



Oxford Cambridge and RSA

# AS Level Mathematics A

H230/01 Pure Mathematics and Statistics

## Practice Paper – Set 1

Time allowed: 1 hour 30 minutes

**You must have:**

- Printed Answer Booklet

**You may use:**

- a scientific or graphical calculator

### INSTRUCTIONS

- Use black ink. HB pencil may be used for graphs and diagrams only.
- Complete the boxes provided on the Printed Answer Booklet with your name, centre number and candidate number.
- Answer **all** the questions.
- **Write your answer to each question in the space provided in the Printed Answer Booklet.** Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the barcodes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.
- The acceleration due to gravity is denoted by  $g \text{ m s}^{-2}$ . Unless otherwise instructed, when a numerical value is needed, use  $g = 9.8$ .

### INFORMATION

- The total mark for this paper is **75**.
- The marks for each question are shown in brackets [ ].
- **You are reminded of the need for clear presentation in your answers.**
- The Printed Answer Booklet consists of **16** pages. The Question Paper consists of **8** pages.

**Formulae**  
**AS Level Mathematics A (H230)**

**Binomial series**

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

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

**Differentiation from first principles**

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

**Standard deviation**

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

**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**

$$v = u + at$$

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

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

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

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

**Section A: Pure Mathematics**Answer **all** the questions.

- 1 Solve the simultaneous equations  $y = 2x$  and  $y = x^2 + 2x - 4$ . [4]

- 2 (i) Jack makes the following claim.

“If  $n$  is any positive integer, then  $3^n + 2$  is a prime number.”

Prove that Jack’s claim is incorrect. [3]

- (ii) Jill writes the following statement.

$$x = 3 \Leftrightarrow x^2 = 9$$

- (a) Explain why Jill’s statement is incorrect. [1]

- (b) Write a corrected version of Jill’s statement. [1]

- 3 Sanjeep invests £250 at 4% compound interest per annum. Interest is added at the end of each complete year.

- (i) What is Sanjeep’s investment worth after 5 years? [2]

- (ii) After how long will Sanjeep’s investment be worth £500? [3]

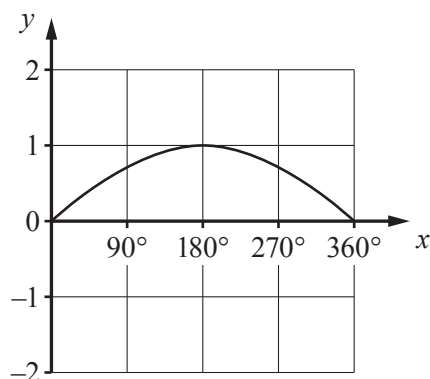
- (iii) State briefly a limitation of the model used in part (ii). [1]

- 4 In this question you must show detailed reasoning.

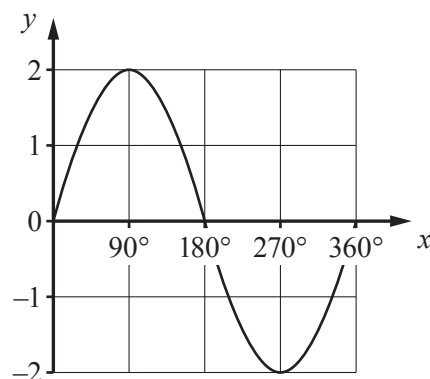
Solve the equation  $\tan 2x = -\sqrt{3}$  for  $0^\circ \leq x < 360^\circ$ . [5]

- 5 Each of the curves shown below is a transformation of part of the curve  $y = \sin x$ .

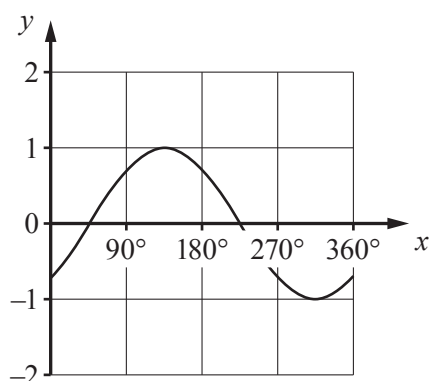
(i)



(ii)



(iii)



Write the equation of each curve in the Printed Answer Booklet.

[3]

- 6 (i) Find  $\int (x^3 - x^2 - 2x) dx$ .

[3]

(ii) In this question you must show detailed reasoning.

Find the area enclosed by the curve  $y = x^3 - x^2 - 2x$  and the positive  $x$ -axis.

[4]

- 7 The point  $A$  has position vector  $\mathbf{i} - 2\mathbf{j}$ . The point  $B$  is such that  $|\overrightarrow{OB}| = |\overrightarrow{OA}|$  and  $\overrightarrow{OB}$  is perpendicular to  $\overrightarrow{OA}$ .

(i) (a) Find  $|\overrightarrow{OB}|$ .

[2]

(b) Find the two possible directions of  $\overrightarrow{OB}$ , giving your answers correct to the nearest degree.

[2]

The point  $C$  is such that  $|\overrightarrow{AC}| = 2$ .

(ii) Find the maximum and minimum values of  $|\overrightarrow{OC}|$ .

[4]

- 8 Prove by exhaustion that if the sum of the digits of a 2-digit number is 5, then this 2-digit number is not a perfect square.

[3]

**9 In this question you must show detailed reasoning.**

A curve has equation  $y = f(x)$ , where  $f(x)$  is a quadratic polynomial in  $x$ . The curve passes through  $(0, 3)$  and  $(4, -13)$ . At the point where  $x = 3$  the gradient of the curve is  $-2$ . Find  $f(x)$ . [8]

**Section B: Statistics**

Answer **all** the questions.

- 10** Joanne has five cards, numbered 1, 1, 1, 2, 2. She picks two cards at random, without replacement. The variable  $X$  denotes the sum of the numbers on the two cards.

(i) Show that  $P(X = 3) = \frac{3}{5}$ . [2]

The table shows the probability distribution of  $X$ .

$x$	2	3	4
$P(X = x)$	$\frac{3}{10}$	$\frac{3}{5}$	$\frac{1}{10}$

Joanne replaces the two cards. Now Liam picks two cards at random from the five cards, without replacement. The variable  $Y$  denotes the sum of the numbers on the two cards that Liam picks.

(ii) Find  $P(X = Y)$ . [2]

- 11** Frances used the pre-release data set to produce the following table which shows information about the residents of Norwich in 2011.

Age	0 to 15	16 to 24	25 to 44	45 to 64	65 and over	Total
Number of residents	21 707	22 921	40 894	27 645	19 345	132 512

(i) State the upper class boundary of the “25 to 44” class. [1]

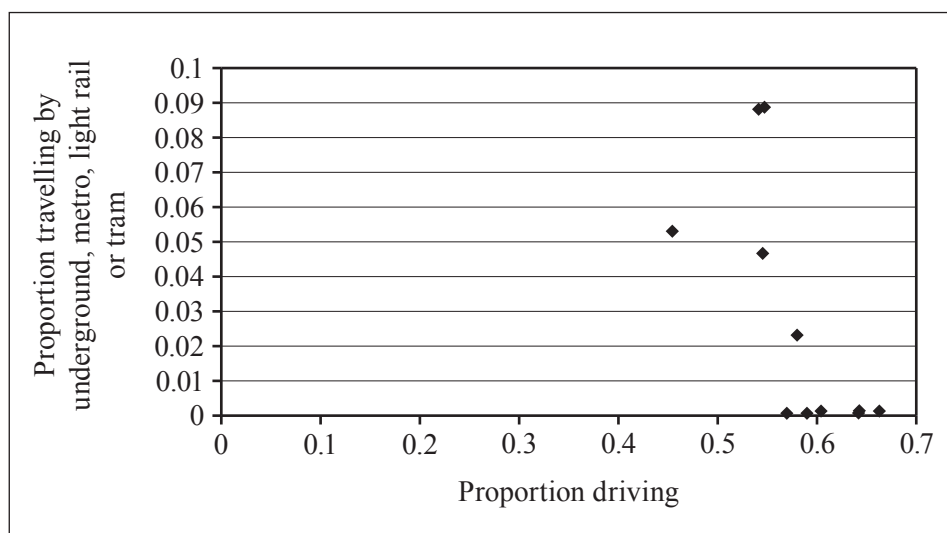
Frances used these data to calculate estimates of the mean and standard deviation of the ages of these residents. She assumed that the oldest resident was aged 105.

(ii) Calculate these estimates. [3]

(iii) Use these estimates to discuss whether there may be any outliers. [2]

(iv) Jacob suggested that more reliable estimates could be obtained by using the value 80 for the last class, instead of the midpoint. Explain, with a reason, whether you think this suggestion is a good one. [1]

- 12 (i) André throws a fair six-sided dice 30 times. The number of throws on which the score is six is denoted by  $X$ .
- (a) State a suitable model for  $X$ , including the values of any parameters. [1]
- (b) Find  $P(X = 9)$ . [1]
- (c) Find  $P(X \geq 9)$ . [2]
- (ii) André has another six-sided dice. He suspects that this dice is biased so that it is more likely to show a six than if it were fair. He throws the dice 30 times and it shows a six on 9 throws. Test at the 5% significance level whether André's suspicion is justified. [6]
- 13 The scatter diagram shows data taken from the pre-release data set for several Local Authorities in a region of the UK. The diagram shows, for each Local Authority, the proportion of workers driving to work, and the proportion travelling to work by underground, metro, light rail or tram.



- (i) On the diagram in the Printed Answer Booklet, identify the points corresponding to two distinct sections of the population represented in the diagram. [1]
- (ii) Suggest a reason why there are two distinct sections of the population represented by the points in the diagram. [1]
- The data for another local authority in this region can be represented by the point (0.62, 0.004).
- (iii) (a) To which of the two distinct sections of the population does this Local Authority belong? Explain your answer. [1]
- (b) What can you deduce about this Local Authority? [1]
- (iv) A student suggests that the Local Authority represented by the point (0.55, 0.089) is a non-metropolitan district. Comment on this suggestion. [1]

**END OF QUESTION PAPER**

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