Number and Algebra: exam practice

10 questions · 28 marks · worked solutions and markschemes

Name _____ Date _____ Score / 28

- 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/number-and-algebra-exam-practice

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

An investor places money in a savings account with a nominal annual interest rate of 6.5%. During the same year, the inflation rate is 2.1%.

Calculate the real rate of return on the investment, giving your answer as a percentage correct to 2 decimal places.

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

Savings earn 4% per year compounded annually while inflation is 3% per year.

Find the real value, in today's money, of $\$10\,000$ after 5 years. **[2]**

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

A loan of $\$9000$ is repaid with 36 equal monthly payments at 8.4% per year compounded monthly.

Find the monthly payment. **[2]**

4. **2 marks · Paper 1 style · calculator allowed**

A field is 120 m long and 80 m wide, each measured to the nearest metre.

Find the upper bound for the perimeter. **[2]**

5. **3 marks · Paper 2 style · calculator allowed**

Ana wants $\$50\,000$ in 12 years. Her account pays 4.5% per year compounded monthly.

Find the monthly deposit needed, paid at the end of each month. **[3]**

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

A salary rises from $\$42\,000$ to $\$45\,500$ in a year in which inflation is 4.1%.

Find the real percentage change in the salary. **[3]**

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

John takes out a loan of €$20\,000$ to renovate his kitchen. The loan is to be repaid over 5 years with fixed monthly payments. The bank charges a nominal interest rate of 6% per annum, compounded monthly.

Calculate the exact amount of John's fixed monthly repayment.

8. 2 marks · Paper 1 style · calculator allowed

$p = 12$ and $q = 4$, each correct to the nearest integer.

Find the upper bound of $\frac{p}{q}$. **[2]**

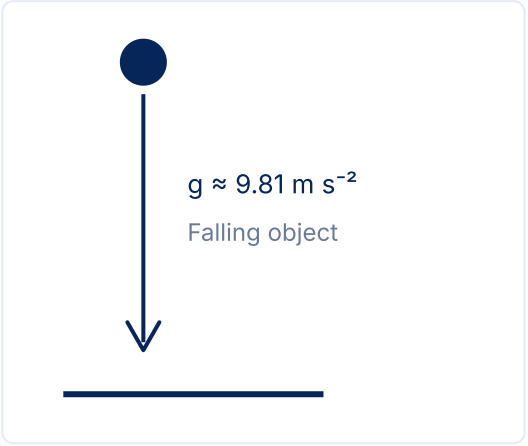
9. 3 marks · Paper 2 style · calculator allowed

An account pays a nominal 5.4% per year, compounded monthly. Inflation is 2.8% per year.

Find the effective annual rate and the approximate real interest rate. **[3]**

10. 4 marks · Paper 1 style · calculator allowed

In an experiment, a student calculates the acceleration due to gravity, g, to be $9.4\ \text{m s}^{-2}$. The accepted true value of g is $9.81\ \text{m s}^{-2}$.



1. Calculate the absolute error of the student's result.
2. Calculate the percentage error of the student's result, giving your answer correct to 2 decimal places.

Answers and worked solutions

Question 1 — 3 marks

Answer: 4.31

Use the relationship between nominal rate, inflation and real rate: $1 + r_{\text{real}} = \frac{1+r_{\text{nominal}}}{1+\text{inflation}}$ **M1**

Substitute the rates as decimals: $1 + r_{\text{real}} = \frac{1+0.065}{1+0.021} = \frac{1.065}{1.021}$ **M1**

$1 + r_{\text{real}} \approx 1.043095\ldots \Rightarrow r_{\text{real}} \approx 0.043095$

Real rate is 4.31% **A1**

Question 2 — 2 marks

Answer: $\$10\,495$

$10000\left(\frac{1.04}{1.03}\right)^{5}$ **M1**

$\$10\,495$ **A1**

Question 3 — 2 marks

Answer: $\$283.69$

GDC **(M1)**

$\$283.69$ **A1**

Question 4 — 2 marks

Answer: 402

$2(120.5 + 80.5)$ **M1**

$402\ m$ **A1**

Question 5 — 3 marks

Answer: $\$262.50$

GDC: $FV = 50000$, $N = 144$, $I\% = 4.5$ M**1A1**

$\$262.50$ **A1**

Question 6 — 3 marks

Answer: 4.07%

nominal rise 8.333% **A1**

$\frac{45500}{42000 \times 1.041} - 1$ **M1**

4.07% **A1**

Question 7 — 4 marks

Answer: €386.66

Set up the GDC financial (TVM) solver for the loan:

$N = 5 \times 12 = 60$ **A1**

$I\% = 6$, $PV = 20000$, $FV = 0$, $P/Y = 12$, $C/Y = 12$ **M1A1**

Solve for PMT:

$PMT = -386.656\ldots$

Monthly repayment = €386.66 **A1**

Question 8 — 2 marks

Answer: $\frac{25}{7} \approx 3.57$

$\frac{12.5}{3.5}$ **M1**

$\frac{25}{7}$ **A1**

Question 9 — 3 marks

Answer: 5.54%; about 2.74%

effective: $\left(1 + \frac{0.054}{12}\right)^{12} - 1 = 5.54\%$ M**1A1**

real $\approx 5.54 - 2.8 = 2.74\%$ **A1**

Question 10 — 4 marks

Answer: (a) 0.41; (b) 4.18

1. Find the absolute error using $|V_A - V_E|$:
   $|9.4 - 9.81|$ **M1**
   $= 0.41\ \text{m s}^{-2}$ **A1**
2. Divide the absolute error by the true value and multiply by 100:
   $\frac{0.41}{9.81} \times 100\%$ **M1**
   $= 4.1794\ldots\% \approx 4.18\%$ (2 d.p.) **A1**

Every solution is also on ibmathrevision.com/hlai/number-and-algebra-exam-practice
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