Surname	
Other Names	
Candidate Signature	

Centre Number						Candidate Number				

Examiner Comments		Total Marks

MATHEMATICS

AS PAPER 1

CM

December Mock Exam (Edexcel Version)

Time allowed: 2 hours

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 round brackets.
- There are 14 questions in this question paper. The total mark for this paper is 100.

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.

AS/P1/D17

1 2 3 3 2 2 1 2 8 D 1 7 4

1 The equation $kx^2 + (3-k)x - 4 = 0$ has two equal roots.

Find the possible values of the constant k. **(3)**

2 Solve the equation

$$a^{\frac{1}{2}} + \sqrt{4a} = 3$$

(3)

3 **Figure 1** shows a sketch of the curve with equation $y = f(x)$.

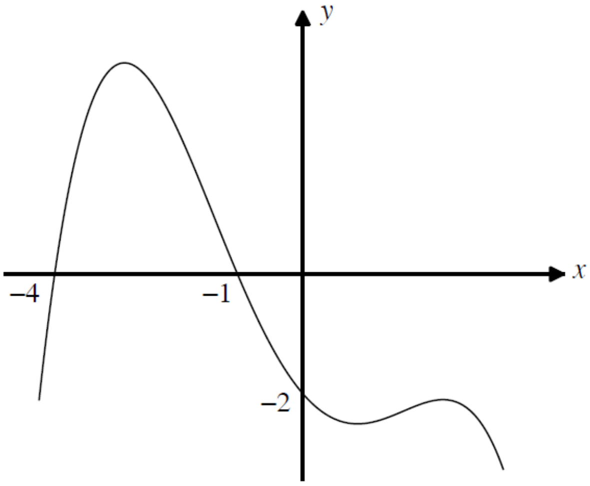

Figure 1

On separate axes, sketch the curves with equation

(i) $y = \frac{1}{2}f(x)$ **(3)**

(ii) $y = f(-x)$ **(3)**

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

4 Three vectors **p**, **q** and **r** are defined such that

$$\mathbf{p} = 12\mathbf{i} - a\mathbf{j}$$

$$\mathbf{q} = 6\mathbf{i} + (9 - 5a)\mathbf{j}$$

$$\mathbf{r} = \mathbf{q} - \mathbf{p}$$

where **i** and **j** are perpendicular unit vectors.

Given that **p** and **q** are parallel vectors,

(a) find the value of the constant a. **(3)**

(b) Find $|\mathbf{r}|$. **(3)**

5 The curve C has the equation $y = \mathrm{f}(x)$, where $\mathrm{f}(x) = px - 18\sqrt{x}$, $x \geq 0$, and p is a constant.

Figure 2 shows a sketch of the curve C.

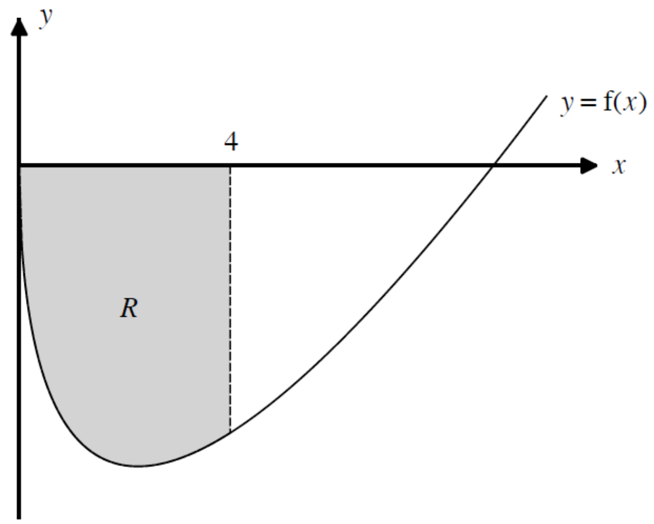

Figure 2

The region R, shown shaded in **Figure 2**, is bounded by the curve, the x axis and the line $x = 4$.

Given that the **area** of the region R is 48 units^2,

(a) find the value of p. **(5)**

(b) Use calculus to find the coordinates of the minimum point on the curve C. **(4)**

(c) Using further differentiation, verify that the point found in (b) is a minimum. **(3)**

6

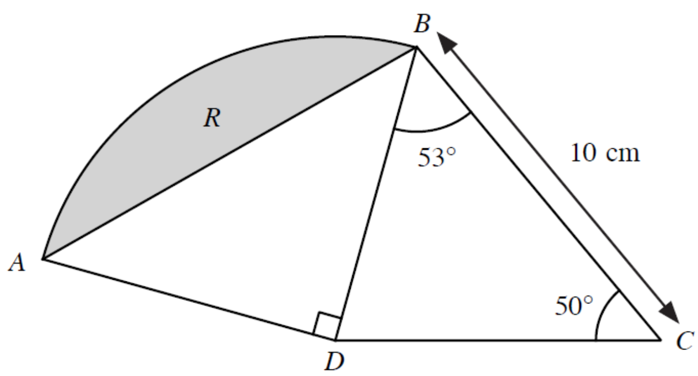

Figure 3

The shape $ABCDA$, as shown in **Figure 3**, consists of a triangle BCD joined to a sector ABD of a circle with centre D.

Angle $DBC = 53°$, angle $BCD = 50°$ and $BC = 10$ cm.

(a) Find the length of AD. **(2)**

(b) Find the area of the shaded region R. **(3)**

(c) Calculate the perimeter of the shape $ABCDA$. Give your answer to one decimal place. **(4)**

7 (a) In descending powers of x, find the first four terms in the binomial expansion of

$$\left(2-\frac{1}{\sqrt{x}}\right)^8$$

giving each term in its simplest form. **(5)**

(b) Bernoulli's inequality states that

$$(1+x)^r \geq 1+rx$$

for all integers $r \geq 0$ and every real number $x \geq -1$.

(i) By using the binomial theorem on $(1+x)^r$, prove Bernoulli's inequality for $x > 0$. **(2)**

(ii) Verify Bernoulli's inequality for the case $x = 0$. **(1)**

(iii) Use a counter-example to show that Bernoulli's inequality is not valid for $x < -1$. **(2)**

8 (i) The function f is defined such that

$$\mathrm{f}(x) = ax^b$$

where a and b are constants.

Given that the curve with equation $y = \mathrm{f}(x)$ passes through the points (4, 5) and (8, 12), find the values of a and b. **(4)**

(ii) The table below shows the atomic number n and the melting point (y degrees Celsius) for some alkali metals.

Metal	Lithium	Sodium	Potassium	Rubidium	Caesium
n	3	11	19	37	55
y	180.5	97.8	63.7	38.9	28.5

A graph of ln(y) against ln(n) is produced using these data. A line of best fit is then drawn for these data and it passes through the points (5, 2.79) and (45, – 22.77).

(a) Express y in terms of n. **(4)**

Francium is also an alkali metal. The atomic number of Francium is 87.

(b) Using your answer to (a), estimate the melting point of Francium. **(2)**

(c) Comment on the reliability of your estimate in (b). **(1)**

9 The curve C has the equation $y = \mathrm{f}(x)$, where

$$\mathrm{f}(x) = -2x^3 + 9x^2 - x - 12$$

(a) Show that the curve C crosses the x axis when $x = 4$. **(1)**

(b) Express f(x) as a product of three linear factors. **(4)**

(c) Sketch the curve with equation $y = \mathrm{f}(x)$.

On your sketch, show clearly the coordinates of any points where the curve C crosses or meets the coordinate axes. **(3)**

(d) Find all the solutions to the equation

$$-2(x-4)^3 + 9(4-x)^2 - (x-4) - 12 = 0$$

(2)

10 The curve C has the equation $y = g(x)$ and is defined such that

$$\frac{dy}{dx} = \frac{16x^3 - 9x}{x(3-4x)},\ x > 1$$

Given that the curve passes through the point $(2, -12)$, find the values of a, b and c such that

$$g(x) = a(x-b)^2 + c$$

(7)

11 The straight line l is perpendicular to the line $qx = -2y + 4$, where q is a constant.

(a) Find, in terms of q, the gradient of the line l. **(2)**

The curve C has the equation $y = \dfrac{1}{x^2} + \dfrac{3\sqrt{x}}{p}$, where p is a constant and x is positive. The tangent to the curve C at $x = 1$ is parallel to l.

(b) Express p in terms of q. **(5)**

12 (a) Solve the equation $\cos\theta = -0.3$ for $-180° \le \theta \le 360°$. **(3)**

(b) (i) Prove that $a^3 - b^3 = (a-b)(a^2 + ab + b^2)$. **(1)**

(ii) Hence, show that

$$\frac{1+\sin x\cos x}{\cos^3 x - \sin^3 x} + \frac{1}{\cos x + \sin x} \equiv \frac{2\cos x}{\cos^2 x - \sin^2 x}$$

(3)

(iii) Deduce that

$$\frac{1+\sin x\cos x}{\cos^3 x - \sin^3 x} + \frac{1}{\cos x + \sin x} + \frac{\sin^2 x - 2\cos x - 1}{\cos^2 x - \sin^2 x} \equiv \frac{1}{\tan^2 x - 1}$$

(3)

13 (a) Prove, from first principles, that

$$\frac{d}{dx}\left(x^3\right) = 3x^2$$

(3)

(b) By considering derivatives, or otherwise, evaluate

$$\lim_{h \to 0} \frac{(x+h)^3 - x^3}{\sqrt{x+h} - \sqrt{x}}$$

(3)