2023 VCE Foundation Mathematics external assessment report

General comments

This is the first year of the Foundation Mathematics examination. There were some excellent responses to questions. The following information may be helpful to remember when completing examinations.

Students should make good use of their reading time and ensure they read questions carefully to identify important information, including questions involving graphs.

If a pencil is used, make sure it has 2B or darker lead, as the papers are scanned. Some light-coloured or erasable pens do not scan properly.

After completing their responses, students should reread questions to make sure they are providing answers for all parts of the question and in the manner required, and that calculated numbers represent 'realistic' values within the context of the question. For example, where the question required a percentage for the final response, it was common to see a number only and not a percentage.

Appropriate working and steps showing the students' thinking must be present in responses to questions worth more than one mark. Numerous responses quoted only the final answer, allowing no opportunity for a partial mark to be awarded. Students should always be encouraged to show as much working as possible with any question they answer.

Students should be careful with their handwriting. Letters, words, digits, numbers and symbols should be clear and written in a neat and presentable form.

Students need to practise 'show that' questions. There were five in this paper: Questions 8bi., 8bii., 9b., 10a. and 10di. This type of question requires that appropriate working is shown to support the development of an answer, statements are mathematically correct and clearly set out, and a logical conclusion is drawn. Informal mathematical statements such as $1833.30 × 52 = $95 331.60 – $2000 = $93 331.60 were quite common and should be separated out over multiple lines to ensure accuracy and clarity.

Some students provided answers that were not rounded correctly, written to the required accuracy or the correct number of significant figures. Many questions require this style of response and students are encouraged to revise the appropriate skills regularly throughout the year.

Rounding numbers should only occur at the final step of the solution and not at any prior steps. The accumulated rounding error that occurs at intermediate steps will often result in an inaccurate final value. Questions 1b., 2d., and 4c. involved this type of thinking. Students are encouraged to practise the skill of 'carrying' accuracy throughout intermediate steps.

Notation was sometimes lacking or placed incorrectly. Money amounts involving 'cents' should always be written to two decimal places and the '$' symbol written at the beginning of the value. For example, numerous responses were seen written as 77.55$ rather than $77.55.

Students are encouraged to revise concepts including ratios, simplifying fractions, substitution, percentages, GST, general financial literacy and rearranging formulas. Many questions required familiarity and understanding of these ideas.

Specific information

This report provides sample answers, or an indication of what answers may have included. Unless otherwise stated, these are not intended to be exemplary or complete responses.

The statistics in this report may be subject to rounding, resulting in a total of more or less than 100 per cent.

Section A – Multiple-choice questions

The table indicates the percentage of students who chose each option. Grey shading indicates the correct response.

Question	Correct answer	% A	% B	% C	% D	% E	% N/A	Comments
1	D	16	12	12	54	5	0	
2	E	8	22	25	19	23	2	$\%\text{ error} = \frac{4\times3-3.57\times3.32}{3.57\times3.32}\times100\%$
3	A	81	7	7	3	2	0	
4	E	14	15	12	8	51	0	
5	D	8	13	29	40	8	1	$L=\left(\frac{3.5}{2\pi}\right)^2\times9.8$
6	C	13	16	39	28	4	1	1.386 billion = 1386 million $\text{natgeo}\,\% = \frac{258}{1386}\times100\%$
7	B	3	71	10	13	2	1	
8	E	6	35	17	6	35	2	21st value increases the mean because it is larger than all other values. The median is the same because the data values at the 10.5th and 11th positions remain at 90.
9	B	14	69	8	6	3	1	
10	E	3	4	7	25	60	1	
11	C	9	15	68	5	2	1	
12	A	46	17	5	20	10	1	Adding all the 'returns' including their sign would result in a positive value, indicating an overall gain from 2005 to 2022.
13	A	37	25	19	9	9	2	Choosing the line showing 'payment' and converting years to months: $\frac{750\ 000}{30\times12}$

Question	Correct answer	% A	% B	% C	% D	% E	% N/A	Comments
14	D	15	10	12	43	18	2	$\text{earnings} = \text{base} + \text{commission}$ $= \$3250 + \left(\$450 + \$(42\ 000 - 40\ 000) \times \frac{2.5}{100}\right)$
15	C	13	15	36	23	13	1	Ratio of 'cost to number of coins' for each option gives option III as the best value for money: $\frac{30}{2500}$
16	B	24	38	14	9	13	2	mean value = $\frac{38.5+38.8}{2} = 38.65$ variation = $\frac{38.8-38.5}{2} = 0.15$
17	C	17	12	41	22	7	2	Converting the car length to cm (300) and finding the ratio: $\frac{300}{60}$
18	B	14	40	20	15	7	3	The ratio of corresponding sides (in mm) is equal as the shapes are similar. $\frac{h}{10} = \frac{1200}{18}$ Solving gives $h = \frac{1200}{18} \times 10$ mm.
19	D	27	13	13	28	17	2	Allowing for two path widths to be added to both pool dimensions and assuming one quarter-circle of radius 0.5 m in each corner, path area is: $2 \times (12 \times 0.5) + 2 \times (8 \times 0.5) + \pi \times 0.5^2$
20	D	40	11	9	28	10	2	Five rectangular surfaces to calculate: $2 \times (20 \times 24) + 2 \times (50 \times 24) + (20 \times 50)$

Section B

Question 1a.

Marks	0	1	2	Average
%	52	24	24	0.7

15 cm and 6″

Many responses showed the values replicated, e.g. 15 × 15 or 6 × 6.

Question 1b.

Marks	0	1	Average
%	94	6	0.1

4′ 6″

This question was not answered well. Students wrote responses that did not show how to convert 54.33 cm to the correct imperial measurement, or showed incorrect rounding. A common incorrect response was 4′ 5″.

Question 1c.

Marks	0	1	2	Average
%	66	26	8	0.5

$$\%\,\text{increase} = \frac{153 \times 203 - 138 \times 188}{138 \times 188} \times 100\% \approx 19.7\%$$

Many students were able to recognise that they needed to find the area of both mattresses, and did so appropriately. Many students incorrectly calculated $\frac{5115}{31\,059}$. The percentage error formula was provided on the formula sheet.

Question 2a.

Marks	0	1	Average
%	14	86	0.9

Australian football, cricket, netball, equestrian

This question was answered well. Some responses included a sport that was not found in either list.

Question 2b.

Marks	0	1	Average
%	24	76	0.8

tennis

This question was answered well. Some students missed the prompt of the three sports mentioned in the information before the question and included them all. Surfing was a common incorrect answer.

Question 2c.

Marks	0	1	Average
%	64	36	0.4

23.46%

Students should review the skill of rounding to a given number of significant figures. Common errors included 23.45% and 23.46000%.

Question 2d.

Marks	0	1	Average
%	91	9	0.1

$$\text{difference in } \% = \left(\frac{1\,114\,000}{7\,249\,000} - \frac{553\,000}{7\,249\,000}\right) \times 100\% \approx 7.7\%$$

This question was not answered well. Students generally rounded too early in intermediate steps, which impacted the accuracy of the final answer. Common inaccurate answers included 7.6% and 7.8%.

Question 2e.

Marks	0	1	Average
%	63	37	0.4

74%

Students did not interpret the graph well. Many quoted answers less than 30%, linking it to the provided vertical graph scale. Some students quoted 0%, interpreting the graph literally. Other students added a column on the graph, misinterpreting the requirements of the question.

Question 3a.

Marks	0	1	Average
%	86	14	0.2

Initial mixture of 1 litre contains 10 000 mg, which is 10 mL of garlic.

Amount of garlic for 5 L mixture is 50 g.

This question was not answered well. Many students did not recognise that the provided list of ingredients added up to 1 L, hence the need to multiply by 5 to answer questions related to 5 L of solution. A common incorrect answer was 10 g.

Question 3b.

Marks	0	1	Average
%	87	13	0.2

Volume of liquid soap in a 5 L mixture is 5 × 45 = 225 mL.

Number of 30 mL bottles of liquid soap is $\frac{225}{30} \approx 8 \text{ bottles}$.

This question was attempted by only a small number of students.

Question 3c.

Marks	0	1	Average
%	81	19	0.2

2 : 19

This question was not answered well. A number of students found the ratio 90 : 855, but did not simplify.

Other students simplified to 1 : 9.5, not recognising that the ratio should contain whole numbers only.

Question 3d.

Marks	0	1	Average
%	78	22	0.2

$$\text{volume} = \frac{2000}{3+5+2} \times 5 = 1000 \text{ mL (or 1 L)}$$

This question was not answered well. Common incorrect responses included 126 mL and 4275 mL.

Question 3e.

Marks	0	1	Average
%	71	29	0.3

total of vitamin C in community $= 90 \times 11 + 45 \times 15 = 1665 \text{ mL}$

minimum number $= \frac{1665}{140} \approx 12$ capsicums

Many students were able to perform the calculations to find 11.89 capsicums but did not proceed to round this to 12 capsicums.

Question 4a.

Marks	0	1	Average
%	61	39	0.4

% sales $= \frac{371 + 331}{32\ 860} \times 100\% \approx 2.1\%$

Students frequently recorded inaccurate values from the graph for the required car sales. Other students rounded inaccurately.

Question 4b.

Marks	0	1	Average
%	40	60	0.6

10 877 × $76 900 + 8717 × $69 300 = $1 440 529 400

This question was answered well.

Common incorrect answers included adding only single values of the sale prices ($76 900 + $69 300). Other incorrect responses were students stating the two separate sales figures ($836 441 300 and $604 088 100) without finding an overall total.

Question 4c.

Marks	0	1	Average
%	56	44	0.5

stamp duty = $\frac{84\ 990}{200} \times \$8.40 \approx \$3570$

Students were generally able to find the stamp duty. Many students inaccurately rounded their answer.

Question 4d.

Marks	0	1	Average
%	95	5	0.1

$$\$43\ 990 \times v = \$5\ 000\ 000 + \$28\ 000 \times v$$
$$v = 313 \text{ vehicles}$$

This question was not answered well. Many students used a graphical approach, leading to an incorrect answer of 320 vehicles.

Question 4e.

Marks	0	1	Average
%	94	6	0.1

$$\text{sale price} \times 200 = 5\ 000\ 000 + 28\ 000 \times 200$$
$$\text{sale price} = \$53\ 000$$

Many students did not attempt this question.

Question 5a.

Marks	0	1	Average
%	60	40	0.4

$$\text{value} = \$28\ 000 - \$28\ 000 \times \frac{8.2}{100} = \$25\ 704$$

Many students did not subtract the depreciated value.

Question 5b.

Marks	0	1	2	Average
%	73	17	10	0.4

$10\%\ \text{of}\ \$28\ 000\ \text{is}\ \$2800$

$$28\ 000 - n \times 28\ 000 \times \frac{8.2}{100} < 2800$$

$$n > 10.9756$$

$$n = 11\ \text{years}$$

Many students did not fully comprehend this question.

The calculation of '10% of the value' was often misinterpreted as 'remove 10% from the value'. Other responses incorrectly applied a reducing balance method of depreciation.

Question 5c.

Marks	0	1	Average
%	62	38	0.4

$\frac{5}{8}$ of a tank can travel 291 km.

1 full tank can travel $291 \times \frac{8}{5} \approx 466\ \text{km}$.

Many students did not recognise the information in the stimulus material as ratio information.

Question 5d.

Marks	0	1	Average
%	77	23	0.3

To fill the tank requires $\frac{3}{4} \times 80 = 60\ \text{L}$.

Amount required to fill the tank is \$2.10 × 60 = \$126.00.

Amount required from 'pay at the pump' is \$125.

Many students missed the information of 'the tank is one quarter full' and responded as if the tank was empty. Other responses had students overfilling the car, not recognising that they could not fill the car exactly.

Question 6a.

Marks	0	1	Average
%	45	55	0.6

$7.4 + 12.7 + 7.2 + 12.9 = 40.2\%$

This question was answered well.

Question 6b.

Marks	0	1	Average
%	71	29	0.3

$\text{black coal} + \text{brown coal}$

$\div (4.2 - 40.6) + (15.4 - 14.8)$

$= 3.6 + 0.6$

$= 4.2\%$

This question was not answered well. Many students did not add the 0.6 and 3.6 percentage values together and quoted two separate values.

Question 6c.

Marks	0	1	2	Average
%	51	11	37	0.9

Non-renewable energy has a decreasing trend while renewable energy has an increasing trend.

This was a 'compare' question, so discussion of information about both groups was needed. Many students restated the statistics (e.g. coal = …%) rather than identifying the overall trend through comparison of statistics.

Question 6d.

Marks	0	1	Average
%	81	19	0.2

Brown coal % in Q4 of 2022 is 14.8%.

Reducing by 0.5% per quarter until 0% will take $\frac{14.8}{0.5} \approx 30$ quarters.

Many students did not attempt this question.

Question 7a.

Marks	0	1	Average
%	51	49	0.5

178.4

This question was answered reasonably well. Incorrect responses were students calculating the ‘mean’ or including the units of dollars ($) rather than cents (c).

Question 7b.

Marks	0	1	Average
%	66	34	0.4

19 Feb

Many students did not interpret the question correctly. Many gave a written interpretation of the graphical data rather than addressing the requirements of the question.

Question 7c.

Marks	0	1	Average
%	76	24	0.3

29 Jan

Many students did not attempt this question.

Question 7d.

Marks	0	1	2	Average
%	70	22	8	0.4

Average (mean) prices are similar for Victorian and National national prices (180.0 compared to 181.0).

Variation in Victorian prices is greater than the variation in National national prices (range of 22.7 compared to 15 or standard deviation of 7.19 compared to 5.02).

Many students assumed the graph was needed to guide their response and ignored the information given in the table. Other responses did not accurately convey the mathematical meaning behind the data in the table, often restating the information without comparison.

Question 8a.

Marks	0	1	Average
%	47	53	0.6

number of weeks = $\frac{\text{year to date}}{\text{weekly pay}} = \frac{18\ 278.00}{703.00} \approx 26 \text{ weeks}$

This question was answered well.

Question 8bi.

Marks	0	1	Average
%	85	15	0.2

$$\begin{aligned}\text{total} &= 20.25 \times \$20 + 10 \times \$30 \\ &= \$405 + \$300 \\ &= \$705\end{aligned}$$

This question was not answered well. Responses frequently did not include a structured and complete response for this 'show that' question.

Many responses included inaccurate mathematical statements, assumed evaluations to required calculations and incomplete justifications. Some responses quoted values such as $405 without providing detail.

Question 8bii.

Marks	0	1	Average
%	83	17	0.2

$$\begin{aligned}\text{superannuation} &= \frac{11}{100} \times \$705 \\ &= \$77.55\end{aligned}$$

This question was not answered well. Responses frequently did not include a structured and complete response for this 'show that' question.

Many responses included inaccurate mathematical statements, assumed evaluations to required calculations and incomplete justifications.

Question 8biii.

Marks	0	1	Average
%	86	14	0.2

total superannuation = $52 \times \$77.55 \approx \$4033$

This question was not answered well. Many students misunderstood the requirements of the question and the definition of superannuation.

Question 8c.

Marks	0	1	Average
%	96	4	0.1

$650 net pay requires $\frac{650}{1-0.19} = \$802.47$ to be earned each week.

An extra $802.47 – $705.00 = $97 is needed each week.

If payment is $20/hour, the number of extra hours to be worked is 5 hours.

The majority of students did not attempt this question.

Question 9a.

Marks	0	1	Average
%	37	63	0.7

$2053 \times \$30.50 = \$62\ 616.50$

This question was answered well. Students should be made aware that money values involving 'cents' should be quoted to two decimal places.

Question 9b.

Marks	0	1	Average
%	33	67	0.7

$$\text{cost} = 2 \times \$40 + 1 \times \$34 + 2 \times \$30.50 + 3 \times \$12.50$$
$$= \$212.50$$

Responses frequently did not include a structured and complete response for this 'show that' question.

Responses included inaccurate mathematical statements, e.g. 'cost = 2 × $40 = $80 + 1 × $34 = $124 + 2 × $30.50 …', assumed evaluations to required calculations and incomplete justifications.

Question 9c.

Marks	0	1	Average
%	74	26	0.3

$$\%\ \text{discount} = \frac{40 - 34}{40} \times 100\% = 15\%$$

This question was not answered well. Common errors showed students calculating a difference of $6, which was immediately changed to 6%. Other responses did not correctly apply the percentage discount calculation.

Question 9d.

Marks	0	1	Average
%	85	15	0.2

ticket cost excl. GST $= \frac{40}{11} \times 10 = \$36.36$

This question was not answered well. Students should review the concept of GST and its associated calculations. Common errors included students rounding their answer to the nearest $10 ($40), adding 10% to the ticket value ($44), subtracting 10 cents ($39.90) and deducting 11% ($36.37).

Question 9e.

Marks	0	1	Average
%	59	41	0.4

Zoo membership. Saving of $114/year or $19/visit.

Many student responses calculated correct values linked to the membership but did not proceed to explicitly state the cheaper option, the amount saved or the time period linked to the saving.

Question 10a.

Marks	0	1	Average
%	69	31	0.3

$$\begin{aligned}\text{taxable income} &= \text{assessable income - allowable deductions}\\ &= 52 \times \$1833.30 - 2000\\ &= \$93331.60\end{aligned}$$

Responses frequently did not include a structured and complete response for this 'show that' question.

Responses included inaccurate mathematical statements, e.g. 52 × $1833.30 = $95 331.60 – $2000 = $93 331.60, assumed evaluations to required calculations and incomplete justifications.

Question 10b.

Marks	0	1	Average
%	79	21	0.2

$$\begin{aligned}\text{tax payable} &= \$5092 + (\$93,331.60 - \$45,000) \times 0.325\\ &= \$20,799.77\end{aligned}$$

This question was not answered well. Common errors included students using the weekly payment instead of the yearly figure and calculating $0 tax payable.

Question 10c.

Marks	0	1	Average
%	89	11	0.1

$$I = \frac{\Pr t}{100} = \frac{(4000 - 600) \times 8.5 \times 2}{100} = \$578$$

This question was not answered well. Common errors included students not deducting the deposit amount of $600 before calculating the interest value. In other responses, students applied compound interest rules.

Question 10di.

Marks	0	1	Average
%	90	10	0.1

amount = principal + interest

= $4000 + $578

= $4578

Many students did not attempt this question. Of those who did, some wrote responses that did not include a structured and complete response appropriate for this 'show that' question.

Responses included inaccurate mathematical statements, assumed evaluations to required calculations and incomplete justifications.

Question 10dii.

Marks	0	1	Average
%	97	3	0.1

$$\text{monthy repayments} = \frac{4578 - 600}{24} = \$165.75$$

Many students did not attempt this question. Some who did attempt this question generally did not deduct the deposit before calculating the monthly payments.

Question 11a.

Marks	0	1	Average
%	91	9	0.1

$$\text{volume} = 6.6 \times 9.1 \times 0.10 \approx 6 \text{ m}^3$$

Many students did not attempt this question. Some who did attempt the question did not convert units correctly. Common incorrect answers included 6006.

Question 11b.

Marks	0	1	Average
%	94	6	0.1

$$\text{cost} = 6.006 \times \$280 \approx \$1700$$

Many students did not attempt this question. Some who did attempt the question did not carry the accuracy of the previous question into this calculation, thus producing an inaccurate response.

Question 11c.

Marks	0	1	Average
%	96	4	0.1

$$V = \pi \times \left(\frac{130}{2}\right)^2 \times 156 = 2070623.7\,\text{cm}^3 \approx 2071\,\text{L}$$

Many students did not attempt this question. Some of those who did attempt the question used the incorrect formula, producing calculations such as 1300 × 1560 = 2 028 000, which was then converted to 2028 L.

Question 11d.

Marks	0	1	Average
%	93	7	0.1

number of tiles = $\frac{2400}{100} \times \frac{3000}{300} = 24 \times 10 = 240$

This is 228 full tiles and 24 half tiles.

Many students did not attempt this question.

Question 11e.

Marks	0	1	Average
%	88	12	0.1

$$\text{Number of boxes } = \frac{240}{25} = 9.6$$

Therefore 10 boxes are required.

cost = 10 × 32 = $320

Many students did not attempt this question. Others who did attempt the question multiplied 25 and 32, resulting in an answer of $800. Some did not realise their answer from 11d. was required for this part.

Question 12a.

Marks	0	1	2	Average
%	96	3	1	0.1

path length = $\left(\sqrt{4^2 + 5^2} + 4 + \sqrt{2^2 + 2^2}\right) \times 50 = 661.578 \approx 662\,\text{m}$

Students did not recognise that Pythagoras' theorem could be used to get an accurate answer. Other students quoted an answer without any associated working but, as the question is worth more than one mark, valid working was required.

Several students used the grid scale (1 cm = 50 m) and a measurement found using a ruler to calculate a justifiable length.

Common incorrect responses included 500 m and 550 m.

Question 12b.

Marks	0	1	Average
%	96	4	0.1

$$\text{area} = \left(12 \times 8 + \frac{1}{4} \times \pi \times 9^2\right) \times 50^2 = 399043\,\text{m}^2 \approx 40\ \text{ha}$$

Many students did not attempt this question.

Question 12c.

Marks	0	1	Average
%	85	15	0.2

$$w = \frac{\sqrt{3}}{2} \times 15 = 12.9904 \approx 13\,\text{m}$$

Many students did not attempt this question.

Question 12d.

Marks	0	1	Average
%	98	2	0.0

$$\text{volume} = 30 \times \frac{1}{2} \times 15 \times 0.015 \times 12.9904 = 43.8 \approx 44\,\text{m}^3$$

Many students did not attempt this question.