

# 

### Semester One Examination, 2018

### Question/Answer booklet

# MATHEMATICS

**SOLUTIONS**

**APPLICATIONS**

**UNIT 1**

## Section Two:

## Calculator-assumed

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Student number: In figures |  |  |  |  |  |  |  |  |  |  |

In words

Your name

## Time allowed for this section

Reading time before commencing work: ten minutes

Working time: one hundred minutes

## Materials required/recommended for this section

***To be provided by the supervisor***

This Question/Answer booklet

Formula sheet (retained from Section One)

***To be provided by the candidate***

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener,  
correction fluid/tape, eraser, ruler, highlighters

Special items: drawing instruments, templates, notes on two unfolded sheets of A4 paper, and up to three calculators approved for use in this examination

## Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised material. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

## Structure of this paper

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Section | Number of questions available | Number of questions to be answered | Working  time (minutes) | Marks available | Percentage of examination |
| Section One:  Calculator-free | 7 | 7 | 50 | 52 | 35 |
| Section Two:  Calculator-assumed | 12 | 12 | 100 | 98 | 65 |
|  | | |  | **Total** | 100 |

## Instructions to candidates

1. The rules for the conduct of examinations are detailed in the school handbook. Sitting this examination implies that you agree to abide by these rules.

2. Write your answers in this Question/Answer booklet.

3. You must be careful to confine your response to the specific question asked and to follow any instructions that are specified to a particular question.

4. Supplementary pages for the use of planning/continuing your answer to a question  
have been provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

5. Show all your working clearly. Your working should be in sufficient detail to allow your answers to be checked readily and for marks to be awarded for reasoning. Incorrect answers given without supporting reasoning cannot be allocated any marks. For any question or part question worth more than two marks, valid working or justification is required to receive full marks. If you repeat any question, ensure that you cancel the answer you do not wish to have marked.

6. It is recommended that you do not use pencil, except in diagrams.

7. The Formula sheet is not to be handed in with your Question/Answer booklet.

Section Two: Calculator-assumed 65% (98 Marks)

This section has**twelve (****12)** questions. Answer **all** questions. Write your answers in the spaces provided.

Working time: 100 minutes.

Question 8 (6 marks)

(a) Evaluate , rounding your answer to the nearest whole number. (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ evaluates  ✓ rounds as required |

(b) Calculate the value of the expression when and .

(2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ substitutes  ✓ evaluates correctly |

(c) Use the formula to calculate the value of when the values of the other pronumerals are , and . (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ substitutes  ✓ evaluates |

Question 9 (7 marks)

A research group was investigating whether the rate at which solid objects of similar volume tend to lose heat is related to their surface area.

The group had a cylinder of radius 6.3 cm and height 27 cm, a sphere of radius 9.3 cm and a cube with all sides of length 15 cm.

(a) Show that the volume of the sphere is close to that of the cube. (3 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ volume of cube  ✓ substitutes into sphere volume formula  ✓ evaluates volume of sphere |

(b) Determine by how much the surface area of the cube exceeds the surface area of the cylinder. (4 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ TSA of cube  ✓ substitutes into cylinder TSA formula  ✓ evaluates cylinder TSA  ✓ calculates difference |

Question 10 (7 marks)

A person who qualifies for a government allowance will be paid $645.90 per fortnight, so long as they do not work. In any fortnight that they do work and earn over $210, their allowance will be reduced by 50 cents in the dollar for earnings over $210.

(a) A student who qualifies for the allowance earns $250 in a fortnight. Calculate the amount of allowance they will receive. (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ calculates reduction  ✓ calculates net allowance |

(b) Another student who qualifies for the allowance has a part-time job for 12 hours each week, earning $18.60 per hour. Calculate

(i) their fortnightly wage. (1 mark)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ calculates wage |

(ii) the amount that the fortnightly allowance is reduced. (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ indicates excess  ✓ calculates reduction |

(iii) the fortnightly sum of their allowance and wage. (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ calculates allowance  ✓ calculates sum |

Question 11 (9 marks)

A grocery store has the same brand of instant coffee for sale in three different sized jars.

The 95, 210 and 350 gram jars are priced at $8.20, $17.85 and 31.85 respectively.

(a) Calculate the price per 100 grams for each jar of coffee. (3 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ divides cost by weight for at least one jar  ✓ at least one price per 100 g correct  ✓ all unit prices |

(b) Assuming price is the only consideration, list the jars in order of value, best value first.

(1 mark)

|  |
| --- |
| **Solution** |
| 210g, 95g, 350g |
| **Specific behaviours** |
| ✓ correct listing |

(c) The store is considering stocking a 485 gram jar, priced at $42.30.

(i) Determine how many of the existing jars are better value than this jar. (2 marks)

|  |
| --- |
| **Solution** |
| 2 of the existing jars are better value |
| **Specific behaviours** |
| ✓ unit price  ✓ states number |

(ii) Would your answer to (i) change if the price of the 485 g jar was decreased by 3%? Justify your response. (3 marks)

|  |
| --- |
| **Solution** |
| New price:  New unit price:  Yes - answer changed, as this jar now has smallest unit price of all jars. |
| **Specific behaviours** |
| ✓ changed price  ✓ unit cost  ✓ conclusion with reason |

Question 12 (9 marks)

A straight ladder has its foot on level ground and its top resting against a vertical wall. The ladder is 4.65 m long and its foot is 1.80 m away from the bottom of the wall.

(a) Sketch a diagram to show this situation and determine how far up the wall the top of the ladder reaches. (3 marks)

|  |  |
| --- | --- |
| **Solution** | |
|  |  |
| **Specific behaviours** | |
| ✓ sketch of right triangle  ✓ correct use of Pythagoras' theorem  ✓ distance, to nearest cm | |

(b) One of the rungs of the ladder is 1.20 m horizontally from the wall and 1.43 m vertically above the ground. Determine how far the rung is from the bottom of the wall. (3 marks)

|  |  |
| --- | --- |
| **Solution** | |
|  |  |
| **Specific behaviours** | |
| ✓ sketch  ✓ correct use of Pythagoras' theorem  ✓ distance, to nearest cm | |

(c) The foot of the ladder is pushed 45 cm closer to the base of the wall. Calculate how far up the wall the top of the ladder moves. (3 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ indicates new distance from wall  ✓ distance up wall  ✓ movement, to nearest cm |

Question 13 (8 marks)

(a) $23 500 is invested in a 60-day term deposit offering simple interest of 3.15% pa.

Calculate the value of the investment at the end of the 60 days. (3 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ substitutes correctly  ✓ evaluates interest  ✓ future value, to nearest cent |

(b) A sum of $16 000 is invested at 3.6% per annum for three years.

(i) Determine the value of the investment after three years if the interest is compounded annually. (2 marks)

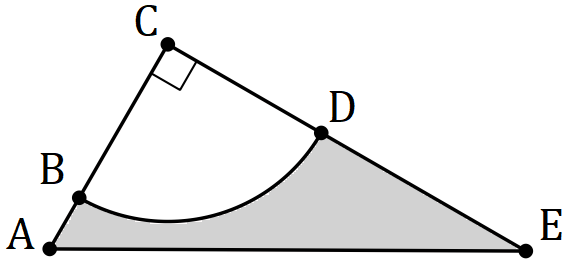
|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ substitutes correctly  ✓ evaluates, to nearest cent |

(ii) Calculate the additional interest earned over three years if the interest is compounded twice a year rather than annually. (3 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ adjusts for compounding twice per year  ✓ evaluates future value  ✓ extra interest, to nearest cent |

Question 14 (8 marks)

An engineering company produces gussets with the shape of the shaded area shown. is a right triangle, is an arc of a circle of radius cm, cm and cm.



(a) Determine, to the nearest cm, the perimeter of the shaded region. (5 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ indicates lengths of sides of triangle  ✓ uses Pythagoras' theorem  ✓ length of  ✓ calculates arc length  ✓ correct perimeter (rounding as guide only, no penalty) |

(b) Determine, to the nearest cm2, the area of the shaded region. (3 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ triangle area  ✓ circle quadrant area  ✓ shaded area (rounding as guide only, no penalty) |

Question 15 (7 marks)

A scale model of a rectangular-based pyramid has a height of 6 cm.

(a) Calculate the scale factor of the model, given that the real pyramid has a height of 18 cm.

(2 marks)

|  |
| --- |
| **Solution** |
| Scale factor of model is . |
| **Specific behaviours** |
| ✓ obtains ratio of heights  ✓ states correct scale factor |

(b) Given that

(i) the length of the diagonal of the base of the scale model is 6.4 cm, calculate the length of the diagonal of the base of the real pyramid. (1 mark)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ correct length |

(ii) the volume of the scale model is 40 cm3, calculate the volume of the real pyramid.

(2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ indicates volume scale factor  ✓ correct volume |

(iii) the total surface area of the real pyramid is 702 cm2, calculate the total surface area of the scale model. (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ indicates area scale factor  ✓ correct TSA |

Question 16 (9 marks)

Solid plastic decorations are made by joining the flat surfaces of two cones together, as shown below. The dimensions of the individual cones are shown in the table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Cone | Radius  (mm) | Slant height (mm) | Perpendicular height (mm) |
| Top | 4.8 | 10.2 | 9.0 |
| Bottom | 4.8 | 19.5 | 18.9 |

(a) Calculate the volume of the top cone. (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ substitutes correctly  ✓ evaluates |

(b) Determine the total volume of one decoration. (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ volume of bottom cone  ✓ sums volumes |

(c) A rectangular prism of plastic, measuring mm is to be melted and re-cast into decorations. Assuming there is no wastage, determine the largest number of decorations that can be made. (3 marks)

|  |
| --- |
| **Solution** |
| Make no more than 531 decorations. |
| **Specific behaviours** |
| ✓ volume of plastic  ✓ divides  ✓ states number, rounding down |

(d) Calculate the total surface area of one decoration. (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ curved area of one cone  ✓ total surface area |

Question 17 (8 marks)

A person invested a sum of $48 000 for a period of six months, depositing half in a simple interest account paying 3.16% pa and using the remainder to buy shares in a technology company for $1.60 each.

(a) Calculate the amount of interest earnt in the deposit account. (3 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ uses correct principle and time  ✓ indicates use of simple interest formula  ✓ correct interest |

(b) Ignoring any costs such as brokerage and so on, determine how many shares the person bought in the company. (1 mark)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ number of shares |

During the six months, the company paid the person a dividend of 5.4 cents per share.

(c) Calculate the dividend they received. (1 mark)

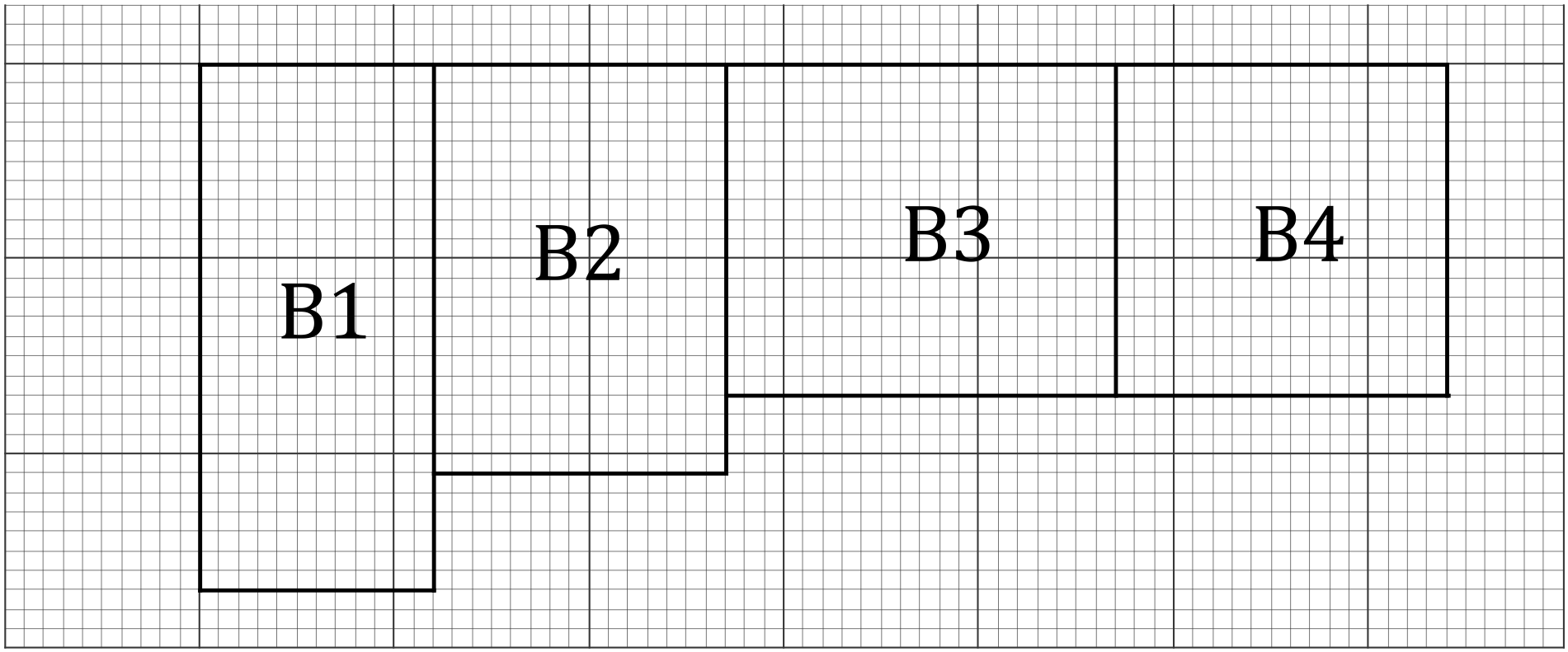
|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ calculates dividend |

(d) At the end of the six months, the person withdrew the principal and interest from the simple interest account and sold the shares for $1.54 each. Calculate the total gain or loss this person made with their investment of $48 000. (3 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ calculates loss on share value  ✓ indicates use of interest, dividend and loss  ✓ correct amount, clearly stating gain |

Question 18 (9 marks)

The diagram below, on two mm grid paper, shows a scale drawing of the floor plan of four small storage areas in the basement of an apartment block, drawn with a scale of 1 to 50.



Use dimensions from the scale drawing to answer the following questions about the actual storage areas in the apartment.

(a) Determine the perimeter, in metres, of storage area B2. (3 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ dimensions, ✓ uses scale, ✓ perimeter, correct units |

(b) Calculate the area, in square metres, of storage area B3. (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ dimensions, ✓ area, in correct units |

(c) Apartment owners can rent any of the storage areas at a cost of $28.50 per square metre per month. Determine the cost to rent storage area B1 for a year. (4 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ dimensions, ✓ area, ✓ monthly cost, ✓ annual cost |

Question 19 (11 marks)

A wine club offers its members Premium () or Ultimate () boxes of wine containing a mixture of Red (), White () or Sparkling () bottles of wine. The matrix below shows the number of bottles of each type of wine in each type of box.

The club purchases the bottles of wine from a wholesaler who charges them $19.50, $22.50 and $27.50 for one bottle of red, white and sparkling wine respectively.

(a) Write the cost of a bottle of red, white and sparkling wine, in that order, in column matrix . (1 mark)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ matrix correct |

(b) Use your calculator to multiply matrices and together to obtain matrix . (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ is a matrix  ✓ matrix correct |

(c) Explain what information matrix represents. (1 mark)

|  |
| --- |
| **Solution** |
| The cost to the club of each type of box (Premium and Ultimate) |
| **Specific behaviours** |
| ✓ correct explanation |

(d) The club has orders for 195 Premium and 85 Ultimate boxes.

(i) Write these numbers in matrix , so that shows the number of bottles of each type of wine required to meet the orders and evaluate . (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ matrix  ✓ matrix multiplication |

(ii) Show use of a matrix method to determine the total cost of buying the bottles of wine to meet the orders for 195 Premium and 85 Ultimate boxes. (3 marks)

|  |
| --- |
| **Solution** |
| Hence, total cost is $76 790. |
| **Specific behaviours** |
| ✓ uses answer from (i)  ✓ shows use of matrix multiplication  ✓ correct total cost |

(e) The club makes a profit of 9% and 15% on each Premium and Ultimate box respectively. Square matrix can be multiplied by matrix to calculate the selling price for each type of box. Write down matrix . (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ indicates correct multipliers  ✓ correct matrix |

Supplementary page

Question number: \_\_\_\_\_\_\_\_\_

Supplementary page

Question number: \_\_\_\_\_\_\_\_\_

Supplementary page

Question number: \_\_\_\_\_\_\_\_\_

Supplementary page

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