A-Level Further Maths Calculated Colouring Christmas 2019

6	3	25	100	18	4
Green	Yellow	Red	Pink	Blue	Orange

1) The imaginary part of $3 + 6\mathrm{i}$.

2) Consider the linear transformation $x' = 6x + 18y$, $y' = 3x + 4y$. Represent this transformation by the matrix A, what is the entry $A_{1,1}$?

3) The real part of the complex solutions of $x^3 - 12x^2 + 61x - 150 = 0$.

4) One quarter of the imaginary part of $(2 + 3\mathrm{i})(4 + 6\mathrm{i})$.

5) The imaginary part of $\dfrac{1 + 2\mathrm{i}}{\frac{1}{12}(1 + \mathrm{i})}$.

6) The x solution of the linear system $\begin{pmatrix} 2 & 3 \\ 4 & 1 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 24 \\ 18 \end{pmatrix}$.

7) Find the denominator of the argument (in radians) of the complex number $\dfrac{1}{2} + \mathrm{i}\dfrac{\sqrt{3}}{2}$.

8) Let $z = a + 2\mathrm{i}$. Find The real part of the solution to the equation $z^3 = -9 + 46\mathrm{i}$ (where the real and imaginary parts of z are both integers).

9) b when you express $\operatorname{arcosh}(2)$ in the form $\ln\left(a + \sqrt{b}\right)$.

10) The real part of the number z such that $z^2 = -27 + 36\mathrm{i}$ where z lies in the positive quadrant.

11) The scale factor of the transformation represented by $\begin{pmatrix} 25 & 0 \\ 0 & 25 \end{pmatrix}$.

12) The square of the magnitude of the complex number $3 + 4\mathrm{i}$.

13) The square of the positive $x-$coordinate where the ellipse $4x^2 + 10y^2 = 100$ crosses the $x-$axis.

14) Square the denominator obtained when you evaluate $\operatorname{sech}\left(\ln(3)\right)$.

15) The absolute value of the imaginary part of the solutions to the equation $z^2 - 200z + 10625$.

16) Express the ellipse $\dfrac{x^2}{25} + \dfrac{y^2}{10} = 1$ in the form $ax^2 + by^2 = c$ where a and b are integers in their simplest form. Double c.

17) The radius of the locus satisfying $|z - (3 + 2\mathrm{i})| = 100$.

18) Consider a mass oscillating on a spring. It is proposed that the frequency can be modelled as $f = pk^\alpha m^\beta x^\gamma$ where p is a constant, k is the spring constant in kgs^{-2}, m is the mass and x is the maximum extension of the spring in metres. Find α and multiply it by 200.

19) The vertical asymptotes of $\dfrac{x^2 + 3x + 1}{x^2 - 104x + 400}$ are $x = a$ and $x = b$ where $b > a$. Find b.

20) Let $z = 8 + \sqrt{36}\mathrm{i}$, find zz^*.

21) The determinant of $\begin{pmatrix} 4 & -1 \\ 2 & 4 \end{pmatrix}$.

22) The bottom entry of the right hand side when you write the simultaneous equations $2x + 3y = 24$ and $4x + y = 18$ in matrix form.

23) The real part of $\dfrac{1+2\mathrm{i}}{\frac{1}{12}(1+\mathrm{i})}$.

24) Given that $\sinh(x) = \dfrac{3}{4}$, find $\sinh(2x)$ and multiply the denominator by 2.

25) The imaginary part of $(3+2\mathrm{i}) + (4+20\mathrm{i}) - (3+4\mathrm{i})$.

26) n such that $(1+3\mathrm{i})^n = 28 - 96\mathrm{i}$.

27) The absolute value of the imaginary part of the complex solutions of $x^3 - 12x^2 + 61x - 150 = 0$.

28) The real part of $(3+2\mathrm{i}) + (4+20\mathrm{i}) - (3+4\mathrm{i})$.

29) If the transformation represented by the matrix $\begin{pmatrix} 5 & 0 \\ 0 & 5 \end{pmatrix}$ is applied to a shape, by what factor does the area of that shape increase.

30) Find the cartesian equation of the locus $|z-2| = |z+6|$ in the form $x = a$.

31) The number a such that $\displaystyle\sum_{r=1}^{n} r^2 = \frac{1}{a} n(n+1)(2n+1)$.

32) 40 subtracted from the imaginary part of $(3+2\mathrm{i})^3$.

33) The y solution of the linear system $\begin{pmatrix} 2 & 3 \\ 4 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 24 \\ 18 \end{pmatrix}$.

34) The real root of $p(x) = x^3 - 12x^2 + 61x - 150$.

35) The imaginary part of the number z such that $z^2 = -27 + 36\mathrm{i}$ where z lies in the positive quadrant .

36) Consider the linear transformation $x' = 6x + 18y$, $y' = 3x + 4y$. Represent this transformation by the matrix A, what is the entry $A_{2,1}$?

37) The denominator of $\operatorname{cosech}\big(\ln(3)\big)$.

38) Find the equation of the vertical asymptote of the rational function $y = \dfrac{x+1}{x-3}$ in the form $x = a$.

39) Find the $y-$coordinate of the point that is mapped to $\begin{pmatrix} 203 \\ 106 \end{pmatrix}$ by the transformation matrix $T = \begin{pmatrix} 2 & 1 \\ 1 & 2 \end{pmatrix}$.

40) Let $A = \begin{pmatrix} 3 & 1 \\ 11 & 4 \end{pmatrix}^{-1}$. Find $A_{2,2}$.

41) The square of the largest eigenvalue of the matrix $A = \begin{pmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{pmatrix}$.

42) The value a such that $\dfrac{25}{-\mathrm{i}} = a\mathrm{i}$.

43) Write the ellipse $4x^2 + 10y^2 = 100$ in the standard form $\dfrac{x^2}{a^2} + \dfrac{y^2}{b^2} = 1$. What is a^2 ?

44) Let $B = \begin{pmatrix} 2 & 1 \\ 4 & 2 \end{pmatrix} \begin{pmatrix} 10 & 1 \\ 5 & 2 \end{pmatrix}$. Find $B_{1,1}$.

45) The square of the denominator of the fraction obtained when evaluating $\cosh(\ln(5))$.

46) The absolute value of the real part of the solutions to the equation $z^2 - 200z + 10625$.

47) If an enlargement of scale factor 10 is applied to a shape, then what is the determinant of the matrix representing the transformation?

48) Find the $x-$coordinate of the point that is mapped to $\begin{pmatrix} 203 \\ 106 \end{pmatrix}$ by the transformation matrix $T = \begin{pmatrix} 2 & 1 \\ 1 & 2 \end{pmatrix}$.

49) Find the determinant of the matrix A^2 where $A = \begin{pmatrix} 4 & 3 \\ 2 & 4 \end{pmatrix}$.

50) The number a where $\left[10\left(\cos\left(\frac{\pi}{4}\right) + \mathrm{i}\sin\left(\frac{\pi}{4}\right)\right)\right]^2$ is expressed in the form $a\mathrm{i}$.

51) a such that $\begin{pmatrix} 3 & 17 \\ 2 & 5 \end{pmatrix} + \begin{pmatrix} 15 & 2 \\ 1 & 9 \end{pmatrix} = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$.

52) The number n such that $\sum_{r=1}^{n} r = 171$.

53) 14 more than the $y-$ coordinate for the maximum point of the rational function $y = \dfrac{x^2+6x+9}{x^2+3x+3}$.

54) Find $\dfrac{(2+3\mathrm{i})^2}{1+\mathrm{i}}$ in the form $\dfrac{p}{q} + \dfrac{r}{s}\mathrm{i}$. Find $r+1$.

55) Find the determinant of the matrix $\begin{pmatrix} -2 & 2 & -3 \\ -1 & 1 & 3 \\ 2 & 0 & -1 \end{pmatrix}$.

56) Find a such that $r^2(r+1)^2 - r^2(r-1)^2 = ar^3$. Use this and the method of differences to prove $\sum_{r=1}^{n} r^3 = \frac{1}{4}n^2(n+1)^2$.

57) The square of the denominator for x such that $\operatorname{artanh}(x) = \ln\left(\sqrt{3}\right)$.

58) The vertical asymptotes of $\dfrac{x^2+3x+1}{x^2-104x+400}$ are $x = a$ and $x = b$ where $b > a$. Find a.

59) Use dimensional analysis to find the dimensions of the spring constant k in Hooke's Law, $T = kx$ (T is tension, x is extension). Multiply the absolute value of the non-unity power in the dimensional expression by two.

60) Consider the linear transformation $x' = 6x + 18y$, $y' = 3x + 4y$. Represent this transformation by the matrix A, what is the entry $A_{2,2}$?