Extended-Response Tasks – Sample questions

Year 10 Tasks

1. **Financial Mathematics** *(calculator allowed)*
   Applying successive percentage increases and decreases, solving problems involving compound interest, compound depreciation, straight-line depreciation, simple interest and recurrence relations, comparing rates and compounding periods, finding the original amount, the residual value, the straight-line fixed amount, the accumulated value of an investment, the depreciated value of an asset and the amount owing on a loan
2. **Real Numbers**
   Performing operations with surds and fractional indices, using the definition of a logarithm, applying the laws of logarithms and the change of base theorem, describing, interpreting and sketching exponential and logarithmic functions and their transformations, solving exponential and logarithmic equations
3. **Algebra**
   Simplifying algebraic products and quotients, applying the four operations to algebraic fractions, factorising monic and non-monic quadratic expressions using trial and error, identities, grouping, completing the square, solving equations arising from formulas, investigating polynomials, applying the remainder and factor theorems
4. **Linear Relationships**
   Solving problems involving linear equations, including those derived from formulas and those involving algebraic fractions, solving linear inequalities and graphing their solutions on a number line, solving linear simultaneous equations, algebraically and graphically, solving problems involving parallel and perpendicular lines
5. **Non-linear Relationships**
   Solving quadratic equations from a variety of contexts using a range of strategies including the quadratic formula, describing, interpreting and sketching the graphs of parabolas, hyperbolas, circles and polynomial functions and their transformations
6. **Measurement** *(calculator allowed)*
   Using Pythagoras' Theorem and similar figures and solving two and three-dimensional problems involving surface area and volume of prisms, right pyramids, right cones, spheres and related composite solids
7. **Geometric Reasoning**
   Deducing properties of geometric figures, applying logical reasoning, including the use of similarity, to proofs and numerical exercises involving plane shapes, proving and applying angle and chord properties of circles
8. **Trigonometry** *(calculator allowed)*
   Using trigonometry to solve two and three-dimensional problems in right-angled triangles, proving and using the sine, cosine and area rules to solve problems in non-right-angled triangles, defining and graphing trigonometric functions using the unit circle, solving trigonometric equations including the use of exact values
9. **Probability and Statistics** *(calculator allowed)*
   Assigning probabilities to the results of chance experiments both with and without replacements, recognising that an event can be dependent on another event and that this will affect the calculation of its probability, investigating the concept of independence, solving conditional probability questions, finding five-number summaries for data sets, interpreting box plots, calculating and interpreting means and standard deviations, comparing data sets, using scatter plots to investigate bivariate numerical data using a straight line to describe the relationship and to make predictions where appropriate

To order the Year 10 Mathematics Extended-Response Tasks, please point your browser to **http://russellboyle.com/orders.html**

Extended-Response Tasks – Sample questions

Year 10: Measurement *(calculator allowed)*

Question 4

The engineer who designed and built the ice-cube maker also supplied the restaurant with a machine that serves ice-cream as perfectly formed spheres. Using this machine, *Mathematically Perfect* has become famous for its *Spherical Pyramid* desserts. One such dish consists of four spheres arranged in a square with a fifth sphere sitting on top of them. The radius of each sphere is 2 cm and the centres of the five spheres form a regular square pyramid.

a. What is the length of each edge of the regular square pyramid?

b. Find the length of the diagonal of the base of the square pyramid.

c. Hence find the height of the square pyramid.

d. Show that the height of the fifth sphere above the bottom of the dessert bowl is $4 + 2\sqrt{2}$ cm.

The dessert comes in a smaller size for the calorie-conscious diner. The smaller dessert has three spheres arranged in a triangle with a fourth sphere on top of them. The radius of each sphere is 2 cm and the centres of the four spheres form a regular triangular pyramid or tetrahedron.

e. Write down the length of each edge of the regular tetrahedron.

f. Calculate the length of the median of the equilateral base of the regular tetrahedron.

g. Given that the height of a regular tetrahedron meets the median of its equilateral base at a point which divides the length of the median in the ratio 2:1, show that the height of the regular tetrahedron joining the centres of the four spheres is $\frac{4}{3}\sqrt{6}$ cm in length.

h. Find the height of the fourth sphere above the bottom of the dessert bowl.

i. Which of the two *Spherical Pyramid* desserts is the taller? What percentage of the smaller height is the larger height? Write the answer correct to one decimal place.

The above question is one of four extended-response questions in the Measurement Task. To order the Year 10 Mathematics Extended-Response Tasks, please point your browser to **http://russellboyle.com/orders.html**

Year 10: Probability and Statistics *(calculator allowed)*

Question 4

The examination results of a group of seventeen students in Mathematics 1 and Mathematics 2 are recorded in the table below

math1	57	90	73	19	65	79	87	66	65	83	59	67	71	65	80	94	49
math2	42	89	59	35	48	66	74	51	66	65	55	67	60	56	64	94	33

a. Draw two parallel boxplots, showing any outliers.

b. Which examination was more difficult for this group of students? Explain why, quoting the values of an appropriate statistic.

c. Draw a scatter plot. Use the x-axis to represent math1 and the y-axis to represent math2.

A line of best fit is drawn through the points on the scatter plot. The equation for this line is $\text{math2} = 0.79 \times \text{math1} + 5.69$.

d. Sketch this line of best fit on your scatterplot in part **c.**

e. Use this equation to predict the math2 result of a student if their math1 result was 50.

f. Use this equation to predict the math1 result of a student if their math2 result was 50.

g. Give a reason why predicting the math2 result of a student whose result in math1 was 0 may have limited reliability.

The above question is one of four extended-response questions in the Probability and Statistics Task. To order the Year 10 Mathematics Extended-Response Tasks, please point your browser to **http://russellboyle.com/orders.html**

