1.6 Pure: Exponentials and Logarithms: 30-minute Pack

EDEXCEL 9MA0 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Simplify $\log_4(8) + \log_4(2)$, giving your answer as an integer.

(Total for Question 1 is 1 mark)

2 Solve $5^{2x} = 125$.

(Total for Question 2 is 2 marks)

3 Solve $4^x = 20$, giving your answer to 3 significant figures.

(Total for Question 3 is 2 marks)

4 The number of bacteria in a culture is modelled by $N = 200 * e^{0.4t}$, where N is the number of bacteria present t hours after the culture is first observed. Find the time taken for the number of bacteria to first exceed 5000, giving your answer to 3 significant figures.

(Total for Question 4 is 3 marks)

5 Solve $\log_5(x + 116) + \log_5(x + 16) = 5$.

(a) Show that the equation can be written as a quadratic and find the quadratic. **(3)**

(b) Hence solve the equation, rejecting any invalid root, and give a reason. **(4)**

(Total for Question 5 is 7 marks)

6 The activity, R, of a radioactive sample t days after it is first measured is modelled by $R = A e^{kt}$. Initially the activity is 375, and after 5 days it is 281.25.

(a) Write down the value of A, and show that $k = (1/5) \ln(3/4)$. **(3)**

(b) Find the value of k to 3 significant figures, and interpret its sign. **(3)**

(c) Find the time at which the activity is 1/8 times its initial value, giving your answer to 3 significant figures. **(3)**

(Total for Question 6 is 9 marks)

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Mark scheme · 1.6 Pure: Exponentials and Logarithms: 30-minute Pack

Question 1

2 cao	**B1**

Answer: 2

Question 2

writes 125 as 5^3 and equates powers, $2x = 3$	**M1**
$x = 1.5$ cao	**A1**

Answer: x = 1.5

Question 3

takes logs of both sides, $x \ln 4 = \ln 20$	**M1**
awrt 2.16	**A1**

Answer: x = 2.16 (3 s.f.)

Question 4

sets up the equation $200e^{0.4t} = 5000$, leading to $e^{0.4t} = 25$	**M1**
takes natural logs of both sides, $0.4t = \ln 25$	**M1**
awrt 8.05	**A1**

Answer: t = 8.05 hours (3 s.f.)

Question 5

(a) uses $\log a + \log b = \log(ab)$	**M1**
(a) converts to index form: $(x + 116)(x + 16) = 5^5 = 3125$	**M1**
(a) $x^2 + 132x - 1269 = 0$	**A1**

(a) Answer: $x^2 + 132x - 1269 = 0$

(b) solves the quadratic	**M1**
(b) $x = 9$ or $x = -141$	**A1**
(b) $x = -141$ makes the argument of a logarithm negative or zero, so it is rejected	**B1**
(b) $x = 9$	**A1**

(b) Answer: x = 9

Question 6

(a) $A = 375$	**B1**
(a) substitutes $t = 5$: $375\ e^{5k} = 281.25$	**M1**
(a) $e^{5k} = 3/4$, so $k = (1/5) \ln(3/4)$ (cso)	**A1**

(a) Answer: A = 375, k = (1/5) ln(3/4)

(b) $k = \ln(3/4)/5$	**M1**
(b) $k = -0.0575$	**A1**
(b) $k < 0$ means decay	**B1**

(b) Answer: k = -0.0575

(c) forms $e^{kt} = 1/8$	**M1**
(c) takes natural logs: $t = \ln(1/8)/k$	**M1**
(c) $t = 36.1$ days	**A1**

(c) Answer: 36.1 days

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