NATIONAL QUALIFICATIONS

Mathematics
Practice Paper G
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. 2 is a root of the equation $2x^3 + 3x^2 - 11x - 6 = 0$. The other roots are

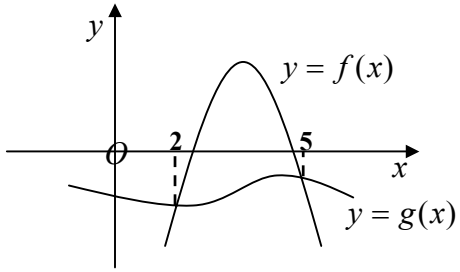
A. $-\frac{1}{2}$ and -3

B. $\frac{1}{2}$ and 3

C. $-\frac{3}{2}$ and -3

D. $\frac{3}{2}$ and 1

2. The diagram shows the graph of two functions *f* and *g*.



The values of *x* for which $g(x) > f(x)$ are

A. $x < 2$ and $x > 5$

B. $2 < x < 5$

C. all values of *x*

D. no values of *x*

3. The line with equation $2x - 3y = 14$ is perpendicular to the line with equation $y = ax + 4$. The value of *a* is

A. $\frac{2}{3}$

B. $-\frac{2}{3}$

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

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

4. If $\boldsymbol{p} = \begin{pmatrix} 2 \\ -3 \\ 4 \end{pmatrix}$ and $\boldsymbol{q} = \begin{pmatrix} 3 \\ -4 \\ -2 \end{pmatrix}$, $\boldsymbol{p} \cdot \boldsymbol{q}$ equals

A. 10

B. 0

C. -14

D. -9

5. Which of the following expressions is equal to $2\cos(x - \frac{\pi}{6})$?

A. $\sqrt{3}\sin x + \cos x$

B. $\sqrt{3}\cos x - \sin x$

C. $\sqrt{3}\sin x - \cos x$

D. $\sqrt{3}\cos x + \sin x$

6. When $3x^2 + 15x - 7$ is expressed in the form $3(x + a)^2 - b$, the value of b is

A. $13 \cdot 75$

B. $25 \cdot 75$

C. $-25 \cdot 75$

D. -7

7. A tangent to the curve $y = x^3 - 4$ is drawn and its gradient calculated to be 12 at the point where $x = k$. The value of k , where $k > 0$, is

A. 4

B. 12

C. $\sqrt[3]{16}$

D. 2

8. The graph of $y = \log_2 4x$ cuts the x - axis at the point with x - coordinate

A. 2

B. -2

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

D. 0

9. The derivative of $\frac{1}{2x^3}$ is

A. $\frac{1}{6x^2}3$

B. $-\frac{3}{2x^2}$

C. $-6x^2$

D. $-\frac{3}{2x^4}$

10. For the quadratic equation $x^2 - 5x + 3 = 0$ the value of the discriminant is

A. 63

B. 37

C. 13

D. -37

11. Given that $\boldsymbol{u} = \begin{pmatrix} 2 \\ -3 \\ 1 \end{pmatrix}$ and $\boldsymbol{v} = \begin{pmatrix} 4 \\ 4 \\ 4 \end{pmatrix}$ which of the following is/are correct?

(1) $\boldsymbol{u}$ and $\boldsymbol{v}$ are perpendicular to each other

(2) the magnitude of $\boldsymbol{u}$ is $\sqrt{14}$

(3) $\boldsymbol{v}$ is a unit vector

A. (1) only

B. (2) only

C. (1) and (2)

D. (1) and (3)

12. Given that $\log_2(x-1) = \log_3 27$, the value of x is

A. 9

B. 7

C. 4

D. 82

13. The limit of the sequence defined by the recurrence relation $U_{n+1} = 0 \cdot 25U_n + 12$ is

A. -16

B. $9 \cdot 6$

C. 48

D. 16

14. The rate of change of the function $f(x) = 2x^3$ when $x = -2$ is

A. 24

B. 16

C. -16

D. -24

15. If $f(x) = (4x + x^2)^3$, the value of $f'(1)$ is

A. 125

B. 300

C. 450

D. 625

16. A circle has equation $x^2 + y^2 - 6x + 4y - 12 = 0$. The length of its radius is

A. 1

B. 5

C. $2\sqrt{10}$

D. 8

17. Given that $\cos\alpha = \frac{2}{3}$, the value of $\cos 2\alpha$ is

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

B. $\frac{\sqrt{5}}{3}$

C. $-\frac{1}{9}$

D. $\frac{4\sqrt{5}}{3}$

18. The value of $7 - x - x^2 + x^3$ when $x = 2$ is

A. 9

B. 51

C. -3

D. -57

19. A curve for which $\frac{dy}{dx} = 4x + 1$ passes through the point $(1, -1)$. y expressed in terms of x equals

A. $2x^2 + x + 4$

B. $2x^2 - 4$

C. $2x^2 + x - 4$

D. 4

20. The maximum value of $1 - (4\sin x - 3\cos x)$ is

A. 8

B. -6

C. 0

D. 6

Section B

21. Two functions are defined on suitable domains as

$$f(x) = \frac{x-2p}{3} \qquad \text{and} \qquad g(x) = x^2 + p \quad , \text{ where } p \text{ is a constant.}$$

(a) Show clearly that the composite function $g(f(x))$ can be expressed in the form

$$g(f(x)) = \tfrac{1}{9}\left(x^2 - 4px + 4p^2 + 9p\right) \qquad \textbf{3}$$

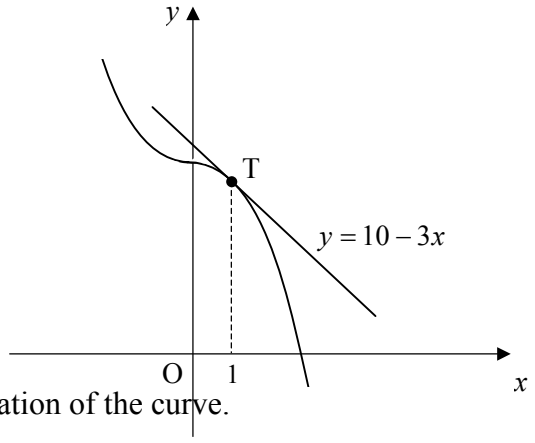
(b) The equation $g(f(x)) = 4p^2$ has **no real** roots.

Use this information to find the range of values for p which would allow this. **5**

22. Part of the graph of a curve is shown opposite.

The diagram is not drawn to scale.

At the point where $x = 1$ the tangent to the curve has equation $y = 10 - 3x$.



(a) Write down the coordinates of the point of tangency, T. **2**

(b) Given that the curve has as its derivative $\frac{dy}{dx} = -3x^2$, establish the equation of the curve. **4**

23. The picture below shows a small section of a larger circuit board.

Relative to rectangular axes the points P , Q and R have as their coordinates (-8,3,1) , (-2,-6,4) and (2,-12,6) respectively.

Prove that the points P , Q and R are collinear, and find the ratio $PQ : QR$. **4**

24. The power , E , emitting from a wave generator is given by the formula

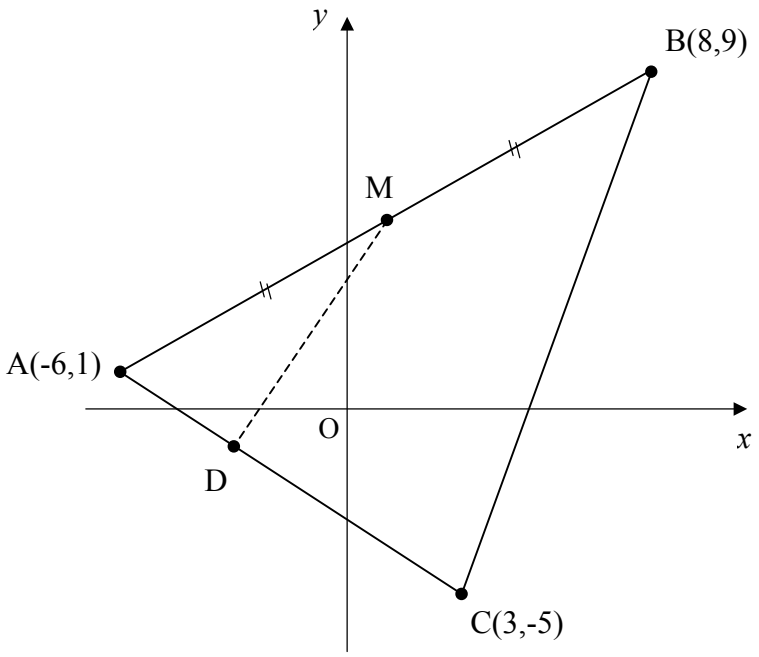
$$E = \cos t^\circ + \sqrt{3}\sin t^\circ + 10 \ ,$$

where t is the time elapsed, in seconds, from switch on.

(a) Express E in the form $E = k\sin(t+\theta)^\circ + 10$, where $k > 0$ and $0 \le \theta \le 360$. **3**

(b) Hence state the maximum value of E and the corresponding replacement for t. **2**

25. Triangle ABC has vertices A(-6,1), B(8,9) and C(3,-5) as shown.
M is the mid-point of side AB and D is a point on side AC.



(a) Find the equation of MD given that MD is **perpendicular** to side AC. **4**

(b) Hence establish the coordinates of D. **3**

[END OF QUESTION PAPER]