IGCSE Mathematics

Syllabus Checklist · 大纲自查表

Tick one box per statement: ☐ not yet ☐ nearly ☐ confident. 每条打一个勾：尚未掌握 / 快会了 / 有把握。

1. Number 数

C1.1 Types of number 数的类型

☐☐☐ Identify and use: • natural numbers • integers (positive, zero and negative) • prime numbers • square numbers • cube numbers • common factors • common multiples • rational and irrational numbers • reciprocals.

C1.2 Sets 集合

☐☐☐ Understand and use set language, notation and Venn diagrams to describe sets.

C1.3 Powers and roots 幂与根

☐☐☐ Calculate with the following: • squares • square roots • cubes • cube roots • other powers and roots of numbers.

C1.4 Fractions, decimals and percentages 分数、小数与百分数

☐☐☐ Use the language and notation of the following in appropriate contexts: • proper fractions • improper fractions • mixed numbers • decimals • percentages.

☐☐☐ Recognise equivalence and convert between these forms.

C1.5 Ordering 排序

☐☐☐ Order quantities by magnitude and demonstrate familiarity with the symbols $=, \neq, >, <, \geqslant$ and $\leqslant$.

C1.6 The four operations 四则运算

☐☐☐ Use the four operations for calculations with integers, fractions and decimals, including correct ordering of operations and use of brackets.

C1.7 Indices I 指数 I

☐☐☐ Understand and use indices (positive, zero and negative integers).

☐☐☐ Understand and use the rules of indices.

C1.8 Standard form 标准形式（科学记数法）

☐☐☐ Use the standard form $A \times 10^n$ where n is a positive or negative integer and $1 \leqslant A < 10$.

☐☐☐ Convert numbers into and out of standard form.

☐☐☐ Calculate with values in standard form.

C1.9 Estimation 估算

☐☐☐ Round values to a specified degree of accuracy.

☐☐☐ Make estimates for calculations involving numbers, quantities and measurements.

☐☐☐ Round answers to a reasonable degree of accuracy in the context of a given problem.

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C1.10 Limits of accuracy 精度范围

☐☐☐ Give upper and lower bounds for data rounded to a specified accuracy.

C1.11 Ratio and proportion 比与比例

☐☐☐ Understand and use ratio and proportion to:

☐☐☐ • give ratios in their simplest form

☐☐☐ • divide a quantity in a given ratio

☐☐☐ • use proportional reasoning and ratios in context.

C1.12 Rates 比率

☐☐☐ Use common measures of rate.

☐☐☐ Apply other measures of rate.

☐☐☐ Solve problems involving average speed.

C1.13 Percentages 百分数

☐☐☐ Calculate a given percentage of a quantity.

☐☐☐ Express one quantity as a percentage of another.

☐☐☐ Calculate percentage increase or decrease.

☐☐☐ Calculate with simple and compound interest.

C1.14 Using a calculator 使用计算器

☐☐☐ Use a calculator efficiently.

☐☐☐ Enter values appropriately on a calculator.

☐☐☐ Interpret the calculator display appropriately.

C1.15 Time 时间

☐☐☐ Calculate with time: seconds (s), minutes (min), hours (h), days, weeks, months, years, including the relationship between units.

☐☐☐ Calculate times in terms of the 24-hour and 12-hour clock.

☐☐☐ Read clocks and timetables.

C1.16 Money 货币

☐☐☐ Calculate with money.

☐☐☐ Convert from one currency to another.

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E1.2 Sets 集合

☐☐☐ Understand and use set language, notation and Venn diagrams to describe sets and represent relationships between sets.

E1.3 Powers and roots 幂与根

☐☐☐ Calculate with the following: • squares • square roots • cubes • cube roots • other powers and roots of numbers.

E1.4 Fractions, decimals and percentages 分数、小数与百分数

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☐☐☐ Use the standard form $A \times 10^n$ where n is a positive or negative integer and $1 \leqslant A < 10$.

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☐☐☐ Round answers to a reasonable degree of accuracy in the context of a given problem.

E1.10 Limits of accuracy 精度范围

☐☐☐ Give upper and lower bounds for data rounded to a specified accuracy.

☐☐☐ Find upper and lower bounds of the results of calculations which have used data rounded to a specified accuracy.

E1.11 Ratio and proportion 比与比例

☐☐☐ Understand and use ratio and proportion to:

☐☐☐ • give ratios in their simplest form

☐☐☐ • divide a quantity in a given ratio

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☐☐☐ Express one quantity as a percentage of another.

☐☐☐ Calculate percentage increase or decrease.

☐☐☐ Calculate with simple and compound interest.

☐☐☐ Calculate using reverse percentages.

E1.14 Using a calculator 使用计算器

☐☐☐ Use a calculator efficiently.

☐☐☐ Enter values appropriately on a calculator.

☐☐☐ Interpret the calculator display appropriately.

E1.15 Time 时间

☐☐☐ Calculate with time: seconds (s), minutes (min), hours (h), days, weeks, months, years, including the relationship between units.

☐☐☐ Calculate times in terms of the 24-hour and 12-hour clock.

☐☐☐ Read clocks and timetables.

E1.16 Money 货币

☐☐☐ Calculate with money.

☐☐☐ Convert from one currency to another.

E1.17 Exponential growth and decay 指数增长与衰减

☐☐☐ Use exponential growth and decay.

E1.18 Surds 无理根式

☐☐☐ Understand and use surds, including simplifying expressions.

☐☐☐ Rationalise the denominator.

2. Algebra and graphs 代数与图像

C2.1 Introduction to algebra 代数导论

☐☐☐ Know that letters can be used to represent generalised numbers.

☐☐☐ Substitute numbers into expressions and formulas.

C2.2 Algebraic manipulation 代数式的运算

☐☐☐ Simplify expressions by collecting like terms.

☐☐☐ Expand products of algebraic expressions.

☐☐☐ Factorise by extracting common factors.

C2.4 Indices II 指数 II

☐☐☐ Understand and use indices (positive, zero and negative).

☐☐☐ Understand and use the rules of indices.

C2.5 Equations 方程

☐☐☐ Construct simple expressions, equations and formulas.
☐☐☐ Solve linear equations in one unknown.
☐☐☐ Solve simultaneous linear equations in two unknowns.
☐☐☐ Change the subject of simple formulas.

C2.6 Inequalities 不等式

☐☐☐ Represent and interpret inequalities, including on a number line.

C2.7 Sequences 数列

☐☐☐ Continue a given number sequence or pattern.
☐☐☐ Recognise patterns in sequences, including the term-to-term rule, and relationships between different sequences.
☐☐☐ Find and use the nth term of the following sequences: (a) linear (b) simple quadratic (c) simple cubic.

C2.9 Graphs in practical situations 实际情境中的图像

☐☐☐ Use and interpret graphs in practical situations including travel graphs and conversion graphs.
☐☐☐ Draw graphs from given data.

C2.10 Graphs of functions 函数的图像

☐☐☐ Construct tables of values, and draw, recognise and interpret graphs for functions of the following forms: • $ax + b$ • $\pm x^2 + ax + b$ • $\frac{a}{x}$ $(x \neq 0)$ where a and b are integer constants.
☐☐☐ Solve associated equations graphically, including finding and interpreting roots by graphical methods.

C2.11 Sketching curves 草绘曲线

☐☐☐ Recognise, sketch and interpret graphs of the following functions: (a) linear (b) quadratic.

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☐☐☐ Know that letters can be used to represent generalised numbers.
☐☐☐ Substitute numbers into expressions and formulas.

E2.2 Algebraic manipulation 代数式的运算

☐☐☐ Simplify expressions by collecting like terms.
☐☐☐ Expand products of algebraic expressions.
☐☐☐ Factorise by extracting common factors.
☐☐☐ Factorise expressions of the form: • $ax + bx + kay + kby$ • $a^2x^2 - b^2y^2$ • $a^2 + 2ab + b^2$ • $ax^2 + bx + c$ • $ax^3 + bx^2 + cx$.
☐☐☐ Complete the square for expressions in the form $ax^2 + bx + c$.

E2.3 Algebraic fractions 代数分式

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☐☐☐ Manipulate algebraic fractions.
☐☐☐ Factorise and simplify rational expressions.

E2.4 Indices II 指数 II

☐☐☐ Understand and use indices (positive, zero, negative and fractional).
☐☐☐ Understand and use the rules of indices.

E2.5 Equations 方程

☐☐☐ Construct expressions, equations and formulas.
☐☐☐ Solve linear equations in one unknown.
☐☐☐ Solve fractional equations with numerical and linear algebraic denominators.
☐☐☐ Solve simultaneous linear equations in two unknowns.
☐☐☐ Solve simultaneous equations, involving one linear and one non-linear.
☐☐☐ Solve quadratic equations by factorisation, completing the square and by use of the quadratic formula.
☐☐☐ Change the subject of formulas.

E2.6 Inequalities 不等式

☐☐☐ Represent and interpret inequalities, including on a number line.
☐☐☐ Construct, solve and interpret linear inequalities.
☐☐☐ Represent and interpret linear inequalities in two variables graphically.
☐☐☐ List inequalities that define a given region.

E2.7 Sequences 数列

☐☐☐ Continue a given number sequence or pattern.
☐☐☐ Recognise patterns in sequences, including the term-to-term rule, and relationships between different sequences.
☐☐☐ Find and use the nth term of sequences.

E2.8 Proportion 比例

☐☐☐ Express direct and inverse proportion in algebraic terms and use this form of expression to find unknown quantities.

E2.9 Graphs in practical situations 实际情境中的图像

☐☐☐ Use and interpret graphs in practical situations including travel graphs and conversion graphs.
☐☐☐ Draw graphs from given data.
☐☐☐ Apply the idea of rate of change to simple kinematics involving distance–time and speed–time graphs, acceleration and deceleration.
☐☐☐ Calculate distance travelled as area under a speed–time graph.

E2.10 Graphs of functions 函数的图像

☐☐☐ Construct tables of values, and draw, recognise and interpret graphs for functions of the following forms: • ax^n (includes sums of no more than three of these) • $ab^x + c$ where $n = -2, -1, -\frac{1}{2}, 0, \frac{1}{2}, 1, 2, 3$; a and c are rational numbers; and b is a positive integer.

☐☐☐ Solve associated equations graphically, including finding and interpreting roots by graphical methods.

☐☐☐ Draw and interpret graphs representing exponential growth and decay problems.

E2.11 Sketching curves 草绘曲线

☐☐☐ Recognise, sketch and interpret graphs of the following functions: (a) linear (b) quadratic (c) cubic (d) reciprocal (e) exponential.

E2.12 Differentiation 微分

☐☐☐ Estimate gradients of curves by drawing tangents.

☐☐☐ Use the derivatives of functions of the form ax^n, where a is a rational constant and n is a positive integer or zero, and simple sums of not more than three of these.

☐☐☐ Apply differentiation to gradients and stationary points (turning points).

☐☐☐ Discriminate between maxima and minima by any method.

E2.13 Functions 函数

☐☐☐ Understand functions, domain and range and use function notation.

☐☐☐ Understand and find inverse functions $f^{-1}(x)$.

☐☐☐ Form composite functions as defined by $gf(x) = g(f(x))$.

3. Coordinate geometry 坐标几何

C3.1 Coordinates 坐标

☐☐☐ Use and interpret Cartesian coordinates in two dimensions.

C3.2 Drawing linear graphs 绘制一次函数图像

☐☐☐ Draw straight-line graphs for linear equations.

C3.3 Gradient of linear graphs 一次函数图像的斜率

☐☐☐ Find the gradient of a straight line.

C3.5 Equations of linear graphs 一次函数图像的方程

☐☐☐ Interpret and obtain the equation of a straight-line graph in the form $y = mx + c$.

C3.6 Parallel lines 平行线

☐☐☐ Find the gradient and equation of a straight line parallel to a given line.

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☐☐☐ Find the gradient of a straight line.

☐☐☐ Calculate the gradient of a straight line from the coordinates of two points on it.

E3.4 Length and midpoint 长度与中点

☐☐☐ Calculate the length of a line segment.

☐☐☐ Find the coordinates of the midpoint of a line segment.

E3.5 Equations of linear graphs 一次函数图像的方程

☐☐☐ Interpret and obtain the equation of a straight-line graph.

E3.6 Parallel lines 平行线

☐☐☐ Find the gradient and equation of a straight line parallel to a given line.

E3.7 Perpendicular lines 垂直线

☐☐☐ Find the gradient and equation of a straight line perpendicular to a given line.

4. Geometry 几何

C4.1 Geometrical terms 几何术语

☐☐☐ Use and interpret the following geometrical terms: • point • vertex • line • parallel • perpendicular • bearing • right angle • acute, obtuse and reflex angles • interior and exterior angles • similar • congruent • scale factor.

☐☐☐ Use and interpret the vocabulary of: • triangles • special quadrilaterals • polygons • nets • simple solids.

☐☐☐ Use and interpret the vocabulary of a circle.

C4.2 Geometrical constructions 几何作图

☐☐☐ Measure and draw lines and angles.

☐☐☐ Construct a triangle, given the lengths of all sides, using a ruler and pair of compasses only.

☐☐☐ Draw, use and interpret nets.

C4.3 Scale drawings 比例尺作图

☐☐☐ Draw and interpret scale drawings.

☐☐☐ Use and interpret three-figure bearings.

C4.4 Similarity 相似

☐☐☐ Calculate lengths of similar shapes.

C4.5 Symmetry 对称

☐☐☐ Recognise line symmetry and order of rotational symmetry in two dimensions.

C4.6 Angles 角

☐☐☐ Calculate unknown angles and give simple explanations using the following geometrical properties: • sum of angles at a point = 360° • sum of angles at a point on a straight line =

180° • vertically opposite angles are equal • angle sum of a triangle = 180° and angle sum of a quadrilateral = 360°.

☐☐☐ Calculate unknown angles and give geometric explanations for angles formed within parallel lines: • corresponding angles are equal • alternate angles are equal • co-interior angles sum to 180° (supplementary).

☐☐☐ Know and use angle properties of regular polygons.

C4.7 Circle theorems 圆的定理

☐☐☐ Calculate unknown angles and give explanations using the following geometrical properties of circles: • angle in a semicircle = 90° • angle between tangent and radius = 90°.

E4.1 Geometrical terms 几何术语

☐☐☐ Use and interpret the following geometrical terms: • point • vertex • line • plane • parallel • perpendicular • perpendicular bisector • bearing • right angle • acute, obtuse and reflex angles • interior and exterior angles • similar • congruent • scale factor.

☐☐☐ Use and interpret the vocabulary of: • triangles • special quadrilaterals • polygons • nets • solids.

☐☐☐ Use and interpret the vocabulary of a circle.

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☐☐☐ Draw and interpret scale drawings.

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E4.4 Similarity 相似

☐☐☐ Calculate lengths of similar shapes.

☐☐☐ Use the relationships between lengths and areas of similar shapes and lengths, surface areas and volumes of similar solids.

☐☐☐ Solve problems and give simple explanations involving similarity.

E4.5 Symmetry 对称

☐☐☐ Recognise line symmetry and order of rotational symmetry in two dimensions.

☐☐☐ Recognise symmetry properties of prisms, cylinders, pyramids and cones.

E4.6 Angles 角

☐☐☐ Calculate unknown angles and give simple explanations using the following geometrical properties: • sum of angles at a point = 360° • sum of angles at a point on a straight line = 180° • vertically opposite angles are equal • angle sum of a triangle = 180° and angle sum of a quadrilateral = 360°.

☐☐☐ Calculate unknown angles and give geometric explanations for angles formed within parallel lines: • corresponding angles are equal • alternate angles are equal • co-interior angles sum to 180° (supplementary).

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☐☐☐ Know and use angle properties of regular and irregular polygons.

E4.7 Circle theorems I 圆的定理 I

☐☐☐ Calculate unknown angles and give explanations using the following geometrical properties of circles: • angle in a semicircle = 90° • angle between tangent and radius = 90° • angle at the centre is twice the angle at the circumference • angles in the same segment are equal • opposite angles of a cyclic quadrilateral sum to 180° (supplementary) • alternate segment theorem.

E4.8 Circle theorems II 圆的定理 II

☐☐☐ Use the following symmetry properties of circles: • equal chords are equidistant from the centre • the perpendicular bisector of a chord passes through the centre • tangents from an external point are equal in length.

5. Mensuration 测量

C5.1 Units of measure 度量单位

☐☐☐ Use metric units of mass, length, area, volume and capacity in practical situations and convert quantities into larger or smaller units.

C5.2 Area and perimeter 面积与周长

☐☐☐ Carry out calculations involving the perimeter and area of a rectangle, triangle, parallelogram and trapezium.

C5.3 Circles, arcs and sectors 圆、弧与扇形

☐☐☐ Carry out calculations involving the circumference and area of a circle.

☐☐☐ Carry out calculations involving arc length and sector area as fractions of the circumference and area of a circle, where the sector angle is a factor of 360°.

C5.4 Surface area and volume 表面积与体积

☐☐☐ Carry out calculations and solve problems involving the surface area and volume of a: • cuboid • prism • cylinder • sphere • pyramid • cone.

C5.5 Compound shapes and parts of shapes 复合图形与图形的部分

☐☐☐ Carry out calculations and solve problems involving perimeters and areas of: • compound shapes • parts of shapes.

☐☐☐ Carry out calculations and solve problems involving surface areas and volumes of: • compound solids • parts of solids.

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☐☐☐ Carry out calculations and solve problems involving perimeters and areas of: • compound shapes • parts of shapes.

☐☐☐ Carry out calculations and solve problems involving surface areas and volumes of: • compound solids • parts of solids.

6. Trigonometry 三角学

C6.1 Pythagoras' theorem 勾股定理

☐☐☐ Know and use Pythagoras' theorem.

C6.2 Right-angled triangles 直角三角形

☐☐☐ Know and use the sine, cosine and tangent ratios for acute angles in calculations involving sides and angles of a right-angled triangle.

☐☐☐ Solve problems in two dimensions using Pythagoras' theorem and trigonometry.

E6.1 Pythagoras' theorem 勾股定理

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☐☐☐ Know and use the sine, cosine and tangent ratios for acute angles in calculations involving sides and angles of a right-angled triangle.

☐☐☐ Solve problems in two dimensions using Pythagoras' theorem and trigonometry.

☐☐☐ Know that the perpendicular distance from a point to a line is the shortest distance to the line.

☐☐☐ Carry out calculations involving angles of elevation and depression.

E6.3 Exact trigonometric values 三角函数的精确值

☐☐☐ Know the exact values of: 1 $\sin x$ and $\cos x$ for $x = 0°, 30°, 45°, 60°$ and $90°$. 2 $\tan x$ for $x = 0°, 30°, 45°$ and $60°$.

E6.4 Trigonometric functions 三角函数

☐☐☐ Recognise, sketch and interpret the following graphs for $0° \leqslant x \leqslant 360°$: • $y = \sin x$ • $y = \cos x$ • $y = \tan x$.

☐☐☐ Solve trigonometric equations involving $\sin x$, $\cos x$ or $\tan x$, for $0° \leqslant x \leqslant 360°$.

E6.5 Non-right-angled triangles 非直角三角形

☐☐☐ Use the sine and cosine rules in calculations involving lengths and angles for any triangle.

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☐☐☐ Use the formula area of triangle $= \frac{1}{2}ab\sin C$.

E6.6 Pythagoras' theorem and trigonometry in 3D 三维中的勾股定理与三角学

☐☐☐ Carry out calculations and solve problems in three dimensions using Pythagoras' theorem and trigonometry, including calculating the angle between a line and a plane.

7. Transformations and vectors 变换与向量

C7.1 Transformations 变换

☐☐☐ Recognise, describe and draw the following transformations:

☐☐☐ Reflection of a shape in a vertical or horizontal line.

☐☐☐ Rotation of a shape about the origin, vertices or midpoints of edges of the shape, through multiples of 90°.

☐☐☐ Enlargement of a shape from a centre by a scale factor.

☐☐☐ Translation of a shape by a vector $\begin{pmatrix} x \\ y \end{pmatrix}$.

E7.1 Transformations 变换

☐☐☐ Transformations

E7.2 Vectors in two dimensions 二维向量

☐☐☐ Vectors in two dimensions

E7.3 Magnitude of a vector 向量的模

☐☐☐ Magnitude of a vector

E7.4 Vector geometry 向量几何

☐☐☐ Vector geometry

8. Probability 概率

C8.1 Introduction to probability 概率导论

☐☐☐ Understand and use the probability scale from 0 to 1.

☐☐☐ Calculate the probability of a single event.

☐☐☐ Understand that the probability of an event not occurring = 1 – the probability of the event occurring.

C8.2 Relative and expected frequencies 相对频率与期望频率

☐☐☐ Understand relative frequency as an estimate of probability.

☐☐☐ Calculate expected frequencies.

C8.3 Probability of combined events 组合事件的概率

☐☐☐ Calculate the probability of combined events using, where appropriate: • sample space diagrams • Venn diagrams • tree diagrams.

E8.1 Introduction to probability 概率导论

- ☐☐☐ Understand and use the probability scale from 0 to 1.
- ☐☐☐ Understand and use probability notation.
- ☐☐☐ Calculate the probability of a single event.
- ☐☐☐ Understand that the probability of an event not occurring = 1 – the probability of the event occurring.

E8.2 Relative and expected frequencies 相对频率与期望频率

- ☐☐☐ Understand relative frequency as an estimate of probability.
- ☐☐☐ Calculate expected frequencies.

E8.3 Probability of combined events 组合事件的概率

- ☐☐☐ Calculate the probability of combined events using, where appropriate: • sample space diagrams • Venn diagrams
- ☐☐☐ • tree diagrams.

E8.4 Conditional probability 条件概率

- ☐☐☐ Calculate conditional probability using Venn diagrams, tree diagrams and tables.

9. Statistics 统计

C9.1 Classifying statistical data 统计数据的分类

- ☐☐☐ Classify and tabulate statistical data.

C9.2 Interpreting statistical data 统计数据的解读

- ☐☐☐ Read, interpret and draw inferences from tables and statistical diagrams.
- ☐☐☐ Compare sets of data using tables, graphs and statistical measures.
- ☐☐☐ Appreciate restrictions on drawing conclusions from given data.

C9.3 Averages and range 平均数与极差

- ☐☐☐ Calculate the mean, median, mode and range for individual data and distinguish between the purposes for which these are used.

C9.4 Statistical charts and diagrams 统计图表

- ☐☐☐ Draw and interpret: (a) bar charts (b) pie charts (c) pictograms (d) stem-and-leaf diagrams (e) simple frequency distributions.

C9.5 Scatter diagrams 散点图

- ☐☐☐ Draw and interpret scatter diagrams.
- ☐☐☐ Understand what is meant by positive, negative and zero correlation.
- ☐☐☐ Draw by eye, interpret and use a straight line of best fit.

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- ☐☐☐ Compare sets of data using tables, graphs and statistical measures.
- ☐☐☐ Appreciate restrictions on drawing conclusions from given data.

E9.3 Averages and measures of spread 平均数与离散程度的度量

- ☐☐☐ Calculate the mean, median, mode, quartiles, range and interquartile range for individual data and distinguish between the purposes for which these are used.
- ☐☐☐ Calculate an estimate of the mean for grouped discrete or grouped continuous data.
- ☐☐☐ Identify the modal class from a grouped frequency distribution.

E9.4 Statistical charts and diagrams 统计图表

- ☐☐☐ Draw and interpret: (a) bar charts (b) pie charts (c) pictograms (d) stem-and-leaf diagrams (e) simple frequency distributions.

E9.5 Scatter diagrams 散点图

- ☐☐☐ Draw and interpret scatter diagrams.
- ☐☐☐ Understand what is meant by positive, negative and zero correlation.
- ☐☐☐ Draw by eye, interpret and use a straight line of best fit.

E9.6 Cumulative frequency diagrams 累积频数图

- ☐☐☐ Draw and interpret cumulative frequency tables and diagrams.
- ☐☐☐ Estimate and interpret the median, percentiles, quartiles and interquartile range from cumulative frequency diagrams.

E9.7 Histograms 直方图

- ☐☐☐ Draw and interpret histograms.
- ☐☐☐ Calculate with frequency density.