IYGB GCE

Mathematics MP2

Advanced Level

Practice Paper K

Difficulty Rating: 4.00/1.400

Time: 2 hours

Candidates may use any calculator allowed by the regulations of this examination.

Information for Candidates

This practice paper follows closely the Pearson Edexcel Syllabus, suitable for first assessment Summer 2018.

The standard booklet "Mathematical Formulae and Statistical Tables" may be used.
Full marks may be obtained for answers to ALL questions.
The marks for the parts of questions are shown in round brackets, e.g. **(2)**.
There are 11 questions in this question paper.
The total mark for this paper is 100.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You must show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.
Non exact answers should be given to an appropriate degree of accuracy.
The examiner may refuse to mark any parts of questions if deemed not to be legible.

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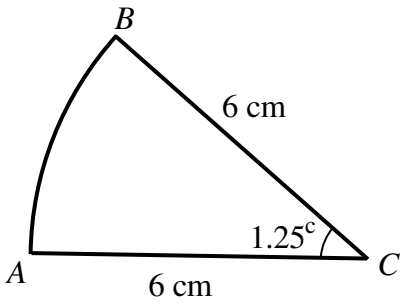
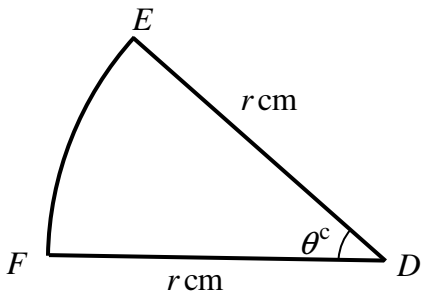
Question 1



The figure above shows a circular sector ABC of radius 6 cm subtending an angle 1.25 radians at C.

a) Find the perimeter and the area of the sector. **(4)**

A **different** sector DEF has radius r cm and subtends an angle of θ radians at its centre D.



b) Given that the two sectors have equal area but the perimeter of the sector DEF is 1.5 cm larger than the perimeter of the sector ABC, determine the possible values of r and the corresponding values of θ. **(6)**

Question 2

a) **Use the trapezium rule** with 6 equally spaced strips to find an estimate, correct to 3 decimal places, for

$$\int_0^{1.2} \sin^2 x \ dx . \qquad (3)$$

b) **Use the answer of part (a)** to find an estimate for

$$\int_0^{1.2} \cos 2x \ dx . \qquad (3)$$

c) **Use the answer of part (b)** to find an estimate for

$$\int_0^{1.2} \left[\cos^4 x - \sin^4 x \right] dx . \qquad (4)$$

Question 3

The points $A(-3,-14,-5)$ and $B(1,-4,-1)$ are referred relative to a fixed origin O.

The point C is such so that ABC forms a straight line.

Given further that $\dfrac{\left|\overrightarrow{AB}\right|}{\left|\overrightarrow{BC}\right|} = \dfrac{2}{5}$, determine the coordinates of C. (4)

Question 4

The functions f and g are defined as

$$f(x) = x^2 - 16,\ x \in \mathbb{R},\ x < 0$$

$$g(x) = 12 - \frac{1}{2}x,\ x \in \mathbb{R},\ x > 8.$$

a) Find, in any order, ...

i. ... the range of $f(x)$ and the range of $g(x)$. **(2)**

ii. ... the domain and range of $fg(x)$. **(3)**

b) Solve the equation

$$fg(x) = f(2x - 22).$$ **(6)**

Question 5

$$\cos(A+B) \equiv \cos A \cos B - \sin A \sin B$$
$$\cos(A-B) \equiv \cos A \cos B + \sin A \sin B$$

a) By using the above identities show that

$$\cos P - \cos Q \equiv -2\sin\left(\frac{P+Q}{2}\right)\sin\left(\frac{P-Q}{2}\right).$$ **(4)**

a) Hence, prove by first principles that

$$\frac{d}{dx}(\cos x) = -\sin x$$ **(6)**

Question 6

$$f(x)=\left(\frac{1}{2}-x\right)^{-3},\quad |x|<\frac{1}{2}.$$

a) Expand $f(x)$, up and including the term in x^3. **(4)**

$$g(x)=\frac{a+bx}{\left(\frac{1}{2}-x\right)^3}.$$

The coefficients of x^2 and x^3 in the expansion of $g(x)$ are 42 and 136 respectively.

b) Show that $a=\frac{1}{4}$ and find the value of b. **(7)**

Question 7

$$y=\arcsin x,\ -1\le x\le 1.$$

a) By expressing $\arccos x$ in terms of y, show that

$$\arcsin x+\arccos x=\frac{\pi}{2}. \qquad \textbf{(3)}$$

b) Hence, or otherwise, solve the equation

$$3\arcsin(x-1)=2\arccos(x-1). \qquad \textbf{(4)}$$

Question 8

Use partial fractions to determine, in exact simplified form, the value of the following integral.

$$\int_0^{\frac{1}{2}} \frac{2x^3-5x^2+5}{\left(x^2-3x+2\right)\left(x^2-2x+1\right)}\,dx. \qquad \textbf{(10)}$$

Question 9

Ladan is repaying an interest free loan of £6200 over a period of n months, in such a way so that her monthly repayments form an arithmetic series.

She repays £350 in the first month, £340 in the second month, £330 in the third month and so on until the full loan is repaid.

Determine, showing a full algebraic method, the value of n. **(7)**

Question 10

The shape of a weather balloon remains spherical at all times. It is filled with a special type of gas and is floating at very high altitude. Gas started escaping from its valve so that the rate at which its surface area is decreasing is directly proportional to the square of its surface area at that time.

Let V m^3 be the volume of the balloon, t hours since $V = 1000$.

a) By relating the volume, the surface area and the radius of the weather balloon show that

$$\frac{dV}{dt} = -kV^{\frac{5}{3}},$$

where k is a positive constant.

$\left[\text{volume of a sphere of radius } r \text{ is given by } \frac{4}{3}\pi r^3\right]$

$\left[\text{surface area of a sphere of radius } r \text{ is given by } 4\pi r^2\right]$ **(4)**

When $t = 20$, $V = 729$.

b) Determine the value of t when $V = 512$. **(6)**

Question 11

$$y = 2x \arcsin 2x + \sqrt{1-4x^2}\ ,\ -\frac{1}{2} \le x \le \frac{1}{2}\,.$$

Show clearly that

$$\frac{d^3y}{dx^3}\left(y - x\frac{dy}{dx} \right) = x\left(\frac{d^2y}{dx^2} \right)^2 . \qquad \textbf{(10)}$$
