Mathematics Standard 2

HSC Marking Feedback 2021

Question 16

Students should:

- substitute the value of the radius into the formula
- round the result of the calculation correctly
- clearly show working.

In better responses, students were able to:

- correctly substitute into the given equation and halve their answer
- show complete working – the formula used, values substituted and then their final response.

Areas for students to improve include:

- showing the operation signs when substituting into an equation, for example, the multiplication sign
- adapting the required formula to the question
- setting out the solution with equal signs working down the page, not across
- giving only one solution
- using the diagram as a guide.

Question 17

Students should:

- calculate interquartile range using the upper and lower quartiles
- calculate the upper bound for an outlier
- justify that 20 is an outlier.

In better responses, students were able to:

- efficiently calculate the bound for the outlier and give a conclusion
- calculate the interquartile range.

Areas for students to improve include:

- realising that just because a five-number summary is given, this does not necessarily mean that a boxplot should be drawn
- understanding how an outlier is defined in this course and choosing the appropriate

formula to use

- knowing the difference between range and IQR.

Question 18

Students should:

- calculate the fuel cost
- use multiplication and division appropriately
- show all calculation steps.

In better responses, students were able to:

- realise when multiplication was needed and when division was needed to calculate the fuel cost
- avoid rounding answers as they worked through the question so that they could calculate the exact cost
- set out their solutions neatly.

Areas for students to improve include:

- realising the need to multiply by the cost per litre rather than to divide by it in order to calculate fuel cost
- knowing not to round answers part-way through a question.

Question 19

Students should:

- use the straight-line depreciation formula from the Reference Sheet
- manipulate the linear equation correctly to calculate the initial value.

In better responses, students were able to:

- use general reasoning to calculate the initial value accurately
- use the formula for straight-line depreciation and correctly solve for the initial value
- work backwards through the problem logically, starting at $\$7500$ and applying repeated addition.

Areas for students to improve include:

- understanding where salvage value and initial value fit into the straight-line depreciation method
- solving a linear equation correctly for an unknown variable
- rearranging a formula and knowing the order of operations.

Question 20

Students should:

- use longitude difference when solving time zone problems
- relate time difference to longitude difference using division by 15
- determine which city is ahead of the other city using longitude values
- include both time *and* day when answering the question.

In better responses, students were able to:

- calculate the required time using longitude difference
- calculate the time difference
- correctly stated that time in Sydney was ahead of time in Sweden
- draw a simple timeline sketch or coordinate sketch to assist their calculations.

Areas for students to improve include:

- understanding that only longitude difference is relevant for time calculations
- understanding why division by 15 is used
- reading the question carefully and remembering to state the day and the time when both are required.

Question 21

Students should:

- calculate an interest rate using the simple interest paid on the opening balance of any of the months
- transfer the closing balance of month 6 to the opening balance for month 7
- apply the interest rate found to the opening balance of month 7
- add the opening balance, the interest calculated and the deposit of $\$500$ to get the closing balance.

In better responses, students were able to:

- identify the steps they needed to follow to arrive at a correct solution
- calculate the interest rate from the amount of interest paid on the opening balance for one of the months, prior to deposit of $\$500$
- note that the question asked for a simple interest rate and that each entry in columns 3 and 4 were deposits
- write their working out clearly.

Areas for students to improve include:

- reading the question carefully to identify the context – in this instance that the third and fourth column represented positive contributions to the account, and represent dollar amounts
- noting that the interest was calculated on the opening balance
- rounding correct to 2 decimal places
- knowing the definitions of basic terms used in finance.

Question 22

Students should:

- calculate taxable income after allowable tax deductions are taken from gross pay
- calculate the Medicare levy from the correct taxable income
- calculating the income tax, managing values in cents and dollars
- check the reasonableness of their answers.

In better responses, students were able to:

- calculate the taxable income by subtracting deductions
- use the taxable income to calculate the Medicare levy
- identify the correct tax bracket from a table to calculate income tax
- use the taxable income to calculate income tax
- understand that the total tax payable is the income tax and the Medicare levy
- show full and correct working with all their taxation calculations.

Areas for students to improve include:

- understanding how to calculate taxable income
- using taxable income to calculate both the Medicare levy and income tax payable
- setting out their calculations in a clear, logical progression
- considering whether their answer may be unrealistic. For example, if the total tax payable exceeds the taxable income.
- converting from cents to dollars.

Question 23

Students should:

- understand that a spanning tree contains no cycles
- make use of the existing network diagram by highlighting or drawing on it
- clearly label edges and vertices
- realise that the shortest path may not be a subset of the minimum spanning tree.

In better responses, students were able to:

- indicate or draw a network diagram without cycles
- locate the minimum spanning tree as opposed to an alternate spanning tree
- clearly indicate edge weights and vertices
- calculate the minimum length.

Areas for students to improve include:

- knowing the difference between a spanning tree and the minimum spanning tree
- reading the question carefully to see that the shortest route was required and clearly indicating this.

Question 24

Students should:

- interpret the word 'initial' to mean when $t = 0$
- correctly substitute $t = 5$ into the formula
- plot the two points associated with $t = 0$ and $t = 5$ and correctly label them on the graph
- draw the graph of a positive exponential function as a smooth curve.

In better responses, students were able to:

- find the initial population without having to substitute $t = 0$ into the given formula

- plot the vertical intercept $(0,2000)$ and the point $(5,4977)$ and draw a smooth positive exponential curve using only these two points
- draw a smooth exponential curve
- only graph endpoints.

Areas for students to improve include:

- practising substituting into an equation
- using the power button on their calculator
- knowing that initial means when time is equal to zero
- recognising that the given equation represents an exponential curve
- recognising that in this case, the origin represented $t = 0$ and $P = 0$.

Question 25

Students should:

- calculate the perimeter of the sportsground using the given scale
- determine a speed
- ensure that the final answer is in the correct units
- show all calculation steps.

In better responses, students were able to:

- understand the process of using the scale to convert the perimeter to a distance
- indicate their knowledge of conversions by writing units
- convert between metric units such as metres and kilometres
- navigate between units of time in a rate.

Areas for students to improve include:

- using a scale effectively
- converting a distance and time into an appropriate rate
- looking at the reasonableness of final answers as a guide to whether their calculations may or may not be correct
- writing logical and systematic working when dealing with a multi-step question.

Question 26

Students should:

- identify that compound interest is to be used to find the value for part (a)
- convert the time and interest rate to reflect months, and use these values in the calculation
- identify that simple interest is to be used to find the value for part (b)
- note that $FV = PV + \text{interest}$ in this question.

In better responses, students were able to:

- recognise the need to adjust the time and interest rate for part (a)
- recognise the need to use the simple interest formula in part (b)
- note that $FV = PV + I$

- rearrange an equation of the form $I = Prn$.

Areas for students to improve include:

- recognising that 6% is written as 0.06
- matching interest rate and time periods in the compound interest formula
- rearranging algebraic expressions rather than using guess and check to save time
- recognising that the simple interest formula uses only the interest not the future value.

Question 27

Students should:

- calculate the power usage for Television B for one year
- determine the running cost of Television B for one year
- calculate the difference in running cost
- find the saving in purchasing Television A compared to Television B
- use the result from part (a) to calculate the number of year.

In better responses, students were able to:

- calculate the power usage of a device over a set period of time
- calculate the total power cost of a device over a set period of time
- calculate the difference in power costs in different devices
- see the link between part (a) and part (b)
- compare the overall costs of two devices and determine when they were equal.

Areas for students to improve include:

- converting units of power
- understanding units of time
- recognising unrealistic answers.

Question 28

Students should:

- identify two places where the line crosses the grid at identifiable coordinates and then use those to calculate the gradient
- notice that the y-intercept is on a grid line
- write down the equation of the line found after finding the gradient and the y-intercept
- realise that when adding a data point, the new line of best fit will probably have a different gradient
- think about where added data point sits in relation to the existing data and the line of best fit, and how its position might impact the gradient.

In better responses, students were able to:

- calculate the gradient using the two points that sat on the line and on the grid – $(0,2)$ and $(5,18)$
- calculate the gradient and use the y-intercept to write down the equation of the line

- think about the placement of the new data point and its impact on the least squares regression line.

Areas for students to improve include:

- knowing that the equation of a line, including a regression line, has an 'equals' sign in it
- knowing which letter on a calculator output represents the gradient (and the coefficient of x) and which represents the constant
- using two points on a given line to find the gradient.

Question 29

Students should:

- show step by step working to solve an equation
- know how to solve equations involving fractions
- check their solution by substitution.

In better responses, students were able to:

- correctly multiply both sides of the equation by 2
- show all steps in their working out
- move the x to the other side and then use the distributive law successfully to multiply by 2
- leave their solution in exact form or use recurring decimals.

Areas for students to improve include:

- multiplying all terms by the denominator, including the x on the LHS, by 2
- remembering to do the opposite operation to solve the equation
- avoiding the use of guess and check.

Question 30

Students should:

- understand terms such as dividend, market share, dividend yield
- decide whether to work in terms of one share or all the shares and hence determine the market price and dividend
- calculate the dividend yield as a percentage.

In better responses, students were able to:

- understand that the dividend yield was a percentage
- write a fraction comparing market price and dividend and then convert this to a percentage.

Areas for students to improve include:

- remembering the formula for dividend yield, or the steps required to find it
- recognising that the dividend yield is a percentage, not a dollar value
- ensuring that the final answer for dividend yield must include a percentage sign
- recognising that $\$810$ was the dividend for all 1500 shares.

Question 31

Students should:

- convert between the yearly rate to a monthly rate
- calculate the number of time periods
- identify the appropriate value in the table
- calculate the monthly repayment.

In better responses, students were able to:

- realise that 1.5% needed to be converted to a monthly rate
- find the number of months required
- identify the correct present value interest factor
- divide $500\ 000$ by the correct present value interest factor.

Areas for students to improve include:

- understanding that the total amount is the result of the monthly repayment multiplied by the present value interest factor
- knowing that there is no need to do compound interest calculations when the present value interest factor is given
- checking the reasonableness of the final answer in the context of the question.

Question 32 (a)

Students should:

- use SOHCAHTOA in right-angled triangles
- establish the correct trigonometric ratio to use
- evaluate trigonometric expressions using angles and side lengths
- use a calculation to find a numerical solution in degrees.

In better responses, students were able to:

- clearly write the fraction for the cosine ratio and show the solution
- correctly use the sine rule to find XY or find YZ from either using the sine ratio or the sine rule, and then use the tangent ratio or Pythagoras to find XY
- ensure the calculator was in degree mode.

Areas for students to improve include:

- correctly naming the sides of the triangle to ensure that the correct trigonometric ratio is used
- using the Reference Sheet to ensure that the trigonometric ratio is correct
- reading the question carefully to ensure they are finding the correct side
- using the diagram to correctly identify the perpendicular sides of the right-angled triangle
- recognising triangles in different orientations.

Question 32 (b)

Students should:

- find the radius of the semi-circle
- find the area of the semi-circle
- find the area of the triangle
- find the shaded area by calculating the area of the semicircle minus the area of the triangle.

In better responses, students were able to:

- identifying that the shaded area in this case was not two semicircles
- correctly find the areas of the semicircle and triangle, showing all working
- clearly show how they found the other missing side if they used $A = \frac{1}{2}bh$ for area of a triangle
- show each step, formula, substitution and working for each part of the question
- use non-right-angled trigonometry for area of a triangle which was the most efficient method.

Areas for students to improve include:

- identifying the correct area formulae supplied on the Reference Sheet
- using the correct sides of a triangle to apply $A = \frac{1}{2}bh$ for the area of a triangle
- interpreting different shapes and knowing the relevant formula to apply to find their area.
- copying the formula correctly from the Reference Sheet: $A = \frac{1}{2}ab\sin C$ not $\cos C$
- understanding that the triangle is the smaller shape in this example and therefore should be the shape that is being subtracted.

Question 33

Students should:

- read the question carefully and understand the terminology used in the statistics
- provide a clear indication of their understanding of a negative gradient
- discuss what happens to both height and temperature
- identify that correlation coefficient describes the strength of the relationship between the variables
- describe the relationship between the variables using both graphs and the information given in the question.

Part (a) (i)

In better responses, students were able to:

- correctly substitute the correct values into the given equation and evaluate it.

Areas for students to improve include:

- writing down their substitution before solving
- evaluating algebraic expressions.

Part (a) (ii)

In better responses, students were able to:

- state that as the height above sea level increases, the temperature decreases (or gets colder)
- interpret the meaning of the gradient within the context of the question.

Areas for students to improve include:

- keeping their answer simple and concise
- providing an interpretation of data
- improving their understanding of what gradient means in practical situations.

Part (b)

In better responses, students were able to:

- make a clear and concise statement. For example, 'Latitude, because the correlation coefficient is stronger for latitude than for height above sea level'.
- identify that when given two negative correlation coefficients, the value closer to -1 is stronger.

Areas for students to improve include:

- making mathematical interpretations rather than geographical answers
- thinking that only $+1$ means strong correlation.

Question 34

Students should:

- know how to substitute numbers into an equation to find the points that lie on a line
- be familiar with graphing a linear equation, particularly when y is not the subject of the equation
- understand that the solution for two simultaneous equations is the point of intersection of the two graphed lines
- plot a series of points and use a ruler to join them, to draw the equation of a line
- write an equation from a word description.

In better responses, students were able to:

- choose appropriate points to substitute into their equations in order to graph each equation
- interpret the 'correct' solution from 'incorrect' graphs and make the connection to the context of the question
- draw linear graphs neatly, with a ruler, and accurately find the point of intersection.

Areas for students to improve include:

- graphing straight lines when y is not the subject of the equation
- graphing neatly and accurately using a ruler and clearly defined points
- being able to accurately interpret the solution in the context of the question including reading off correct values for x, for goannas and y, for emus
- breaking down a multi-step question into smaller parts or processes.

Question 35

Students should:

- analyse the quadratic model to interpret the situation and the meaning of the variables
- find the x-coordinate of the turning point and determine the price the publisher charges
- determine the value of the R-intercept from the form of the equation or by substituting $x = 0$.

In better responses, students were able to:

- interpret the question and correctly apply the context to a quadratic model
- calculate the x-value for the axis of symmetry of the parabola
- calculate the intercept of a parabola with the vertical axis
- recognise that they had to add 10 to the x-value found for the maximum revenue.

Areas for students to improve include:

- solving practical problems involving quadratic functions or expressions of the form $y = ax^2 + bx + c$
- reading the information presented to understand clearly what is being asked
- understanding the applications of a quadratic model
- identifying information from a quadratic model
- understanding the difference between the x- and y-intercepts
- understanding how to find and use the axis of symmetry of a parabola.

Question 36

Students should:

- find the critical path (the longest path in time) and recognise that this is the minimum time needed to complete the project
- identify an activity through EST and LST
- calculate the float time by subtracting EST from LST that is, using LST − EST.

In better responses, students were able to:

- recognise the difference between the minimum time to complete the project and the minimum length path
- locate the start and end of an activity through its LST and EST
- use LST − EST to calculate the float time
- find the float time correctly and find the correct location for X.

Areas for students to improve include:

- distinguishing between the concept of minimum time to complete in a network and the minimum path in a network. Although these use similar words they have very different meanings
- understanding the meaning of LST and EST
- understanding the terminology around networks and critical paths.

Question 37

Students should:

- use the sine ratio to find an angle in a triangle
- show substitution into the sine rule
- calculate the acute angle
- apply the ambiguous case to find the obtuse angle.

In better responses, students were able to:

- correctly substitute into the sine rule and find the required angle
- complete the question fully by finding the obtuse angle.

Areas for students to improve include:

- identifying the side/angle combinations to use sine rule instead of cosine rule
- recognising that Pythagoras' theorem cannot be used in a non-right-angled triangle
- practising manipulation of the sine rule to find an angle
- practising finding an obtuse angle when the calculator result is an acute angle.

Question 38

Students should:

- read the whole question carefully to understand what is represented by the data in the given table
- calculate the z-score (standardised score) corresponding to a particular value in a dataset
- use z-scores to identify probabilities of events less or more extreme than a given event
- use statistical tables to determine probabilities.

In better responses, students were able to:

- interpret the information from the table to show the probability range from a z-score
- calculate a z-score using the formula on the Reference Sheet
- use the associated probability of a z-score to calculate the number within a group
- see the link between part (a) and part (b).

Areas for students to improve include:

- showing calculations when using z-scores
- understanding how to use a table to calculate probabilities from z-scores
- converting a z-score to an associated probability from a table
- applying a probability to find the number of items in a group
- recognising that the probability required is for a value of z 'greater than 0.3' and utilise the provided table and diagram to assist with the correct calculation
- develop the skill to answer a 'show' type question.

Question 39

Students should:

- remember to how to use a calculator to find an angle from a given sine
- use the area of a non-right-angled triangle formula to determine the angle size of $\angle COB$
- determine the angle size of $\angle COD$ using the bearings given in the diagram
- use the cosine rule to determine the length of CD
- find the perimeter of triangle COD.

In better responses, students were able to:

- find the angle by manipulating the area of a non-right-angled triangle formula
- apply the cosine rule to find a side length
- read the question carefully and follow the instructions to find the fencing needed.

Areas for students to improve include:

- realising that right-angled trigonometry can only be used with right-angled triangles
- realising that a triangle may appear close to right-angled but that it cannot be assumed to be right-angled just because of this appearance
- knowing how to use the area of a non-right-angled triangle formula and how to rearrange it to find the angle included between two sides given the area of the triangle
- understanding the radial diagram given and how the bearings relate to angle sizes in the triangles.

Question 40

Students should:

- identify the interest rate per period from the table of future values
- apply the compound interest formula
- convert a percentage into a decimal.

In better responses, students were able to:

- use the table accurately and understand what the values in the table represented
- identify the correct interest rate of 8.2132 from the table
- apply the compound interest formula
- recognise that the question involved two distinct steps.

Areas for students to improve include:

- practising using a future value table
- converting percentages to decimals: $0.75\% = 0.0075$
- understanding the difference between an annuity and compound interest
- checking the reasonableness of their solution.

Question 41

Students should:

- read the questions carefully and apply their knowledge of the normal distribution

- learn the non-common percentages on a normal distribution curve, not just the ones provided on the Reference Sheet, so that they label them correctly
- convert the female heights to z-scores
- position the female heights on a normal distribution curve
- calculate the mean of female heights using the required number of standard deviations
- calculate the mean and standard deviation of male heights using the relationship given in the table
- use the mean and standard deviation to calculate the height of the selected male.

In better responses, students were able to:

- use the normal distribution curve to place the given values correctly
- correctly calculate the standard deviation for the females
- understand and use the information given in the table connecting male and female means and standard deviations
- calculate the height of the male.

Areas for students to improve include:

- using the empirical rule on the Reference Sheet to aid calculation
- calculating the standard deviation from points marked on the normal curve
- recognising and using the mean and standard deviation notation
- practising the use of z-score questions that are fractional combinations of 68%, 95%, 99.7%. For example 84%, 16%, and 97.5%
- recognising the meaning of basic algebra, for example, 1.05μ means $1.05 \times \mu$, not $1.05 = \mu$
- checking the reasonableness of their answer for a height of a male.