

PRIFYSGOL BANGOR
BANGOR UNIVERSITY



PRIFYSGOL
BANGOR
UNIVERSITY

ARHOLIADAU YSGOLORIAETHAU MYNEDIAD 2025
SCHOLARSHIP ENTRANCE EXAMINATIONS 2025

PWNC / SUBJECT: MATHEMATEG / MATHEMATICS

Amser a ganiateir: 2 awr

Time allowed: 2 hours

Cyfarwyddiadau / Instructions:

You may attempt any of the questions. Credit will be given for complete answers.

Assume $g = 9.8 \text{ m.s}^{-2}$

1. The sum of the first 3 terms of an arithmetic series is 27 and the sum of the first 6 terms is 117. Find the 17th term.

2. Find all the solutions to the equation

$$4\sin^2 x + \cos x - 2 = 0 \quad 0 \leq x \leq 2\pi$$

3. Evaluate the definite integral

$$\int_0^1 \sin x \cos x \, dx$$

4. Find the equation of the normal to the circle

$$x^2 + y^2 - 4x - 2y - 671 = 0$$

from the point (26, 11), and the tangent to the circle at the point (12, -23).

5. Express

$$\frac{6x^2 + 31x + 37}{(x+1)(x+3)(x+4)}$$

in partial fractions.

6. Expand

$$(1+x)^{\frac{1}{5}}$$

in ascending powers of x , up to the term in x^3 .

For what values of x is the expansion valid?

Find an approximation to the fifth root of 1.01 using the first four terms of the expansion.

How accurate is your approximation?

7. Rearrange the expression

$$\log_a x = b$$

to yield an expression for x .

Hence solve

$$\log_3 x = 4$$

8. The vertices A, B, C of a triangle have position vectors $\mathbf{a}, \mathbf{b}, \mathbf{c}$. Point X lies on the line AB such that $AX : XB = 4 : 3$. Write an expression for the position vector of X in terms of $\mathbf{a}, \mathbf{b}, \mathbf{c}$.

Find, in terms of $\mathbf{a}, \mathbf{b}, \mathbf{c}$, the position vector of point P which divides XC in the ratio

$$XP : PC = \lambda : 1 - \lambda$$

9. A body of mass 5 kg is suspended from a light string. The string is looped over a frictionless pulley and the other end attached to a 4 kg mass on a frictionless plane inclined at 30 degrees to the horizontal. Draw a sketch of the system. If the two masses are initially at rest, in which direction will the masses begin to move? Through what distance will the vertically suspended mass move in 1 second?

10. Solve the differential equation

$$\frac{d^2 f}{dx^2} - f = 0$$

with initial condition $\left. \frac{df}{dx} \right|_{x=0} = 0, f(0) = 1$.

11. The continuous random variable X has probability density function f defined by

$$f(x) = \lambda x(2 - x) \quad 0 \leq x \leq 2$$

Find the parameter λ , and the mean and standard deviation of f . Sketch the probability density function.

12. Three balls are chosen at random from a box containing 5 red balls, and 3 blue balls. Find the probability that

- a) two red balls and one blue ball are chosen (in some order);
- b) all three balls will be the same colour.

13. The volume of suntan lotion in each bottle from a production line comes from a normal distribution, with mean 125 ml and standard deviation 2.0 ml.

Calculate the probability that a randomly chosen bottle contains between 123.5 ml and 124.0 ml of suntan lotion.