Dr Oliver Mathematics
GCSE Mathematics
2020 Paper 1H: Non-Calculator
1 hour 30 minutes

The total number of marks available is 80.
You must write down all the stages in your working.

1. The first five terms of an arithmetic sequence are (2)

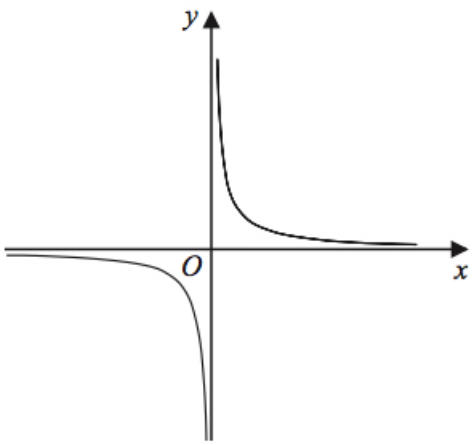
$$1 \quad 4 \quad 7 \quad 10 \quad 13.$$

Write down an expression, in terms of n, for the nth term of this sequence.

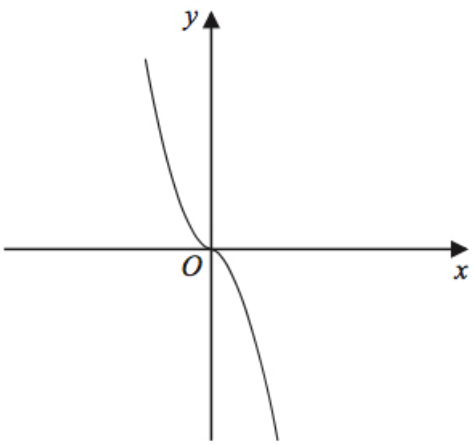
2. Show that (3)

$$2\tfrac{1}{3} \times 3\tfrac{3}{4} = 8\tfrac{3}{4}.$$

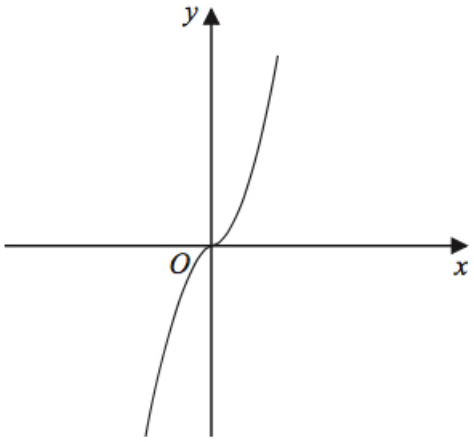
3. The diagram shows four graphs. (2)



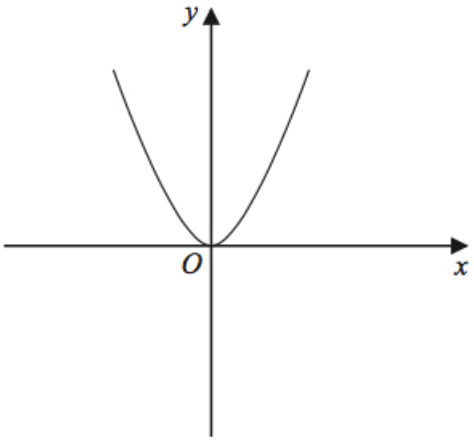
Graph **A**



Graph **B**



Graph **C**

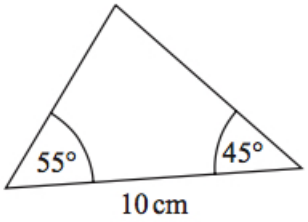


Graph **D**

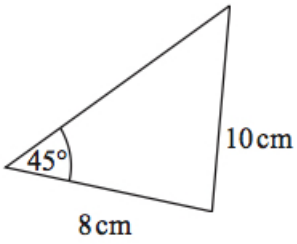
Each of the equations in the table is the equation of one of the graphs.
Complete the table.

Equation	Letter of graph
$y = -x^3$	
$y = x^3$	
$y = x^2$	
$y = \frac{1}{x}$	

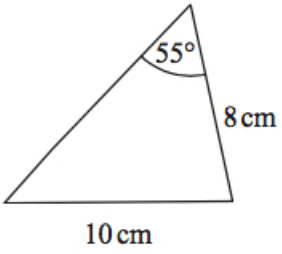
4. The diagram shows four triangles. (1)



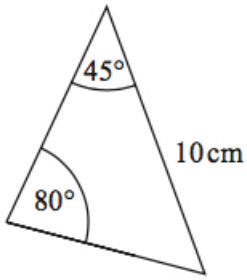
Triangle **A**



Triangle **B**



Triangle **C**



Triangle **D**

Two of these triangles are congruent.

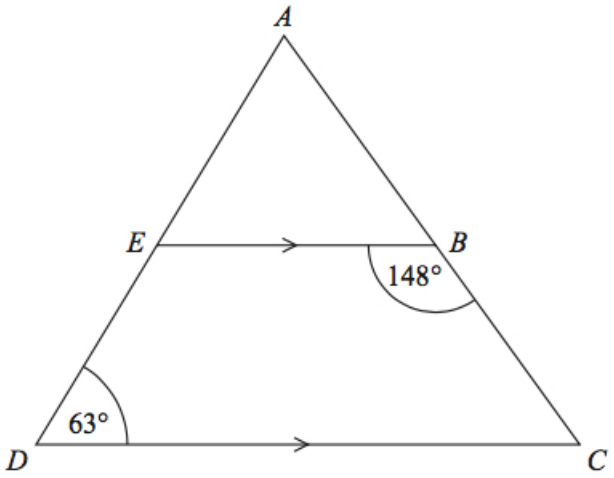
Write down the letters of these two triangles.

5. Sean pays £10 for 24 chocolate bars. (3)

He sells all 24 chocolate bars for 50p each.

Work out Sean's percentage profit.

6. *ADC* is a triangle. (5)



AED and ABC are straight lines.
EB is parallel to DC.

Angle $EBC = 148°$.
Angle $ADC = 63°$.

Work out the size of angle EAB.
You must give a reason for each stage of your working.

7. The table shows information about the heights, in cm, of a group of Year 9 girls. (3)

Least height	150 cm
Median	165 cm
Greatest height	170 cm

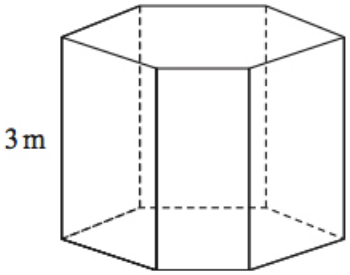
This stem and leaf diagram shows information about the heights, in cm, of a group of 15 Year 9 boys.

15	8 9 9
16	4 5 7 7 8
17	0 3 4 4 7
18	0 2

Key: 15 | 8 represents 158 cm

Compare the distribution of the heights of the girls with the distribution of the heights of the boys.

8. The diagram shows a prism placed on a horizontal floor. (3)



$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

The prism has height 3 m.
The volume of the prism is 18 m^3.

The pressure on the floor due to the prism is 75 newtons/m^2.

Work out the force exerted by the prism on the floor.

9. Write these numbers in order of size. (2)
Start with the smallest number.

$$6.72 \times 10^5 \qquad 67.2 \times 10^{-4} \qquad 672 \times 10^4 \qquad 0.000\,672$$

10. Given that (3)

$$\frac{a}{b} = \frac{2}{5} \text{ and } \frac{b}{c} = \frac{3}{4},$$

find $a : b : c$.

11. (a) Find the value of (2)

$$\sqrt[4]{81 \times 10^8}.$$

(b) Find the value of $64^{-\frac{1}{2}}$. (2)

(c) Write (2)

$$\frac{3^n}{9^{n-1}}$$

as a power of 3.

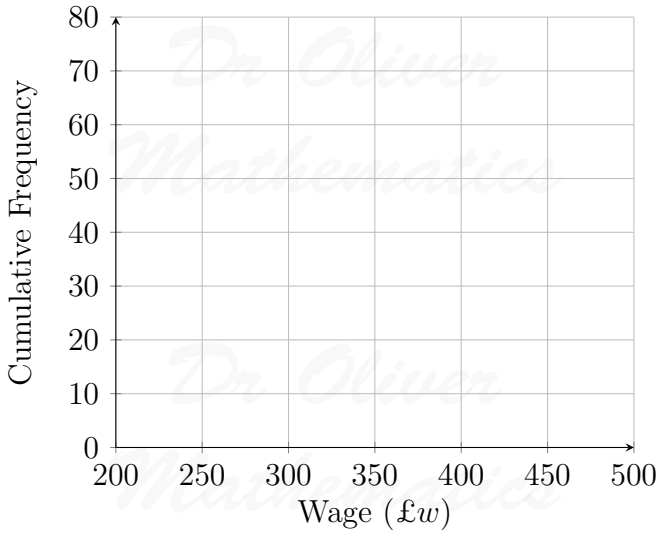
12. The table gives information about the weekly wages of 80 people.

Wage (£w)	Frequency
$200 < w \leqslant 250$	5
$250 < w \leqslant 300$	10
$300 < w \leqslant 350$	20
$350 < w \leqslant 400$	20
$400 < w \leqslant 450$	15
$450 < w \leqslant 500$	10

(a) Complete the cumulative frequency table. (1)

Wage (£w)	Cumulative Frequency
$200 < w \leqslant 250$	
$200 < w \leqslant 300$	
$200 < w \leqslant 350$	
$200 < w \leqslant 400$	
$200 < w \leqslant 450$	
$2000 < w \leqslant 500$	

(b) On the grid below, draw a cumulative frequency graph for your completed table. (2)



Juan says, "60% of this group of people have a weekly wage of £360 or less."

(c) Is Juan correct? (3)
You must show how you get your answer.

13. Liquid **A** and liquid **B** are mixed to make liquid **C**. (3)

Liquid **A** has a density of 70 kg/m^3.
Liquid **A** has a mass of 1400 kg.

Liquid **B** has a density of 280 kg/m^3.
Liquid **B** has a volume of 30 m^3.

Work out the density of liquid **C**.

14. Sally plays two games against Martin. (3)
In each game, Sally could win, draw, or lose.

In each game they play,

- the probability that Sally will win against Martin is 0.3,
- the probability that Sally will draw against Martin is 0.1.

Work out the probability that Sally will win **exactly** one of the two games against Martin.

15. The straight line L_1 has equation (3)

$$y = 3x - 4.$$

The straight line L_2 is perpendicular to L_1 and passes through the point $(9, 5)$.

Find an equation of line L_2.

16. Shirley wants to find an estimate for the number of bees in her hive.

On Monday she catches 90 of the bees.
She puts a mark on each bee and returns them to her hive.

On Tuesday she catches 120 of the bees.

She finds that 20 of these bees have been marked.

(a) Work out an estimate for the total number of bees in her hive. (3)

Shirley assumes that none of the marks had rubbed off between Monday and Tuesday.

(b) If Shirley's assumption is wrong, explain what effect this would have on your answer to part (a). (1)

17. Make f the subject of the formula (4)

$$d = \frac{3(1-f)}{f-4}.$$

18. x is proportional to $\sqrt{y}$, where $y > 0$. (3)

y is increased by 44%.

Work out the percentage increase in x.

19. f and g are functions such that

$$f(x) = \frac{12}{\sqrt{x}} \text{ and } g(x) = 3(2x + 1).$$

(a) Find g(5). (1)

(b) Find g f(9). (2)

(c) Find $g^{-1}(6)$. (2)

20. Show that (4)

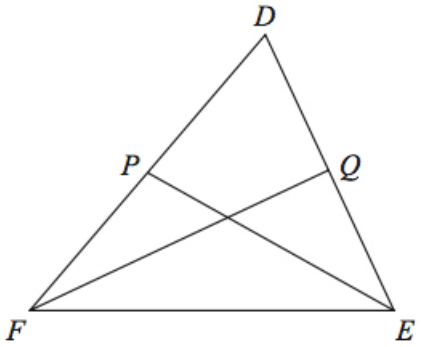
$$\frac{\sqrt{180} - 2\sqrt{5}}{5\sqrt{5} - 5}$$

can be written in the form

$$a + \frac{\sqrt{5}}{b},$$

where a and b are integers.

21. DEF is a triangle. (4)



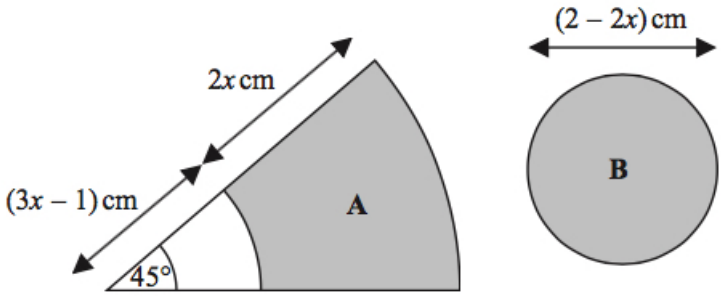
P is the midpoint of FD.
Q is the midpoint of DE.

$\overrightarrow{FD} = \mathbf{a}$ and $\overrightarrow{FE} = \mathbf{b}$.

Use a vector method to prove that PQ is parallel to FE.

22. The diagram shows two shaded shapes, **A** and **B**. (5)

Shape **A** is formed by removing a sector of a circle with radius $(3x-1)$ cm from a sector of the circle with radius $(5x-1)$ cm.
Shape **B** is a circle of diameter $(2-2x)$ cm.



The area of shape **A** is equal to the area of shape **B**.

Find the value of x.
You must show all your working.

23. There are four types of cards in a game. (3)

Each card has a black circle or a white circle or a black triangle or a white triangle.

Number of cards with a black shape : number of cards with a white shape = 3 : 5.

Number of cards with a circle : number of cards with a triangle = 2 : 7.

Express the total number of cards with a black shape as a fraction of the total number of cards with a triangle.