Surname	
Other Names	
Candidate Signature	

Centre Number						Candidate Number				

Examiner Comments	

Total Marks

Mathematics

AS PAPER 1

CM

March Mock Exam (OCR Version) Time allowed: 1 hour and 30 minutes

Instructions to candidates:

• In the boxes above, write your centre number, candidate number, your surname, other names and signature.

• Answer ALL of the questions.

• You must write your answer for each question in the spaces provided.

• You may use a calculator.

Information to candidates:

• Full marks may only be obtained for answers to ALL of the questions.

• The marks for individual questions and parts of the questions are shown in square brackets.

• There are 12 questions in this question paper. The total mark for this paper is 75.

Advice to candidates:

• You should ensure your answers to parts of the question are clearly labelled.

• You should show sufficient working to make your workings clear to the Examiner.

• Answers without working may not gain full credit.

Section A: Pure Mathematics

Answer **all** the questions

1 Express $4x^2 + 4x + 3$ in the form $a(x + b)^2 + c$, where a, b and c are constants to be found. **[4]**

2 The point A has position vector $3\mathbf{i} - 4\mathbf{j}$ and the point B has position vector $a\mathbf{i} + 7\mathbf{j}$, where a is a constant.

Given that $\left|\overrightarrow{AB}\right| = 5\sqrt{5}$, find the largest possible value of the constant a. **[4]**

3 The curve C has the equation $y = \mathrm{f}(x)$, where $\mathrm{f}(x) = \tan(x - 40^\circ)$ for $0 \leq x \leq 360^\circ$.

(i) Solve the equation $\mathrm{f}(x) = 0$. **[2]**

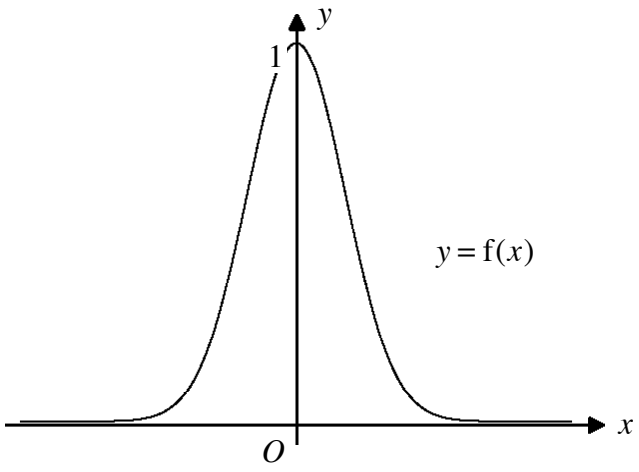
(ii) Find the coordinates where the curve C crosses the y-axis. **[1]**

(iii) Write down the equations of any asymptotes to the curve C. **[2]**

(iv) Sketch the curve C.

On your sketch, you should show clearly the coordinates of any points where the curve crosses or meets the coordinate axes and the equations of any asymptotes. **[2]**

4



The diagram above shows a sketch of the curve with equation $y = \mathrm{f}(x)$. The curve crosses the y-axis at the point $(0, 1)$.

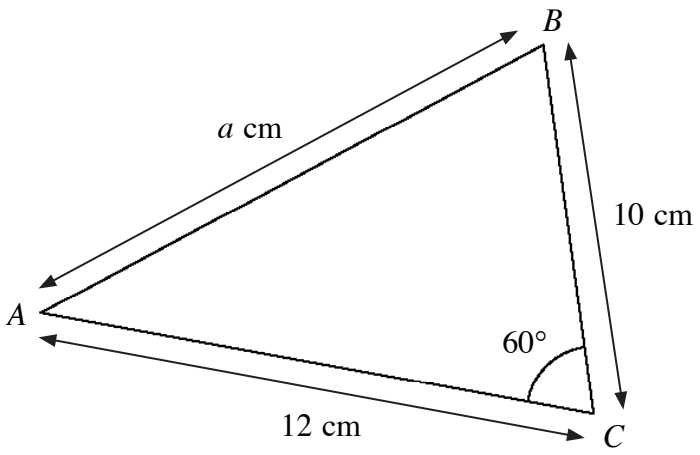
On separate axes, sketch the curves with equation

(i) $y = 2\mathrm{f}(x)$ **[2]**

(ii) $y = \mathrm{f}'(x)$ **[2]**

On each sketch, you should show clearly the coordinates of any points where the curve crosses or meets the coordinate axes.

5



The triangle ABC is shown in the diagram above, where angle $ACB = 60^{\circ}$, $AC = 12$ cm, $BC = 10$ cm, $AB = a$ cm and a is a constant.

(i) Find the area of the triangle ABC. Give your answer to one decimal place. **[2]**

(ii) Calculate the value of a. **[2]**

(iii) Given that the angle $BAC = x^{\circ}$, show that $\sin x = \dfrac{5\sqrt{93}}{2}$. **[1]**

Edward says,

"there are two possible values of x: either $x = \sin^{-1}\left(\dfrac{5\sqrt{93}}{62}\right)$ or $x = 180° - \sin^{-1}\left(\dfrac{5\sqrt{93}}{62}\right)$."

Edward's teacher says he is wrong and only one of these values is correct in this case.

(iv) (a) Identify the correct value of x. **[1]**

(b) Show that Edward's incorrect angle does not work. **[1]**

6 The curves C_1 and C_2 have the equations $y = 5^{x^2}$ and $y = 4^{k-6x}$ respectively, where k is a constant.

(i) Show that x coordinates of the points of intersection between C_1 and C_2 satisify

$$(\log 5)x^2 + (6\log 4)x - k\log 4 = 0$$

[4]

(ii) Given that the curves C_1 and C_2 do not intersect, show further that

$$k < \frac{9\log 0.25}{\log 5}$$

[3]

7 **(a)** Given that

$$\frac{dy}{dx} = x^3 - \frac{1}{\sqrt{x}}, \quad x > 0$$

and that when $x = 1$, $y = 4$, express y in terms of x. **[6]**

(b) Jessie proposes that given any two functions f and g, $\int_0^1 \mathrm{f}(x)\mathrm{g}(x)dx = \int_0^1 \mathrm{f}(x)dx \int_0^1 \mathrm{g}(x)dx$

By choosing suitable functions for f and g, show that Jessie's claim is false. **[3]**

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

The curve C_1 has the equation $y = \mathrm{f}(x)$ where $\mathrm{f}(x) = x^2 - 3\sqrt{x^3} + 4, \quad x > 0$.

The line l is a normal to the curve C_1 when $x = 4$.

(i) Find the equation of the line l. Give your answer in the form $y = mx + c$. **[5]**

The curve C_2 has the equation $y = \mathrm{g}(x)$ where $\mathrm{g}(x) = 4x^3 + qx^2 - 2x + 10$ and q is a constant.

(ii) Given that l is a tangent to C_2 at $x = -1$, find the value of q. **[4]**

Section B: Statistics

Answer **all** the questions

9 The random variable Y has the probability function

$$P(Y = y) = \begin{cases} k^{-1}y & y = 1,\ 2,\ 3 \\ 0 & \text{otherwise} \end{cases}$$

(i) Find the value of the constant k. **[2]**

(ii) Calculate $P(-2 \leq Y \leq 2.5)$. **[1]**

10 Harvey used some data from the 2011 UK census to compare the age structure between E06, E07, E08 and E09 Local Authorites. He picks one Local Authority from each of these different groups and records their population and mean age. His results are shown in the table below.

Local Authority	Group	Population	Mean Age
Derby	E06	248 752	37.6
Warwick	E07	137 648	38.5
Birmingham	E08	1 073 045	35.3
Havering	E09	237 232	40.4

Harvey's data is a sample of the census.

(i) State **one** advantage of Harvey using a sample of the available data points. **[1]**

Harvey claims that his data suggests that metropolitan boroughs in England have the lowest life expectancy.

(ii) Use the data to give one reason to support Harvey's claim. **[1]**

(iii) Comment on the reliability of Harvey's claim. **[1]**

Jemma wants to use the 2011 UK census to compare the proportion of individuals using the **underground** in London boroughs. She wants to take a simple random sample of the data from 10 of the London boroughs in the data set, which she will then process.

(iv) Explain why the 2011 UK census does not have exactly the information Jemma wants. **[1]**

(v) Describe how Jemma can use random numbers to generate her simple random sample. **[2]**

11 Jasmine records the speed of cars, in miles per hour (mph), on a stretch of a UK motorway. Her results are given in the table below.

Speed (s mph)	Frequency (f)	Speed midpoint (x)
$40 \leq s < 55$	67	47.5
$55 \leq s < 65$	102	60
$65 \leq s < 70$	255	67.5
$70 \leq s < 75$	483	72.5
$75 \leq s < 85$	192	80

$\left(\text{You may use } \sum x^2 f = 5\ 447\ 781.25.\right)$

A histogram has been drawn to represent these data.

The bar representing the speed $55 \leq s < 65$ has width 2 cm and height 4 cm.

(i) Calculate the width and height of the bar representing the speed $65 \leq s < 70$. **[2]**

(ii) (a) Show that the mean speed of the cars on the motorway is 70 mph. **[1]**

(b) Find an estimate for the standard deviation of the speeds of the cars on the motorway. **[2]**

Jasmine thinks she has miscounted and left out a number of cars that were travelling at 70 mph from the table. She wants to include these missing data points into the calculation of the mean and standard deviation.

(iii) Without further calculations, state, giving a reason, what effect including these data points will have on your estimate of the standard deviation. **[1]**

12 **(i)** State **two** conditions for a random variable X to have a binomial distribution. **[1]**

In a regular deck of cards, the probability of taking a clubs card is a quarter.

Jeremy takes a deck of cards. Jeremy takes, at random, 32 cards from the deck. He writes down whether the card is a clubs card or not. After each individual card selection, the card is replaced and the deck is shuffled before the next card is picked. Jeremy suspects that the deck is not a regular deck of cards. Jeremy found that 14 of the 32 cards randomly selected from the deck were clubs cards.

(ii) Test Jeremy's suspicion at the 5% level of significance. You should state your hypotheses clearly and the p-value of the test. **[7]**

It turns out that after Jeremy forgot to shuffle the deck after several card selections from the deck.

(iii) Comment on the validity of the model used to obtain the answer to part **(ii)**, giving a reason for your answer. **[1]**

END OF QUESTION PAPER