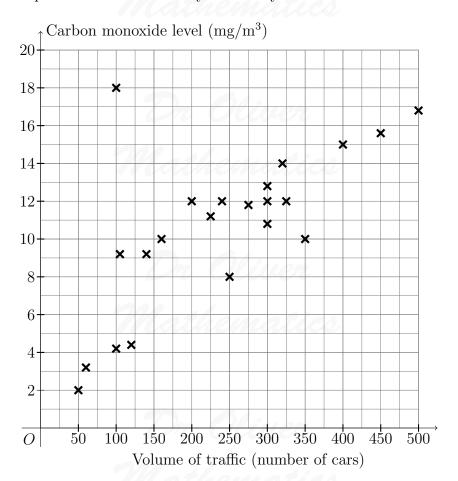# Dr Oliver Mathematics
GCSE Mathematics
2021 November Paper 3H: Calculator
1 hour 30 minutes

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

1. The scatter graph shows information about the volume of traffic and the carbon monoxide level at a point on a road each day for 22 days.

One point is an outlier.

(a) Write down the coordinates of this point. (1)

For another day, 370 cars pass the point on the road.

(b) Estimate the carbon monoxide level for this day. (2)

Alfie says, "Because there is an outlier, there is no correlation."

(c) Is Alfie correct? (1)
You must give a reason for your answer.

2. Natalie makes potato cakes in a restaurant. (4)

She mixes potato, cheese and onion so that

weight of potato : weight of cheese : weight of onion $= 9 : 2 : 1$.

Natalie needs to make $6\,000$ g of potato cakes.

Cheese costs £2.25 for 175 g.

Work out the cost of the cheese needed to make $6\,000$ g of potato cakes.

3. (a) Write (1)
$$4.5 \times 10^5$$

as an ordinary number.

(b) Write (1)
$$0.007$$

in standard form.

(c) Work out (2)
$$4.2 \times 10^3 + 5.3 \times 10^2.$$

Give your answer in standard form.

4. A water tank is empty. (4)
Anil needs to fill the tank with $2\,400$ litres of water.

Company **A** supplies water at a rate of 8 litres in 1 minute 40 seconds.
Company **B** supplies water at a rate of 2.2 gallons per minute.

1 gallon $= 4.54$ litres.

Company **A** would take more time to fill the tank than Company **B** would take to fill the tank.

How much more time?
Give your answer in minutes correct to the nearest minute.

5. The first four terms of a Fibonacci sequence are (3)

$$a \qquad 2a \qquad 3a \qquad 5a.$$

The sum of the first five terms of this sequence is 228.

Work out the value of a.

6. In a bag there are only red counters, blue counters, green counters, and pink counters. A counter is going to be taken at random from the bag.

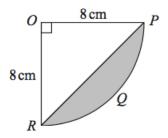   The table shows the probabilities of taking a red counter or a blue counter.

Colour	Red	Blue	Green	Pink
Probability	0.05	0.15		

   The probability of taking a green counter is 0.2 more than the probability of taking a pink counter.

   (a) Complete the table. (2)

   There are 18 blue counters in the bag.

   (b) Work out the total number of counters in the bag. (2)

7. The diagram shows a sector $OPQR$ of a circle, centre O and radius 8 cm. (4)
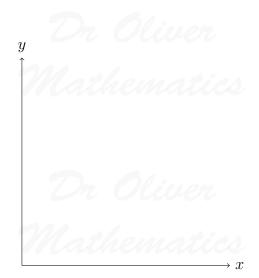

   OPR is a triangle.

   Work out the area of the shaded segment PQR.
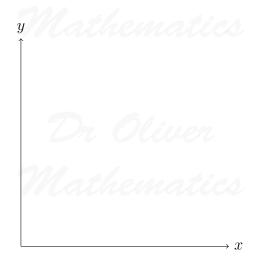   Give your answer correct to 3 significant figures.

8. (a) Using the axes below, sketch a graph to represent the statement (1)

   y is directly proportional to x.

(b) Using the axes below, sketch a graph to represent the statement (1)

y is inversely proportional to x.

9. On Monday, 12 people took 5 hours to clean a number of cars.
   On Tuesday, 15 people cleaned the same number of cars.

   Assuming that all the people worked at the same rate,

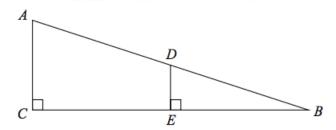   (a) work out how many hours the 15 people took to clean the cars. (2)

   The assumption is wrong.

   (b) How might this affect the time taken for the 15 people to clean the cars? (1)

10. The diagram shows two right-angled triangles ACB and DEB. (4)

- $AD = 9$ cm.
- $DE = 2$ cm.
- $DB = 6$ cm.

Calculate the length of CB.
Give your answer correct to 2 decimal places.

11. Freya writes down the value of x, correct to 1 decimal place. (2)

She writes $x = 6.4$.

Complete the error interval for x.

12. (2)
$$\left(ax^6\right)^{\frac{1}{n}} = 7x^3.$$

Work out the value of a and the value of n.

13. A pattern is made from four identical rectangles. (5)
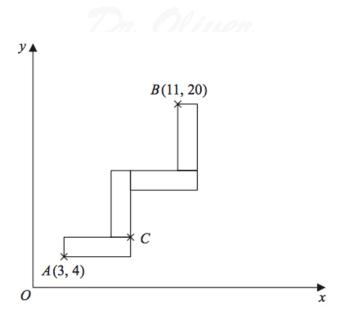The sides of the rectangles are parallel to the axes.

Point A has coordinates $(3, 4)$.
Point B has coordinates $(11, 20)$.
Point C is marked on the diagram.

Work out the coordinates of C.
You must show all your working.

14. Olivia and Jessica have in total half as many sweets as Fran and Gary have in total. (4)

Fran and Gary share their sweets in the ratio $2 : 3$.
Olivia and Jessica share their sweets in the ratio $9 : 1$.
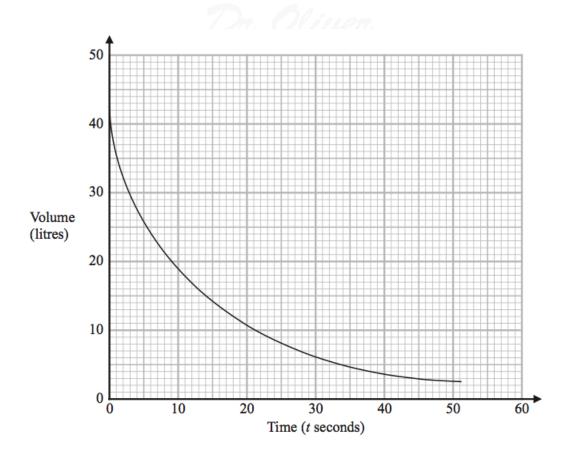
Fran got w sweets.
Gary got x sweets.
Olivia got y sweets.
Jessica got z sweets.

Find, in its simplest form,
$$w : x : y : z.$$

15. The graph gives the volume of water, in litres, in a container at time t seconds after the water started to flow out of the container. (3)

Using the graph, work out an estimate for the rate at which the water is flowing out of the container when $t = 12$.
You must show your working.

(4)

16. The curve C has equation
$$y = x^2 + 3x - 3.$$

The line **L** has equation
$$y - 5x + 4 = 0.$$

Show, algebraically, that C and **L** have exactly one point in common.

(4)

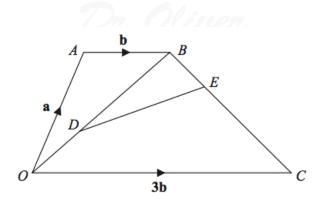17. x is directly proportional to the square of y.
y is directly proportional to the cube of z.

$z = 2$ when $x = 32$.

Find a formula for x in terms of z.

(4)

18. $OABC$ is a trapezium.

(4)

$\overrightarrow{OA} = \mathbf{a}$.
$\overrightarrow{AB} = \mathbf{b}$.
$\overrightarrow{OC} = 3\mathbf{b}$.

D is the point on OB such that $OD : DB = 2 : 3$.
E is the point on BC such that $BE : EC = 1 : 4$.

Work out the vector $\overrightarrow{DE}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.
Give your answer in its simplest form.

19. At the start of year n, the number of animals in a population is P_n. (3)

    At the start of the following year, the number of animals in the population is P_{n+1} where
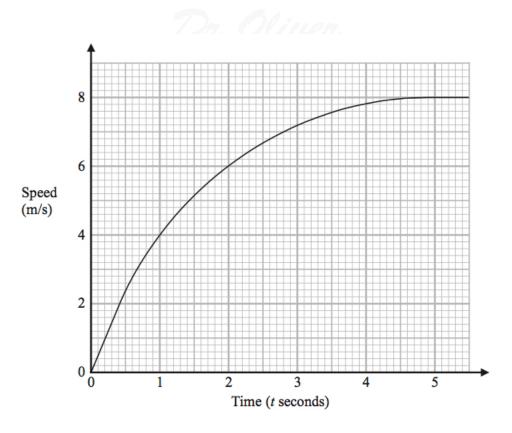
    $$P_{n+1} = kP_n.$$

    At the start of 2017 the number of animals in the population was $4\,000$.
    At the start of 2019 the number of animals in the population was $3\,610$.

    Find the value of the constant k.

20. Pat throws a fair coin n times. (2)

    Find an expression, in terms of n, for the probability that Pat gets at least 1 head and at least 1 tail.

21. Here is a speed-time graph showing the speed, in metres per second, of an object t seconds after it started to move from rest.

(a) Using 3 trapeziums of equal width, work out an estimate for the area under the graph between $t = 1$ and $t = 4$. (3)

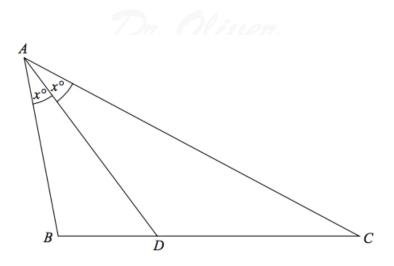(b) What does this area represent? (1)

22. Show that (3)

$$\frac{6x^3}{(9x^2 - 144)} \div \frac{2x^4}{3(x - 4)}$$

can be written in the form

$$\frac{1}{x(x + r)},$$

where r is an integer.

23. ABC is a triangle. (4)

D is the point on BC such that

$$\text{angle } BAD = \text{angle } DAC = x°.$$

Prove that

$$\frac{AB}{BD} = \frac{AC}{DC}.$$