1.

a. Expand $(3+x)^4$ fully.

(2)

b. Hence find the exact value of 1003^4

(2)

2.

a. Show that $(x-3)$ is a factor of $\mathrm{f}(x) \equiv 2x^3 - 5x^2 - 7x + 12$

(1)

b. Factorise $\mathrm{f}(x)$

(2)

c. Find the exact solutions of

i. $\mathrm{f}(x) = 0$

(1)

ii. $\mathrm{f}(x+2) = 0$

(1)

3.

Find the values of constants A,B, C, D and E such that

$$\frac{3x^4 - 2x^3 + 4x + 1}{x-3} \equiv Ax^3 + Bx^2 + Cx + D + \frac{E}{x-3}$$

(5)

4.

A 10 sided polygon is drawn so that the exterior angles increase as you go round the polygon. The angle between the first and second sides is $\frac{1}{5}$ of the angle between the tenth and first sides.

a. Given that the angles form an arithmetic progression, find the first term and the common difference.

(4)

b. Given that the angle forms a geometric progression, find the exact value of the common ratio and the value of the first term in degrees correct to 1 decimal place.

(4)

5.

a. Use the formula for $\sin{(A+B)}$ to show that

$$\sin 3x \equiv 3\sin x - 4\sin^3 x$$

(3)

b. Solve the equation

$$\sin 3x = 2\sin x$$

in the range $0 \leqslant x \leqslant 2\pi$ giving your answers in terms of π

(5)

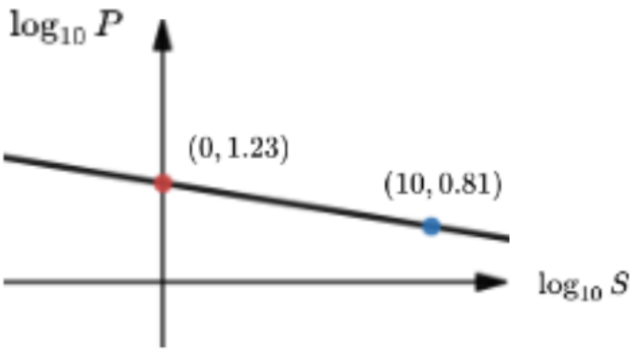
6.

" $3^n + 2$ is a prime number for all positive integers *n*"

Disprove this statement.

(2)

7.



The figure shows a graph of $\log_{10} P$ against $\log_{10} S$

a. Find an equation relating P and S in the form

$$P = aS^b$$

giving the values of *a* and *b* correct to 2 decimal places.

(4)

b. In an experiment P was measured to be 1.20 when S was 20. Comment on these values.

(2)

8.

A population of peafowl is modelled by the formula

$$P(t) = \frac{200e^{0.1t}}{40 + e^{0.1t}},\ t \geqslant 0$$

and a population of quails is modelled by the formula

$$Q(t) = 20 + \frac{3}{2}e^{0.1t},\ t \geqslant 0$$

where *t* is measured in years.

a. Find the initial sizes of the two populations.

(2)

b. Find when $P(t) = 100$ giving your answer to 1 decimal place.

(3)

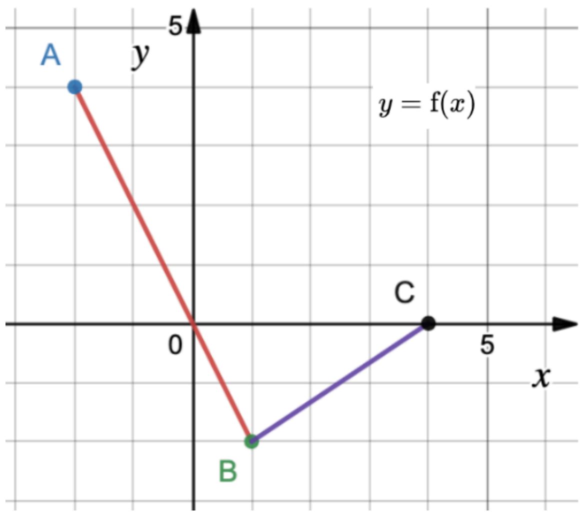
c. Find the range of the function $P(t)$

(2)

d. Find the values of *t* when the populations are equal giving your answers to 1 decimal place.

(4)

9.



The graph of $y = \mathrm{f}(x)$ consists of 2 line segments between $A(-2, 4)$ and $B(1, -2)$ and between B and $C(4, 0)$

Function $\mathrm{g}(x) = \sqrt{16 - x^2}, \ -4 \leqslant x \leqslant 4$

a. Find $\mathrm{ff}(-2)$

(1)

b. Solve $\mathrm{f}(x) = -1$

(4)

c. Fnd $\mathrm{gf}(1)$

(2)

d. Find $\mathrm{gg}(x)$

(1)

10.

Find the range of values of *k* such that the line $y = x + k$ cuts the circle $(x + 2)^2 + y^2 = 8$ at two distinct points.

(4)

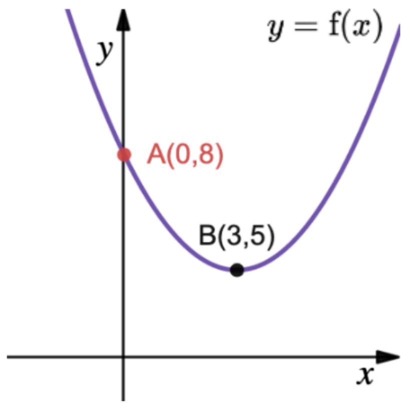
11.

Find the value of *a* such that

$$\log_a 5 + 2 \log_a 6 = \log_a (6a)$$

(2)

12.



The graph of $y = \mathrm{f}(x)$ is shown in fig 3. It cuts the y axis at $A(0, 8)$ and has a minimum point at $B(3, 5)$

a. Sketch on separate axes the graphs of

i. $y = \mathrm{f}(2x)$

ii. $y = 3 + \mathrm{f}(-x)$

iii. $y = \mathrm{f}(|x|)$

giving the coordinates of the points to which A and B are transformed.

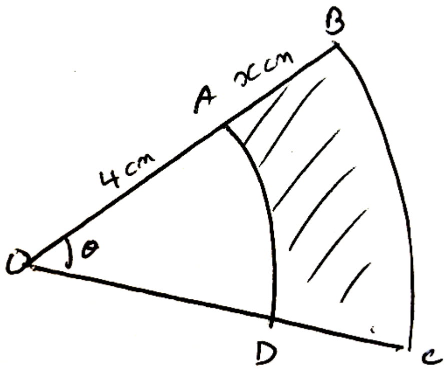
(6)

The graph of $y = a + \mathrm{f}(x + b)$ has a minimum point at the origin.

b. Find the values of *a* and *b*.

(2)

13.



OAD and OBC are concentric sectors with $OA = 4\,\text{cm}$ and $AB = x\,\text{cm}$

Given that arc AD is 3.2 cm,

a. find the value of θ

(1)

Given that the $\text{area of } ABCD = \frac{2}{3}\text{ area of OBC}$

b. Find the exact value of x

(4)
