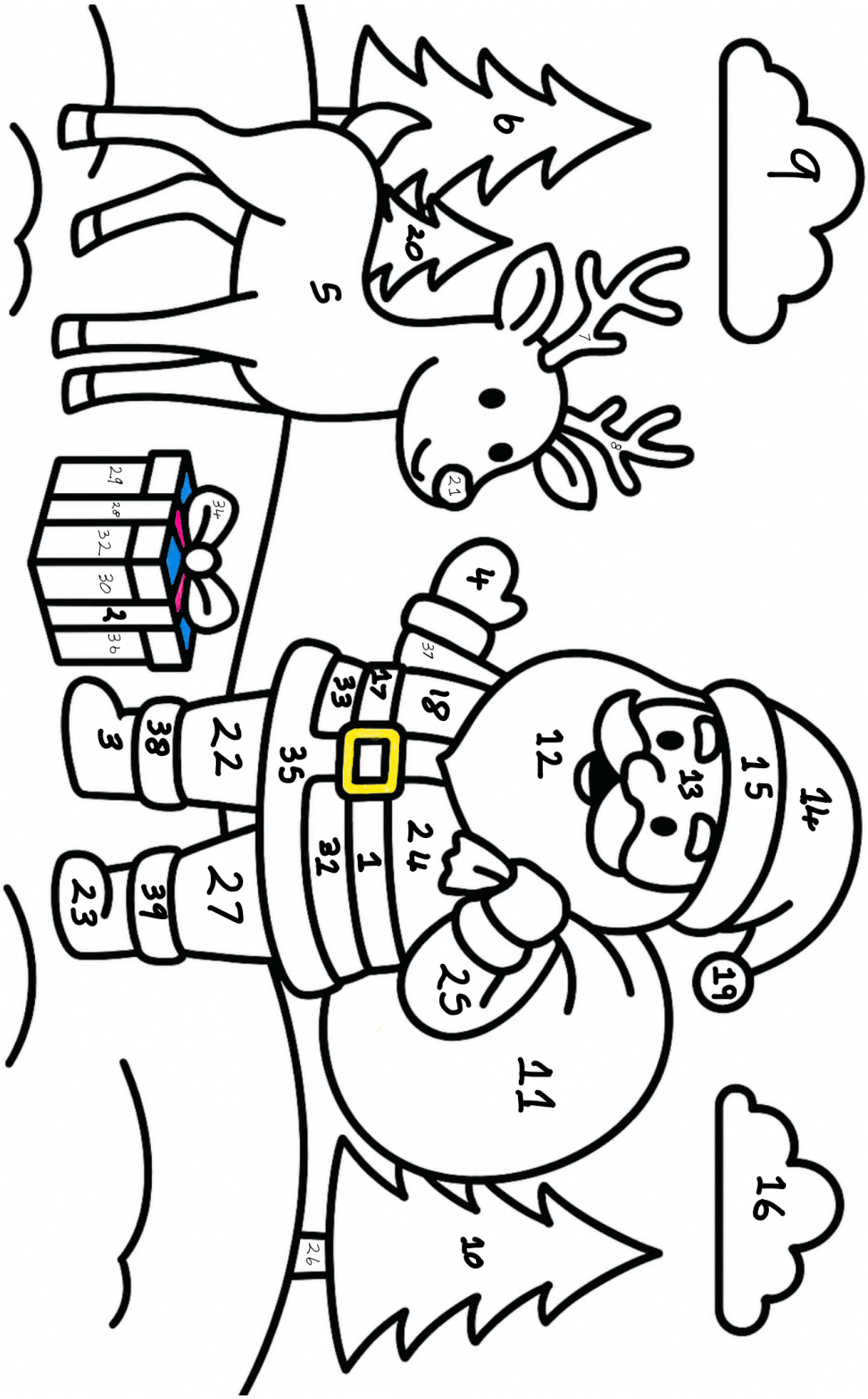
Further Maths Christmas Colouring 2025



Number	1 or 8	2 or 7	5	3 or 10
Colour	Grey	Green	Brown	White
Number	25 or 12	4 or 20	10 or 6	
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1 Let $z = 4 + 2\mathrm{i}$. Find zz^*.

2 Find b when you express $\operatorname{arsinh}(3)$ in the form $\ln\left(a + \sqrt{b}\right)$

3 The largest eigenvalue of the matrix $\mathbf{A} = \begin{pmatrix} 4 & -1 \\ 0 & 3 \end{pmatrix}$.

4 Sketch $y = \dfrac{3x - 2}{x + 1}$, giving the equations of the asymptotes in the form $x = a$ and $y = b$. What is b?

5 The real part of the complex roots of $p(z) = z^3 - 7z^2 - 4z + 78$.

6 Find the invariant lines of the matrix $\mathbf{A} = \begin{pmatrix} -\frac{3}{5} & \frac{4}{5} \\ \frac{4}{5} & \frac{3}{5} \end{pmatrix}$. What is the gradient of the line passing through the origin?

7 Find $\mathbf{A}^{-1}$ for the matrix $\mathbf{A} = \begin{pmatrix} 3 & -1 \\ -14 & 5 \end{pmatrix}$. What is the value of the entry in $\mathbf{A}^{-1}_{1,1}$

8 The vectors $\mathbf{u} = \begin{pmatrix} a \\ -3 \\ 2 \end{pmatrix}$ and $\mathbf{v} = \begin{pmatrix} 2a \\ 5a \\ -4 \end{pmatrix}$ are perpendicular. Find the positive possible value of a.

9 Line l_1 passes through the points $A(1,1,1)$ and $B(5,1,9)$.
Line l_2 passes through the points $C(-5,5,2)$ and $D(9,-3,4)$.
Find the point of intersection of l_1 and l_2. What is the $y-$coordinate of this point.

10 Find $\displaystyle\int \frac{2}{\sqrt{x^2 - 4x - 2}}\,\mathrm{d}x$ in the form $m\operatorname{arcosh}\left(\dfrac{x - n}{\sqrt{p}}\right)$.
What is the value of n?

11 Find the product of the roots of the polynomial $p(z) = 2z^3 - 5z^2 + 4z - 16$.

12 Find n such that $\left(1 - 5\mathrm{i}\right)^n = -74 + 110\mathrm{i}$.

13 Sketch $y = \dfrac{2x^3 + 2x^2 - 25x - 46}{x^2 - 2x - 8}$. What is the $y-$intercept of the oblique asymptote?

14 Write the ellipse $9x^2 + 25y^2 = 225$ in the form $\dfrac{x^2}{a^2} + \dfrac{y^2}{b^2} = 1$. What is the value of a^2?

15 Find the number n such that $\displaystyle\sum_{r=1}^{n} r^2 = 385.$

16 The imaginary part of the quantity

$$q = \left(2 + 5\mathrm{i}\right)\left(3 + 2\mathrm{i}\right) + 2\left(3 - 3\mathrm{i}\right) - \left(4 + 5\mathrm{i}\right)$$

17 Let $z = 2\left(\cos\left(\dfrac{\pi}{4}\right) + \mathrm{i}\sin\left(\dfrac{\pi}{12}\right)\right)$. Write z^4 in the form $a + \mathrm{i}b$. Find $\sqrt{|z|}$.

18 If the transformation represented by the matrix $\mathbf{T} = \begin{pmatrix} 4 & 3 \\ -3 & 4 \end{pmatrix}$ is applied to a shape, by what factor does the area of that shape change.

19 The complex number z satisfies $\left|z - 3 - 2\mathrm{i}\right| = 10$ and $\arg(z) = \dfrac{\pi}{4}$. Find $|z|$ in the form $a + b\sqrt{c}$. What is a?

20 The denominator when you evaluate $\sinh\left(\ln(7)\right)$.

21 Write the simultaneous equations

$$\begin{aligned} 3x + 2y + 4z &= 26 \\ x - y + z &= 14 \\ -x - 6y + 2z &= 4 \end{aligned}$$

in matrix form and solve them. What is the value of x. (*No cheating with a calculator here :))*

22 The matrix $\mathbf{A} = \begin{pmatrix} 2 & 5 \\ 1 & -1 \end{pmatrix}$ acts on the point (p, q) and gives the image point $(100,15)$. Find p.

24 Sketch $y = \dfrac{3x+1}{x^2-7x+12}$. If the vertical asymptotes are $x = a$ and $x = b$ what is ab?

25 The square of the denominator when you evaluate $\operatorname{sech}\left(\ln(3)\right)$

26 Half of the y component when you evaluate $\begin{pmatrix}1\\3\\2\end{pmatrix} \times \begin{pmatrix}4\\3\\-2\end{pmatrix}$.

27 Find the asymptotes of the hyperbola $\dfrac{x^2}{16} - \dfrac{y^2}{9} = 1$ in the form $y = \pm\dfrac{m}{n}x$.
Find the product mn.

28 The roots of $p(x) = x^3 - 21x^2 + ax - 216$ form a geometric sequence. Find the middle root when they order of increasing size.

29 The imaginary part of $\left(3+4\mathrm{i}\right)\left(1+\mathrm{i}\right)$.

30 Consider $P(n) = 15^n - 8^{n-2}$.
By evaluating $P(n)$ for $n = 2,3,4,5$ and 6 find a value a such that $P(n)$ is divisible by a for all $n \geq 2$. Prove your conjecture by induction. What is a?

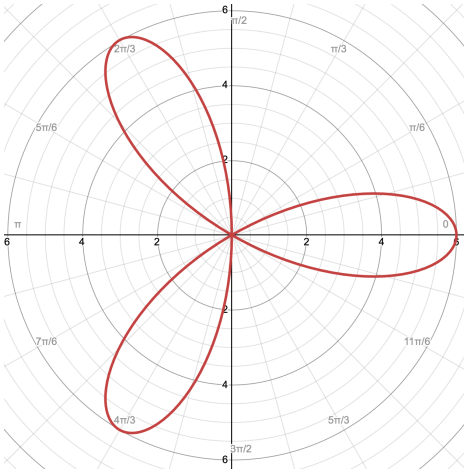
31 Find the denominator of the argument (in radians) of the complex number

$$\frac{3\left(1+\sqrt{3}\right)}{2\sqrt{2}} + \frac{3\left(-1+\sqrt{3}\right)}{2\sqrt{2}}\mathrm{i}$$

32 The $x-$coordinate of the focus of the conic section $y^2 + 6y = 4x - 33$.

33 Add 12 to the denominator of $\dfrac{2+7\mathrm{i}}{3-2\mathrm{i}}$ when rationalised.

34 The curve shown has the form $r = a\cos(b\theta)$. What is a?



35 The vertices of a triangle, when plotted in the complex plane satisfy $z^3 = 8$. Find the area of the triangle in the form $a\sqrt{b}$. What is the value of a?

36 Find the coordinates of the turning points of $y = \dfrac{x^2 + 6x + 9}{x^2 + 3x + 3}$. Double the largest (in magnitude) $y-$coordinate of these.

37 The number appearing in the Cartesian equation of the locus $|z - 6| = |z - 18|$.

38 $a \pm b\mathrm{i}$ are solutions of the equation $z^2 - 8z + 25 = 0$. Find b.

39 Find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$ for $y = \arctan(2x + 3)$. Double the value of the constant term in the expanded form of the denominator.

40 Find the shortest distance, d, from the point $(4,2,2)$ to the line $\mathbf{r} = \begin{pmatrix} 3 \\ 1 \\ -1 \end{pmatrix} + \lambda \begin{pmatrix} 1 \\ -1 \\ 2 \end{pmatrix}$. If $d = \sqrt{m}$, where m is a natural number, what is m?