**Mathematics**

**Practice Paper I**

**Paper 1**

**Assessing Units 1, 2 & 3**

NATIONAL QUALIFICATIONS

**Time allowed - 1 hour 30 minutes**

**Read carefully**

**Calculators may NOT be used in this paper.**

**Section A - Questions 1 - 20 (40 marks)**

Instructions for the completion of **Section A** are given on the next page.

For this section of the examination you should use an **HB pencil**.

**Section B (30 marks)**

1. Full credit will be given only where the solution contains appropriate working.
2. Answers obtained by readings from scale drawings will not receive any credit.

**FORMULAE LIST**

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

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

Scalar Product: $\quad a \cdot b = |a||b|\cos\theta$, where $\theta$ is the angle between $a$ and $b$.

or

$$a \cdot b = a_1b_1+a_2b_2+a_3b_3 \quad \textit{where} \quad a = \begin{pmatrix} a_1 \\ a_2 \\ a_3 \end{pmatrix} \quad \textit{and} \quad b = \begin{pmatrix} b_1 \\ b_2 \\ b_3 \end{pmatrix}$$

Trigonometric formulae:

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

Table of standard derivatives:

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

Table of standard integrals:

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

**All questions should be answered**

**Section A**

**1.** A, B, C and D are the points (3, 2), (2, 3), $(-2, -1)$ and ($p$, 5) respectively. If AB is parallel to CD, the value of $p$ is

**A.** $-8$

**B.** $-4$

**C.** $8$

**D.** $-\frac{1}{4}$

**2.** The minimum turning point of the graph of the parabola $y = 2x^2 - 6x + 11$ is

**A.** $(1\cdot 5,\ 6\cdot 5)$

**B.** $(-1\cdot 5,\ 6\cdot 5)$

**C.** (3, 2)

**D.** $(1\cdot 5,\ 8\cdot 75)$

**3.** The range of values of $x$ for which the function $f(x) = x^2 + 4x - 5$ is decreasing is

**A.** $x < -2$

**B.** $x > -2$

**C.** $x < 2$

**D.** $x > 2$

**4.** The point A$(-3, 2)$ lies on the graph with equation $y = f(x)$.

If the graph of the related function $y = f(x+2) - 3$ is drawn, the image of point A will be

**A.** (0, 4)

**B.** $(-6, 4)$

**C.** $(-5, -1)$

**D.** $(-1, -1)$

**5.** The gradient of the tangent to the curve $y = 5x - 2x^2$ at the point $(2, -2)$ is

**A.** $-2$

**B.** $-18$

**C.** $-3$

**D.** $13$

**6.** The two sequences defined by the recurrence relations $U_{n+1} = 0 \cdot 2U_n + p$ and $V_{n+1} = 0 \cdot 3V_n + q$ have the same limit. When $p$ is expressed in terms of $q$, $p$ equals

**A.** $\frac{7}{8}q$

**B.** $\frac{8}{7}q$

**C.** $\frac{2}{3}q$

**D.** $\frac{3}{2}q$

**7.** When $x^4 + px^3 - 5x + 11$ is divided by $x - 3$ the remainder is $-4$. The value of $p$ is

**A.** $0$

**B.** $-1$

**C.** $-4$

**D.** $-3$

**8.** How many real roots does the equation $(x-2)(x^2 - x + 7) = 0$ have?

**A.** none

**B.** 1

**C.** 2

**D.** 3

**9.** $\int_{-4}^{4} x \; dx$ equals

**A.** 16

**B.** 8

**C.** 0

**D.** 1

**10.** The equation of the circle with centre $(-3, 1)$ and radius 5 is

**A.** $(x+3)^2 + (y-1)^2 = 25$

**B.** $(x+3)^2 + (y-1)^2 = 5$

**C.** $(x-3)^2 + (y+1)^2 = 25$

**D.** $(x-3)^2 + (y+1)^2 = 5$

**11.** The gradient of the tangent to the circle $x^2 + y^2 = 41$ at the point $(-5, 4)$ is

**A.** $-\frac{5}{4}$

**B.** $\frac{5}{4}$

**C.** $\frac{4}{5}$

**D.** $-\frac{4}{5}$

**12.** If $f'(x) = 2x - 5$ and $f(2) = 6$, $f(x)$ equals

**A.** $x^2 - 5x - 12$

**B.** $x^2 - 5x + 12$

**C.** $x^2 - 5x$

**D.** $x^2 - 5x - 4$

**13.** The line with equation $y + \sqrt{3}x = 2$ makes an angle of $a^{\circ}$ with the positive direction of the $x$ - axis. $a$ is equal to

**A.** $60^{\circ}$

**B.** $30^{\circ}$

**C.** $120^{\circ}$

**D.** $150^{\circ}$

**14.** A is the point (6, 1, 7) and B is $(-9, 6, -3)$. The point K divides AB in the ratio 4 : 1. The coordinates of K are

**A.** $(-3, -2, -5)$

**B.** $(-6, 5, -1)$

**C.** $(6, -5, 1)$

**D.** $(3, 2, 5)$

**15.** $\int 4\cos 2x \; dx$ equals

**A.** $8\sin 2x + C$

**B.** $-8\sin 2x + C$

**C.** $-2\sin 2x + C$

**D.** $2\sin 2x + C$

**16.** $\frac{d}{dx}\sqrt{(x+2)(x-2)}$ equals

**A.** $x(x^2-4)^{-\frac{1}{2}}$

**B.** $\frac{1}{2}(x^2-4)^{-\frac{1}{2}}$

**C.** $\frac{2}{3}(x^2-4)^{\frac{3}{2}}$

**D.** $(x^2-4)^{\frac{1}{2}}$

**17.** If $\log_2 x = 5,$ the value of $x$ is

**A.** 25

**B.** $2 \cdot 5$

**C.** 32

**D.** 10

**18.** The exact value of $\cos(\frac{7\pi}{6})$ is

**A.** $-\frac{\sqrt{3}}{2}$

**B.** $-\frac{1}{2}$

**C.** $\frac{\sqrt{3}}{2}$

**D.** $\frac{1}{2}$

**19.** Given that $k\cos\alpha = -1$ and $k\sin\alpha = 1$, $k > 0;\ 0 \le \alpha \le 360$, the values of $k$ and $\alpha$ are

**A.** $k = \sqrt{2};\ \alpha = 45°$

**B.** $k = 2;\ \alpha = 45°$

**C.** $k = \sqrt{2};\ \alpha = 135°$

**D.** $k = 2;\ \alpha = 135°$

**20.** Given that $|\boldsymbol{a}| = 3$, $|\boldsymbol{b}| = 5$ and $\boldsymbol{a}.\boldsymbol{b} = 7$, the value of $\boldsymbol{a}.(\boldsymbol{a}+\boldsymbol{b})$ is

**A.** 15

**B.** 16

**C.** 35

**D.** 49

## Section B

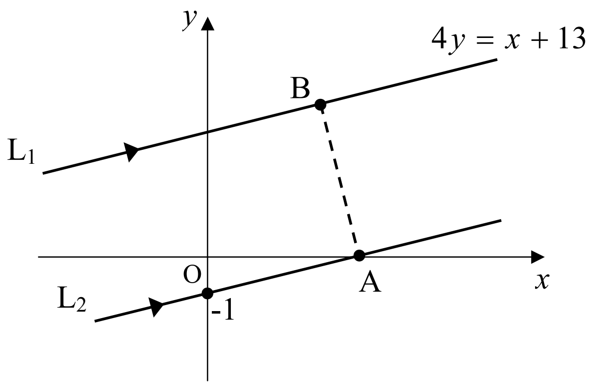
**21.** Two functions, defined on suitable domains, are given as

$$f(x) = x(x^2 - 1) \qquad \text{and} \qquad g(x) = x - 1.$$

(a) Show that the composite function, $h(x) = f\left(g(x)\right)$, can be written in the form $h(x) = ax^3 + bx^2 + cx$, where $a$, $b$ and $c$ are constants, and state the value(s) of $a$, $b$ and $c$. **4**

(b) Hence solve the equation $h(x) = 6$, for $x$, showing clearly that there is only one solution. **4**

**22.** Part of the line, $L_1$, with equation $4y = x + 13$, is shown in the diagram.
The line $L_2$ is parallel to $L_1$ and passes through the point (0,-1). Point A lies on the $x$-axis.




(a) Establish the equation of line $L_2$ and write down the coordinates of the point A. **3**

(b) Given that the line AB is perpendicular to both lines, find, algebraically, the coordinates of point B. **5**

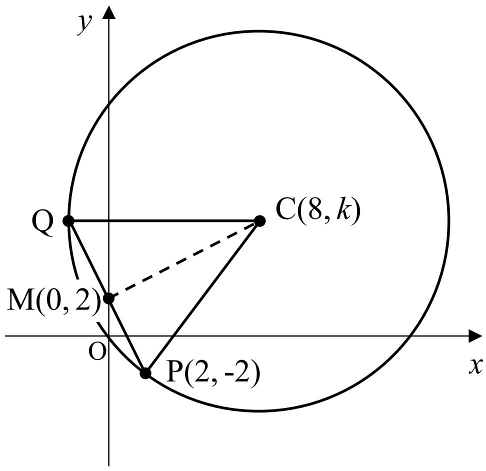
(c) Hence calculate the **exact** shortest distance between the lines $L_1$ and $L_2$. **2**

**23.** Two vectors are defined as $F_1 = 3\boldsymbol{i} + 4\boldsymbol{j} - \boldsymbol{k}$ and $F_2 = 2\boldsymbol{i} - 3\boldsymbol{j} - 6\boldsymbol{k}$.

Show clearly that these two vectors are perpendicular. **3**

**24.** A circle, centre $C(8, k)$, has the points $P(2,-2)$ and Q on its circumference as shown.

$M(0,2)$ is the mid-point of the chord PQ.




(a) Find the coordinates of Q. **1**

(b) Given that radius CQ is horizontal, write down the value of $k$, the $y$-coordinate of C. **1**

(c) Hence establish the equation of the circle. **3**

**25.** Given that $\log_2(x^2+8) - 2\log_2 3 = 3$, find the value of $x$ where $x > 0$. **4**

[ END OF QUESTION PAPER ]