

EXAM-DAY · 90-MIN REVISION CARD

## Mathematical Reasoning

Print this · Fold it · Carry to the exam-hall gate · Revise once · Then walk in.

### FORMULAS & KEY RESULTS

**STATEMENT:** a sentence that is definitely TRUE or definitely FALSE (never both, never ambiguous). Questions, commands, opinions and open sentences ( $x + 2 = 5$ ) are NOT statements.

**NEGATION ( $\sim p$ ):** the statement with the opposite truth value of  $p$ . If  $p$  is true,  $\sim p$  is false, and vice versa.

**AND (conjunction,  $p \wedge q$ ):** TRUE only when BOTH  $p$  and  $q$  are true; otherwise FALSE.

**OR (disjunction,  $p \vee q$ ):**  
**INCLUSIVE** — TRUE when  $p$ ,  $q$ , or BOTH are true; FALSE only when both are false.

**QUANTIFIERS:**  $\forall$  = 'for all / for every' (universal);  $\exists$  = 'there exists / for some' (existential).

**NEGATING QUANTIFIERS:**  $\sim(\forall x, P) = \exists x, \sim P$  ('not all' = 'some are not');  $\sim(\exists x, P) = \forall x, \sim P$  ('none' = 'all are not').

**CONDITIONAL:** 'if  $p$  then  $q$ ' =  $p \Rightarrow q$ . 'p only if  $q$ ' =  $p \Rightarrow q$  ( $q$  necessary). 'p if  $q$ ' =  $q \Rightarrow p$  ( $q$  sufficient).

**BICONDITIONAL:** 'p if and only if  $q$ ' =  $p \Leftrightarrow q = (p \Rightarrow q) \text{ AND } (q \Rightarrow p)$ ;  $q$  is NECESSARY AND SUFFICIENT for  $p$ .

**CONVERSE** of  $p \Rightarrow q$ :  $q \Rightarrow p$  (swap). NOT equivalent to the original.

**INVERSE** of  $p \Rightarrow q$ :  $\sim p \Rightarrow \sim q$  (negate both). NOT equivalent to the original.

**CONTRAPOSITIVE** of  $p \Rightarrow q$ :  $\sim q \Rightarrow \sim p$  (negate AND swap). LOGICALLY EQUIVALENT to the original.

**VALIDATING:** direct method (assume  $p$ , show  $q$ ); contrapositive (assume  $\sim q$ , show  $\sim p$ ); contradiction

### TOP 5 PYQ PATTERNS

**1 Converse / inverse / contrapositive of a conditional**

3 marks · 95% of years

Name  $p$  and  $q$ . Converse = swap ( $q \Rightarrow p$ ) · Inverse = negate both ( $\sim p \Rightarrow \sim q$ ) · Contrapositive = negate AND swap ( $\sim q \Rightarrow \sim p$ , equivalent to original).

**2 Negation of a statement (incl. quantified)**

2 marks · 85% of years

Flip the truth value · for 'all' write 'some ... not' ( $\forall \rightarrow \exists \sim$ ) · for 'some' write 'none / all ... not' ( $\exists \rightarrow \forall \sim$  not).

**3 Identify statement vs non-statement + truth value**

1 mark · 75% of years

Reject questions/commands/opinions/open sentences · for a genuine statement give T or F with a one-line reason.

**4 Compound statement with AND / OR and its truth value**

2 marks · 70% of years

AND true only if BOTH true · OR (inclusive) false only if BOTH false · split a compound into components + connective when asked.

**5 Validate / disprove a statement**

3 marks · 60% of years

Universal false  $\Rightarrow$  one counter-example · prove by direct / contrapositive / contradiction · state the final T/F conclusion.

### 90-MIN REVISION FLOW

**0-15 min**

Memorise the four forms of  $p \Rightarrow q$  (converse = swap, inverse = negate both, contrapositive = negate+swap) and that ONLY the contrapositive is equivalent to the original. This is the chapter's highest-yield fact.

**15-30 min**

Write the converse, inverse and contrapositive for 5 different conditionals back-to-back. Name  $p$  and  $q$  each time.

**30-45 min**

Negate 6 statements, including 3 quantified ones ('all', 'some', 'there exists'). Check each against the  $\forall \leftrightarrow \exists \sim$  rule.

**45-60 min**

Build the truth tables for  $p \wedge q$  and  $p \vee q$  from memory; then decide the truth value of 4 compound statements.

**60-80 min**

Translate 4 'only if' / 'if and only if' sentences into  $\Rightarrow$  /  $\Leftrightarrow$  form, then disprove 3 universal statements by counter-example.

**80-90 min**

Self-check — state from memory: the definition of a statement, the negation of 'all A are B', and which of converse/contrapositive equals the original. If all three are instant, you are chapter-ready.

(assume statement false, derive impossibility).

DISPROOF: a universal ('for all') is disproved by ONE counter-example; an existential ('there exists') is proved by ONE example.

**Confidence, not anxiety.** You've practised this all year. Trust your steps. Don't change strategy on exam morning.  
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