2012 HSC Notes from the Marking Centre – General Mathematics

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Introduction

This document has been produced for the teachers and candidates of the Stage 6 General Mathematics course. It contains comments on candidate responses to the 2012 Higher School Certificate examination, indicating the quality of the responses and highlighting their relative strengths and weaknesses.

This document should be read along with the relevant syllabus, the 2012 Higher School Certificate examination, the marking guidelines and other support documents developed by the Board of Studies to assist in the teaching and learning of General Mathematics.

General comments

The instructions at the beginning of Section II indicate that relevant mathematical reasoning and/or calculations should be included in the responses to Questions 26 to 30. Candidates are reminded that where a question is worth several marks, full marks may not be awarded for an answer, even if the answer given is correct, if no working is shown.

This is because mathematical communication and reasoning are included in the objectives and outcomes assessed by the examination.

Candidates are advised to show all their working so that marks can be awarded for some correct steps towards their answer. A simple example is when candidates have to round their answer to a certain degree of accuracy. Candidates should always write their calculator display before rounding their answer. They should only round their answer in the last step of working, not in an earlier step. Markers can then see that candidates have rounded correctly, even if the answer is not correct.

Some questions required candidates to explain their answer and/or justify their result in words and/or by using calculations. This presented a problem for a significant number of candidates. Candidates need to become familiar with appropriate terminology and should read their answers after writing them to ensure that the answers make sense.

Candidates need to pay attention to the number of marks allocated to each part of a question so that they know how extensive their answers should be. They should pay particular attention to the situation where a question asks them to justify with calculations or examples, and should ensure that they respond appropriately.

Candidates should bring a ruler to the examination for drawing graphs and diagrams accurately. They should also take note of diagrams where ‘NOT TO SCALE’ is indicated, since in these cases, measuring lines or angles to obtain a result will not be awarded any marks.

In better responses, candidates:

- showed a clear, concise and appropriate method to solve each problem
- worked in a logical manner, clearly stated what they were doing, and showed all necessary working
- referred correctly to the formulae sheet, were familiar with it, and used it carefully where necessary
- drew large, clear, well-labelled diagrams and included given information, as well as information calculated while responding to the question
- did not round off too early in their calculations
- articulated their explanations, either with the support of calculations or in clear written form
- considered the reasonableness of their answers within the context of the question.

Section II

Question 26

(a) (i) Many candidates answered this question correctly.

(ii) In better responses, candidates understood the difference between probability and the number of possible outcomes.

(b) This question was answered well by most candidates. In better responses, candidates used the declining balance formula instead of 3 successive uses of the straight-line method.

(c) In better responses, candidates knew how many days there are in January and recognised the need to convert the yearly interest rate to an equivalent daily interest rate. Only a relatively small percentage of candidates obtained full marks for this question. Many candidates used 22 days instead of 23 days.

(d) (i) In better responses, candidates understood the order of the steps involved in the process of statistical inquiry. Most candidates showed enough understanding to gain one mark.

(ii) Most candidates answered this question correctly.

(e) (i) This question was well answered by most candidates.

(ii) Most candidates answered this question correctly. In better responses, candidates showed a clear understanding of probability and used the fraction $\frac{7}{14}$ in their conclusion that the sample space had increased.

(f) In better responses, candidates were able to correctly use the capture-recapture technique to find the population in 2012, and then the unitary method to find the population for 2008. Many candidates increased their estimated population for 2012 by 11%.

(g) In better responses, candidates showed a clear understanding of the need to convert from kilograms to grams and correctly determined the number of cups of chlorine that were required each week. They understood that the question required them to answer in full weeks.

Question 27

(a) In better responses, candidates used the weekly wage as the basis of calculation. In the best responses, candidates identified clear steps to show deductions, net wage and percentage. Candidates who knew that there were 52 weeks in a year scored better. Candidates who understood the difference between expenses and deductions were able to calculate the net wage (weekly or annual) and, subsequently, the percentage expenses.

(b) In better responses, candidates understood the meaning of perimeter. Those who could identify the arc length formula from the formulae sheet had success in finding the length of the major arc. In better responses, candidates identified the major arc (with its angle of 230°) and the two radii as constituting the perimeter of the sector. A large number of candidates correctly calculated the length of the major arc by subtracting the length of the minor arc from the circumference of the circle, and some remembered to add the two radii. Many candidates who calculated the area of the sector rather than the arc length correctly added the two radii.

(c) (i) In better responses, candidates reflected the understanding that 1 unit on the map represented 500 000 of the same unit in real life. Candidates who knew how to convert from cm to km handled this part well and many performed the conversion from cm to km in two steps. Units were necessary only if their answer was anything other than 10.

(ii) In better responses, candidates converted from km to cm and from cm to km.

(d) In better responses, candidates used a simplified version of the given diagram as a starting point. Candidates who identified the height of 39 cm and the base of the triangle as $(60 + d)$ cm were on the way to solving the problem correctly. An easier path to the solution was to be found if the complementary angle of 85° was used, as this eliminated the need to manipulate the equation $\tan 5^\circ = \frac{39}{60+d}$ to make d the subject (or some other pronumeral chosen to represent $(60 + d)$). In many better responses, candidates found the length of the ramp using the sine ratio, then Pythagoras' theorem to find the horizontal distance.

(e) (i) In better responses, candidates correctly reduced the appropriate numerators, or correctly reduced the denominators. For many candidates, this was the only part in (e) that was answered correctly.

(ii) In better responses, candidates used values on the branches of their tree diagram to answer this part. Most candidates realised that the product of the top two branches was necessary.

(iii) In better responses, candidates dealt with mutually exclusive and independent probabilities (ie multiplying along branches and adding the separate results).

Question 28

(a) A small proportion of candidates demonstrated a strong understanding in this area, creating a realistic drawing and showing all their construction lines. In the majority of responses, candidates did not appear to know what vanishing points were.

(b) In many responses, candidates had difficulty with algebra.

(c) Candidates demonstrated resourcefulness in applying a wide range of approaches to this part. In better responses, candidates effectively dealt with the complicated algebra $\frac{1.5}{d} = \frac{4}{d+3}$ coming from the similar pair of triangles drawn. In some responses, candidates observed a third similar triangle with sides 2.5 and 3 units, which neatly led to solution. In addition to the expected use of similar triangles, considerable use of trigonometry was made, which commonly led to a correct solution. Various part-solutions were provided by many candidates.

(d) (i) In better responses, candidates found an interquartile range from a pair of box-and-whisker plots and did not simply state a range or median.

(ii) In better responses, candidates provided effective and accurate analysis involving appropriate metalanguage. They were clear as to the specific meaning of location and the metalanguage of the question – mean, median, range, interquartile range, standard deviation and negative skewness. To gain full marks, comparison statements needed to be made.

(e) This question required candidates to obtain the flat interest rate charged from initial deposit and repayment conditions. In better responses, candidates gave the correct answer as 12%, or made significant progress stating that $907.20 was paid in interest overall.

Question 29

This question examined candidates' ability to interpret data displayed as a scatter plot and to analyse data that was normally distributed, using either a bell curve or *z*-scores. Aspects of applying right-angled and non-right-angled trigonometry and Pythagoras' theorem were also tested, as well as using the future value formula.

(a) (i) In most responses, candidates read and interpreted data correctly from the graph, giving the exact minimum waiting time (70 minutes).

(ii) Candidates who accurately answered part (i) generally answered this part correctly.

(iii) In better responses, candidates used the terminology of directly proportional, or stated that the graph displayed positive correlation. Candidates who responded that the longer the eruption, the longer the waiting time to the next eruption also received full marks.

(b) In better responses, candidates displayed highly effective skills in representing the data in a normal bell curve or displayed competency in representing the data in terms of *z*-scores. They correctly analysed the data and justified their answer with accurate calculations. Many candidates gave the range of settings that were acceptable on the machine, but did not use this information correctly to state which two nails were acceptable. In better responses, candidates gave the suitable calculations and non-contradictory conclusions. Some of these candidates also used an accurate diagram as part of their solution.

(c) A number of different strategies were employed to solve both parts of this question.

(i) In better responses, candidates used a correct rule, either sine or cosine, to calculate the length of a side. In some responses, candidates did not calculate the correct angle size but did show the correct substitution and gain part marks.

Candidates could use the solver function on their graphic calculators to answer this question.

(ii) In better responses, candidates used Pythagoras' theorem on the right-angled isosceles triangle to find the side lengths. In other strong responses, candidates accurately used the sine rule or right-angled trigonometry. Many candidates wrote an expression involving Pythagoras or trigonometry, but did not evaluate it. Quite a number of students correctly calculated the side lengths using trial and error.

(d) (i) In most responses, candidates calculated a percentage; however, many calculated 5% of only the yearly income instead of the monthly income.

(ii) Most candidates used the future value formula to find what the accumulated value would be. In better responses, candidates correctly calculated the rate and identified 156 months as being the time period (n).

Candidates using a graphic calculator should list their information before entering it into their calculator.

Question 30

A significant portion of the marks awarded for this question were for 'explain', 'show' and 'justify'. In better responses, candidates expressed themselves well and were concise in their answers.

(a) In better responses, candidates showed an angular distance of $9° + 4° = 13°$, followed by $13° \times 60 = 780$, and then $780 \div 30 = 26$ hours. In most responses, candidates applied the relationship between speed, distance and time correctly. In better responses, candidates exhibited a very good understanding of units in this question.

(b) (i) Most candidates answered this question correctly, accurately reading the maximum height from the graph.

(ii) In better responses, candidates read the graph accurately and then subtracted the two readings to find the horizontal distance between the two occasions of 35 metres.

(iii) In many responses, candidates identified an acceptable height where

$17 \leq h \leq 18$.

(iv) In better responses, candidates identified two domains, $d < 0$ and d > 300, accompanied by a valid reason for each. Many candidates referred only to the $d < 0$ domain, stating that the ball could not travel backwards or a negative distance. Partial domains of $-100 < d < 0$ and $300 < d < 400$, or simply stating values such as -100, 300 and 400, were common.

(c) (i) Most candidates answered this question correctly, accurately reading the value of 6 600 000 from the graph.

(ii) In better responses, candidates correctly identified that 3 000 000 people was the initial population of 2010.

(iii) (1) In better responses, candidates made a sufficient comparison and stated that using $b = 1.05$ would cause the population to increase rather than decrease, or that $b = 1.05$ was larger than $b = 1.04$, the existing rate of population growth.

(2) In better responses, candidates used the 'guess-and-check' method to correctly determine, by calculation, a value below (ie $b = 1.02$) and a value above (ie $1.02 < b \leq 1.03$) and conclude that b was closest to 1.02 (correct to 2 decimal places). Many had a correct estimate for 1.02 with the correct conclusion but no estimate for 1.03, or an estimate between 1.02 and 1.03 to justify that 1.02 was the closest.

(iv) In better responses, candidates used $b = 1.02$ (or their answer from (c) (iii) (2)) in the calculation $3\,000\,000\left(1.02\right)^{40} = 6\,624\,119$ and indicated that this figure was under 7 000 000 and therefore achieved the aim. Many used a power of 50, overlooking that the graph started in the year 2010. In better responses, candidates correctly interpreted the question with the aim to be under 7 000 000 and not equal to 7 000 000.