

Year 12 AS Pure Mathematics Mock Revision Worksheets

Targeted Mixed Practice for End-of-Year Mock Examinations

Course: Pearson Edexcel / AQA / OCR AS Pure Mathematics

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Worksheet 1: Pure Revision Paper A

Time Allowed: 1 Hour 15 Minutes | Total Marks: 60 Marks

Q1. [Proof]

- (a) Prove by exhaustion that $n^2 + 3n + 1$ is an odd integer for all integers n in the range $1 \leq n \leq 4$. [2]
- (b) Prove algebraically that the sum of the squares of any two consecutive even integers is always divisible by 4, but never divisible by 8. [4]

Q2. [Coordinate Geometry - Circles] A circle C has equation $x^2 + y^2 - 6x + 8y - 11 = 0$.

- (a) Find the coordinates of the centre of C and show that the radius of C is 6. [3]
- (b) The line L has equation $y = 2x + k$, where k is a constant. Given that L is a tangent to the circle C , find the two exact possible values of k . [5]

Q3. [Polynomials & Factor Theorem] Let $f(x) = 2x^3 - 3x^2 - 11x + 6$.

(a) Show that $(x + 2)$ is a factor of $f(x)$. [1]

(b) Express $f(x)$ as a product of three linear factors. [3]

(c) Hence solve the equation:

$$2(3^{3y}) - 3(3^{2y}) - 11(3^y) + 6 = 0$$

giving any non-integer answers to 3 significant figures. [4]

Q4. [Trigonometric Equations & Identities]

(a) Show that $3 \sin^2 \theta + \cos \theta - 1 = 0$ can be written as $3 \cos^2 \theta - \cos \theta - 2 = 0$. [2]

(b) Hence solve, for $0 \leq x < 360^\circ$, the equation:

$$3 \sin^2(2x + 15^\circ) + \cos(2x + 15^\circ) - 1 = 0$$

giving your answers to 1 decimal place where necessary. [6]

Q5. [Differentiation - Tangents & Normals] The curve $y = 4\sqrt{x} - \frac{8}{x}$ is defined for $x > 0$.

(a) Find $\frac{dy}{dx}$ in simplest indexed form. [3]

(b) Find the equation of the normal to the curve at the point $P(4, 6)$, giving your answer in the form $ax + by + c = 0$, where a , b , and c are integers. [5]

Q6. [Integration & Bounded Area] Figure 1 shows the curve $y = x^2 - 4x + 5$ and the straight line $y = 5 - x$.

(a) Find the coordinates of the points of intersection between the curve and the line. [3]

(b) Calculate the exact area of the region bounded between the curve and the line. [6]

Q7. [Exponentials & Logarithms] The mass, M grams, of a radioactive substance after t years is modeled by:

$$M = Ae^{-kt}$$

where A and k are positive constants.

(a) State the physical meaning of the constant A . [1]

(b) Given that the initial mass is 120g and that after 5 years the mass decreases to 90g, find the exact value of k in terms of a natural logarithm. [3]

- (c) Find the time taken for the mass to decay to half of its initial value (the half-life). Give your answer to 3 significant figures. [3]

Worksheet 2: Pure Revision Paper B

Time Allowed: 1 Hour 15 Minutes | Total Marks: 60 Marks

Q1. [Binomial Expansion]

- (a) Find the first 4 terms in ascending powers of x of the binomial expansion of $(2 - 3x)^6$, simplifying each term. [4]
- (b) Use your expansion with a suitable value of x to find an estimate for $(1.97)^6$, showing your working clear to 2 decimal places. [2]

Q2. [Vectors] In a triangle OAB , $\vec{OA} = 3\mathbf{i} + 4\mathbf{j}$ and $\vec{OB} = 9\mathbf{i} - 2\mathbf{j}$.

- (a) Find the vector $\vec{AB}$ in terms of $\mathbf{i}$ and $\mathbf{j}$. [2]
- (b) Find the magnitude $|\vec{AB}|$ in exact surd form. [2]
- (c) The point M is the midpoint of AB . Find the unit vector in the direction of position vector $\vec{OM}$. [3]

Q3. [Quadratics & Inequalities] The curve C has equation $y = kx^2 + 4x + (k - 3)$, where k is a non-zero constant.

(a) Given that C lies entirely above the x -axis, show that k satisfies $4k^2 - 12k - 16 > 0$. [3]

(b) Hence find the complete range of possible values for k . [4]

Q4. [Logarithmic Equations] Solve the equation:

$$\log_2(x + 5) + \log_2(x - 1) = 1 + \log_2(x + 1)$$

Show all working clearly and justify why any extraneous roots are rejected. [6]

Q5. [Graph Transformations] The graph of $y = f(x)$ has a local minimum turning point at $(3, -8)$ and crosses the y -axis at $(0, 10)$. State the coordinates of the turning point and y -intercept for the following transformed curves:

(a) $y = f(x - 2) + 3$ [2]

(b) $y = -2f(x)$ [2]

(c) $y = f(2x)$ [2]

Q6. [Calculus - Optimization] A open rectangular tank is to be constructed with a square base of side length x metres and vertical height h metres. The tank must hold a volume of 32 m^3 .

(a) Show that the total external surface area, $S \text{ m}^2$, is given by:

$$S = x^2 + \frac{128}{x}$$

[3]

(b) Use calculus to find the value of x that minimizes the surface area.

[4]

(c) Prove that this turning point is indeed a minimum using the second derivative test. [2]

(d) Calculate the minimum surface area required.

[1]

Q7. [Differentiation from First Principles] Prove from first principles that the derivative of $3x^2 - 5x$ is $6x - 5$. [5]

END OF REVISION WORKSHEET SET