

FORMULAE LIST**Circle**

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

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

Scalar product

$\mathbf{a} \cdot \mathbf{b} = |\mathbf{a}||\mathbf{b}| \cos \theta$, where θ is the angle between \mathbf{a} and \mathbf{b}

or

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

Trigonometric formulae

$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$

$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$

$$\sin 2A = 2 \sin A \cos A$$

$$\cos 2A = \cos^2 A - \sin^2 A$$

$$= 2 \cos^2 A - 1$$

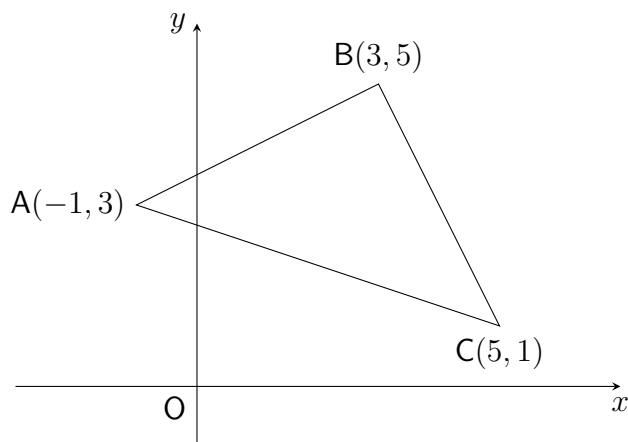
$$= 1 - 2 \sin^2 A$$

1. Find $\int (6\sqrt{x} - 10x^3) \, dx$. (4)

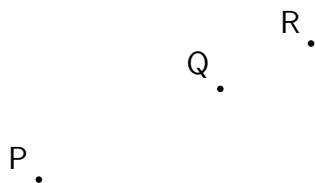
2. Find the coordinates of the stationary points on the curve $y = x^3 - 3x + 2$. (4)

3. A function f is defined on a suitable domain by $f(x) = \sqrt[3]{4+x}$. (3)
Find an expression for $f^{-1}(x)$.

4. Triangle ABC has vertices $A(-1, 3)$, $B(3, 5)$ and $C(5, 1)$.



- (a) Find the equation of the perpendicular bisector of AB. (3)
 - (b) Find the equation of the median through B. (3)
 - (c) Determine the coordinates of the point where these lines meet. (2)
 - (d) Show that triangle ABC is right-angled at B. (2)
5. Functions f and g are defined on \mathbb{R} by $f(x) = 3x^2 - 3$ and $g(x) = x - 4$.
- (a) Find an expression for $f(g(x))$. (2)
 - (b) Solve $f(g(x)) = 0$. (2)
6. The diagram below shows points P, Q and R where $P(-5, -2)$, $Q(-1, 0)$ and $R(1, 1)$.



- (a) Show that points P, Q and R are collinear. (3)
- (b) State the ratio in which Q divides PR. (1)
- (c) Point S divides PQ in the ratio 1:3. Find the coordinates of S. (3)

7. Solve $3 \cos 2x + 3 \sin x = 0$ for $0 \leq x \leq 2\pi$. (5)

8. During the summer, a small pond with no protection from the sun loses 10% of its water daily due to evaporation. The owner is able to put 8 litres of water back into the pond at the end of each day, using unused household water. The volume of water w in the pond can be described by the recurrence relation:

$$w_{n+1} = aw_n + b$$

- (a) State the values of a and b . (2)

The water in the pond is measured one morning to be 120 litres.

- (b) Calculate the expected volume of water in the pond the next morning. (2)

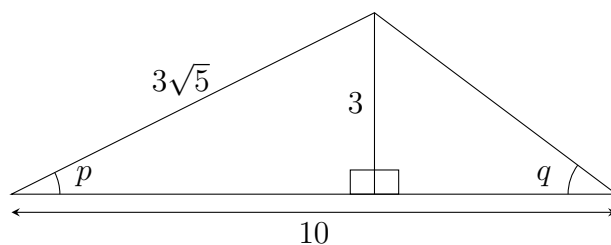
The plants in the pond should survive the summer provided the volume of water in the long-run remains above 70 litres.

- (c) Explain whether the plants are likely to survive the summer. (2)

9. The equation $px^2 - 8x + p = 0$ has no real roots. (4)

Determine the range of values for p .

10. The diagram below shows angles p and q within two right-angled triangles.



- (a) Find the values of $\sin p$ and $\sin q$. (2)

- (b) Hence find the value of $\sin (q - p)$. (3)

11. The function $f(x) = \sqrt[3]{x-2}$ is defined on a suitable domain such that it is strictly increasing with range $1 \leq f(x) \leq 5$.

- (a) Determine the domain of f . (2)

- (b) State the range of function g given $g(x) = f(x) + 3$ (1)

Question	Topic	Marks Available	Marks Awarded
1	Integration	4	
2	Differentiation II	4	
3	Sets and Functions	3	
4	Straight Line	10	
5	Sets and Functions	4	
6	Straight Lines/Vectors	7	
7	Addition Formulae	5	
8	Recurrence Relations	6	
9	Quadratic Theory	4	
10	Addition Formulae	5	
11	Sets and Functions	3	
Total		55	

ANSWERS - Practice Exam B Paper 1

- $4x^{\frac{3}{2}} - \frac{5}{2}x^4 + C$
- $(-1, 4)$ and $(1, 0)$
- $f^{-1}(x) = x^3 - 4$
- $y = -2x + 6$
 - $y = 3x - 4$
 - $(2, 2)$
 - $m_{AB} \times m_{BC} = -1$, hence AB,BC perpendicular \implies ABC right-angled.
- $f(g(x)) = 3x^2 - 24x + 45$
 - $x = 3, x = 5$
- $m_{PQ} = m_{QR} = \frac{1}{2}$ and full collinearity conclusion.
 - $2 : 1$
 - $(-4, -\frac{3}{2})$
- $x = \frac{\pi}{2}, \frac{7\pi}{6}, \frac{11\pi}{6}$
- $a = 0.9, b = 8$
 - 116 litres
 - Limit is 80 litres \implies plants are likely to survive
- $p < -4, p > 4$ with a sketch drawn
- $\sin p = \frac{1}{\sqrt{5}}$ and $\sin q = \frac{3}{5}$
 - $\sin(q - p) = \frac{2}{5\sqrt{5}}$
- $3 \leq x \leq 127$
 - $4 \leq g(x) \leq 8$