H

National
Qualifications
EXEMPLAR PAPER ONLY

EP30/H/01

Mathematics
Paper 1
(Non-Calculator)

Date — Not applicable

Duration — 1 hour and 10 minutes

Total marks — 60

Attempt ALL questions.

You may NOT use a calculator.

Full credit will be given only to solutions which contain appropriate working.

State the units for your answer where appropriate.

Write your answers clearly in the answer booklet provided. In the answer booklet you must clearly identify the question number you are attempting.

Use **blue** or **black** ink.

Before leaving the examination room you must give your answer booklet to the Invigilator; if you do not you may lose all the marks for this paper.

EP30H01

FORMULAE LIST

Circle:

The equation $x^2 + y^2 + 2gx + 2fy + c = 0$ represents a circle centre $(-g, -f)$ and radius $\sqrt{g^2 + f^2 - c}$.

The equation $(x - a)^2 + (y - b)^2 = r^2$ represents a circle centre (a, b) and radius r.

Scalar Product: $\mathbf{a.b} = |\mathbf{a}||\mathbf{b}| \cos \theta$, where θ is the angle between $\mathbf{a}$ and $\mathbf{b}$

or $\mathbf{a.b} = a_1b_1 + a_2b_2 + a_3b_3$ where $\mathbf{a} = \begin{pmatrix} a_1 \\ a_2 \\ a_3 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} b_1 \\ b_2 \\ b_3 \end{pmatrix}$.

Trigonometric formulae:

$$
\begin{aligned}
\sin (A \pm B) &= \sin A \cos B \pm \cos A \sin B \\
\cos (A \pm B) &= \cos A \cos B \mp \sin A \sin B \\
\sin 2A &= 2\sin A \cos A \\
\cos 2A &= \cos^2 A - \sin^2 A \\
&= 2\cos^2 A - 1 \\
&= 1 - 2\sin^2 A
\end{aligned}
$$

Table of standard derivatives:

$f(x)$	$f'(x)$
$\sin ax$	$a \cos ax$
$\cos ax$	$-a \sin ax$

Table of standard integrals:

$f(x)$	$\int f(x)dx$
$\sin ax$	$-\frac{1}{a}\cos ax + C$
$\cos ax$	$\frac{1}{a}\sin ax + C$

MARKS

Total marks — 60

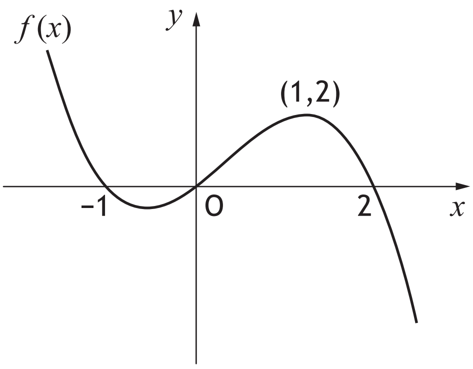
Attempt ALL questions

1. The point P (5,12) lies on the curve with equation $y = x^2 - 4x + 7$.

Find the equation of the tangent to this curve at P. **3**

2. The diagram shows the curve with equation $y = f(x)$, where $f(x) = kx(x+a)(x+b)$.

The curve passes through (-1,0), (0,0), (1,2) and (2,0).



Find the values of a, b and k. **3**

3. Evaluate $\int_1^2 \frac{1}{6}x^{-2}\, dx$. **3**

4. For the function $f(x) = 2 - 3\sin\left(x - \frac{\pi}{3}\right)$ in the interval $0 \leq x < 2\pi$, determine which two of the following statements are true **and justify your answer**. **3**

Statement A The maximum value of $f(x)$ is -1.

Statement B The maximum value of $f(x)$ is 5.

Statement C The maximum value occurs when $x = \frac{5\pi}{6}$.

Statement D The maximum value occurs when $x = \frac{11\pi}{6}$.

MARKS

5. For the polynomial, $x^3 - 4x^2 + ax + b$

- $x - 1$ is a factor
- -12 is the remainder when it is divided by $x - 2$

(a) Determine the values of a and b. **4**

(b) Hence solve $x^3 - 4x^2 + ax + b = 0$. **4**

6. (a) Find the equation of l_1, the perpendicular bisector of the line joining P $(3,-3)$ and Q $(-1,9)$. **4**

(b) Find the equation of l_2 which is parallel to PQ and passes through R $(1,-2)$. **2**

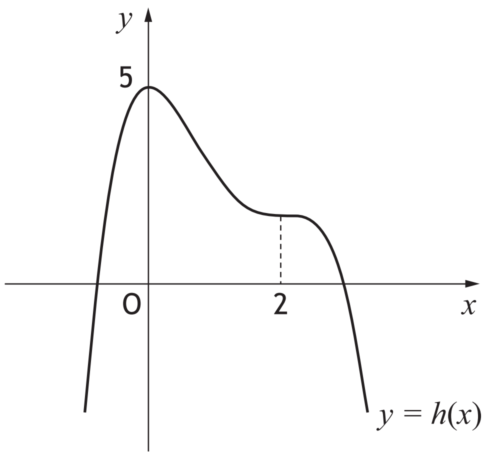
(c) Find the point of intersection of l_1 and l_2. **3**

(d) Hence find the shortest distance between PQ and l_2. **2**

7. (a) Solve $\cos 2x° - 3\cos x° + 2 = 0$ for $0 \leq x < 360$. **5**

(b) Hence solve $\cos 4x° - 3\cos 2x° + 2 = 0$ for $0 \leq x < 360$. **2**

8. The diagram below shows the graph of a quartic $y = h(x)$, with stationary points at $x = 0$ and $x = 2$.



On separate diagrams sketch the graphs of:

(a) $y = 2 - h(x)$. **3**

(b) $y = h'(x)$. **3**

MARKS

9. The expression $\cos 4x - \sqrt{3}\sin 4x$ can be written in the form $k\cos(4x + a)$ where $k > 0$ and $0 \leq a \leq 2\pi$.

(a) Calculate the values of k and a. **4**

(b) Find the points of intersection of the graph of $y = \cos 4x - \sqrt{3}\sin 4x$ with the x axis, in the interval $0 \leq x \leq \frac{\pi}{2}$. **3**

10. The gradient of a tangent to a curve is given by $\frac{dy}{dx} = 3\cos 2x$.

The curve passes through the point $\left(\frac{7\pi}{6}, \sqrt{3}\right)$.

Find y in terms of x. **4**

11. Functions f and g are defined on suitable domains by $f(x) = x^3 - 1$ and $g(x) = 3x + 1$.

(a) Find an expression for $k(x)$, where $k(x) = g(f(x))$. **2**

(b) If $h(k(x)) = x$, find an expression for $h(x)$. **3**

[END OF EXEMPLAR QUESTION PAPER]