Mathematics Standard 2

HSC Marking Feedback 2020

Question 16

Students should:

- understand how to find an angle in a right-angle triangle
- set up a correct trigonometry ratio before attempting to solve the problem
- be able to apply Pythagoras' theorem to find the value of a side
- show all their working.

In better responses, students were able to:

- show structured setting out using $\tan\theta = \frac{8}{10}$ or $\theta = \tan^{-1}\left(\frac{8}{10}\right)$
- identify the correct trigonometric ratio for the given sides, using the Reference Sheet
- calculate the correct answer of 12.8, using a mixture of strategies including using the sine rule or the sine or cos ratio involving the angle they had found in part (a)
- use Pythagoras' theorem correctly.

Areas for students to improve include:

- reading the question carefully and evaluating what is required to achieve the correct answer, for example, right-angled trigonometry and Pythagoras' theorem
- using the easiest method of basic trigonometry rather than more complex methods to solve the answer
- checking their solution from the given diagram.

Question 17

Students should:

- read the question carefully to identify that the area of land is required
- make connections with the language of the question and show that 1000 by 1000 is 1000×1000.

In better responses, students were able to:

- show evidence of an understanding of measurement concepts through combining one of the areas with proportionality.

Areas for students to improve include:

- showing step by step working for their calculations.

Question 18

Students should:

- be able to draw a connected, weighted spanning tree given information from a diagram
- show structured setting out.

In better responses, students were able to:

- construct the network diagram and indicate weightings correctly
- make an adjustment in the event of incorrect connections
- choose the smallest number for each step as they created their minimum spanning tree
- correctly add their weights to have a length of 14
- correctly add $14 + 10 = 24$ in part (b).

Areas for students to improve include:

- showing an understanding of the concept of a minimum spanning tree
- writing weightings and nodes correctly
- drawing neat and legible diagrams that are clearly and correctly labelled
- labelling all vertices with a letter and all edges with a number (weight).

Question 19

Students should:

- recognise that there are 2 values for x on this graph for which the area is $30\,000$
- consider all possible solutions not just the first one they encounter
- use the labels on the axes to understand what the graph is telling them.

In better responses, students were able to:

- determine that 200 is greater than 100 and is therefore the larger value
- solve the question algebraically substituting $A = 30000$ into $A = 450x - 1.5x^2$
- determine the axis of symmetry to read off the x-value that corresponds to the maximum area.

Areas for students to improve include:

- identifying that the question asked for the largest value of x when $A = 30\,000$
- not setting x and y respectively equal to zero to try and determine the values of x and y
- understanding the difference between a linear and a non-linear equation.

Question 20

Students should:

- carefully check that they read all parts of the questions
- be able to identify the correct row in a tax table and calculate the tax payable
- understand that an annual amount involves the conversion of monthly to yearly by multiplying \$3000 by 12.

In better responses, students were able to:

- identify the correct tax rates and clearly calculate the tax to be \$32 888.60

- recognise that a refund involves subtraction and calculate the answer of $\$36\,000 - \$32\,888.60 = \$3111.40$. That is, calculate total tax payable minus PAYG.

Areas for students to improve include:

- identifying the terms relating to tax calculations and knowing when to calculate the taxable income and when it is already given in the question
- using the correct order of operations when calculating their tax from a table
- understanding that the subtraction of PAYG must be performed after their tax calculation, not before.

Question 21

Students should:

- be aware that to find the original price does not involve calculating the percentage increase/decrease and adding or subtracting this from the value given
- check they are correctly rounding to the nearest cent
- review changing a percentage to a decimal.

In better responses, students were able to:

- apply the FV/PV formula successfully
- apply the unitary method successfully
- divide by 1.02 to reach the correct answer.

Areas for students to improve include:

- solving practical problems using the unitary method
- determining the impact of inflation and realising that a new price value is not equivalent to 100%
- considering other methods such as guess and check to calculate a solution.

Question 22

Students should:

- review the concept of interest rate as meaning a percentage calculation
- be able to identify that the interest calculation required is compound interest rather than simple interest.

In better responses, students were able to:

- show a substitution into the compound interest or future value formula and recognise that payment is then taken away from the total.

Areas for students to improve include:

- calculating the daily interest rate from the given annual rate with a division by 365 and not 360 or 364.

Question 23

Students should:

- carefully read the question so that they are aware that the 3 litres does not represent the whole tropical drink but only one ingredient
- review conversion and volume of a prism concepts and recognise that the formula for volume of a prism not pyramid is required
- clearly indicate their answer.

In better responses, students were able to:

- show their understanding of proportionality ($15/3$) and use the unitary method effectively
- calculate the volume of the container and multiply by $9/28$. They were also able to show logical reasoning in their working
- find the simple or less complicated method of solving the problem.

Areas for students to improve include:

- showing working out in a concise manner
- reviewing their understanding of volume and capacity
- considering whether their answer may be unrealistic (too large for a drink container).

Question 24

Students should:

- use a ruler to construct a straight line and be able to extend the line to the correct x- and y-intercepts
- identify an algebraic expression to represent Tank B and be able to graph the straight line representing the volume of Tank B on the grid for part (a)
- correctly identify the point of intersection either graphically or algebraically
- use graphical or algebraic means to find a time when Tank A plus Tank B equals 1000.

In better responses, students were able to:

- plot a series of points, or the x- and y-intercepts, and connect them to create a straight line
- graph the correct line for Tank B on the grid in part (a) and correctly identify the point of intersection from the lines for Tank A and Tank B
- create the correct equation for Tank B and hence, find the solution for the equations for Tank A and Tank B algebraically
- understand that the question asked for the time taken for both tanks to have a combined total.

Areas for students to improve include:

- graphing a linear equation when the y-intercept is not given and solve algebraically
- graphing the solution to a linear relationship where only the x-intercept is given
- using their graphs to demonstrate the time when the combined total reached 1000.

Question 25

Students should:

- calculate the surface area of a composite solid
- calculate the area of a square, rectangle and triangle
- rearrange the area of a triangle formula to calculate its height.

In better responses, students were able to:

- clearly set out the components required to calculate the area of the squares, rectangles and triangles
- clearly identify the area of each shape along with the multiples required
- find the height of the triangle by subtraction of the measurements given or the use of Pythagoras' theorem.

Areas for students to improve include:

- differentiating between the height of the triangle and the hypotenuse to calculate area
- recognising all of the faces of the solid
- knowing whether to calculate surface area or volume.

Question 26

Students should:

- be able to forward scan on a network diagram
- not confuse the shortest path with the critical path
- ensure they do not go against the direction of the arrows on a path.

In better responses, students were able to:

- forward and backward scan, labelling all sections of the network correctly
- highlight the critical path on the diagram for ease of copying to the answer space
- calculate the float time using their forward and backward scanning values.

Areas for students to improve include:

- practising the calculation of earliest start time and latest start time
- reviewing the different types of diagrams that could be given to represent a network and understanding how they are read
- listing their path in the order in which they progress through the network.

Question 27

Students should:

- apply the Trapezoidal rule twice by dividing the shape into 2 equal parts
- use a scale to convert measurements
- develop their understanding of how the Trapezoidal rule calculates and approximates the area required
- refer to the diagram given for their explanation.

In better responses, students were able to:

- clearly label the diagram and apply the Trapezoidal rule twice

- show their converted lengths on their diagram
- provide a clear indication of their understanding of the Trapezoidal rule by the addition of lines on their diagram
- support their written response referring to their diagram and clearly showing the excess between the curve and the boundary of the trapezium.

Areas for students to improve include:

- converting scale lengths first before applying the Trapezoidal rule
- displaying their converted numbers on the graph/diagram provided
- reading the question carefully, especially where their response is to choose one of the three options
- referring to the diagram in their explanation.

Question 28

Students should:

- be able to identify the medians and means from two data sets
- be able to apply the mathematical concept of the difference of medians and use this information in an equation to calculate a new score.

In better responses, students were able to:

- calculate the two medians and means from the two data sets
- apply their understanding of the difference of medians to form an equation to solve for the new score.

Areas for students to improve include:

- understanding statistical terms including the definitions of mean and median
- practising deriving an equation from given information and being able to solve it.

Question 29

Students should:

- be able to identify the question from within the information given
- understand terms such as annual, dividend yield and portfolio
- show all relevant working.

In better responses, students were able to:

- calculate the ABC and XYZ total dividends
- set up an equation linking the XYZ dividend with the number of shares
- show clear lines of working for each step of the solution.

Areas for students to improve include:

- solving equations rather than using ‘guess and check’ method
- operating with decimals instead of rounding to whole numbers within the solution of a problem
- understanding how to operate with percentages.

Question 30

Students should:

- realise that the maximum flow cannot be greater than the largest edge capacity value
- know that minimum cut = maximum flow
- know how to calculate the value of a cut.

In better responses, students were able to:

- show structured reductions of flow on the diagram to determine the maximum flow
- draw and determine the value of cuts on their diagram and compare this to their answer from part (a)
- show the actual minimum cut on their diagram
- use the minimum cut = maximum flow concept to justify their answer.

Areas for students to improve include:

- knowing how to determine maximum flow
- understanding the difference between maximum flow and EST/LFT
- checking that only flows going from source to sink are to be added to give the cut value
- giving a reason for their answer.

Question 31

Students should:

- write a numerical statement to show the calculation of their answer
- identify the correct rule to use in non-right-angled triangles based on the given information
- be able to use the given angle from part (a) as part of their solution for part (b)
- remember to use angles between parallel lines and apply them to bearings.

In better responses, students were able to:

- demonstrate their understanding of bearings to find an angle
- correctly identify and substitute into the cosine rule
- apply the sine or cosine rule to find an angle in the triangle APB then use knowledge of parallel lines and angle sum of triangle to find the bearing
- show full working out from their calculated angle to find the bearing.

Areas for students to improve include:

- knowing how to answer a 'show' question and realising that the result given is the answer they need to obtain at the end of their working
- checking the validity of their solution when using the cosine rule to find a side
- understanding the language of bearings, and the meanings of 'of' and 'from'
- interpreting bearings to identify an angle in a diagram
- applying their knowledge of the angle sum of a triangle.

Question 32

Students should:

- identify that the regular decagon can be split into triangles and not sectors

- know what the perimeter of a shape refers to and how to use this to find a side.

In better responses, students were able to:

- identify 8 as the side length and $36°$ as the angle in triangle ABO and use trigonometry to find length OA or OB
- draw separate diagrams of their triangle and label their diagrams clearly
- correctly find the area of a triangle and multiply by 10.

Areas for students to improve include:

- using the Reference Sheet correctly when finding the areas of triangles and not getting them confused with sectors
- learning the names of polygons and the number of sides of each
- using the correct properties of a triangle to find its area. That is: using the correct values of the sides and the included angle when using $A = \frac{1}{2}ab\sin C$; using $A = \frac{1}{2}bh$ for a right-angled triangle.

Question 33

Students should:

- be able to identify on the diagram the point $n = 40$ and read the corresponding y-value
- recognise from the information given, that the initial value of the bacteria 1000, represents A
- be able to use trial and error to calculate b, correct to 2 decimal places by substituting a point from the graph into the equation.

In better responses, students were able to:

- accurately read the value from the graph and correctly identify 4000
- deduce, or calculate through substitution, that $A = 1000$
- solve for b, algebraically or by trial and error, giving an upper and lower value.

Areas for students to improve include:

- writing their answer as 4000, not adding any extra zeros
- recognising that 'initially' finds A in the equation when $t = 0$
- remembering that $b^0 = 1$.

Question 34

Students should:

- understand the relevance of subscript notation: $A_0,\ A_n, A_{n-1}$
- appreciate the difference between 0.005 and 0.005%
- use the equation supplied in the question.

In better responses, students were able to:

- apply the recurrence relationship and follow through to the correct answer
- recognise the connection between their result in part (a) and how it followed onto determining the result in part (b)

- demonstrate their understanding of the process that is needed to calculate each step of an annuity.

Areas for students to improve include:

- transcribing numbers containing several zeros
- rounding their calculations at the end of the question unless specified earlier
- understanding the impact of repayments/withdrawals on the interest calculation.

Question 35

Students should:

- be able to calculate the z-score and calculate the appropriate percentage relating to the z-score
- understand the use of the distribution curve to calculate the z-score
- use the percentage calculated and multiply by the number of adults given in the question
- derive two equations based on the information given and solve these equations simultaneously.

In better responses, students were able to:

- calculate the z-score by formula
- use the normal distribution diagram, indicating the mean and the z-scores clearly
- accurately apply the percentage breakdown
- set up and equate the two z-score equations and solve these equations simultaneously.

Areas for students to improve include:

- using the z-score formula and calculating the corresponding percentages to the z-score
- recognising that IQ referred to the score and it was the same in both cities
- interpreting the need to form an equation relating to both cities as opposed to separate equations that could not be connected
- solving equations involving fractions.

Question 36

Students should:

- practise changing the subject of the formula in unfamiliar equations
- complete each calculation as they progress through a question to build the information required for the final solution
- be familiar with the terminology used in statistics-based questions.

In better responses, students were able to:

- determine $\bar{x}$ and $\bar{y}$ and substitute these correctly to determine the value of b
- carry through the value of an answer, for example, $b = 2.08644$ ... for a more precise answer
- provide an equation and calculate the answer from information they provided.

Areas for students to improve include:

- correctly substituting values into a given formula

- understanding that different pronumerals can have different meanings according to their application, for example, b in this question.

Question 37

Students should:

- understand what the values in a present value interest table represent
- be able to convert from percentages to decimals
- realise that the minimum value of the lump sum needs to be less than the total paid back.

In better responses, students were able to:

- determine the value of $1000 annuity
- use only values in the 0.02 column of the table
- add two ‘present value of an annuity’ calculations to give a lump sum
- show structured working.

Areas for students to improve include:

- checking their answer
- knowing how to use a present value interest table as opposed to the compound interest formula
- understanding that a change in withdrawal values requires the difference of two ‘present value of an annuity’ calculations.