Justify your answer.

c) Estimate the 3rd quartile for group B.

4 marks

2. The shape shown is a regular octagon of side 5cm.
Find length AE to 3 significant figures.



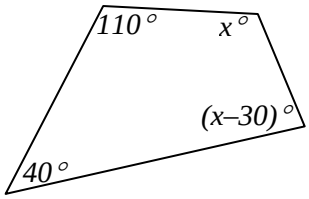
5 marks

3. Simplify the expressions

a) $2x^5 \times 3x^6$ b) $\frac{y^6}{y^2}$ c) $(y^7)^5$

3 marks

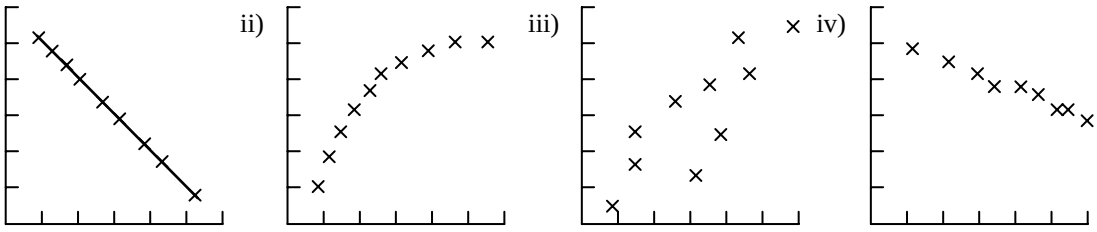
4. a) Work out an equation in x.
b) Solve your equation to find x.



4 marks

5. Describe the correlation, if any, in each of the scatter diagrams below. A line of correlation is shown on diagram i).

i) ii) iii) iv)



4 marks

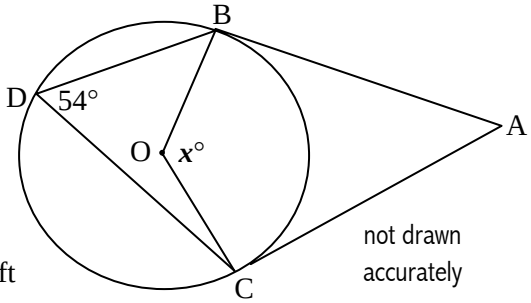
6. a) Calculate angle BOC, labelled ***x***.

b) i) Write down angle ABO, justifying your answer.

ii) Calculate angle BAC.

A students says that ABDC is a cyclic quadrilateral.

c) Are they correct? Justify your answer.



D is now moved around the circumference, but remains to the left of BC, until OBDC forms a kite. Points O, B and C do not change.

d) i) Which angles in the shape OBDC remain unchanged as D is moved into position?

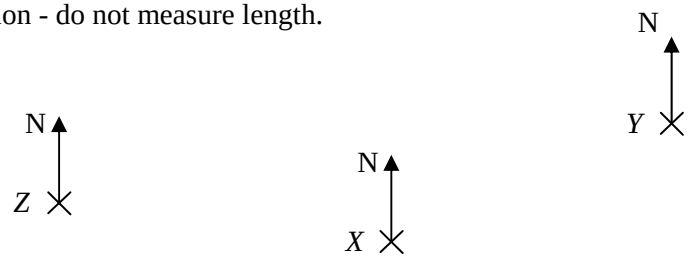
ii) Given D's new position calculate angle OBD, justifying your answer.

6 marks

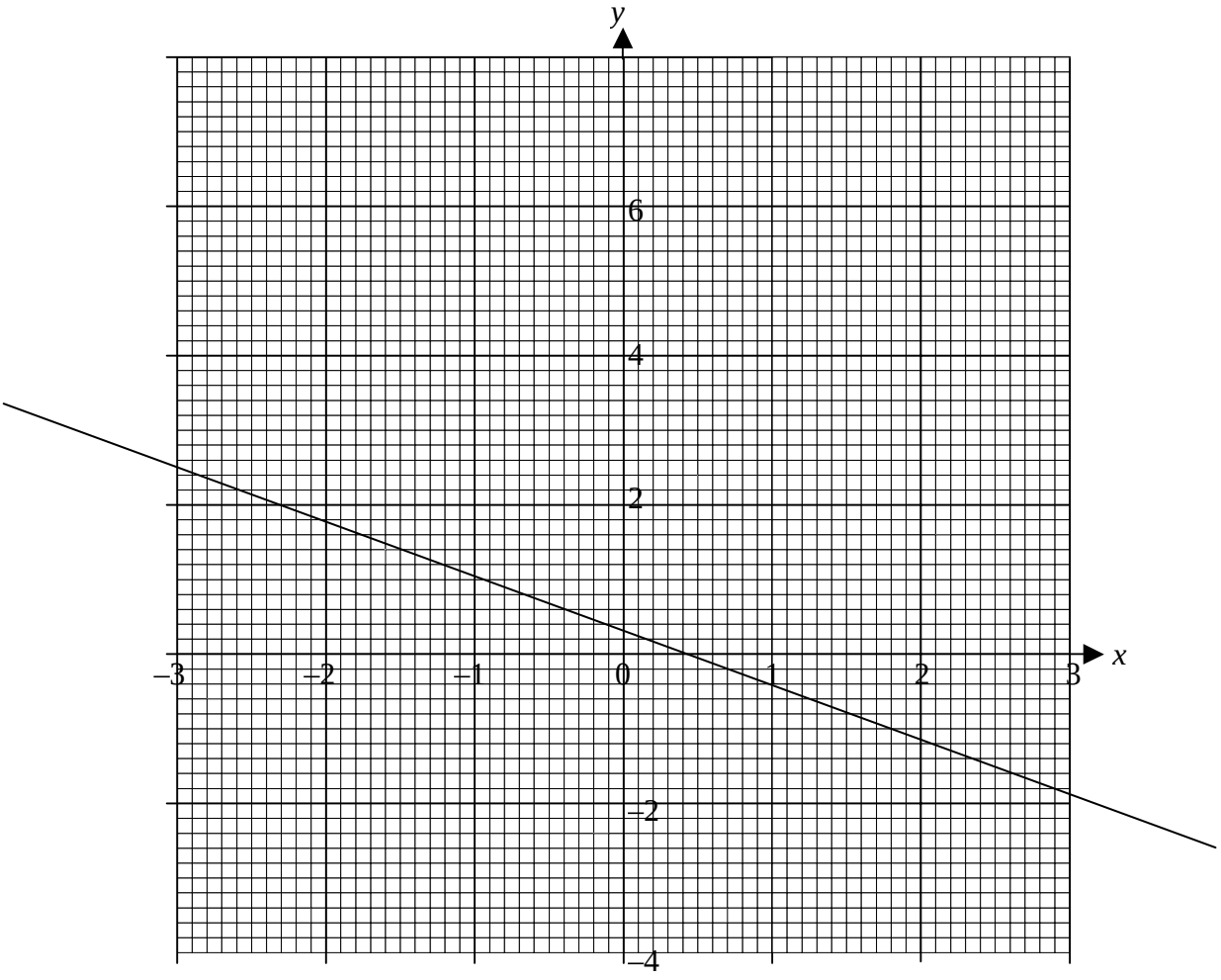
7. The diagram below shows the position of three radar stations, *X*, *Y* and *Z*. Copy the points.
You do **not** need to construct an accurate copy of the points**.**

a) A helicopter moves among the radar towers, such that it is equidistant from *XY* and *ZY*.
Using a ruler and compasses only, construct the locus of the helicopter.

b) At midnight, the helicopter is equidistant from *X* and *Y*.
On your diagram, use a **ruler and compasses only** to find the position of the helicopter, by construction - do not measure length. 4 marks



8. Estimate the equation of the graph of the straight line shown. 7 marks



9. a) Copy and complete the table of values for $y = x^2 - 2x - 1$

x	–2	–1	0	1	2	3
y				–2		

b) Using your table of values, draw a graph of $y = x^2 - 2x - 1$.
c) Use your graph to estimate the solutions to the equation $0 = x^2 - 2x - 1$ 8 marks

10. Make w the subject of the following formulae
a) $s = w(r - 14)$
b) $p = qw^3$ 5 marks

11. A scientist investigating the population of whales off the coast of Norway has estimated the population to be decreasing at a rate of 2.3% per year.

a) Given that the population in 2002 was exactly 3450 whales, calculate the expected population size in 2022, correct to four significant figures.

b) Still taking the population in 2002 to be exactly 3450 whales, and assuming the decreasing rate of 2.3% per year is accurate to 1 decimal place, calculate the greatest **lower bound** for the population in 2022, correct to four significant figures. 5 marks

12. A straight line, $f(x)$ is perpendicular to another line, $y = 4 - 3x$. $f(x)$ intersects the x axis at 18.

a) Find the equation of $f(x)$ in the form $y = mx + c$

b) f(x) is mapped to a new function by a transformation. The transformation is either–

i) translation by 2 units to the right along the x-axis to give f(x–2) or

ii) scaling by a factor of 2 in y direction to give 2f(x).

State whether the new function after the transformation is still perpendicular to $4 - 3x$. Justify your answers to part b). 5 marks

13. a) The expression $x^2 + 18x + a$ can be written in the form $(x + b)^2$.

Find a and b.

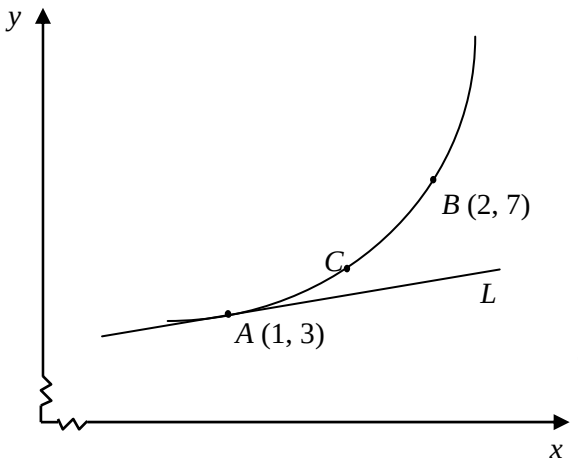
b) Solve the equation $x^2 + 18x + 81 = 102$ **without** using the quadratic formula, and give your answers exactly. 7 marks

14. The curve $y = x^2 + 2$ passes through the points A (1, 3), B (2, 7) and C as shown.

a) Calculate the gradient of the straight line AB.

b) The x-coordinate of C is 1.4. Calculate the gradient of the straight line AC.

c) By selecting another point on the curve, calculate a better estimate for the gradient of the tangent at A. 6 marks



15. a) Factorise $x^2 - 16$

b) Simplify fully $\dfrac{x^2 - 16}{3x^2 - 14x + 8}$ 3 marks

16. The ages of people who completed a small marathon were recorded by an event organiser, as shown below.

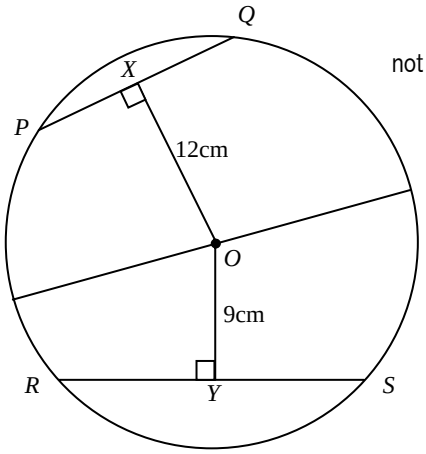
Age (a)	Number of People
$10 \le a < 20$	18
$20 \le a < 25$	38
$25 \le a < 30$	41
$30 \le a < 40$	34
$40 \le a < 60$	26
Total	157

a) To construct a histogram to represent this data we would calculate the frequency densities. Extend the table and calculate the frequency densities. ***Do not draw the histogram***.

b) Estimate the mean age of the competitors to 1 decimal place.

c) Two people are randomly selected after the race for a survey. Calculate the probability that both of them were aged between 30 and 40. 6 marks

17. OX = 12cm, OY = 9cm as shown.
Chord length RS = 24cm.

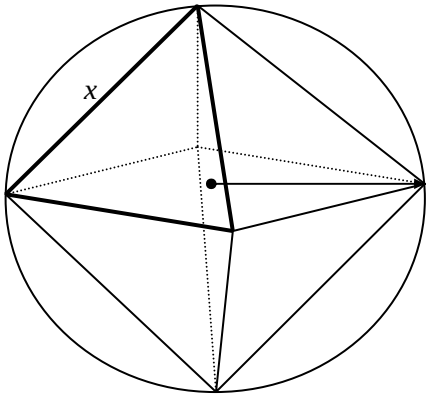


a) Calculate the radius of the circle

b) Calculate the length of the chord PQ

4 marks

18. A regular 3D object is contained within a sphere, radius 8cm.
The 3D shape is made up of 8 congruent equilateral triangles of side x.
Each of the vertices of the object just touches the sphere.



a) Calculate the length of x

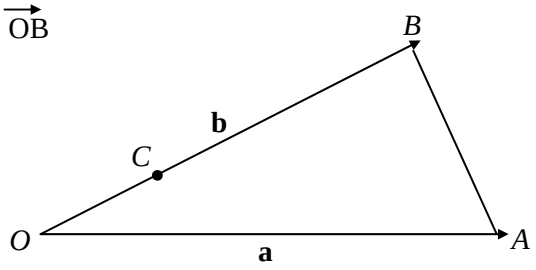
b) Calculate the volume of the 3D shape inside the sphere.

5 marks

19. $\overrightarrow{OC} = {}^{2}/_{5}\,\overrightarrow{OB}$,

a) Express in terms of **a** and/or **b**, where **a** = $\overrightarrow{OA}$, **b** = $\overrightarrow{OB}$

i) $\overrightarrow{CB}$ ii) $\overrightarrow{BA}$



D is the point on BA such that BD:DA = 3:2

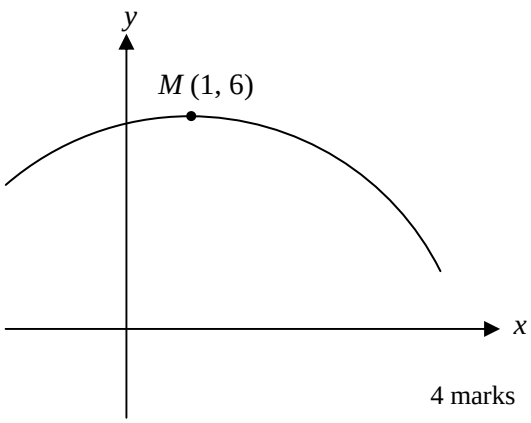
b) express in terms of **a** and/or **b**–

i) $\overrightarrow{BD}$ ii) $\overrightarrow{CD}$

c) What can you conclude about CD and OA?

5 marks

20. This is a sketch of the quadratic curve with equation $y = f(x)$.
$f(x) = -(x-1)^2 + 6$
M is the maximum point on the curve, with coordinates (1, 6)



State the coordinates of the maximum point for the curves given below.

a) $y = f(x) + 3$
b) $y = f(-x)$
c) $y = f(x - 6)$
d) $y = f(2x)$

4 marks