NATIONAL QUALIFICATIONS

Mathematics
Practice Paper H
Paper 1
Assessing Units 1, 2 & 3

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

or

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

Trigonometric formulae:

$$\sin(A \pm B) = \sin A\cos B \pm \cos A\sin B$$
$$\cos(A \pm B) = \cos A\cos B \mp \sin A\sin B$$
$$\cos 2A = \cos^2 A - \sin^2 A$$
$$= 2\cos^2 A - 1$$
$$= 1 - 2\sin^2 A$$
$$\sin 2A = 2\sin A\cos A$$

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. Triangle PQR has vertices P(4, 7), Q(−2, 3) and R(2, 9). PM is a median of this triangle. The coordinates of M are

A. (3, 8)

B. (0, 6)

C. (1, 5)

D. (2, 6)

2. The sequence defined by the recurrence relation $U_{n+1} = aU_n + 6$ has limit 10.

The value of a is

A. $2 \cdot 5$

B. $0 \cdot 6$

C. $0 \cdot 4$

D. $-0 \cdot 4$

3. A function f is defined as $f(x) = 3 - \frac{6}{x}$. The value of $f(f(-2))$ is

A. 0

B. 2

C. 3

D. 6

4. A circle has equation $x^2 + y^2 - 6x + 8y - 1 = 0$. The centre of it is

A. (6, 8)

B. $(-3, 4)$

C. $(3, -4)$

D. $(-6, 8)$

5. Which of the following is **NOT** a factor of the equation $x^3 - 4x^2 + x + 6 = 0$.

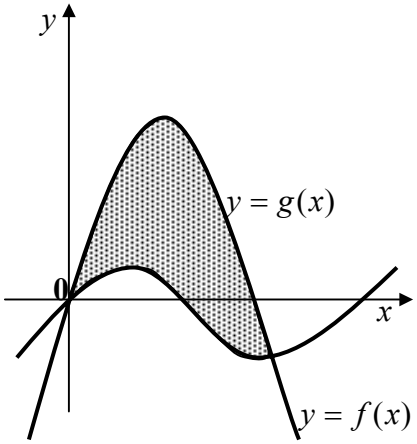
A. $(x+1)$

B. $(x-2)$

C. $(x+3)$

D. $(x-3)$

6. The diagram shows part of the graphs of $y = f(x)$ and $y = g(x)$. The curves intersect at the point $(2, -1)$ and the origin.



The area enclosed by the two curves is given by

A. $\int_0^2 (g(x) - f(x))\, dx$

B. $\int_0^2 (g(x) + f(x))\, dx$

C. $\int_0^2 (g(x) \times f(x))\, dx$

D. $\int_0^2 (f(x) - g(x))\, dx$

7. The exact value of $\sin(\frac{11\pi}{6})$ equals

A. $\frac{1}{2}$

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

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

D. $-\frac{\sqrt{3}}{2}$

8. A sequence is defined by $U_{n+1} = 1 \cdot 5U_n - 2$ with $U_0 = 12$. The value of U_3 is

A. 69

B. 38

C. 31

D. 22

9. The point (81, k) lies on the graph $y = \log_3 x$. The value of k is

A. $\frac{1}{4}$

B. 3^{81}

C. 27

D. 4

10. The exact value of $2\sin 75° \cos 75°$ is

A. $-\frac{1}{2}$

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

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

D. $-\frac{\sqrt{3}}{2}$

11. The integral of $\sqrt{(1+4x)}\ dx$ is

A. $\frac{2}{3}(1+4x)^{\frac{3}{2}} + C$

B. $\frac{2}{(1+x)^{\frac{1}{2}}} + C$

C. $\frac{1}{6}(1+4x)^{\frac{3}{2}} + C$

D. $\frac{1}{2}(1+4x)^{\frac{3}{2}} + C$

12. The magnitude of vector $\boldsymbol{g}$, where $\boldsymbol{g} = 7\boldsymbol{i} + 3\sqrt{5}\boldsymbol{j} - 5\sqrt{2}\boldsymbol{k}$, is

A. 12

B. $5\sqrt{3}$

C. 2

D. $\sqrt{2}$

13. The derivative of $(4-x)^4$ with respect to x is

A. $-\frac{1}{5}(4-x)^5$

B. $-4(4-x)^3$

C. $-3(4-x)^3$

D. $4(4-x)^3$

14. Given that $(x+3)$ is a factor of $x^3-5ax-3$, the value of a is

A. $\frac{2}{5}$

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

C. 2

D. $-\frac{2}{5}$

15. A parabola has equation $y=x^2-10x+16$. The coordinates and nature of its turning point are

A. $(-5,-9)$ and maximum

B. $(-5,-9)$ and minimum

C. $(5,-9)$ and maximum

D. $(5,-9)$ and minimum

16. The curve with equation $y=2x^3-5x^2-4x+3$ has 2 turning points one of which is minimum. The x - coordinate of this minimum turning point is

A. $-\frac{1}{3}$

B. 2

C. -2

D $\frac{1}{3}$

17. The maximum value of $\dfrac{1}{x^2+6x-3}$ is

A. $-\dfrac{1}{3}$

B. 12

C. $\dfrac{1}{12}$

D. $-\dfrac{1}{12}$

18. $\int 2\sin(3x+1)\ dx$ equals

A. $\dfrac{2}{3}\cos(3x+1)+C$

B. $6\cos(3x+1)+C$

C. $-\dfrac{2}{3}\cos(3x+1)+C$

D. $2\cos(3x+1)+C$

19. P is the point $(-4, -1, -2)$ and R is the point $(5, 8, 7)$. The point T divides PR in the ratio 5 : 4. The coordinates of T are

A. $(1, 7, 5)$

B. $(1, 4, 3)$

C. $(1, 1, 1)$

D. $(-1, -4, -3)$

20. When $3\sin x+\cos x$ is expressed in the form $k\cos(x-a)$, the value of k and the range of values for a are

A. $k=2$ and $\dfrac{\pi}{2}\le a\le\pi$

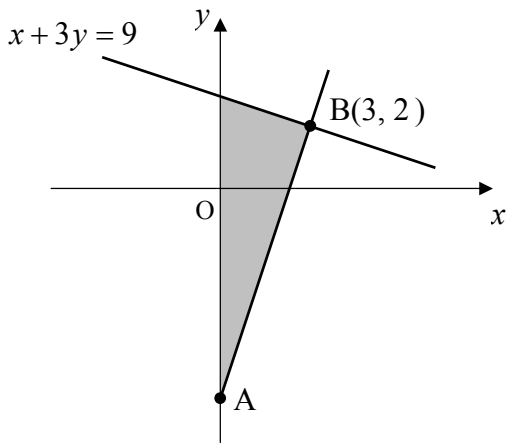
B. $k=\sqrt{10}$ and $\dfrac{\pi}{2}\le a\le\pi$

C. $k=2$ and $0\le a\le\dfrac{\pi}{2}$

D. $k=\sqrt{10}$ and $0\le a\le\dfrac{\pi}{2}$

Section B

21. Part of the line with equation $x + 3y = 9$ is shown in the diagram. B lies on this line and has coordinates (3, 2).



(a) Given that the line AB is perpendicular to the line $x + 3y = 9$, find the equation of the line AB. **3**

(b) Hence write down the coordinates of A. **1**

(c) Calculate the area of the shaded triangle. **4**

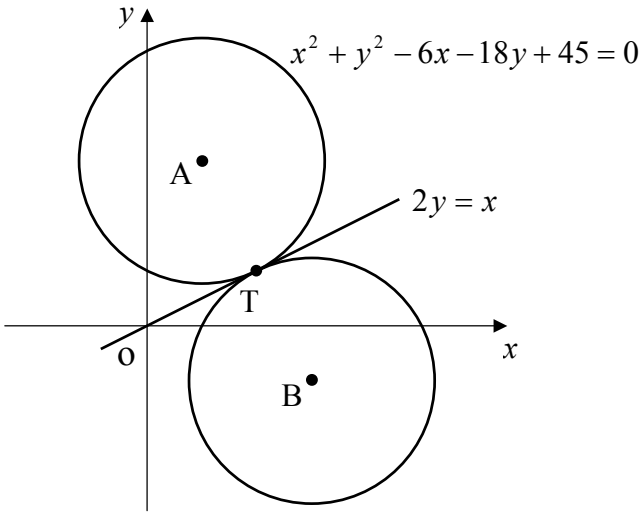
22. What can you say about p if the equation, in x, $\frac{x}{p} + \frac{9}{px} = 1$ has **no real** roots ? **6**

23. With reference to an origin O, the coordinates of A and B are (1,2,3) and (4,1,5) respectively.

(a) Prove that triangle OAB is isosceles. **3**

(b) Calculate the size of angle AOB. **3**

24. The diagram below shows two congruent circles which touch at a single point T.
The circle, centre A, has as its equation $x^2 + y^2 - 6x - 18y + 45 = 0$.
The line with equation $2y = x$ is the common tangent to the two circles through T.



(a) **Show algebraically** that T has coordinates (6,3). **4**

(b) Hence establish the the coordinates of B, the centre of the lower circle, and find the equation of this circle. **6**

[END OF QUESTION PAPER]