Question 1

Kanesha is examining her gas bill. She sees that a unit of gas sells for £a. This price is then increased by b%.

A month later, Kanesha notices that the new price is reduced by $(b - 1)$%, and that takes the unit price back to £a.

What, to 3 significant figures, is b?

To get your final answer, multiply your value by 79155, add 10 and take the integer part.

Question 2

Evan rolls a fair dice 10 times.

What is

$$\frac{\text{P(Evan gets exactly four fours)}}{\text{P(Evan gets exactly five fives)}} \quad ?$$

To get your final answer, multiply your value by 9057, add 10 and take the integer part.

Question 3

Yu Yan is watching two cricket teams play a 20 overs a side game. The team chasing have been set a target of T runs, but Yu Yan can't see what T is on the scoreboard.

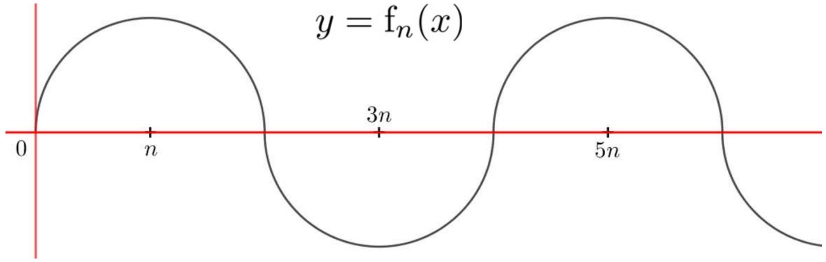
After 10 overs they have scored 78 runs, and after 11 overs they have scored 88 runs. The run-rate (average runs already scored per over already bowled) and the required run-rate (average runs required per over remaining to be bowled) are calculated after the 10th and 11th overs, and Yu Yan notices that on the scoreboard they both increase by the same amount.

What is T?

To get your final answer, multiply your value by 2199.7, add 6 and take the integer part.

Question 4

Wendy defines the graph of a periodic function f_n for positive x as follows;



•a semicircle above the x-axis with centre $(n, 0)$,

•a semicircle below the x-axis with centre $(3n, 0)$,

•a semicircle above the x-axis with centre $(5n, 0)$,

and so on, all with radius n.

Wendy discovers that if all the curves $y = f_n(x)$ are drawn (for all positive integers n) then the line $y = -mx$ (where m is finite and as large as possible) is a tangent to every curve. What is the value of m to 3 significant figures?

To get your final answer, multiply your value by 123053, add 1 and take the integer part.

Question 5

Olivia draws a quadrilateral with four interior angles that are in geometric progression.

The common ratio r is an integer.

The smallest of the four angles is α degrees, and 10α is an integer.

If Olivia has drawn the quadrilateral where r takes the largest possible value, what is α?

An Excel spreadsheet may be useful to you here.

To get your final answer, multiply your value by 2812, add 1 and take the integer part.

Question 6

Ramesh constructs an acute angle of size $x°$.

He notices that $\sin x°$, $\cos x°$ and $\tan x°$ in that order are consecutive terms from an arithmetic progression.

What is x to 3 significant figures?

A graphing program may be needed here to solve an equation.

To get your final answer, multiply your value by 5743, add 3 and take the integer part.

Question 7

Davina is examining world record times for the marathon in various years.
She writes down two such times as follows;

Belayneh Densamo (Ethiopia)	**2:06:50**	**Rotterdam, 1988**
Eliud Kipchoge (Kenya)	**2:01:39**	**Berlin, 2018**

Davina assumes the graph of world record time against year is linear, and on the basis of these two times calculates the expected world record time for the marathon in 2050 to the nearest second. What is this time?
Assume that all these marathons take place at the same time of year.
Give your answer as HMMSS.

To get your final answer, multiply your value by 4.33, add 134 and take the integer part.

Question 8

Sita puts 26 tiles bearing the letters A to Z into a bag and draws three tiles one by one at random without replacing them as she goes.

What’s the probability, to 3 significant figures, that she draws the three tiles in alphabetical order?

To get your final answer, multiply your value by 1024832, add 1 and take the integer part.

Question 9

Donald draws ten mathematical objects that can be labelled from 3 to 12. Donald puts them into a natural sequence as follows;

$$10\text{-}12\text{-}11\text{-}7\text{-}6\text{-}a\text{-}b\text{-}c\text{-}d\text{-}e$$

where a, b, c, d and e are the digits 3, 4, 5, 8 and 9 in some order.
What is the five-digit number $abcde$?

To get your final answer, multiply your value by 0.0437, add 5 and take the integer part.

Question 10

Ian constructs a large cube in layers from unit cubes as follows.

The first layer is one cube scoring 100. This layer scores 100.

The second layer is 26 cubes surrounding the first layer, creating a solid $3\times3\times3$ cube, with each of these new cubes scoring 99. This new layer scores $26\times99 = 2574$.

The third layer is 98 cubes surrounding the second layer, creating a solid $5\times5\times5$ cube, with each of these cubes scoring 98. This layer scores $98\times98 = 9604$.

This continues until Ian adds the 100th layer, with each of these cubes scoring 1.

What is the score for the highest scoring layer?

To get your final answer, multiply your value by 0.1222, add 319 and take the integer part.

Question 11

Oscar draws a pair of circles.

The circumferences of the two circles add to πa, while their areas add to πb.

If a is 24, what is

$$(\text{maximum possible value of } b) - (\text{minimum possible value of } b)?$$

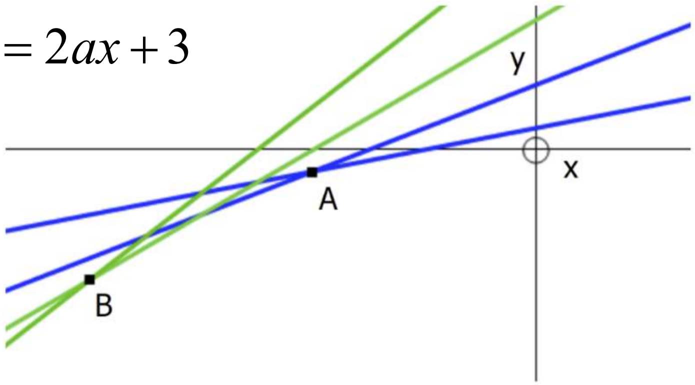
A point can be seen as a circle of zero radius.

To get your final answer, multiply your value by 15.1, add 56 and take the integer part.

Question 12

Paula draws the lines $y = ax + 1$ and $y = 2ax + 3$ which meet at A.
She then draws the lines $y = 3ax + 6$ and $y = 4ax + 10$, which meet at B.
The value a is a positive integer.

If $\text{AB} = \frac{\sqrt{629}}{5}$, what is a?



To get your final answer, multiply your value by 14223.1, add 1 and take the integer part.

Question 13

Haris is making models of a regular tetrahedron, *T*, a regular octahedron, *O*, and a cube, *C*.

He is using sticks of various lengths to make the models. Each of the edges of the cube *C* is a 10cm long stick.

Haris wants the combined surface areas of *T* and *O* to add to the total surface area of *C*. He also wants the combined total stick-length for *T* and *O* to add to the total stick-length for *C*.

Find the length of one of the sticks needed to build *T* in cm to 3 significant figures.

To get your final answer, multiply your value by 91, add 19 and take the integer part.

Question 14

Aisha is trying to save £x.

After a week, she's saved a total of £p, which is q% of the total required.

After a further week, she's saved a total of £q, which is $(p+7.5)$% of the total required.

Aisha notices that $p+q=\frac{x}{10}$. What is x?

To get your final answer, multiply your value by 3694.1, add 15 and take the integer part.

Question 15

Nigel is initially baffled by this cryptic clue;

Neither impossible nor easy,
this elegant examination needs terrific insight
(made eventually straightforward, thankfully)
when everything looks very enigmatic…

But eventually he solves it to get a three digit number. What is this number?

To get your final answer, multiply your value by 36.1, add 117 and take the integer part.