Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Logarithmic and exponential functions

Time allowed: 1 hour 50 minutes

Subject code **0606**

Additional Mathematics

Questions from Paper 1 and Paper 2

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.
Questions 1, 3, 5, 9 (Paper 1): no calculator.
Questions 2, 4, 6-8, 10 (Paper 2): calculator allowed.

Total marks

/ 71

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.
- Unless a question says otherwise, give answers that are not exact to 3 significant figures, and angles in degrees to 1 decimal place.

Information

- This paper has 10 questions worth 71 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

1 The population, P, of a certain bacterium t days after the start of an experiment is modelled by $P = 800e^{kt}$, where k is a constant.

(i) State what the figure 800 represents in this experiment. [1]

(ii) Given that the population is 20 000 two days after the start of the experiment, calculate the value of k. [3]

(iii) Calculate the population three days after the start of the experiment. [2]

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2 Solve the equation $64^{x+\frac{1}{3}} + 2^{3x} - 3 = 0$. [4]

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3 Solve the equation $\log_2(x+1) - 4\log_{(x+1)}2 = 3$. [5]

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4 The profit $\$P$ made by a company in its nth year is modelled by

$$P = 1000\mathrm{e}^{an+b}.$$

In the first year the company made \$2000 profit.

(i) Show that $a + b = \ln 2$. [1]

In the second year the company made \$3297 profit.

(ii) Find another linear equation connecting a and b. [2]

(iii) Solve the two equations from parts **(i)** and **(ii)** to find the value of a and of b. [2]

(iv) Using your values for a and b, find the profit in the 10th year. [2]

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5 **(a)** Given that $\log_2 x + 2\log_4 y = 8$, find the value of xy. [3]

(b) Using the substitution $y = 2^x$, or otherwise, solve $2^{2x+1} - 2^{x+1} - 2^x + 1 = 0$. [4]

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6 **(a)** Solve the equation $5^{2y-1} = 6 \times 3^{y}$, giving your answer correct to 3 decimal places. [3]

(b) Solve the equation $e^{2x} - 4 + 3e^{-2x} = 0$, giving your answers in exact form. [4]

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7 **(a)** Solve the equation $\log_6(2x-3)=\frac{1}{2}$. Give your answer in exact form. [2]

(b) Solve the equation $\ln 2u-\ln(u-4)=1$. Give your answer in exact form. [3]

(c) Solve the equation $\frac{3^v}{27^{2v-5}}=9$. [3]

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8 **(a)** Solve the equation $\dfrac{9^{5x}}{27^{x-2}} = 243$. [3]

(b) $\log_a \sqrt{b} - \dfrac{1}{2} = \log_b a$, where $a > 0$ and $b > 0$.

Solve this equation for b, giving your answers in terms of a. [5]

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9 **(a)** Express $2+3\lg x-\lg y$ as a single logarithm to base 10. [3]

(b) **(i)** Solve $6x+7-\frac{3}{x}=0$. [2]

(ii) Hence, given that $6\log_a 3+7-3\log_3 a=0$, find the possible values of a. [4]

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10 **(a)** **(i)** Solve $\frac{5^{2x+3}}{25^{2x}} = \frac{25^{2-x}}{125^{x}}$. [3]

(ii) Solve $1g\ y + 1g(y - 15) = 2$. [4]

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(b) Without using a calculator, and showing each stage of your working, find the value of

$$2\log_{12} 4 - \frac{1}{2}\log_{12} 81 + 4\log_{12} 3.$$ [3]

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