1. In an experiment researchers found that a specific culture of bacteria increases in number according to the formula

$$N = 150 \times 2^t,$$

where N is the number of bacteria present and t is the number of hours since the experiment began.

Use this formula to calculate

(a) the number of bacteria present at the start of the experiment;

(b) the number of bacteria present after 3 hours;

(c) the number of hours it would take for the number of bacteria to reach 19 200.

Working:

Answers:

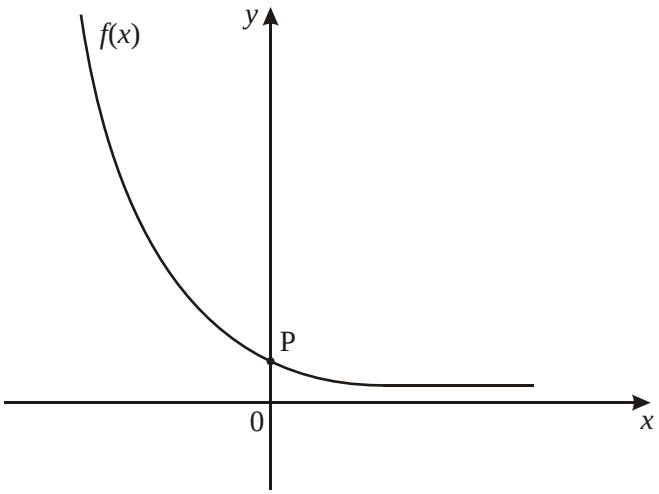
(a) ……..

(b) ……..

(c) ……..

(Total 4 marks)

2. The following diagram shows part of the graph of an exponential function $f(x) = a^{-x}$, where $x \in \mathbb{R}$.



(a) What is the range of f ?

(b) Write down the coordinates of the point P.

(c) What happens to the values of $f(x)$ as elements in its domain increase in value?

Working:

Answers:

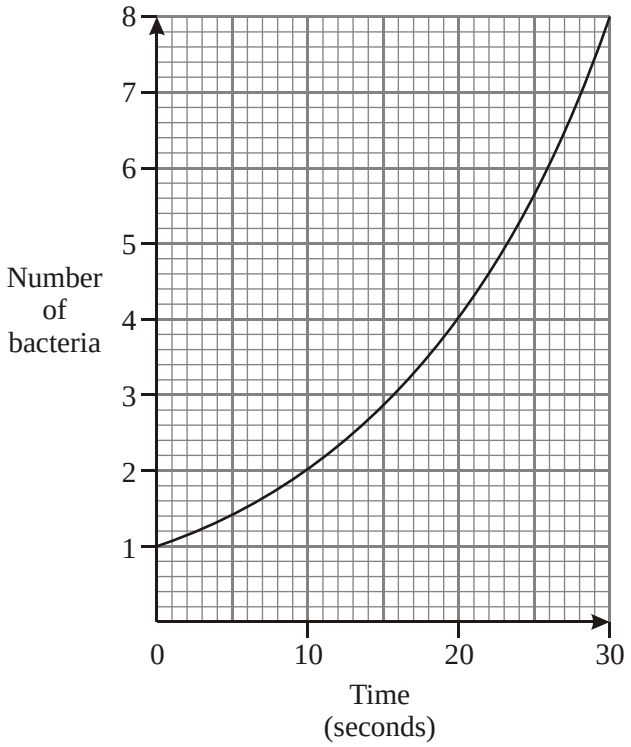
(a) ……..

(b) .....

(b) ……..

(Total 4 marks)

3. Under certain conditions the number of bacteria in a particular culture doubles every 10 seconds as shown by the graph below.



(a) Complete the table below.

Time (seconds)	0	10	20	30
Number of bacteria	1			

(b) Calculate the number of bacteria in the culture after 1 minute.

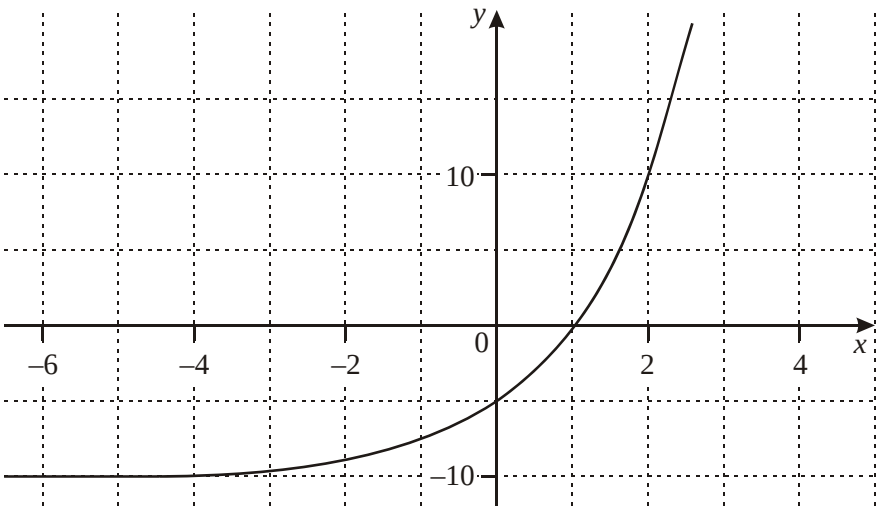
Working:

Answer:

(b) .....

(Total 4 marks)

4. The graph below shows the curve $y = k(2^x) + c$, where k and c are constants.



Find the values of c and k.

Working:

Answers:

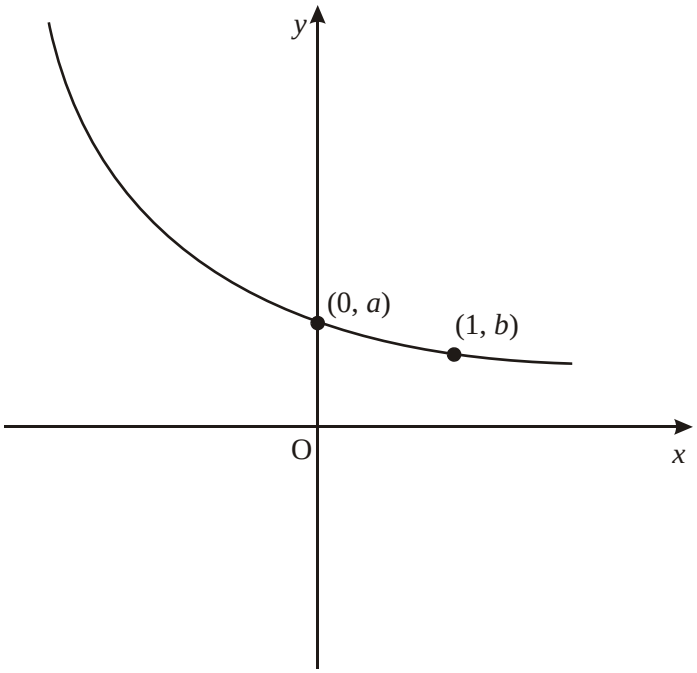
.....

.....

(Total 4 marks)

5. The following diagram shows the graph of $y = 3^{-x} + 2$. The curve passes through the points (0, a) and (1, b).

Diagram not to scale



(a) Find the value of

(i) a;

(ii) b.

(b) Write down the equation of the asymptote to this curve.

Working:

Answers:

(a) (i) .....

(ii) .....

(b) .....

(Total 8 marks)

1. (a) $N = 150\times2^0 = 150$ (A1) (C1)

(b) $N = 150\times2^3 = 1200$ (A1) (C1)

(c) $19200 = 150\times2^t$ (M1)

$128 = 2^t$

$7 = t$ (A1) (C2)

[4]

2. (a) $\mathbb{R}^+$ (A1)

(b) P(0, 1) (A1)

(c) Decreases towards 0 ***or*** $\rightarrow 0$ (A1)(A1)

Note: *Award (A1) for 'Decrease', and (A1) for* $\rightarrow 0$.

Marks awarded at examiner's discretion.

[4]

3. (a)

Time (seconds)	0	10	20	30
Number of bacteria	1	**2**	**4**	**8**

(A2) (C2)

Note: *Award [½ mark] for each correct entry (round up)*

(b) $N = 2^6$ (M1)

Note: *Award (M1) for any correct method*

$= 64$ (A1) (C2)

[4]

4. $c = -10$ (asymptote of graph) (M1)(A1)

$0 = k(2^1) - 10 \Rightarrow 2k = 10$ (M1)

$\Rightarrow k = 5$ (A1)

OR

$k + c = -5$ (M1)

$2k + c = 0$ (M1)

Therefore, $k = 5$ (A1)

$c = -10$ (A1)

[4]

5. (a) (i) $y = 3^{-0} + 2$ (M1)

$y = 1 + 2$ (A1)

$a = 3$ (A1) (C3)

(ii) $y = 3^{-1} + 2$ (M1)

$y = \frac{1}{3} + 2$ (A1)

$b = 2\frac{1}{3}$ (A1)(C3)

(b) $y = 2$ (A2)(C2)

Note: *Award (A1) for y = any constant.*

[8]