

INKMATHS FLASHCARDS

Further Pure 2

groups, matrices and number theory

15 cards · fronts and backs

Print double-sided, flipping on the long edge, and each answer lands behind its question. Cut along the card borders.

Definitions in precise wording, the standard results the formulae booklet does not print, a check-yourself question per topic, and the slips that lose marks. The same cards run on the website with spaced-repetition scheduling, at inkphysics.co.uk/maths/flashcards.

DEFINITION

Define: Group.

FURTHER PURE 2: GROUPS, MATRICES AND NUMBER THEORY

DEFINITION

Define: Lagrange's theorem.

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STANDARD RESULT

Reduction formula:

$$I_n = \int_0^{\pi/2} \sin^n x \, dx: n I_n = ?$$

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STANDARD RESULT

Arc length:

cartesian, then polar = ?

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STANDARD RESULT

Surface of revolution:

about the x-axis, S = ?

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STANDARD RESULT

Eigenvalues:

2 by 2 characteristic equation = ?

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STANDARD RESULT

Diagonalisation:

$$M^n = ?$$

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DEFINITION

Define: Cayley-Hamilton theorem.

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DEFINITION

The order of any subgroup of a finite group divides the order of the group, so the order of every element divides it too.

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DEFINITION

A set with a binary operation satisfying closure, associativity, the existence of an identity, and an inverse for every element. Commutativity is not required.

FURTHER PURE 2: GROUPS, MATRICES AND NUMBER THEORY

STANDARD RESULT

$$\int \sqrt{1 + ((dy)/(dx))^2} dx, \int \sqrt{r^2 + ((dr)/(d\theta))^2} d\theta$$

FURTHER PURE 2: GROUPS, MATRICES AND NUMBER THEORY

STANDARD RESULT

$$(n-1) I_{n-2}, \text{ with } I_0 = (\pi)/(2), I_1 = 1$$

FURTHER PURE 2: GROUPS, MATRICES AND NUMBER THEORY

STANDARD RESULT

$$\lambda^2 - (\text{trace})\lambda + \det = 0$$

FURTHER PURE 2: GROUPS, MATRICES AND NUMBER THEORY

STANDARD RESULT

$$2\pi \int y ds = 2\pi \int y \sqrt{1 + ((dy)/(dx))^2} dx$$

FURTHER PURE 2: GROUPS, MATRICES AND NUMBER THEORY

DEFINITION

Every square matrix satisfies its own characteristic equation, which turns any power of it into a linear combination of lower powers and, when $\det M \neq 0$, hands over the inverse without cofactors.

FURTHER PURE 2: GROUPS, MATRICES AND NUMBER THEORY

STANDARD RESULT

$P D^n P^{-1}$, P of eigenvectors, D of eigenvalues in matching order

FURTHER PURE 2: GROUPS, MATRICES AND NUMBER THEORY

DEFINITION

Define: Apollonius locus.

FURTHER PURE 2: GROUPS, MATRICES AND NUMBER THEORY

STANDARD RESULT

Inversion:

$w = (1)/(z)$: image of a line missing 0?

FURTHER PURE 2: GROUPS, MATRICES AND NUMBER THEORY

STANDARD RESULT

Fermat's little theorem:

p prime, a not a multiple of p: $a^{p-1} \equiv ?$

FURTHER PURE 2: GROUPS, MATRICES AND NUMBER THEORY

DEFINITION

Define: Bezout's identity.

FURTHER PURE 2: GROUPS, MATRICES AND NUMBER THEORY

STANDARD RESULT

Recurrence relations:

$u_{n+2} + b u_{n+1} + c u_n = 0$: $u_n = ?$

FURTHER PURE 2: GROUPS, MATRICES AND NUMBER THEORY

SPOT THE ERROR

Say what is wrong with this claim:

The letters of BANANA can be arranged in 6! ways.

FURTHER PURE 2: GROUPS, MATRICES AND NUMBER THEORY

CHECK YOURSELF

A group has order 8. Explain why it cannot contain an element of order 3.

FURTHER PURE 2: GROUPS, MATRICES AND NUMBER THEORY

STANDARD RESULT

a circle through 0, and the map sends that circle back to a line

FURTHER PURE 2: GROUPS, MATRICES AND NUMBER THEORY

DEFINITION

The set of points whose distances from two fixed points are in a fixed ratio other than 1. It is a circle, not a line; equal distances give the perpendicular bisector instead.

FURTHER PURE 2: GROUPS, MATRICES AND NUMBER THEORY

DEFINITION

The highest common factor of a and b can be written as $ax + by$ for integers x and y , found by unwinding the Euclidean algorithm. When that factor is 1, x is the inverse of a modulo b .

FURTHER PURE 2: GROUPS, MATRICES AND NUMBER THEORY

STANDARD RESULT

$1 \pmod{p}$, so exponents reduce modulo $p - 1$

FURTHER PURE 2: GROUPS, MATRICES AND NUMBER THEORY

SPOT THE ERROR

$6!$ counts the arrangements as though every letter were distinguishable. Three As and two Ns are not, so divide by the repeats: $6!/(3!2!) = 60$, not 720. Any arrangement question with a repeated object needs that denominator, and forgetting it is the single most common combinatorics error.

FURTHER PURE 2: GROUPS, MATRICES AND NUMBER THEORY

STANDARD RESULT

$A m_1^n + B m_2^n$, repeated root needs $(A + Bn)m^n$

FURTHER PURE 2: GROUPS, MATRICES AND NUMBER THEORY

CHECK YOURSELF

The powers of such an element would form a subgroup of order 3, and 3 does not divide 8, contradicting Lagrange's theorem.

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