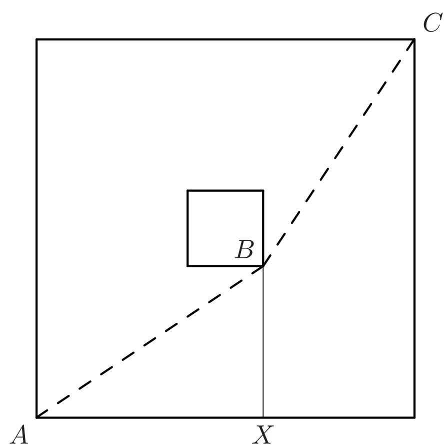
1. **Correct answer - D.**
2. **Correct answer - B.** Explanation: $\frac{1}{2} - \frac{1}{3} + \frac{1}{4} = \frac{6}{12} - \frac{4}{12} + \frac{3}{12} = \frac{5}{12}$.
3. **Correct answer - A.** Explanation: How do we compare two rational numbers? We can use the following fact: If a, b, c and d are positive whole numbers then $\frac{a}{b} > \frac{c}{d}$ if and only if $ad > bc$. So $\frac{9}{10} > \frac{13}{15}$ since $9 \times 15 = 180 > 10 \times 13 = 130$. Similarly $\frac{13}{15} > \frac{17}{20} > \frac{4}{5} > \frac{3}{4}$.
4. **Correct answer - E.** Explanation: After six days, Sammy will be $12(2^6)$cm in length. Now $2^6 = (2^3)^2 = (2 \times 2 \times 2)^2 = 8^2 = 64$ so Sammy will be $12 \times 64cm = 768cm = 7.68m$ long which is about the width of a tennis court - certainly none of the other options are anywhere near to 7.68m.
5. **Correct answer - B.** Explanation: Certainly $3^2 = 9 > 2^3 = 8 > \frac{31}{4} > \frac{15}{2}$. Also $\sqrt{90} > \sqrt{81} = 9 > \frac{15}{2}$.
6. **Correct answer - C.** Since John has no siblings, his father's son is himself. Therefore, John may as well have said "That man's father is me".
7. **Correct answer - B.** Explanation: Note that

$$\begin{aligned} a^2 + b^2 + 2a + 2a + 2ab &= a^2 + 2ab + b^2 + 2a + 2b \\ &= (a+b)^2 + 2(a+b) \\ &= 10^2 + 2(10) \\ &= 120 \end{aligned}$$

8. **Correct answer - D.** Explanation: Ann cuts down 30 trees per day and Mary cuts down 15 trees per day, so together they cut down 45 trees per day. Therefore it would take them 2 days to cut down 90 trees.
9. **Correct answer - A.** Explanation: Of the numbers between 20 and 50, 10 are divisible by 3, 7 numbers that are divisible by 5, and 2 are divisible by both 3 and 5 (i.e. divisible by 15). Therefore, 10+7-2 = 15 of these numbers are divisible by either 3 or 5 and 16 of them are divisible by neither.

10. **Correct answer - D.** Explanation: We can count the number of possible games as follows. There are 5 choices for the player with the white pieces and 4 choices for the player with the black pieces. This gives a total of $5 \times 4 = 20$ possibilities. However, this is twice as many as we actually have, as under this counting scheme each player plays every other player twice - once as white and once as black. Therefore, the number of games is $\frac{20}{2} = 10$.
11. **Correct answer - E.** Explanation: Consider the following diagram - a shortest path is marked as the dotted path:



We can calculate the length of AB using Pythagoras' Theorem, since ABX is a right angled triangle. Thus

$$|AB| = \sqrt{6^2 + 4^2} = \sqrt{52} = 2\sqrt{13}.$$

Similarly

$$|BC| = 2\sqrt{13}.$$

Therefore the dotted path has total length $4\sqrt{13}$.
12. **Correct answer - C.** Explanation: Observe the following pattern

Number	Remainder on division by 5
2	2
2^2	4
2^3	3
2^4	1
2^5	2
2^6	4
$\vdots$	$\vdots$

More rigourously, we note that $2^{10} = 1024 = 1020 + 4 = 5(204) + 4$.

13. **Correct answer - E.** Explanation: One way to do this is to count 20 occurrences of the digit 1 between 1 and 99 (inclusive). Now we observe that for the numbers between 100 and 199 we have 100 occurrences of 1 as the first digit together with 20 more (corresponding to ones between 1 and 99). This gives a total of 140.
14. **Correct answer - C.** Explanation: Observe that $ABCO$ is a rectangle so AC has the same length as BO. But BO is a radius of the circle and is therefore of length 5.
15. **Correct answer - A.** Explanation: Niamh's speed is $\frac{9}{10}$ of Aoife's speed, and Orla's speed is $\frac{9}{10}$ of Niamh's speed. Therefore Orla's speed is $\frac{81}{100}$ of Aoife's speed. So when Aoife has run 100m, Orla has run 81m - she has 19m to go.
16. **Correct answer - C.** Explanation: Let H be the value of the horse. We know that
$$\frac{7}{12}(H + 1200) = H + 400.$$
If we solve this equation for H, we get
$$H = 720.$$
17. **Correct answer - B.** Explanation: Suppose that a, b, c and d are the amounts of money that the people have. We may as well assume that $a \leq b \leq c \leq d$. We know that

$$a + b + c + d = 100 \tag{1}$$

Also, we know that

$$a + b \geq 47$$
$$a + c \geq 47$$
$$a + d \geq 47$$

If we add these three inequalities together, we get

$$3a + b + c + d \geq 141$$

or

$$2a + (a + b + c + d) \geq 141$$

But $a + b + c + d = 100$. Therefore

$$2a \geq 41$$

and

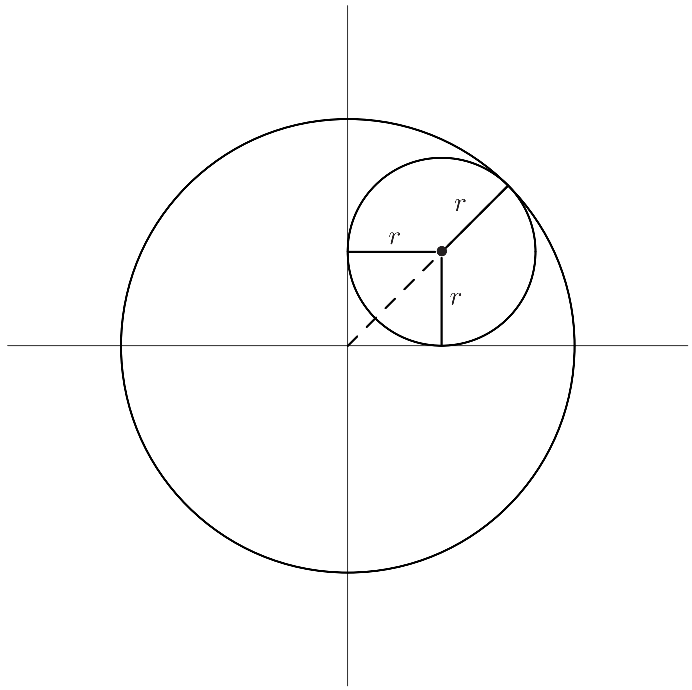
$$a \geq 20.5$$

So each of them has at least 20.50. Is it possible to achieve this bound? Yes - let $a = 20.50$ and let $b = c = d = 26.50$.

18. **Correct answer - E.** Explanation: He should pack 3 socks and 6 T-shirts. Since he has 3 socks, 2 of them must be them same colour and no matter what colour that is, one of his 6 T-shirts must match it. Of course, we must show that it cannot be done with less than 9 items. Suppose that he only packs 8 items. He must pack at least 3 socks, otherwise he cannot be guaranteed a matching pair of socks. That leaves him with at most 5 shirts, so he cannot be guaranteed to have one of a given colour. That means that he must pack enough socks to be guaranteed pairs of **both colours**. This would require that he packs at least 10 socks.
19. **Correct answer - B.** Explanation: This is much easier if you observe that given three numbers that sum to an even number, at least one of them must be even. Now there is only one even prime number, namely 2. So 2 is the smallest and the other two must sum to 38. It is easy to check that the only two positive prime numbers

that sum to 38 are 31 and 7. Therefore the answer to the problem is $31 - 2 = 29$.

20. **Correct answer - D.** Explanation: Let r be the radius of the smaller circles. Now consider the following diagram, where we have only drawn one of the small circles.



Using Pythagoras' Theorem, we see that

$$r + \sqrt{r^2 + r^2} = \text{radius of big circle} = 1.$$

Therefore,

$$r + r\sqrt{2} = 1$$

and

$$r = \frac{1}{1 + \sqrt{2}}$$