OCR
Oxford Cambridge and RSA

AS Level Mathematics B (MEI)

H630/02 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.

INFORMATION
- The total number of marks for this paper is **70**.
- The marks for each question are shown in brackets **[ ]**.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is used. You should communicate your method with correct reasoning.
- The Printed Answer Booklet consists of **12** pages. The Question Paper consists of **8** pages.

Formulae AS Level Mathematics B (MEI) (H630)

Binomial series

$$(a+b)^n = a^n + {}^n\mathrm{C}_1 a^{n-1}b + {}^n\mathrm{C}_2 a^{n-2}b^2 + \ldots + {}^n\mathrm{C}_r a^{n-r}b^r + \ldots + b^n \qquad (n \in \mathbb{N}),$$

where ${}^n\mathrm{C}_r = {}_n\mathrm{C}_r = \binom{n}{r} = \dfrac{n!}{r!(n-r)!}$

$$(1+x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + \ldots + \frac{n(n-1)\ldots(n-r+1)}{r!}x^r + \ldots \qquad (|x| < 1,\ n \in \mathbb{R})$$

Differentiation from first principles

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

Sample variance

$$s^2 = \frac{1}{n-1}S_{xx} \text{ where } S_{xx} = \Sigma(x_i - \bar{x})^2 = \Sigma x_i^2 - \frac{(\Sigma x_i)^2}{n} = \Sigma x_i^2 - n\bar{x}^2$$

Standard deviation, $s = \sqrt{\text{variance}}$

The binomial distribution

If $X \sim \mathrm{B}(n, p)$ then $\mathrm{P}(X = r) = {}^n\mathrm{C}_r p^r q^{n-r}$ where $q = 1 - p$

Mean of X is np

Kinematics

Motion in a straight line

$$v = u + at$$

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

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

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

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

Answer **all** the questions

1 Given that $y = 6x + 3 - \frac{5}{x^2}$ find $\frac{dy}{dx}$. **[3]**

2 The maximum daytime temperature was recorded on each day in May 2016 at a weather station in Canada. The data are shown in the stem-and-leaf diagram below.

0	3
5	
10	0 0 1 3 3
15	0 1 1 2 3 4
20	0 0 1 2 2 3 3 4
25	0 0 1 2 2 2
30	0 0 2 2 3

key: 15 | 1 represents a temperature of 16 °C

(i) Describe the shape of the distribution. **[1]**

(ii) Find the interquartile range. **[2]**

(iii) Hence determine whether 3 is an outlier. **[2]**

3 You are given that $f(x) = 6x^3 - 25x^2 + 2x + 8$.

(i) Evaluate f(4). **[1]**

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

Express f(x) as the product of three linear factors. **[4]**

4 Expand $(2x - 3)^5$, writing each term in its simplest form. **[4]**

5 The discrete random variable X takes the values 0, 1, 2 and 3 only. You are given that

$$P(X = r) = k\,r!, \text{ where } k \text{ is a positive constant.}$$

(i) Show that $k = 0.1$. **[2]**

(ii) Find $P(X = 3)$. **[1]**

(iii) Calculate the probability of obtaining the value 3 exactly 16 times when 32 independent observations of X are made. **[2]**

6 Prove that $f(x) = x^3 - 3x^2 + 6x + 5$ is an increasing function for all real values of x. **[5]**

7 A recruitment company advertises vacancies on their website. Information on the salaries for 36 of these vacancies is given in Fig. 7. The data have been grouped.

Salary in thousands of pounds	20 –	25 –	30 –	35 –	40 –	45 –	50 – 55
Number of vacancies	3	6	6	12	3	3	3

Fig. 7

(i) For these salaries, calculate estimates of

- the mean,
- the sample standard deviation.

Give your answers to the nearest pound. **[4]**

(ii) Explain why your values are only estimates. **[1]**

(iii) Give a reason why it would not be appropriate to use the mean calculated in part **(i)** as an estimate of the mean salary for all vacancies in the country. **[1]**

(iv) Another vacancy has an annual salary of £52 573. This was not included in the table. Without further calculation, state how the mean salary would be affected if it were to be recalculated including this value. **[1]**

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

Mr. Evans is standing for re-election to the local council. At the last election 49% of voters voted for Mr. Evans, but it is thought that the level of support for Mr. Evans may have changed. A random sample of 38 voters are asked about their voting intentions and 13 say they intend to vote for Mr. Evans.

Carry out an appropriate hypothesis test at the 5% level to investigate whether or not the level of support for Mr. Evans has changed. **[7]**

9 A fisherman has collected statistics for the number of rod-caught salmon in England and Wales. He obtained the following results.

End of year	2004	2005	2006	2007	2008	2009	2015
Number of rod-caught salmon	28 193	21 418	18 776	17 556	16 243	14 526	11 261

Taking y as the number of rod-caught salmon and t as the time in completed years from 2003, the fisherman plotted the graph of $\log_{10} y$ against $\log_{10} t$. This is shown in Fig. 9. The relationship between $\log_{10} y$ and $\log_{10} t$ is modelled by the straight line with equation

$$\log_{10} y = -0.37 \log_{10} t + c.$$

This line is also shown in Fig. 9.

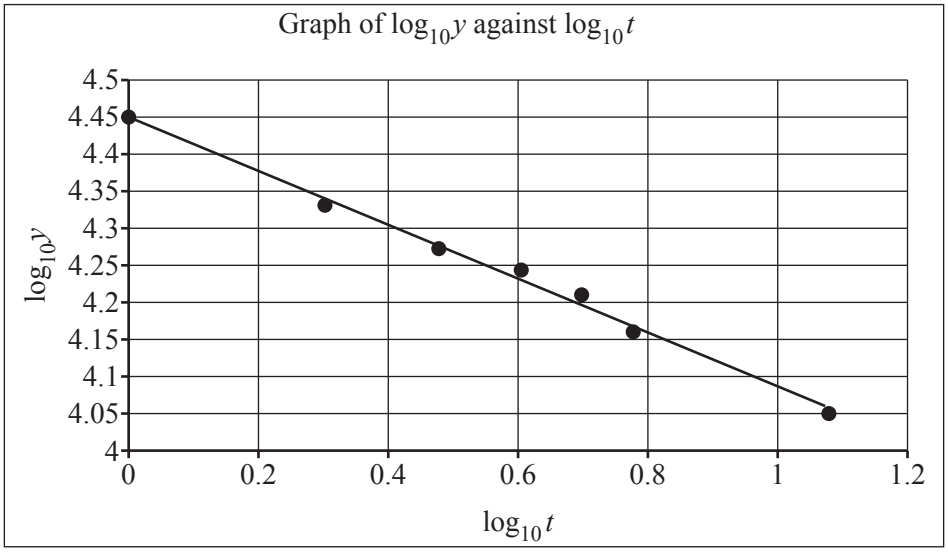

Fig. 9

(i) Use the graph to write down the value of c. **[1]**

(ii) Show that $y \approx 28\,200 t^{-0.37}$. **[3]**

(iii) Verify that the model works well for the year 2006. **[1]**

(iv) Use the model to estimate the number of rod-caught salmon in

(A) 2012, **[1]**

(B) 2025. **[1]**

(v) Comment on the reliability of your answers to part **(iv)**. **[2]**

10 A curve passes through the point $(4, 122)$ and its gradient is given by

$$\frac{dy}{dx} = 1 - \frac{4}{\sqrt{x}} + 6x^2.$$

Find the equation of the curve. **[5]**

11 The managing director of an international internet communications company wishes to investigate the number of internet users and the number of mobile phone users for different countries in Eastern Europe. He wishes to identify a country with the potential to increase the number of internet users so that he can consider investing in that country.

Fig. 11.1 shows all the countries of Eastern Europe.

Country (in Eastern Europe)	**Mobile phone subscribers (millions)**	**Internet users (millions)**
Albania	3.50	1.30
Belarus	10.68	2.64
Bosnia and Herzegovina	3.35	1.42
Bulgaria	10.78	3.40
Croatia	4.97	2.23
Czech Republic	12.97	6.68
Estonia	2.07	0.97
Hungary	11.58	6.18
Kosovo	0.56	missing
Moldova	4.08	1.33
Montenegro	1.13	0.28
Poland	50.84	22.45
Romania	22.70	7.79
Serbia	9.14	4.11
Slovakia	6.10	4.06
Slovenia	2.25	1.30
Ukraine	59.34	7.77

Source: CIA World Factbook

Fig. 11.1

(i) Are the countries in Fig. 11.1 a sample or a population? Explain your answer. **[1]**

(ii) These data have been used to construct the scatter diagram in Fig. 11.2. Use your knowledge of the large data set to comment on the correlation in the scatter diagram. **[2]**

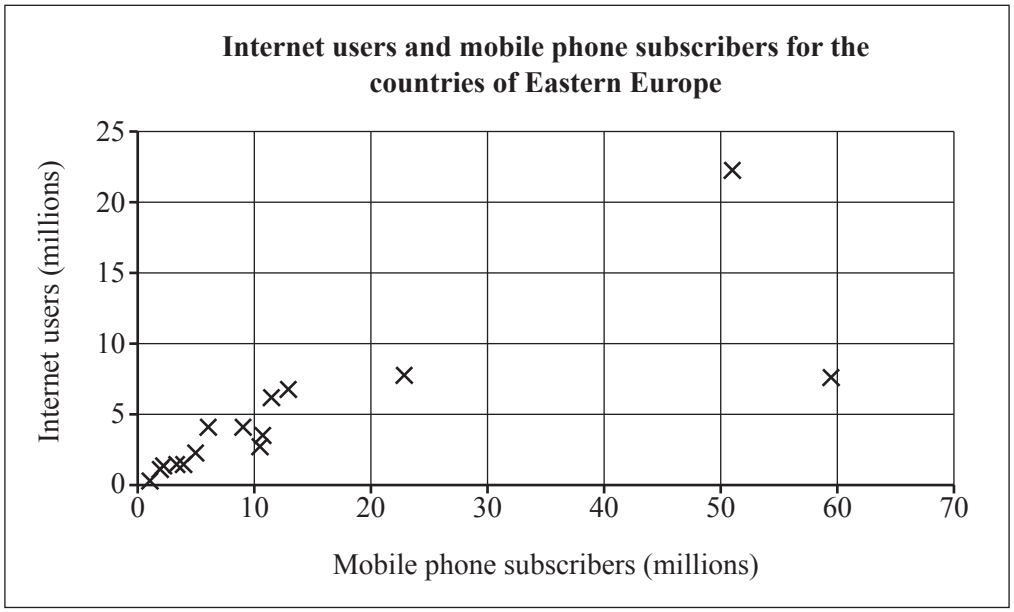

Fig. 11.2

(iii) Use the scatter diagram to identify a country that appears to have high potential to increase the number of internet users. Give a reason for your choice. **[2]**

(iv) Having decided on the country he wishes to invest in, the director will select a sample of 20 marketing consultants from that country to contact for information and advice. He has found a website listing 600 marketing consultants. Give clear instructions for the director on how to select a simple random sample of 20 marketing consultants from the 600. **[3]**

12 In this question you must show detailed reasoning.

Solve the equation

$$2\tan\theta + \cos\theta = 0$$

in the range $0° < \theta < 360°$. **[7]**

END OF QUESTION PAPER