SACE Board of SA | South Australian Certificate of Education

Government of South Australia

The external assessment requirements of this subject are listed on page 23.

General Mathematics
2017 Sample paper

Question Booklet

- Questions 1 to 9
- Answer ***all*** questions
- Write your answers in this question booklet
- You may write on page 15 if you need more space

GENERAL INFORMATION

Examination material

- one 23-page question booklet
- one SACE registration number label

Reading time

- 10 minutes
- You may make notes on scribbling paper

Writing time

- 2 hours
- Show all working in this question booklet
- Appropriate steps of logic and correct answers are required for full marks
- Use black or blue pen
- You may use a sharp dark pencil for graphics and diagrams

Total marks 90

Attach SACE registration number label to this box

Graphics calculator	
1. Brand	
Model	
2. Brand	
Model	

For office use only

Supervisor check	Re-marked

QUESTION 1 (7 marks)

Roberto wants to save $\$10\,000$ to buy his first car. He finds a savings account with an interest rate of 5.6% per annum, compounded monthly.

He plans to deposit $\$200$ per month into this account.

(a) Show that Roberto would have more than $\$2400$ in his savings account after 1 year.

(2 marks)

(b) Calculate how long (in years) it would take Roberto to reach his savings goal of $\$10\,000$. Assume that his monthly deposit and the conditions of the account remain constant.

(2 marks)

(c) Calculate the time (in months) that Roberto could save if he deposits $\$250$ per month instead of $\$200$ per month into the savings account. Assume that the conditions of the account remain constant.

(2 marks)

(d) State *one* strategy — other than making a larger monthly deposit — that Roberto could use to reach his savings goal of $\$10\,000$ sooner.

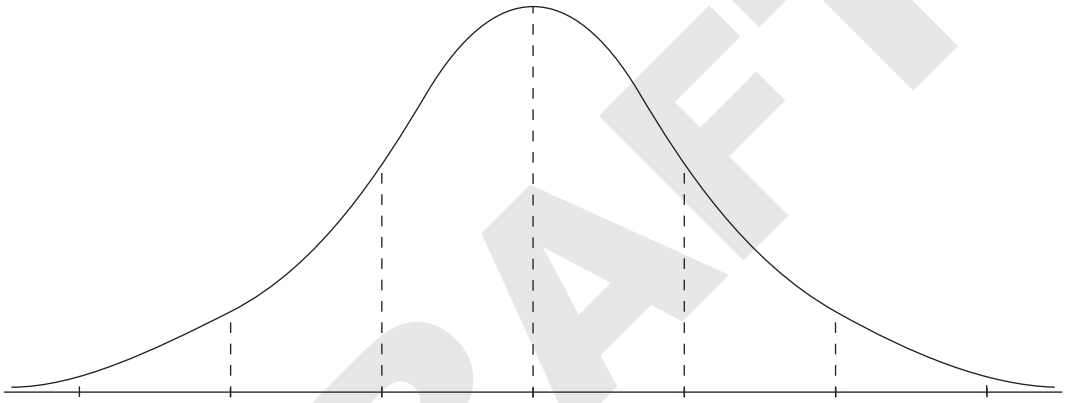
(1 mark)

QUESTION 2 (10 marks)

The Marshmallow Company weighed 1800 individual marshmallows. The weights of these marshmallows are normally distributed, with a mean weight of 13 grams and a standard deviation of 0.75 grams.

(a) Complete the scale on the normal distribution graph below. You are not required to show the standard proportions (percentages) on the graph.

Marshmallow weights



Weight (grams)

(1 mark)

(b) Calculate the percentage of marshmallows that you would expect to weigh more than 14.5 grams.

(1 mark)

(c) The Marshmallow Company rejects all marshmallows that weigh less than 11.7 grams.

Of the 1800 marshmallows that were weighed, how many would you expect to be rejected?

(2 marks)

(d) Calculate the minimum weight of the heaviest 12% of the marshmallows.

(2 marks)

The Marshmallow Company buys a new production machine. The new machine produces marshmallows with weights that are still normally distributed, with the same mean weight of 13 grams but with a standard deviation of 0.375 grams.

(e) On the graph in part (a), draw the distribution curve for the weights of the marshmallows that will be produced on the new production machine.

(2 marks)

(f) Explain why using the new production machine results in fewer marshmallows being rejected.

(2 marks)

QUESTION 3 (12 marks)

A company has four employees — Adrian, Ellen, Cathy, and Ishraq — who can perform any one of four tasks required to build a cabinet. The company wants to determine which employee should complete each task to minimise the total time spent to build a cabinet.

The table below shows the time spent (in minutes) by each employee to complete each task:

Employee	*Task 1*	*Task 2*	*Task 3*	*Task 4*
Adrian	26	21	22	25
Ellen	31	28	21	42
Cathy	29	26	20	27
Ishraq	40	26	28	35

(a) Interpret the meaning of the value '40' in the table above.

(1 mark)

(b) State which employee takes the longest time to complete Task 4.

(1 mark)

(c) (i) Using the Hungarian algorithm, determine which employee should complete each task to minimise the completion time for building a cabinet.

(4 marks)

(ii) Find the minimum completion time for building a cabinet.

(1 mark)

(iii) If Cathy was unable to complete Task 4, state the effect this would have on the minimum completion time for building a cabinet.

(1 mark)

(d) Adrian injured his hand. He now takes 10 minutes longer to complete Task 1 and 10 minutes longer to complete Task 3.

Using the Hungarian algorithm, the new reduced array is:

6	0	11	0
1	7	0	17
0	6	0	3
5	0	2	5

(i) Under the new conditions, state which employee should complete each task to minimise the completion time for building a cabinet.

(1 mark)

(ii) Show that the new minimum completion time for building a cabinet will be 101 minutes.

(1 mark)

(iii) Explain why the minimum completion time for building a cabinet has not increased by the 10 minutes extra that it now takes Adrian to complete either Task 1 or Task 3.

(2 marks)

QUESTION 4 (10 marks)

Julianne has obtained a $\$280\,000$ home loan. The interest rate for the loan is 4.5% per annum, compounded fortnightly over 30 years.

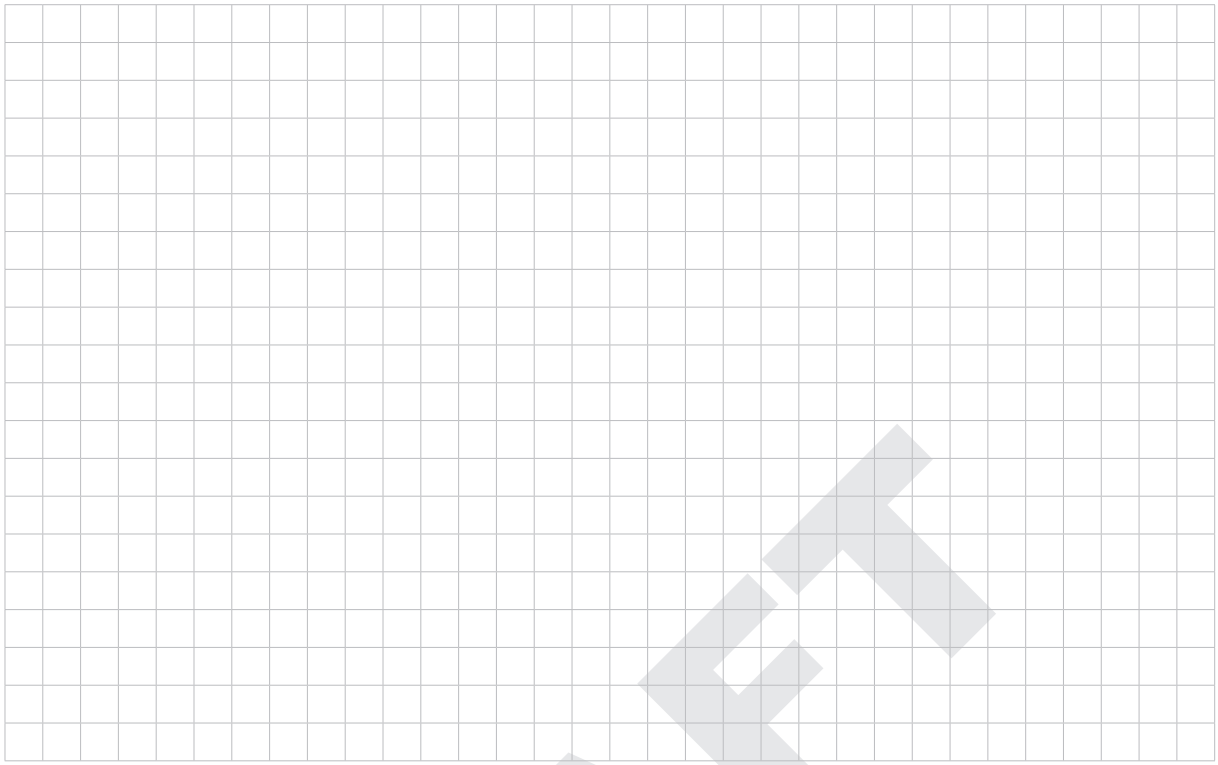
(a) Calculate Julianne's fortnightly repayment.

(2 marks)

(b) Show that the balance of Julianne's loan after the first 5 years is approximately $\$255\,000$.

(2 marks)

(c) (i) Calculate the difference between the amount of interest paid over the first 5 years of Julianne's loan and the amount of interest paid over the last 5 years of her loan.



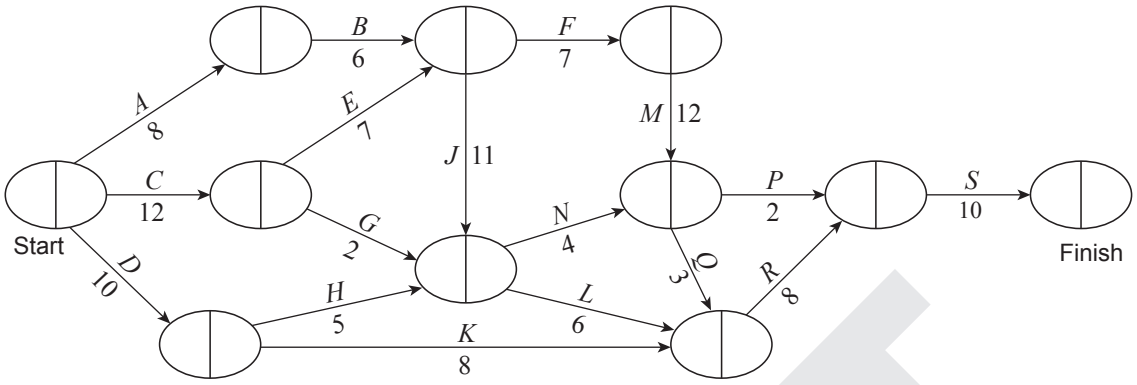
(4 marks)

(ii) Explain why there is a difference between the amount of interest paid over the first 5 years of Julianne's loan and the amount of interest paid over the last 5 years of her loan.

(2 marks)

QUESTION 5 (10 marks)

An engineering company has designed a super-fast battery charger. For the product to be manufactured it needs to go through several processes. The times needed to complete each process (in minutes) and the order of completion are shown on the following network:



(a) List all the processes that need to be undertaken before process N can start.

(2 marks)

(b) Using the network diagram above, find the critical path and the minimum completion time (by completing a forward and backward scan) for the battery charger to be manufactured.

Write the critical path and the minimum completion time in the boxes below.

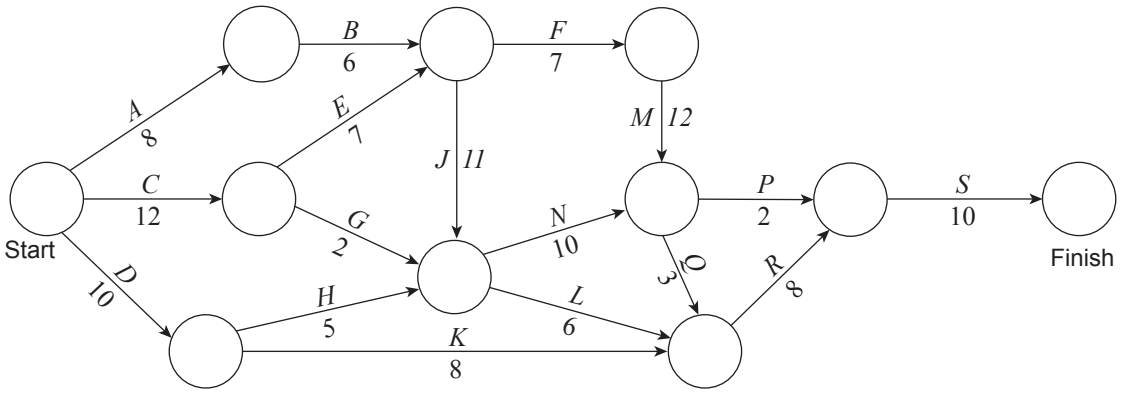
Critical path:

Minimum completion time: minutes (3 marks)

(c) Calculate the amount of slack time (in minutes) for process P.

(1 mark)

(d) The engineer in charge has redesigned the battery charger slightly, and as a result the time to complete process N has now increased from 4 minutes to 10 minutes:



(i) Mark the new critical path on the network diagram above. (1 mark)

(ii) Calculate the difference between the original minimum completion time and the new minimum completion time.

(1 mark)

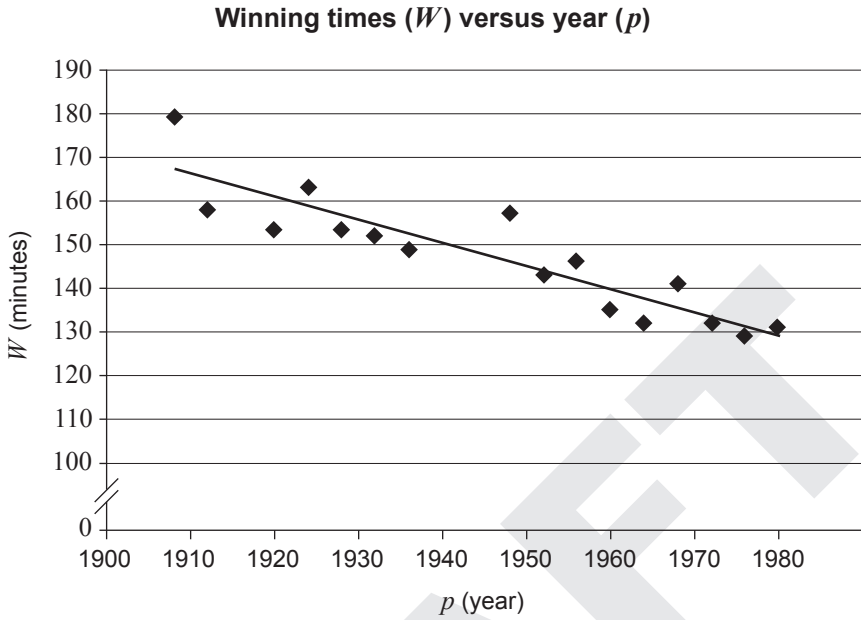
(iii) The engineer can change either process J or process H to make either process 3 minutes faster to complete.

State which process the engineer should change. Justify your answer.

(2 marks)

QUESTION 6 (10 marks)

The scatter plot below shows the winning times (in minutes) for the annual men's marathon between the years 1908 and 1980. The linear model for the least squares regression line (line of best fit) shown on the graph is $W = 1173 - 0.527p$.



(a) State the dependent variable for the scatter plot above.

(1 mark)

(b) Interpret the meaning of '-0.527' in $W = 1173 - 0.527p$ in the context of the winning times for the men's marathon.

(2 marks)

(c) The data in the scatter plot has a coefficient of determination (r^2) value of 0.812.

Determine the value of r.

(2 marks)

(d) (i) Using the linear model $W = 1173 - 0.527p$, predict the winning time (to the nearest minute) for the men's marathon in the year 2040.

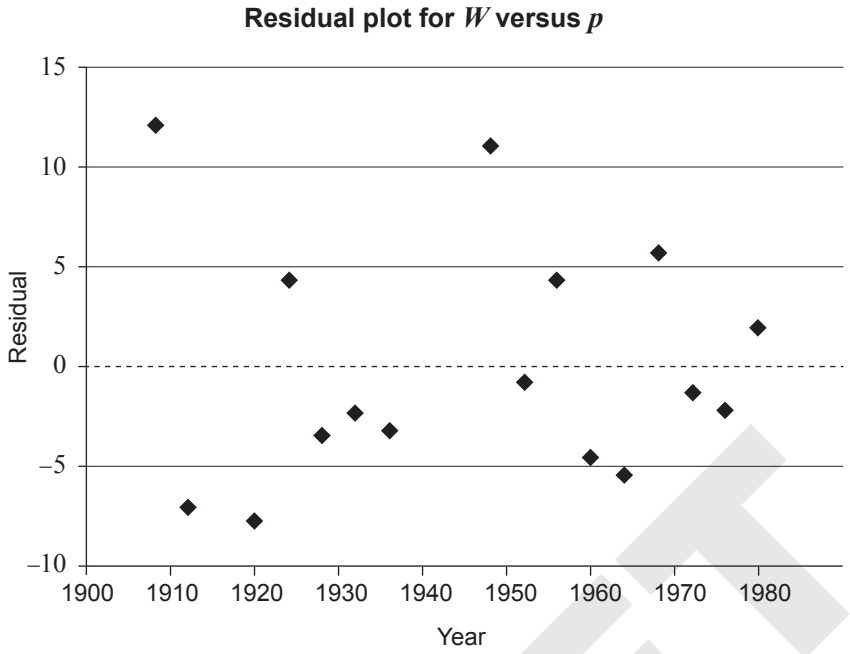
(1 mark)

(ii) Comment on the reliability of your calculations in part (d)(i).

(2 marks)

Question 6 continues on page 14.

A residual plot for the linear model $W = 1173 - 0.527p$ is shown below.



(e) (i) Circle the *two* points on the residual plot above that represent the years in which the winning times for the men's marathon were much longer than the model predicts.

(1 mark)

(ii) If the two data points for these longer winning times were removed from the scatter plot on page 12, it would result in a new linear model.

Tick the appropriate box to indicate which *one* of the following values is most likely to be the slope of the new line of best fit.

–0.455 ☐ –0.527 ☐ –0.632 ☐ (1 mark)

You may write on this page if you need more space to finish your answers to any question. Make sure to label each answer carefully (e.g. 'Question 5(b) continued').

QUESTION 7 (10 marks)

A council is planning to construct a new road. The various jobs, A–J, are described in the precedence table below.

Job	*Time (months)*	*Prerequisites*	*Earliest start time*	*Latest start time*
A	10	None	0	0
B	6	None	0	1
C	3	B	6	7
D	7	A and C	10	11
E	4	A and C	10	10
F	4	E	14	14
G	5	E	14	18
H	5	D and F	18	18
I	7	D and F	18	20
J	3	G and H	23	23

(a) Use the information in the table above to answer parts (i) to (iv).

(i) State *one* job that is on the critical path. Justify your answer.

(2 marks)

(ii) Calculate the minimum completion time for the construction of the road.

(1 mark)

(iii) Explain why there would be no advantage in reducing the time taken to complete Job G. Use information from the precedence table on page 16 to support your answer.

(2 marks)

(iv) If the completion of Job C is delayed, how many months' leeway does the council have in order for the delay to have no effect on the minimum completion time?

(1 mark)

(b) Draw a labelled network diagram using the information in the precedence table on page 16.

(4 marks)

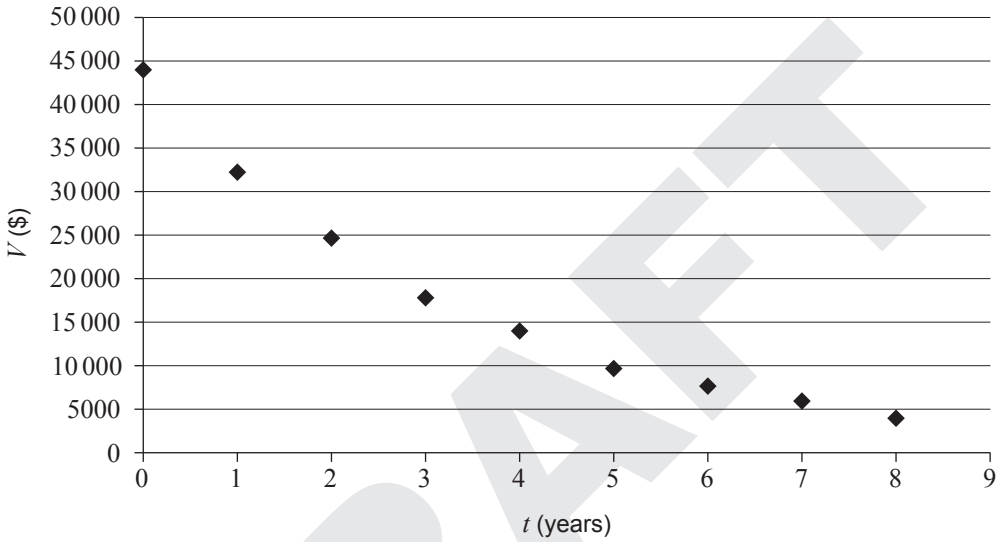
QUESTION 8 (8 marks)

A car was bought for $\$44\,000$, and the value of the car at the end of each year of ownership is shown below.

Time (t years)	0	1	2	3	4	5	6	7	8
Value ($\$V$)	44 000	32 200	24 800	17 800	14 200	9800	7800	5900	4500

The data in the table above is represented on the scatter plot below.

Car value (V) versus time (t)



(a) Determine the equation of the exponential model in the form $V(t) = a.b^t$, where a and b are constants.

(2 marks)

(b) (i) Calculate $V(9)$.

(1 mark)

(ii) Interpret your answer to part (b)(i) in the context of this question.

(2 marks)

(c) Using the exponential model that you determined in part (a), calculate the average annual percentage decrease in the value of the car.

(1 mark)

(d) Calculate how long the car has been owned when its value is 5% of its original value.

(2 marks)

QUESTION 9 (13 marks)

Minh started earning $\$46\,000$ per annum at age 25. Minh's employer contributes an amount equal to 9.5% of his salary to his superannuation account.

(a) Show that the employer's quarterly contribution to Minh's superannuation account is approximately $\$1100$.

(1 mark)

(b) (i) Minh's superannuation account pays an interest rate of 7.6% per annum, compounded quarterly.

Show that Minh will have approximately $\$1\,100\,000$ in his superannuation account when he retires at age 65.

(2 marks)

(ii) State *one* assumption made in calculating your answer to part (b)(i).

(1 mark)

(c) When Minh retires at age 65 he will transfer $\$1\,100\,000$ into an allocated pension that has an interest rate of 5.5% per annum, compounded monthly.

Calculate how much Minh will be able to withdraw monthly in retirement if he wants his allocated pension to last 20 years.

(2 marks)

(d) Minh currently lives on $\$2500$ a month. If inflation averages 3.2% per annum, will he be able to maintain his standard of living in retirement? Include a calculation to support your answer.

(2 marks)

(e) If Minh decides to withdraw $\$8500$ from his allocated pension each month in retirement, how many years will his allocated pension last?

(2 marks)

(f) At age 30 (after working for 5 years) the interest rate on Minh's superannuation account changes to 7.3% per annum, compounded quarterly.

Minh begins to make a voluntary contribution — in addition to the employer's contribution — to his superannuation account of $\$300$ each quarter until he retires.

How much money will now be available for Minh in his superannuation account when he retires at age 65?

(3 marks)

2017 SAMPLE GENERAL MATHEMATICS PAPER

The purpose of this sample paper is to show the structure of the General Mathematics examination and the style of questions that may be used. The following extract is from the 2017 subject outline for General Mathematics:

EXTERNAL ASSESSMENT

Assessment Type 3: Examination (30%)

Students undertake a 2-hour external examination in which they answer questions on the following three topics:

- Topic 3: Statistical Models
- Topic 4: Financial Models
- Topic 5: Discrete Models.

The examination is based on the key questions and key concepts in topics 3, 4, and 5. The considerations for developing teaching and learning strategies are provided as a guide only, although applications described under this heading may provide contexts for examination questions.

The examination consists of a range of problems, some focusing on knowledge, routine skills, and applications, and others focusing on analysis and interpretation. Students provide explanations and arguments, and use correct mathematical notation, terminology, and representations throughout the examination.

Students may take one unfolded A4 sheet (two sides) of handwritten notes into the examination room.

Students may use approved electronic technology during the external examination. However, students need to be discerning in their use of electronic technology to find solutions to questions/problems in examinations.

Graphics calculators that are approved for 2017 are as follows:

Casio fx-9860G AU
Casio fx-9860G AU Plus
Casio fx-CG20 AU
Hewlett Packard HP 39GS
Sharp EL-9900
Texas Instruments TI-83 Plus
Texas Instruments TI-84 Plus
Texas Instruments — TI 84 Plus C — silver edition
Texas Instruments — TI 84 Plus CE

Students may bring two graphics calculators or one scientific calculator and one graphics calculator into the examination room.

There is no list of Board-approved scientific calculators. Any scientific calculator, except those with an external memory source, may be used.

For this assessment type, students provide evidence of their learning in relation to the following assessment design criteria:

- concepts and techniques
- reasoning and communication.

Source: *General Mathematics 2017 Draft Subject Outline Stage 2*, pp 32–3, on the SACE website, www.sace.sa.edu.au