Applications of Functions: exam practice

10 questions · 32 marks · worked solutions and markschemes

Name _____ Date _____ Score / 32

- Answer every question before you look at the solutions. They start after the last question, with the marks for each line: M for method, A for accuracy, R for reasoning.
- Online, with more practice: ibmathrevision.com/hlai/applications-of-functions-exam-practice

1. **3 marks · Paper 1 style · calculator allowed**

A phone plan costs $\$15$ per month plus $\$0.08$ per minute of calls.

Write a model for the monthly cost C for m minutes, and find C for 240 minutes. **[3]**

2. **2 marks · Paper 2 style · calculator allowed**

Coffee cools according to $T = 22 + 68e^{-0.045t}$ (°C, t in minutes).

Find the time for the coffee to reach 50 °C. **[2]**

3. **3 marks · Paper 2 style · calculator allowed**

Data (x, y) are thought to follow $y = ax^b$. Taking logs, the regression line of $\ln y$ on $\ln x$ is $\ln y = 1.8 \ln x + 0.65$.

Find a and b. **[3]**

4. **3 marks · Paper 2 style · calculator allowed**

A car's value is $V = 25\,000 \times 0.85^{t}$ dollars, t years after purchase.

Find the value after 4 years and the time for the value to halve. **[3]**

5. **3 marks · Paper 1 style · calculator allowed**

A culture of 500 bacteria grows to 1500 in 4 hours, following $N = 500e^{kt}$.

Find the exact value of k, and the number after 6 hours. **[3]**

6. **3 marks · Paper 2 style · calculator allowed**

For a set of data the regression line of $\log_{10} y$ on $\log_{10} x$ is $\log_{10} y = -0.5 \log_{10} x + 1.3$.

Write y in the form ax^{b} and find y when $x = 16$. **[3]**

7. **4 marks · Paper 2 style · calculator allowed**

A ball is kicked and its height is recorded: $(0, 0)$, $(1, 9)$, $(2, 14)$, $(3, 15)$ in metres after t seconds. A quadratic $h = at^2 + bt + c$ fits these points exactly.

Find the model and the time when the ball lands. **[4]**

8. 3 marks · Paper 2 style · calculator allowed

The values of y for $x = 1, 2, 3, 4, 5$ are $3.1,\ 4.7,\ 7.2,\ 10.8,\ 16.5$. A model $y = ae^{bx}$ is fitted using the regression line of $\ln y$ on x.

Find a and b. **[3]**

9. 4 marks · Paper 2 style · calculator allowed

A town's population is $P(t) = 12\,000 \times 1.035^t$, t years after 2020.

(a) Find the population in 2030. **[2]**

(b) Find the year in which the population first exceeds $20\,000$. **[2]**

10. 4 marks · Paper 2 style · calculator allowed

The profit from selling x items is $P(x) = -0.5x^2 + 60x - 800$ dollars.

(a) Find the number of items that gives the maximum profit, and the maximum profit. **[2]**

(b) Find the values of x for which the company makes a profit. **[2]**

Answers and worked solutions

Question 1 — 3 marks

Answer: $\$34.20$

$C = 15 + 0.08m$ **A1**

$15 + 0.08(240)$ **M1**

$\$34.20$ **A1**

Question 2 — 2 marks

Answer: 19.7 minutes

$e^{-0.045t} = \dfrac{28}{68}$ **M1**

19.7 min **A1**

Question 3 — 3 marks

Answer: $a = 1.92$, $b = 1.8$

$\ln y = \ln a + b \ln x$ **M1**

$b = 1.8$ **A1**

$a = e^{0.65} = 1.92$ **A1**

Question 4 — 3 marks

Answer: $\$13\,050.16$; 4.27 years

$25000 \times 0.85^4 = \$13\,050.16$ **A1**

$0.85^t = 0.5$ **M1**

4.27 years **A1**

Question 5 — 3 marks

Answer: $k = \dfrac{\ln 3}{4}$; 2600

$e^{4k} = 3$, $k = \dfrac{\ln 3}{4}$ $M1$**A1**

$500 \times 3^{1.5} = 2600$ **A1**

Question 6 — 3 marks

Answer: 4.99, from $y = 20.0x^{-0.5}$

$y = 10^{1.3}x^{-0.5} = 19.95x^{-0.5}$ $M1$**A1**

4.99 **A1**

Question 7 — 4 marks

Answer: $h = -2t^2 + 11t$; $t = 5.5\ s$

$c = 0$; $a + b = 9$, $4a + 2b = 14$ **M1**

$h = -2t^2 + 11t$ **A1A1**

lands at $t = 5.5\ s$ **A1**

Question 8 — 3 marks

Answer: $a = 2.04$, $b = 0.418$

regression of $\ln y$ on x:

$\ln y = 0.418x + 0.714$ $M1$**A1**

$a = 2.04$, $b = 0.418$ **A1**

Question 9 — 4 marks

Answer: (a) $16\,900$; (b) 2035

(a)

12000×1.035^{10} **M1**

$16\,900$ **A1**

(b)

$t > 14.8$ **M1**

2035 **A1**

Question 10 — 4 marks

Answer: (a) 60 items, $\$1000$; (b) $16 \le x \le 104$

(a)

$x = 60$ **A1**

$\$1000$ **A1**

(b)

$P(x) = 0$ at $x = 15.3$ and 104.7 **M1**

$16 \le x \le 104$ **A1**

Every solution is also on ibmathrevision.com/hlai/applications-of-functions-exam-practice
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