Exponential and Logarithms - Edexcel Past Exam Questions 2

1. The area, A mm^2, of a bacterial culture growing in milk, t hours after midday, is given by

$$A = 20e^{1.5t}, \qquad t \geq 0.$$

(a) Write down the area of the culture at midday. **(1)**

(b) Find the time at which the area of the culture is twice its area at midday. Give your answer to the nearest minute. **(5)**

Jan 12 Q3

---

2. The value of Bob's car can be calculated from the formula

$$V = 17000e^{-0.25t} + 2000e^{-0.5t} + 500.$$

where V is the value of the car in pounds (£) and t is the age in years.

(a) Find the value of the car when $t = 0$. **(1)**

(b) Calculate the exact value of t when $V = 9500$. **(4)**

(c) Find the rate at which the value of the car is decreasing at the instant when $t = 8$. Give your answer in pounds per year to the nearest pound. **(4)**

Jan 13 Q8

---

3. Find algebraically the exact solutions to the equations

(a) $\ln(4 - 2x) + \ln(9 - 3x) = 2\ln(x + 1), \quad -1 < x < 2,$ **(5)**

(b) $2^x e^{3x+1} = 10.$

Give your answer to (b) in the form $\dfrac{a + \ln b}{c + \ln d}$ where a, b, c and d are integers. **(5)**

June 13 Q6

4.

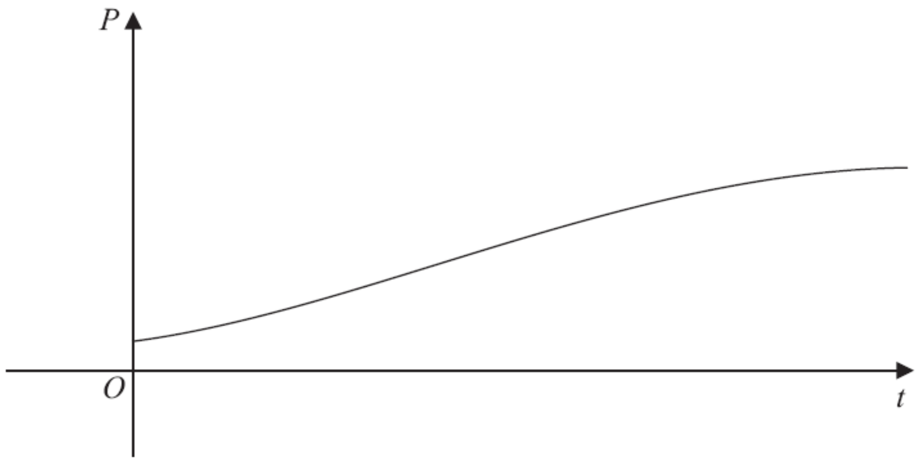

Figure 3

The population of a town is being studied. The population P, at time t years from the start of the study, is assumed to be

$$P = \frac{8000}{1+7e^{-kt}}, \qquad t \geq 0$$

where k is a positive constant.

The graph of P against t is shown in Figure 3.

Use the given equation to

(a) find the population at the start of the study, **(2)**

(b) find a value for the expected upper limit of the population. **(1)**

Given also that the population reaches 2500 at 3 years from the start of the study,

(c) calculate the value of k to 3 decimal places. **(5)**

Using this value for k,

(d) find the population at 10 years from the start of the study, giving your answer to 3 significant figures. **(2)**

(e) Find, using $\frac{\mathrm{d}P}{\mathrm{d}t}$, the rate at which the population is growing at 10 years from the start of the study. **(3)**

June 13(R) Q8

5. Find the exact solutions, in their simplest form, to the equations

(*a*) $2 \ln (2x + 1) - 10 = 0$ **(2)**

(*b*) $3^x e^{4x} = e^7$ **(4)**

June 14 Q2

---

6. A rare species of primrose is being studied. The population, P, of primroses at time t years after the study started is modelled by the equation

$$P = \frac{800e^{0.1t}}{1+3e^{0.1t}}, \qquad t \geq 0, \quad t \in \mathbb{R}$$

(*a*) Calculate the number of primroses at the start of the study. **(2)**

(*b*) Find the exact value of t when $P = 250$, giving your answer in the form $a \ln(b)$ where a and b are integers. **(4)**

(*c*) Find the exact value of $\frac{dP}{dt}$ when $t = 10$. Give your answer in its simplest form. **(4)**

(*d*) Explain why the population of primroses can never be 270. **(1)**

June 14 Q8

This part is for Year 13

7. Water is being heated in an electric kettle. The temperature, θ °C, of the water t seconds after the kettle is switched on, is modelled by the equation

$$\theta = 120 - 100e^{-\lambda t}, \qquad 0 \le t \le T.$$

(*a*) State the value of θ when $t = 0$. **(1)**

Given that the temperature of the water in the kettle is 70 °C when $t = 40$,

(*b*) find the exact value of λ, giving your answer in the form $\frac{\ln a}{b}$, where a and b are integers. **(4)**

When $t = T$, the temperature of the water reaches 100 °C and the kettle switches off.

(*c*) Calculate the value of T to the nearest whole number. **(2)**

June 15 Q4

---

8. The amount of an antibiotic in the bloodstream, from a given dose, is modelled by the formula

$$x = De^{-0.2t},$$

where x is the amount of the antibiotic in the bloodstream in milligrams, D is the dose given in milligrams and t is the time in hours after the antibiotic has been given.

A first dose of 15 mg of the antibiotic is given.

(*a*) Use the model to find the amount of the antibiotic in the bloodstream 4 hours after the dose is given. Give your answer in mg to 3 decimal places. **(2)**

A second dose of 15 mg is given 5 hours after the first dose has been given. Using the same model for the second dose,

(*b*) show that the **total** amount of the antibiotic in the bloodstream 2 hours after the second dose is given is 13.754 mg to 3 decimal places. **(2)**

No more doses of the antibiotic are given. At time T hours after the second dose is given, the total amount of the antibiotic in the bloodstream is 7.5 mg.

(*c*) Show that $T = a \ln\left(b + \frac{b}{e}\right)$, where a and b are integers to be determined. **(4)**

June 16 Q9

---

9. Find the exact solutions, in their simplest form, to the equations

(*a*) $e^{3x-9} = 8$ **(3)**

(*b*) $\ln(2y + 5) = 2 + \ln(4 - y)$ **(4)**

June 17 Q2