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Thursday 14 May 2026 – Afternoon

AS Level Mathematics A

H230/01 Pure Mathematics and Statistics

Time allowed: 1 hour 30 minutes

2655984207

You must have:
• thePrinted Answer Booklet
• a scientific or graphical calculator

QP

INSTRUCTIONS

- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided in the **Printed Answer Booklet**. If you need extra space use the lined pages at the end of the Printed Answer Booklet. The question numbers must be clearly shown.
- Fill in the boxes on the front of the Printed Answer Booklet.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.
- Give non-exact numerical answers correct to **3** significant figures unless a different degree of accuracy is specified in the question.
- The acceleration due to gravity is denoted by g m s^{-2}. When a numerical value is needed use $g = 9.8$ unless a different value is specified in the question. •

You can write on this Question Paper but it will **not** be sent for marking.

INFORMATION

- The totalmark for this paper is **75**.
- The marks for each question are shown in brackets **[ ]**.
- This document has **12** pages.

ADVICE

- Readeach question carefully before you start your answer.

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Formulae
AS Level Mathematics A (H230)

Binomial series

$$(a+b)^n = a^n + {}^nC_1 a^{n-1}b + {}^nC_2 a^{n-2}b^2 + \ldots + {}^nC_r a^{n-r}b^r + \ldots + b^n \quad (n \in \mathbb{N})$$

where ${}^nC_r = nC_r = \binom{n}{r} = \frac{n!}{r!(n-r)!}$

Differentiation from first principles

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

Standard deviation

$$\sqrt{\frac{\sum (x-\bar{x})^2}{n}} = \sqrt{\frac{\sum x^2}{n} - \bar{x}^2} \quad \text{or} \quad \sqrt{\frac{\sum f(x-\bar{x})^2}{\sum f}} = \sqrt{\frac{\sum fx^2}{\sum f} - \bar{x}^2}$$

The binomial distribution

If $X \sim B(n, p)$ then $P(X = x) = \binom{n}{x} p^x (1-p)^{n-x}$, mean of X is np, variance of X is $np(1-p)$

Kinematics

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$s = \frac{1}{2}(u+v)t$$

$$v^2 = u^2 + 2as$$

$$s = vt - \frac{1}{2}at^2$$

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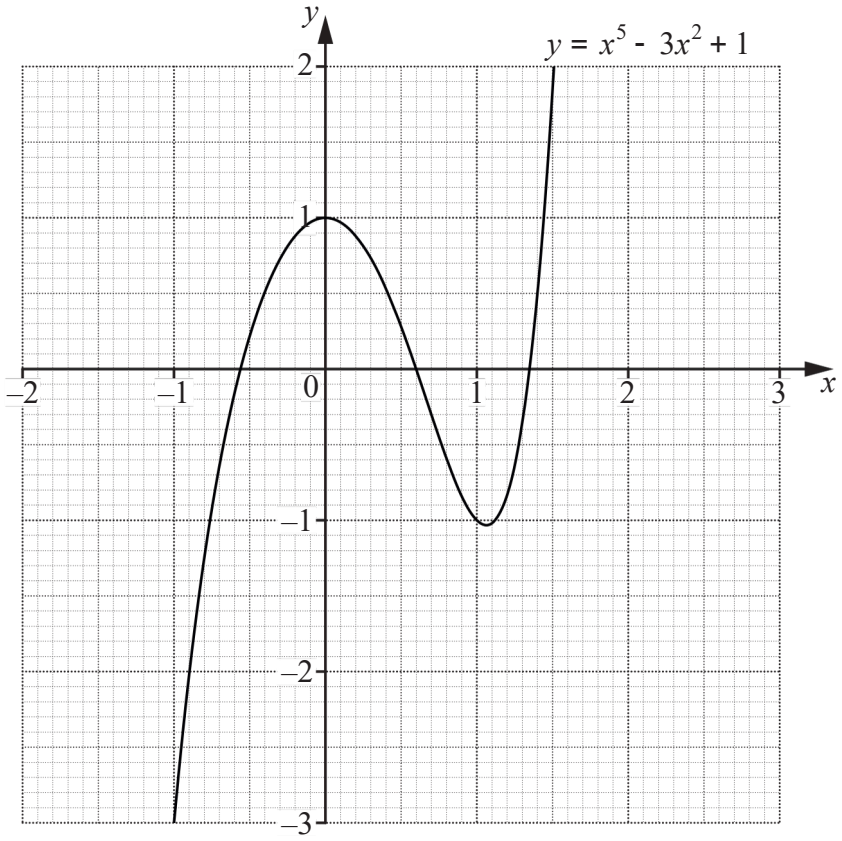
Section A
Pure Mathematics

1 **(a)** Express $\frac{x^3 \times \sqrt{x}}{x^2}$ in the form x^a where a is a constant to be determined. **[2]**

(b) **In this question you must show detailed reasoning.**

Show that $\frac{\sqrt{20}-2}{\sqrt{5}+1}$ can be written as $3-\sqrt{5}$. **[3]**

2 The diagram shows part of the graph of $y = x^5 - 3x^2 + 1$.



(a) Write the equation $x^5 - 3x^2 - x + 2 = 0$ in the form $x^5 - 3x^2 + 1 = ax + b$ where a and b are integers to be determined. **[1]**

(b) Hence use the copy of the graph of $y = x^5 - 3x^2 + 1$ in the **Printed Answer Booklet** to solve approximately the equation $x^5 - 3x^2 - x + 2 = 0$. **[3]**

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3 The function f is defined by $f(x)=(x-a)(x-b)(x-c)(x-d)$ where a, b, c and d are constants which are all different.

Only one of the following curves could be the graph of $y = f(x)$.

Fig. 1

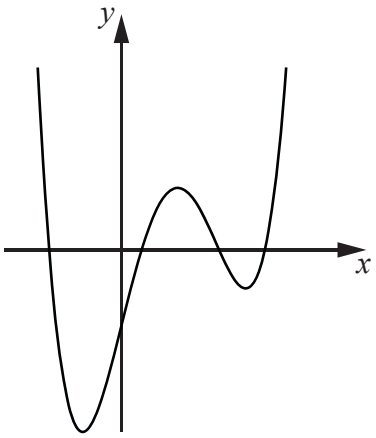


Fig. 2

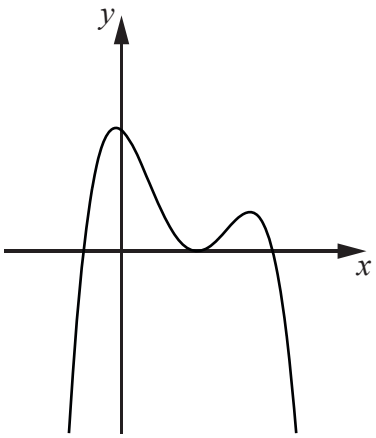


Fig. 3

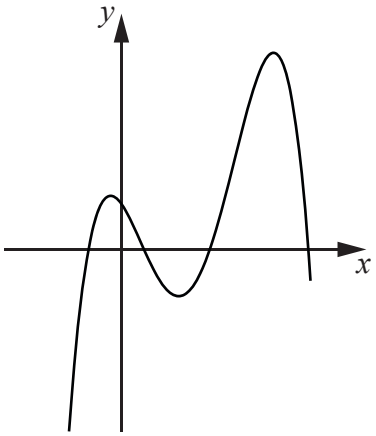
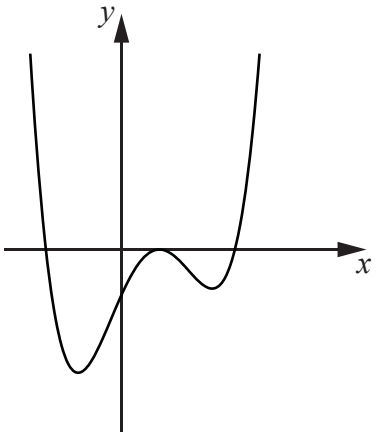


Fig. 4



(a) Identify the curve that could be the graph of $y=f(x)$. **[1]**

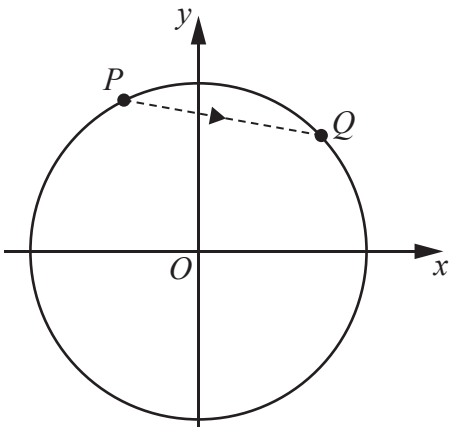
(b) For each of the other three curves, give a reason why it could **not** be the graph of $y=f(x)$. **[2]**

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4 **(a)** The points A, B and C lie on a straight line such that $AB = BC$.
The point M is the midpoint of AB.
The position vector of A is $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$ and the position vector of M is $\begin{pmatrix} 4 \\ 1 \end{pmatrix}$.

Determine the position vector of C. **[3]**

(b)



The points P and Q lie on a circle whose centre is at the origin, O.
The point P has position vector $-2\mathbf{i}+4\mathbf{j}$.
The point Q is such that $\overrightarrow{PQ} = k(3\mathbf{i}-\mathbf{j})$ where k is a constant.

(i) Find the exact radius of the circle. **[1]**

(ii) Write down an expression for $\overrightarrow{OQ}$ in terms of k. **[1]**

(iii) Hence determine the two values of k. **[4]**

(iv) State what the value $k = 0$ shows about one of the two possible positions of Q. **[1]**

5 **(a)** Write down the binomial expansion of $(x+h)^4$. **[1]**

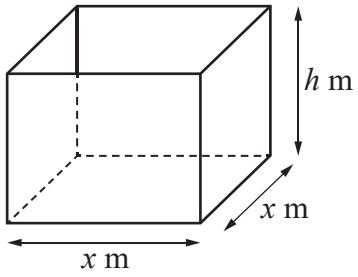
(b) The variables x and y are related by the equation $y = x^4 + 2x$.

Use differentiation from first principles to find $\frac{dy}{dx}$. **[4]**

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6 Hugo constructs an **open** water tank with a square base and vertical rectangular sides.

Each edge of the square base is x m and the height of each rectangular side is h m.



When the tank is full it contains 4m^3 of water.

(a) Show that the external surface area, $A\text{m}^2$, of the tank is given by

$$A=x^2+\frac{16}{x}.$$ **[2]**

(b) Hugo wants to make the value of A as small as possible.

(i) Determine the minimum value of A. **[4]**

(ii) Show that your value is a minimum. **[2]**

7 Taylor places £350 in a savings account. Interest is added into the savings account at the end of each year.

For the first 2 years, the account pays 3% compound interest per year.

After the first 2 years, the account pays 1.5% compound interest per year.

(a) Determine the value of Taylor's investment at the end of 15 years. **[3]**

(b) **In this question you must show detailed reasoning.**
Using logarithms, find the number of years after which Taylor's investment is first worth more than £500.

[4]

8 **In this question you must show detailed reasoning.**
A curve has the following properties.

- The gradient of the curve is given by $\frac{\mathrm{d}y}{\mathrm{d}x}=2x+3$.
- The curve passes through the points $(2, a)$ and $(3, 2a)$ where a is a constant.

Find the coordinates of the points where the curve meets the line $y=4x+4$. **[7]**

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Section B
Statistics

9 A six-sided spinner has sides numbered 1, 1, 1, 2, 2, 3. When the spinner is spun, it is equally likely to land on any side. The score is the number of the side on which the spinner lands.

(a) The spinner is spun once.

Find the probability that the score is **not** 2. **[1]**

(b) The spinner is spun twice. The variable X denotes the sum of the scores on the two spins.

Show that P(X=5) $1=\frac{1}{9}$. **[2]**

The table shows the probability distribution of X.

Sum of the scores on two spins, x	2	3	4	5	6
P($X = x$)	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{5}{18}$	$\frac{1}{9}$	$\frac{1}{36}$

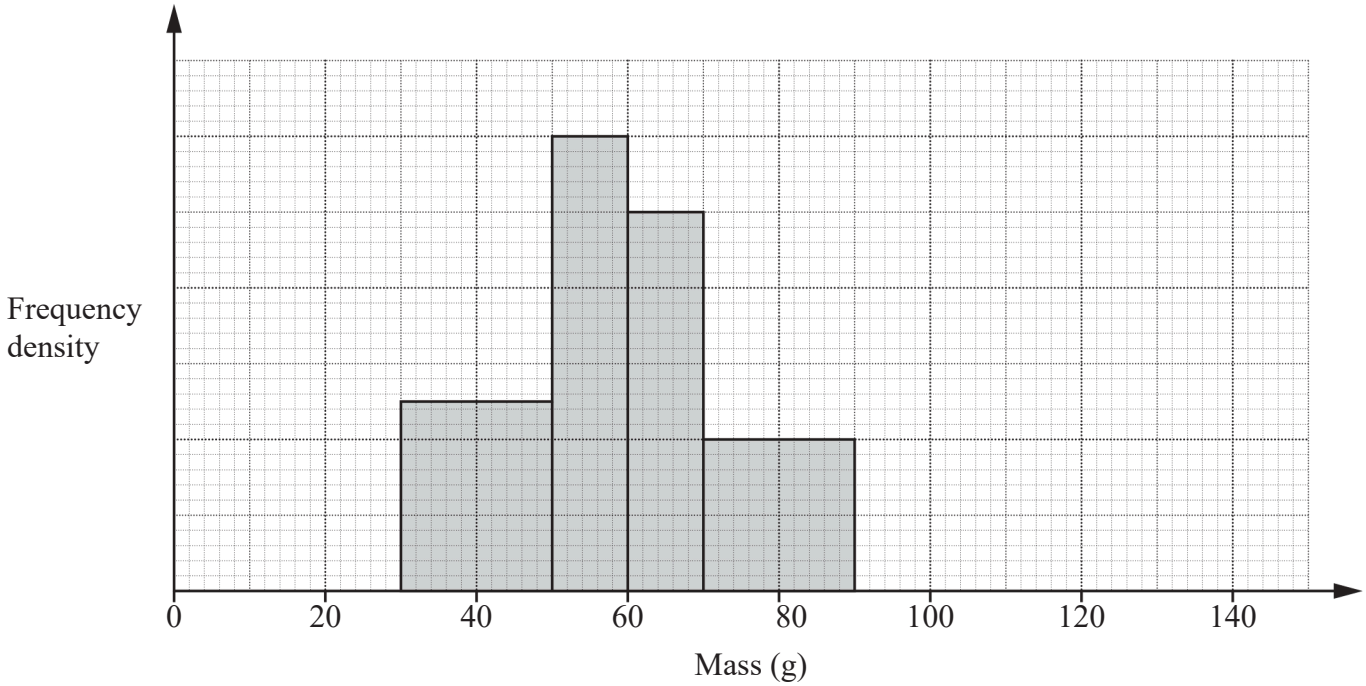
(c) The spinner is spun four times.

Determine the probability that the sum of the scores on the first two spins is exactly double the sum of the scores on the last two spins. **[2]**

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10 The masses, in grams, of a sample of potatoes were measured. All the potatoes had masses between 30 and 120 grams. A histogram was drawn to illustrate the results.

The diagram shows part of this histogram.



- The sample contained 545 potatoes.
- There were 150 potatoes in the 50 – 60 class.
- The block for the 90 – 120 class is omitted from the diagram.

(a) Show that the frequency for the 90 – 120 class is 45. **[3]**

(b) Calculate an estimate of the mean mass of the potatoes in the sample. **[2]**

(c) Explain why your answer is only an estimate. **[1]**

11 Hiro believes that on any given day 20% of the cars in a certain large car park in his town are blue.

In order to test this belief, Hiro chooses a random sample of 60 cars in the car park on a certain day and notes the number X which are blue.

(a) Assuming that Hiro's belief is correct, find P(X=12). **[1]**

Hiro finds that there are exactly 6 blue cars in his sample.

(b) (i) Use a suitable model to test Hiro's belief at the 5% significance level. **[7]**

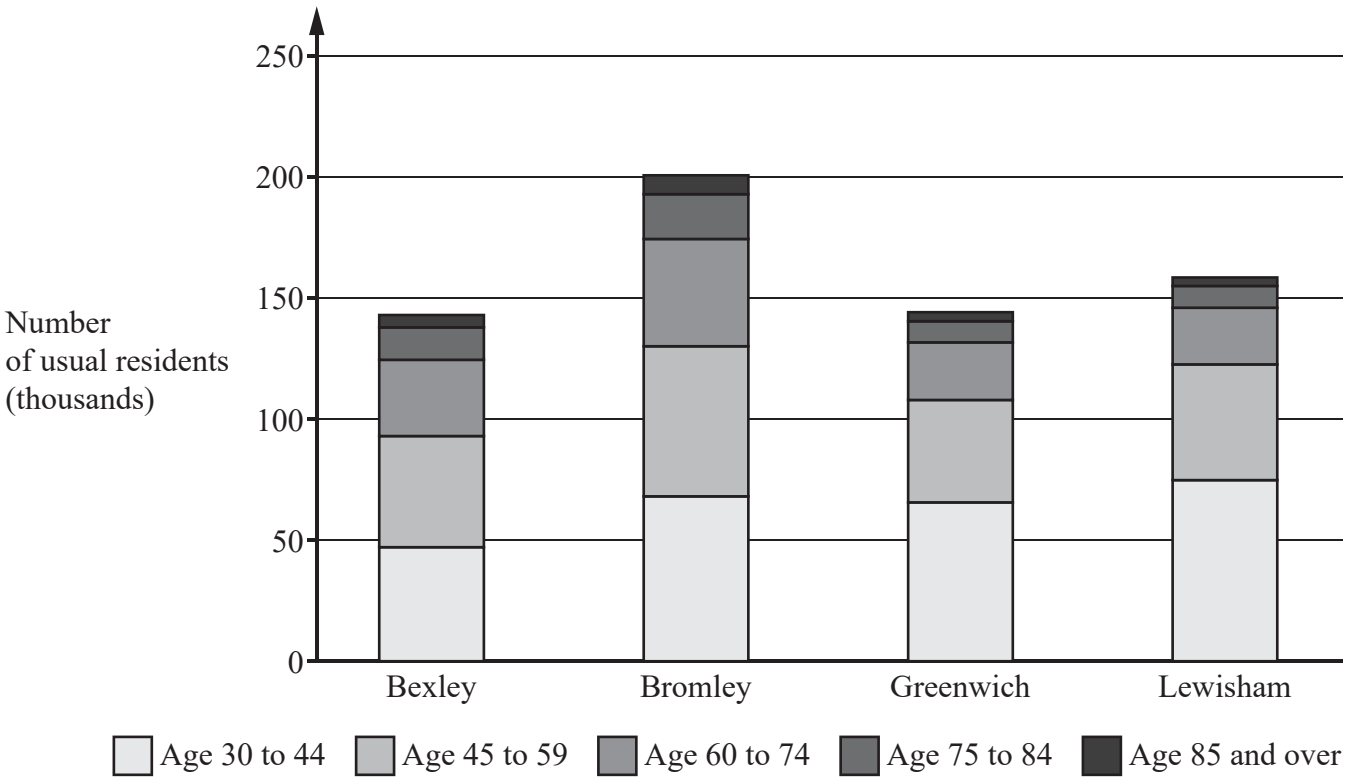
(ii) Hiro's sample of cars was chosen on a Saturday.

Explain whether this might affect the validity of the conclusion of the test. **[1]**

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9

12 The chart shows the distributions of ages of usual residents in four Local Authorities (LAs) in South East London in 2011. Residents of ages below 30 are omitted from the chart.



(a) (i) State **one** similarity between the **proportions** of usual residents in these age categories in the LAs of Bexley and Greenwich. **[1]**

(ii) State **one** difference between the **proportions** of usual residents in these age categories in the LAs of Bexley and Greenwich. **[1]**

In 2011 a director of a company intended to build a new care home for people aged 80 and over in one of these four LAs. The director estimated that it would take 5 years to build the new care home.

(b) Explain which of the four LAs the director should have chosen so as to meet the greatest demand for care home places in the first 15 years after the new care home opened. **[2]**

(c) State an assumption needed to justify your answer to part **(b)**. **[1]**

(d) Explain whether your answer to part **(b)** would change if the director considered the likely demand in the first 45 years after the new care home opened. **[1]**

END OF QUESTION PAPER

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