RIGOUR

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Numeracy for Learning, Life and Work

December Higher Maths Calendar

#abitofmathseveryday

1 Two functions are defined as $f(x) = x^2 - 5$ and $g(x) = 4x - 1$.

Calculate $f(g(x))$.

2

Change 480° into radians.

3 Calculate...

$$\int \frac{6}{\sqrt{x}}\,dx$$

4 Fully factorise the following polynomial...

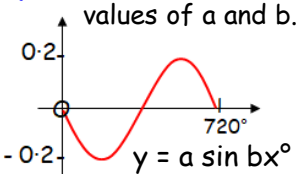
$g(x) = x^3 - 52x + 96$

5 Calculate the coordinates of the stationary points on the curve $y = x^3 - 3x + 9$ and determine their nature.

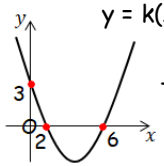
6 Solve the following exponential equation...

$$8^x = 1 \cdot 7$$

7 Write down the values of a and b.



8 This function has an equation of the form $y = k(x + a)(x + b)$.



Determine the equation of the graph.

9 Differentiate with respect to x...

$$f(x) = \frac{x^7 + 1}{x^4}$$

10 P is the point (-1, 7, 0) and Q is (-1, 7, -1).

Is $\overrightarrow{PQ}$ a unit vector? You must give a reason for your answer!

11 Does the point $(\frac{1}{2}, 3)$ lie on the graph with equation $y = 9^x$?

You MUST give a reason for your answer!

12 Find the equation of the tangent at the point (6, -3) on the circle

$x^2 + y^2 + 4x + 2y + 3 = 0$

13 Differentiate with respect to x...

$$\sqrt{8x - 15}$$

14 Simplify the following logarithmic expression...

$3\log_{10} 5 + 3\log_{10} 2$

15 State any restrictions on the domain, on the set of real numbers, for the following function;

$$f(x) = \frac{x - 3}{x^4 + x^3}$$

16 Calculate...

$$\int sin5x\,dx$$

17 The following recurrence relation has a limit of 20.

Calculate the value of a.

$u_{n+1} = au_n + 8$

18 Find the equation of the tangent to the curve $y = x^3 - 8x$ at the point where $x = -2$.

19 A curve for which $\frac{dy}{dx} = 6x^2 - 2x$ passes through the point (-1, 2).

Express y in terms of x.

20 Show that the line $y = 7x - 3$ is a tangent to the curve $y = x^2 + 11x + 1$ and find the coordinates of the point of contact.

21 If A and B are acute angles with $\sin A = \frac{2}{5}$ and $\cos B = \frac{1}{\sqrt{3}}$ find the exact value of cos(A - B).

22 Find the points of intersection between the line $y = x + 4$ and the circle $x^2 + y^2 + 4x - 10y = 0$.

23 Write this quadratic in the form...

$y = a(x + b)^2 + c.$

$y = -7x^2 - 14x + 9$

24 Find the inverse function of k(x) when...

$$k(x) = \frac{x + 3}{10}$$

25 Solve

$\sin 2x = \sqrt{3}\sin x$ for $\pi < x < 2\pi$.

26 A sequence is defined by the recurrence relation

$u_{n+1} = au_n + b$, $u_0 = 36$

If $u_1 = 8$ and $u_2 = 1$, find the values of a and b

27 For what values of x is the function

$y = \frac{1}{3}x^3 - 2x^2 - 32x$

increasing?

28 Find the equation of the circle which has A(-7, -5) and B(1, 5) as the end points of a diameter.

29 The vectors

$\underline{u} = \begin{pmatrix} k \\ 4 \\ 8 \end{pmatrix}$ and $\underline{v} = \begin{pmatrix} 0 \\ 6 \\ k \end{pmatrix}$

are perpendicular.

What is the value of k?

30 Show that the circles

$x^2 + y^2 + 8x + 12y + 20 = 0$

and $(x - 4)^2 + (y - 3)^2 = 19$

do not intersect.

31 Given that $x^2 + 4p = -px + 15$ has no real roots, find the range of values for p.