Odipodes and Kitten – advanced maths paper

This paper is designed to prepare students for the toughest 11 Plus maths exams. Some questions (such as **12** *and* **21(b)***) go slightly beyond the standard Key Stage 2 syllabus, so you shouldn't be concerned if you are unable to complete everything in this paper. Work carefully with the solutions, and then see how far you can get when you try the tricky questions a second time.*

If you want to time your work, I suggest allowing 75 minutes.

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1. **(a)** What is $4 \div 2 - 3 \times 2 + (-7)$?

Answer: ……………… **(2)**

(b) Add brackets to make the following calculation correct:

$$6 + 3 \div 3 + 2 = 5$$

(2)

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2. What is $(113 + 115 + 117 + 119 + 121) \div 5$?

Answer: ……………… **(2)**

3. Divide 34344 by 24.

Answer: .... **(2)**

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4. Circle two numbers which have the same value:

$2\frac{25}{8}$ 2.25 2.125 $\frac{9}{5}$ $\frac{18}{8}$

(2)

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5. Write down the 5 prime numbers which multiply to make 1820.

Answer: .... **(3)**

6. Two whole numbers between 60 and 70 have a product of 4092.

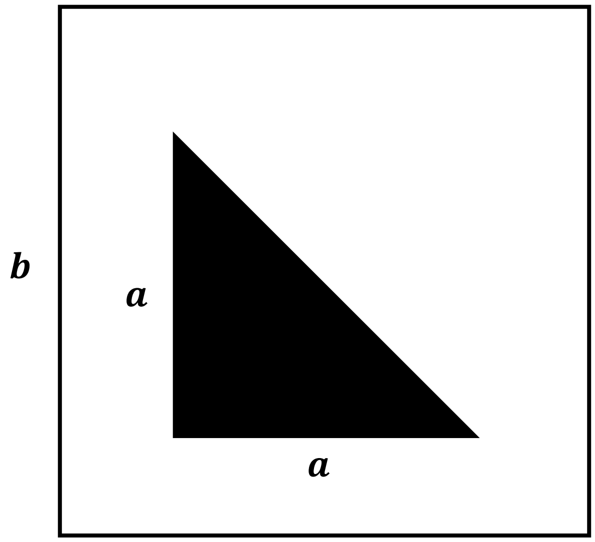
What are they?

Answer: ……… and ……… **(2)**

7. A triangle is cut from a square. The remaining area of the square is 41 cm².

Length ***a*** is 4 cm.

What is the side length ***b*** of the square?



Not to scale

Answer: .... **(4)**

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8. A forester is conducting a survey of the trees in a wood.

(a) She records information about 150 trees in a given area, writing down whether they are evergreen (keep their leaves all year) or deciduous (lose their leaves for part of each year), and whether their leaves are broad or in the form of needles.

70% of the trees with needles are evergreen.

$\frac{29}{50}$ of the trees are evergreen.

30 trees have broad leaves.

Complete the following table, writing the correct number of trees in each box:

	Evergreen	**Deciduous**
Broad Leaves		
Needles		

(4)

(b) There are 33,150 trees in the wood, and the mix of trees is similar throughout. Using your results from **(a)**, estimate the number of broad-leaved evergreen trees in the wood.

Answer: .... **(3)**

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9. **(a)** $\frac{2}{9} \times \frac{1}{5} =$

Answer: .... **(2)**

(b) $\frac{4}{3} \div 2\frac{2}{5} =$

Answer: .... **(2)**

(c) $\frac{6}{7} - \frac{3}{4} =$

Answer: ……………… **(2)**

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10. What is the total value of the prime numbers between 120 and 130?

Answer: ……………… **(3)**

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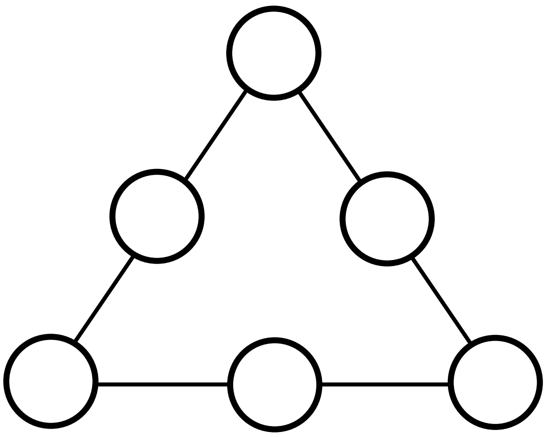
11. Complete the triangle by writing a different digit from 1 to 6 in each circle. Each side should add up to 11.



(4)

12.

$$x + 2y + 2z = 32$$

$$z = 2x$$

$$x + 3y + z = 30$$

Find the values of x, y and z.

x: ……… y: ……… z: ……… **(5)**

13. Nimisha is writing a 1500 word essay. She starts work at 5:18 pm and finishes at 9:28 pm.

(a) For how many hours and minutes does Nimisha work?

Answer: …… hrs …… mins **(2)**

(b) On average, how many words does Nimisha write in an hour?

Answer: ……………… **(3)**

14. Shakirat and Ferdinand win the same amount of money in a spelling competition. Shakirat gives Ferdinand £1.30 because she copied his answers. Now Ferdinand has twice as much prize money as Shakirat.

How much money did they each win in the first place?

Answer: ……………… **(4)**

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15. My hot water bottle is $^2/_5$ full. When I add another 360 ml it is $^2/_3$ full.

How much water did it contain when it was $^2/_5$ full?

Answer: ……………… **(4)**

16. The following table shows the first four numbers in three sequences, A, B and C:

	A	**B**	**C**
Row 1	3	5	7
Row 2	11	13	15
Row 3	19	21	23
Row 4	27	29	31

In which row and column would the following numbers appear?

(a) 37

Row: ...... Column: ...... **(2)**

(b) 71

Row: ...... Column: ...... **(2)**

(c) 3749

Row: ...... Column: ...... **(2)**

17. Each letter in the following word represents a different number from 1 to 5.

$$S \quad N \quad O \quad R \quad E$$

$$S + O + N = 11$$

$$R + O + N = 7$$

$$O + R + E = 6$$

(a) What does $O + N$ equal?

Answer: .... **(3)**

(b) What does $N + O + S + E$ equal?

Answer: .... **(2)**

18. Stephanie buys a cutlery set online, but the retailer accidentally sends her three sets.

In one cutlery set, the number of knives plus the number of forks is 16, the number of forks plus the number of spoons is 26, and the number of spoons plus the number of knives is 30.

(a) Which kind of cutlery does a set contain most of?

Answer: .... **(1)**

(b) Which kind of cutlery does a set contain fewest of?

Answer: .... **(1)**

(c) How many pieces of cutlery does Stephanie have in total?

Answer: .... **(5)**

19. The Edgar Process uses the symbol E.

$x\ E\ y$ means "add x and y then multiply the result by 3".

(a) **(i)** What is $4\ E\ 3$?

Answer: .... **(1)**

(ii) What is $1\ E\ (-1)$?

Answer: .... **(2)**

(iii) What is $(-37)\ E\ (-21)$?

Answer: .... **(2)**

(b) What is $[5\ E\ (-3)]\ E\ (-2)$?

Answer: .... **(2)**

(c) What is θ, if $\theta\ E\ (\theta\ E\ 4) = 36$?

Answer: .... **(4)**

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20. Complete the following sequences:

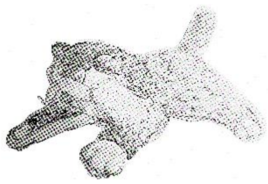
(a) 2 2 2 6 10 18 ___ ___

(b) -5 ___ 3 10 19 ___ 43

(c) 3 5 4 ___ ___ 3 9 2 13 1

(6)

21. 5 years ago, the combined age of Odipodes and Kitten was 29. The range of their ages is 17 years.



(a) What will their combined age be in 30 years?

Answer: ……………… **(3)**

(b) Odipodes is older than Kitten. How old is Odipodes?

Answer: ……………… **(5)**

TOTAL 100 MARKS

Marking Guide

The following solutions focus on the *maths* needed to answer each question. Here is a simple guide to marking, which should lead to a fair and broadly accurate overall score. Not all schools will mark in exactly this way (for example, some won't remove a mark for missing units, and others won't use half marks), but a student who can work to this marking style will be prepared for any exam.

A correct answer with correct units (£, kg, etc.) will get **full marks**, irrespective of the student's working out – or lack of it – unless the question directly asks for working to be provided.

If units are missing, a mark should be deducted; half a mark if it is a one-mark question.

If the answer is slightly wrong but the working is almost completely correct, deduct only one mark. (Your working might be different from my suggested method, but still be valid.)

If the answer is wrong and the working is substantially wrong, look for correct moments in the working: for example, the first stage of the method is right, after which it veers off course. Correct moments in a substantially wrong answer might together be worth up to half a mark in a two-mark question, one mark in a three-mark question, two marks in a four-mark question, and so on.

If an answer requires drawing, deduct marks when the drawing is so messy or inaccurate that the answer can no longer reasonably be called correct – for example, if a line does not pass through a specified coordinate, or if it is supposed to be straight but bends noticeably.

Follow-through marking

If the answer to e.g. part **(b)** of a question is based on an incorrect answer from part **(a)**, but is otherwise correct, award **(b)** full marks: *a single mistake shouldn't be penalised again in a different section of the same question*. (If the student makes the same mistake **again** in **(b)**, of course that's a different matter!)

Solutions

1. **(a)** What is $4 \div 2 - 3 \times 2 + (-7)$? **(2)**

$4 \div 2 - (3 \times 2) - 7 = 2 - 6 - 7$

$= -4 - 7 = \underline{\underline{-11}}$

Remember **BIDMAS**: <u>Division and Multiplication happen before Addition and Subtraction</u>.

In other words, you need to work out $4 \div 2$ and 3×2, then add and subtract in order, from left to right.

Remember that adding a minus $(+ - 7)$ is **the same as only subtracting**: -7.

(b) Add brackets to make the following calculation correct:

$$(6 + 3) \div 3 + 2 = 5$$

(2)

It would also be acceptable (though it's unnecessary) to include extra brackets, as follows:

$$[(6 + 3) \div 3] + 2 = 5$$

The important thing is to recognise that $9 \div 3 + 2 = 5$, giving nine when you add 6 and 3. Without brackets, BIDMAS would force you to work out $3 \div 3$ first (giving $6 + 1 + 2$, which equals 9).

2. What is (113 + 115 + 117 + 119 + 121) ÷ 5 ? **(2)**

2 2 2 2

117 is the mean.

$$\frac{117 \times 5}{5} = 117$$

Because the five numbers in brackets are evenly spaced and 117 is in the middle, **it must be the mean of these numbers**.

In other words, 113 + 115 + 117 + 119 + 121 is the same as 117 + 117 + 117 + 117 + 117.

Therefore, if you divide the total of these five numbers by 5, you will get 117.

There would be nothing wrong with working this out the long way, but if you follow the long route too often in a paper like this, you will run out of time.

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3. Divide 34344 by 24. **(2)**

$24 = 6 \times 4$

$4 \overline{)3 4 {}^{2}3 {}^{3}4 {}^{2}4}$ = 8 5 8 6

$6 \overline{)8 {}^{2}5 {}^{1}8 6}$ = 1 4 3 1

$\underline{\underline{1431}}$

This method – finding factors of the **divisor** and using them one at a time – is simpler than long division.

Of course, this method would not be available if you needed to divide by a prime number such as 23, rather than a number such as 24 which has convenient factors: you would need to use long division.

You might choose to check your answer if you have time at the end of the exam, multiplying 1431 by 24 to make sure that you get back to 34344.

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4. Circle two numbers which have the same value: **(2)**

$\cancel{2\frac{25}{8}}$ 2.25 2.125 $\cancel{\frac{9}{5}}$ $\frac{18}{8} = 2\frac{2}{8} = 2\frac{1}{4}$

$2\frac{25}{8}$ is the only number which is greater than 3, and $\frac{9}{5}$ is the only number less than 2, so these can both be eliminated. The rest are between 2 and 3.

$\frac{18}{8}$ simplifies to $2\frac{1}{4}$, so is the same as 2.25.

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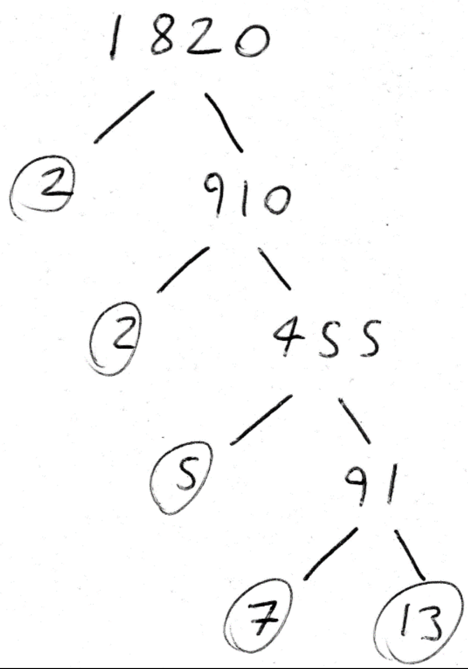
5. Write down the 5 prime numbers which multiply to make 1820. **(3)**



$2 \times 2 \times 5 \times 7 \times 13$

or

$2^2 \times 5 \times 7 \times 13$

You'll have come across factor trees in my previous papers.

At each step, find two factors (for instance, $5 \times 91 = 455$). Whenever you meet a prime number, it can be useful to circle it.

The question only asks for the factors, so the multiplication signs between them in my answer aren't strictly necessary.

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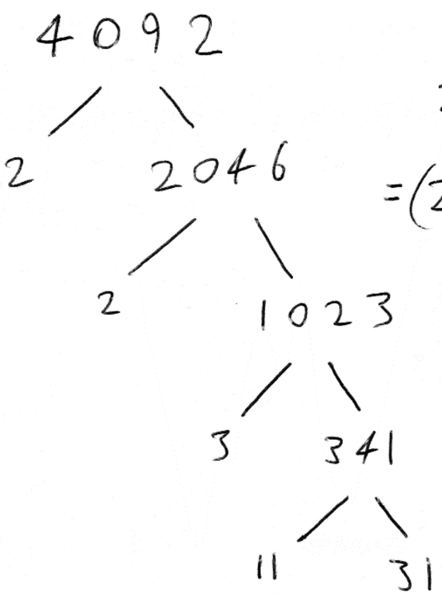
6. Two whole numbers between 60 and 70 have a product of 4092.

What are they? **(2)**



$2 \times 2 \times 3 \times 11 \times 31 = 4092$

$= (2 \times 31) \times (2 \times 3 \times 11) = 62 \times 66$

The method of factors shown here is fairly simple:

- Find the prime factors, as in **Question 5**.
- Find factors which multiply to give a number between 60 and 70 (for instance, $2 \times 31 = 62$).
- The other factors will multiply to give the other solution (either 66 or 62).

Alternatively, you could use trial and improvement to find your answer: $4092 \div 60 = \cdots$, $4092 \div 61 = \cdots$, etc.

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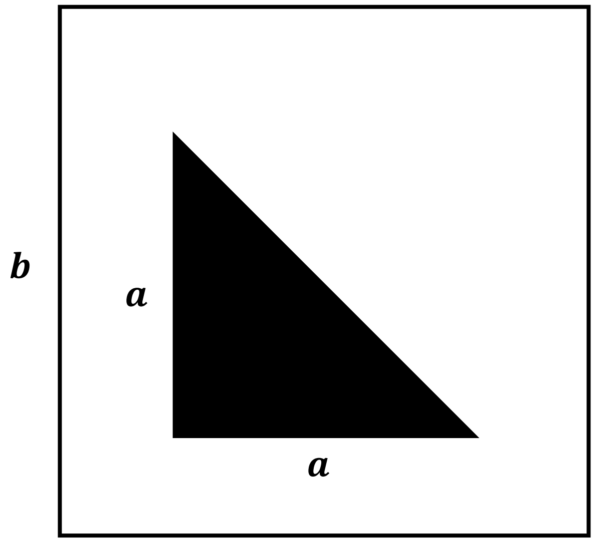
7. A triangle is cut from a square. The remaining area of the square is 41 cm².

Length ***a*** is 4 cm.

What is the side length ***b*** of the square? **(4)**



Not to scale

Triangle : $\frac{1}{2} \times b \times h = \frac{1}{2} \times 4 \times 4 = 8 \text{ cm}^2$

Square : $41 + 8 = 49 \text{ cm}^2$

$b = \sqrt{49} = \underline{\underline{7 \text{ cm}}}$

The area of the triangle, as given by the formula $\frac{1}{2} \times base \times height$ (which will probably be familiar by now), is 8 cm².

If the area of the square without the triangle is 41 cm², then **the area of the complete square** must be 49 cm² (41 cm² plus the area of the triangle).

Because the sides of a square are the same length and $7 \times 7 = 49$, each side must be 7 cm long.

8. A forester is conducting a survey of the trees in a wood.

(a) She records information about 150 trees in a given area, writing down whether they are evergreen (keep their leaves all year) or deciduous (lose their leaves for part of each year), and whether their leaves are broad or in the form of needles.

70% of the trees with needles are evergreen.

$\frac{29}{50}$ of the trees are evergreen.

30 trees have broad leaves.

Complete the following table, writing the correct number of trees in each box: **(4)**

120
0.7
84.0

	Evergreen	**Deciduous**	
Broad Leaves	3	27	30
Needles	84	36	120
	87	63	150

$\frac{29}{50} \overset{\times 3}{=} \frac{87}{150}$

You need to work round this table step by step. The most useful information to begin with will not always be the first information you're given – and that is the case here. In this instance, the first item in the list is likely to be the last piece of the puzzle.

- Start by writing "150" in the corner, because this is the total number of trees, and our **total of the rows and columns** – across and down.
- If 30 trees have broad leaves, then 120 must have needles.
- If $\frac{29}{50}$ are evergreen, which is 87 trees out of 150, then 63 must be deciduous (because $150 - 87 = 63$).

So far, we've only filled in information outside the table. The first piece of information given in the question ("70% of the trees with needles are evergreen") is important now: it is our way in.

- If 120 trees have needles, and 70% of the trees with needles are evergreen, then that is 84 trees (0.7 × 120) – so 36 are deciduous.
- If 87 trees are evergreen and 84 of these have needles, then 3 of them have broad leaves.
- The leftover number must be 27, whichever direction you count in!

(b) There are 33,150 trees in the wood, and the mix of trees is similar throughout. Using your results from **(a)**, estimate the number of broad-leaved evergreen trees in the wood. **(3)**

$$\frac{3315\cancel{0}}{15\cancel{0}} = \frac{3315}{3 \times 5} = \frac{1105}{5}$$

$$\begin{array}{r} 221 \\ 5\overline{)11^{1}05} \end{array}$$

$$\begin{array}{r} 221 \\ \times \quad 3 \\ \hline 663 \end{array}$$

$$\underline{\underline{663}}$$

If there are 33,150 trees in the wood, then this is **221 times the sample of 150 trees**.

We're told that the mix of trees is similar throughout, which means that you can find your estimate if you **multiply 3 by 221**, giving 663.

A note on marking: Your answer will be marked correct so long as you take your number from the top-left hand box in the table (part **(a)**) and multiply it by 221: if you made a mistake in **(a)**, you won't be penalised again for it here. Your answer is also **likely** to be marked correct if it is rounded to the nearest 5 (665), the nearest 10 (660) or *possibly* the nearest

50 (650), because the question asks for an estimate – so long as your working shows that you found the number 663 first.

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9. **(a)** $\frac{2}{9} \times \frac{1}{5} =$ **(2)**

$$\frac{2}{9} \times \frac{1}{5} = \frac{2}{45}$$

Multiply the top (**numerator**) of each fraction, multiply the bottoms (**denominators**) … and you're there!

(b) $\frac{4}{3} \div 2\frac{2}{5} =$ **(2)**

$$\frac{4}{3} \div 2\frac{2}{5} = \frac{4}{3} \div \frac{12}{5} = \frac{\cancel{4}^{1}}{3} \times \frac{5}{\cancel{12}_{3}} = \frac{5}{9}$$

$2\frac{2}{5}$ is $\frac{12}{5}$ as an **improper fraction** (it's important to **get rid of any mixed numbers** before multiplying or dividing).

- To divide fractions, <u>invert the **second** fraction</u> and then <u>multiply</u>.

(c) $\frac{6}{7} - \frac{3}{4} =$ **(2)**

$$\frac{6}{7} - \frac{3}{4} = \frac{24-21}{28} = \frac{3}{28}$$

A **common denominator** of 7 and 4 is 28.

${}^{6}/_{7}$ is ${}^{24}/_{28}$ and ${}^{3}/_{4}$ is ${}^{21}/_{28}$.

10. What is the total value of the prime numbers between 120 and 130?

(3)

~~121~~ ~~123~~ ~~125~~ 127 ~~129~~

(11) (3) (5) (3)

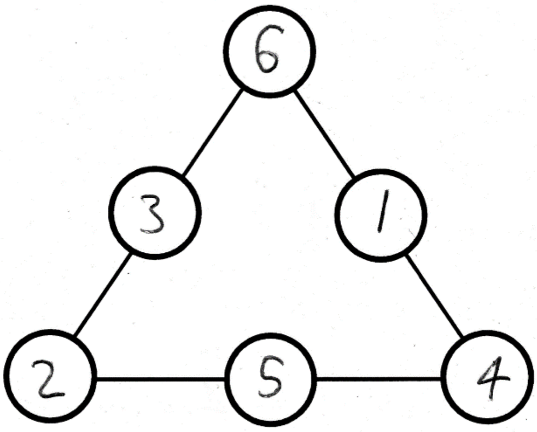
127

The even numbers cannot be prime, so there's no need to consider them (**2 is the only even prime number**).

- 121 isn't prime – it has factors such as 11.
- 3 is a factor or 123 (you will know that 120 is 40 × 3, so 123 must also divide by 3).
- … and so on.

Only 127 is prime, so the **total value** of the prime numbers between 120 and 130 is **127**.

11. Complete the triangle by writing a different digit from 1 to 6 in each circle. Each side should add up to 11. **(4)**



11 is a fairly large number to make using only three of the digits from 1 to 6, so it's likely that you'll want to make the best possible use of the largest number: 6.

- Therefore, it makes sense to put 6 at a corner, where it can be used in two directions.

5 has to go in the only place where it doesn't share a row with the 6 (because 6 and 5 make 11 by themselves).

1 can't share a row with the 5, because in that case you'd need another 5 to make 11. Therefore, it needs to go half way down one of the other sides.

4 needs to go at the end of the row which already contains 6 and 1.

The rest of the triangle is simple to complete.

A note on marking: Any correct configuration will get the marks here.

12.

$$x + 2y + 2z = 32$$

$$z = 2x$$

$$x + 3y + z = 30$$

Find the values of x, y and z. **(5)**

$x + 2y + 2(2x) = 32 \quad \therefore \quad 5x + 2y = 32$

$x + 3y + 2x = 30 \quad \therefore \quad 3x + 3y = 30$

$\therefore \quad x + y = 10$

$\therefore \quad 2x + 2y = 20$

$5x + 2y = 32$

$-(\ 2x + 2y = 20\ )$

$3x = 12$

$x = 4$

$x + y = 10$

$4 + y = 10$

$y = 10 - 4 = 6$

$z = 2x = 2 \times 4 = 8 \quad \underline{\underline{x = 4}},\ \underline{\underline{y = 6}},\ \underline{\underline{z = 8}}$

This is a very difficult question for 11 Plus, and involves skills which many primary schools will not teach. This arguably makes it an unfair 11 Plus question – but I have included it because this sort of thing does occasionally turn up in exams for the most competitive schools, and this is supposed to be an advanced-level practice paper.

If you have no idea what is going on here, please don't panic. You may choose to ignore this solution and move on. However, I'd encourage you to give it some thought, because it should be (if nothing else) a useful algebra lesson.

$z = 2x$, so it makes sense to replace z in both longer equations with $2x$.

Next, simplify the equations, to get $5x + 2y = 32$ and $2x + 2y = 20$.

- This is the stage where students are most likely to get lost. The main thing is to **collect similar terms** (xs, ys and other numbers) together. For instance:

$$x + 2y + 2(2x) = x + y + (2 \times 2x) = x + y + 4x = 5x + y$$

Subtracting these two equations from each other, you discover that $3x = 12$, so $x = 4$.

- Because $x + y = 10$, y must equal 6.
- $z = 2x$, which means that it has a value of 8.

And there we are!

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13. Nimisha is writing a 1500 word essay. She starts work at 5:18 pm and finishes at 9:28 pm.

(a) For how many hours and minutes does Nimisha work? **(2)**

$$5:18 \xrightarrow{4\text{ hrs}} 9:18 \xrightarrow{10\text{ mins}} 8:28$$

4 hrs 10 mins

I strongly recommend a timeline of this sort whenever you need to count time. It is a simple way to avoid silly (but extremely common) errors!

(b) On average, how many words does Nimisha write in an hour?

(3)

4 hrs = 60 × 4 = 240 mins

∴ 4 hrs 10 mins = 250 mins

$\frac{150\cancel{0}}{25\cancel{0}} = 6$ words/min

60 × 6 = 360 words/hour

Working in minutes – and converting to hours at the end – is the best way to keep things simple.

- You could also stick to hours and work out $1500 \div 4\frac{1}{6}$ (because 4 hours 10 minutes is $4\frac{1}{6}$ hours):

$1500 \div 4\frac{1}{6} = 1500 \div \frac{25}{6} = \frac{1500}{1} \times \frac{6}{25} = \frac{60}{1} \times \frac{6}{1} = \frac{360}{1} = 360$ words/hour

14. Shakirat and Ferdinand win the same amount of money in a spelling competition. Shakirat gives Ferdinand £1.30 because she copied his answers. Now Ferdinand has twice as much prize money as Shakirat.

How much money did they each win in the first place? **(4)**

$$x + 1.3 = 2(x - 1.3)$$
$$x + 1.3 = 2x - 2.6$$
$$x + 3.9 = 2x$$
$$3.9 = x$$

£3.90

If the amount of money originally won by each of Shakirat and Ferdinand is x, then Ferdinand's amount **after receiving £1.30 from Shakirat** $(x + 1.3)$ is the same as ***twice*** Shakirat's amount **after giving £1.30 to Ferdinand**: $2(x - 1.3)$.

Solving the resulting equation, we find that the original amount, x, was £3.90.

You could also use a **trial and improvement** method such as the following:

Original	− 1.30	+ 1.30	Double?
£2	70p	£3.30	✗
£4	£2.70	£5.30	✗ close
£3.80	£2.50	£5.10	✗
£3.90	£2.60	£5.20	✓

15. My hot water bottle is $^2/_5$ full. When I add another 360 ml it is $^2/_3$ full.

How much water did it contain when it was $^2/_5$ full? **(4)**

$$\frac{2}{3} - \frac{2}{5} = \frac{10}{15} - \frac{6}{15} = \frac{4}{15}$$

$$\frac{4}{15} \text{ is } 360\text{ml} \;\therefore\; \frac{1}{15} \text{ is } \frac{360}{4} = 90\text{ ml}$$

$$\frac{2}{5} = \frac{6}{15} \quad \text{If } \frac{1}{15} \text{ is } 90\text{ ml then } \frac{6}{15} \text{ is } 90 \times 6$$

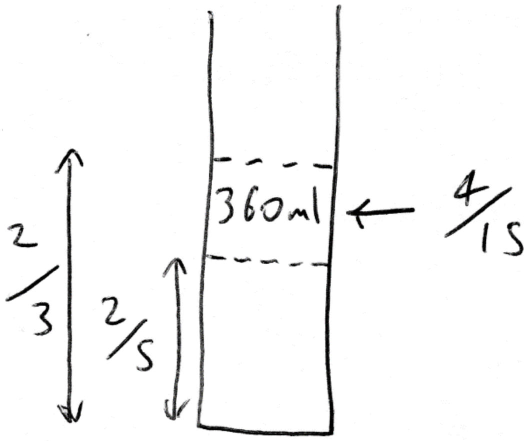
$$= \underline{\underline{540\text{ml}}}$$

It might help if you start by writing the question as a sum:

$$^2/_5 + 360ml = {}^2/_3$$

Then you can see clearly that you need to find the difference between $^2/_5$ and $^2/_3$ … or rearrange the equation, to see what 360 ml is as a fraction of the hot water bottle: $360ml = {}^2/_3 - {}^2/_5 = \cdots = {}^4/_{15}$.

You might also choose to sketch a diagram such as the one below, which can help to keep your thoughts in order while you work:



- The **difference** between $^2/_5$ and $^2/_3$ is $^4/_{15}$ (because $\frac{2}{3} - \frac{2}{5} = \frac{4}{15}$).

- If $^4/_{15}$ is 360 ml then $^1/_{15}$ is 90 ml.
- I need to find $^2/_5$, which is $^6/_{15}$. **6 lots of 90 ml is 540 ml**.

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16. The following table shows the first four numbers in three sequences, A, B and C:

	A	**B**	**C**
Row 1	3	5	7
Row 2	11	13	15
Row 3	19	21	23
Row 4	27	29	31

+8
+8
+8

r3 r5 r7

In which row and column would the following numbers appear?

(a) 37 **(2)**

$8 \overline{)37}$ 4 r 5 ∴ B

29 + 8 = 37

Row 5, Column B

Each number is 8 times greater than the number in the box above it, so sequences **A**, **B** and **C** are all **similar to the 8 times table**.

If you divide the numbers in sequence **A** by 8, you get a remainder of 3.

If you divide the numbers in sequence **B** by 8, you get a remainder of 5.

If you divide the numbers in sequence **C** by 8, you get a remainder of 7.

- 37 ÷ 5 gives a remainder of 5, so **37 is in sequence B**.
- 37 is 8 more than 29, so it is the **next value** in sequence **B**: it is in row 5.

(b) 71 **(2)**

$8\overline{)71}$ = 8 r 7 ∴ C

Row 9, Column C

$31 + 8 + 8 + 8 + 8 + 8 = 71$

This uses the same process as **(a)**. However, the methods in **(c)** would also be helpful here.

(c) 3749 **(2)**

$8\overline{)3\,7\,{}^{5}4\,{}^{6}9}$ = 468 r 5 ∴ B

$8\overline{)3\,7\,{}^{5}5\,{}^{7}2}$ = 469

Row 469, Column B

$8n - 3 = 3749$
$8n = 3752$

By finding the remainder, we can see that 3749 is in sequence **B**.

Because 8 goes into 3749 468 times with a remainder, it must be in the 469th row.

- To see why this is, bear in mind that 8 goes into 5 0 times with a remainder, and 5 is in the 1st row.

You can also find the row by using the n^{th} term formula for sequence **B**:

- Because the sequence goes up in 8s, it is based around $8n$.
- Each number in the sequence is 3 less than the equivalent number in the 8 times table, so the relevant expression is $8n - 3$.
- $8n - 3 = 3749$, so $8n = 3752$ and $n = 469$.

17. Each letter in the following word represents a different number from 1 to 5.

S N O R E

$$S + O + N = 11$$

$$R + O + N = 7$$

$$O + R + E = 6$$

(a) What does $O + N$ equal? **(3)**

$$\begin{aligned} & S + O + N = 11 \\ - & (R + O + N = 7) \\ \hline & S - R = 4 \end{aligned}$$

$\therefore$ $S = 5$

$R = 1$

$R + O + N = 7$

$R = 1$

$\therefore$ $O + N = 6$

There are a number of logical routes to the answer here. The example is only one of many possibilities.

- From looking at "SON" and "RON", we can see that **S** is 4 greater than **R**.
- Because we only have numbers 1 to 5, this means that **S** must be 5 and **R** 1.
- If "RON" is worth 7 and **R** = 1, then "ON" (**O** + **N**) must be worth 6.

(b) What does $N + O + S + E$ equal? **(2)**

$O + R + E = 6$
$R = 1$
$\therefore O + E = 5 \quad \therefore$ One of them $= 3$, the other 2
From (a), $S = 5$ and $R = 1 \quad \therefore N = 4$
$N = 4,\ S = 5,\ O + E = 5 \quad \therefore N + O + S + E = \underline{\underline{14}}$

- "ORE" is worth 6, and we already know that **R** = 1, so **O** + **E** = 5.
- 1 is already taken (by **R**), so this means that one of **O** and **E** must be worth 3 and the other 2.
- **N** is the remaining letter and 4 is the remaining number, so **N** is worth 4.
- If **N** is worth 4, **S** is worth 5 and **O** + **E** is also worth 5, then "NOSE" is worth 14.

As with part **(a)**, there are innumerable other ways of solving this problem.

A note on marking: Because it would be possible to work out **(a)** by finding all the letters, and then simply write the answer for **(b)**, this question should be marked **as a whole**, rather than by calculating the marks for **(a)** and **(b)** separately. For instance, if **(b)** only has a wrong answer and no working, but the working in **(a)** is relevant to **(b)**, credit should be given for that working.

18. Stephanie buys a cutlery set online, but the retailer accidentally sends her three sets.

In one cutlery set, the number of knives plus the number of forks is 16, the number of forks plus the number of spoons is 26, and the number of spoons plus the number of knives is 30.

(a) Which kind of cutlery does a set contain most of? **(1)**

Spoons

The two largest pairs (forks and spoons, and spoons and knives) both contain spoons.

(b) Which kind of cutlery does a set contain fewest of? **(1)**

Forks

The two smallest pairs (knives and forks, and forks and spoons) both contain forks.

(c) How many pieces of cutlery does Stephanie have in total? **(5)**

One set: $K + F = 16$

$F + S = 26$

$K + S = 30$

$2K + 2F + 2S = 72$

$K + F + S = 36$

Three sets: $36 \times 3 = 108$

If you add together the cutlery listed in the question, you will find that you have **a complete double cutlery set**: $2K + 2F + 2S$ in the example.

Once you know that two sets of cutlery contain 72 items, you also know that **one set will contain 36**.

Stephanie received three sets, so she has 108 pieces of cutlery in total.

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19. The Edgar Process uses the symbol E.

$x\ E\ y$ means "add x and y then multiply the result by 3".

(a) **(i)** What is $4\ E\ 3$? **(1)**

$(4 + 3) \times 3 = 21$

Even if the answer is obvious to you, it is a good idea to write your working for answers like this. If you develop a clear way to express your calculations, it will help you later in the question.

(ii) What is $1\ E\ (-1)$? **(2)**

$(1-1)\times 3 = 0\times 3 = \underline{\underline{0}}$

$1 + (-1)$ is, of course, 0.

(iii) What is $(-37)\ E\ (-21)$? **(2)**

$(-37-21)\times 3 = (-58\times 3) = \underline{\underline{-174}}$

(b) What is $[5\ E\ (-3)]\ E\ (-2)$? **(2)**

$5\ E\ (-3) = (5-3)\times 3 = 2\times 3 = 6$

$6\ E\ (-2) = (6-2)\times 3 = 4\times 3 = \underline{\underline{12}}$

It's possible to perform a calculation like this in one go – rewriting the whole problem using ordinary mathematical operations, rather than "*E*".

However, you will be less likely to make mistakes if you break your solution into stages:

Solve $5\ E\ (-3)$, then use the solution, 6, to calculate $6\ E\ (-2)$.

(c) What is θ, if $\theta\ E\ (\theta\ E\ 4) = 36$? **(4)**

$$\theta\ E\ 4 = (\theta + 4) \times 3 = 3\theta + 12$$

$$\therefore\ \theta\ E\ (\theta\ E\ 4) = \theta\ E\ (3\theta + 12) = (\theta + (3\theta + 12)) \times 3$$

$$= (4\theta + 12) \times 3 = 12\theta + 36$$

$$12\theta + 36 = 36$$

$$\therefore\ 12\theta = 0$$

$$\theta = 0$$

The overall process here is fairly simple: **rewrite the problem as an ordinary equation, then solve it**. However, the steps along the way are a bit fiddly.

- First of all, the Edgar Process is applied to the section in brackets: $(\theta\ E\ 4)$. This gives us $3\theta + 12$.
- Then, using this result, the Edgar Process is applied to the whole problem, giving $12\theta + 36$.
- We know from the question that this equals 36, and if $12\theta + 36 = 36$, it follows that $12\theta = 0$.

This can only be the case if $\theta = 0$.

It would also be possible to solve this problem using trial and improvement: experimenting with different values of θ until you find one which works. The risk with such a method is that it can take a long time, without producing the correct answer. For this reason, it's important to set trial and improvement out logically, perhaps in a table.

20. Complete the following sequences: **(6)**

(a) 2 2 2 6 10 18 34 62

6 10 18

This is an advanced paper, so these sequences are unusually tricky. However, the types of problem are relevant to 11 Plus.

You may be familiar with sequences which begin like this:

2 2 4 …

The repeated numbers at the beginning are often a clue that they will be added together to produce the next result.

In the question, the sequence begins with three repeated numbers. These are added to give 6, and so on: **each term is the sum of the three terms before it**.

(b) −5 −2 3 10 19 30 43

3 5 7 9 11 13

This is a much more standard kind of sequence, but it is hard to identify because of the way unknown terms are distributed.

However, if you see that the gap between 3 and 10 is 7, and the next gap between 10 and 19 is 9, you might guess that **the difference is 2 greater each time**.

Try this throughout the sequence, and everything fits together.

(c) 3 5 4 <u>4</u> <u>6</u> 3 9 2 13 1

−1 −1 −1

+1 +2 +3 +4

Two overlapping sequences are fairly common at 11 Plus. You can usually spot them when the numbers in a sequence look random – appearing to make no sense at all (3, 9, 2, 13, 1 ?!).

The problem here is that the two overlapping sequences follow very different rules, and this is made harder by the fact that the missing terms are in the middle, not at the end.

For this reason, it's extremely important to mark the differences in as you work, as shown in the example.

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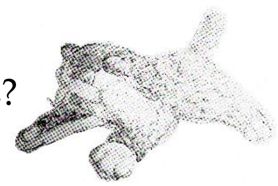
21. 5 years ago, the combined age of Odipodes and Kitten was 29. The range of their ages is 17 years.

(a) What will their combined age be in 30 years? **(3)**



Now: 29 + (5×2) = 39

+30 yrs: 39 + (30×2) = <u>99</u>

It's important to remember that over 5 years, the **combined** age of Odipodes and Kitten increases by 10 years.

Similarly, over 30 years, their combined age increases by 60 years.

(b) Odipodes is older than Kitten. How old is Odipodes?

$$\emptyset + k = 39$$
$$+\left(\emptyset - k = 17 \right)$$
$$2\emptyset = 56$$
$$\emptyset = \underline{\underline{28}}$$

This is a very hard 11 Plus question. Only a small number of schools are likely to set a problem like this.

You could solve this by trial and improvement, if you have time. However, some very simple simultaneous equations will probably get you there a lot more quickly.

- **The combined age of Odipodes and Kitten is 39**: $O + K = 39$ (notice that I put a line across the O in my handwritten working, so that it can't be confused with the number 0).
- **The range (difference) between their ages is 17 years**: $O - K = 17$.
- **Adding these two equations together**, the Ks cancel each other out, leaving $2O = 56$: so $O = 28$.

You could also have *subtracted* the equations, giving $2K = 22$ and $K = 11$. Adding 17, you find Odipodes' age: 28.

I asked Odipodes if this was correct, but she told me to mind my own business.

END