

### Semester One Examination, 2019

### Question/Answer booklet

# MATHEMATICS APPLICATIONS

**UNIT 1**

## Section Two:

## Calculator-assumed

 Your name

Teacher’s Name Hennighan Hill Scorer Toh

(Please circle)

## 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 | Workingtime (minutes) | Marks available | Percentage of examination |
| --- | --- | --- | --- | --- | --- |
| Section One:Calculator-free | 8 | 8 | 50 | 52 | 35 |
| Section Two:Calculator-assumed | 13 | 13 | 100 | 98 | 65 |
|  |  | **Total** | 100 |

| Markers use only |
| --- |
| Question | Maximum | Mark |
| 9 | 5 |  |
| 10 | 7 |  |
| 11 | 8 |  |
| 12 | 6 |  |
| 13 | 6 |  |
| 14 | 9 |  |
| 15 | 7 |  |
| 16 | 6 |  |
| 17 | 12 |  |
| 18 | 8 |  |
| 19 | 8 |  |
| 20 | 8 |  |
| 21 | 8 |  |
| S2 Total | 98 |  |
| S2 Wt (×0.6633) | 65% |  |

## 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 preferably using a blue/black pen.
Do not use erasable or gel pens.

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

4. 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.

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

6. Supplementary pages for planning/continuing your answers to questions are 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.

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**thirteen (****13)** questions. Answer **all** questions. Write your answers in the spaces provided.

Working time: 100 minutes.

**Question 9 (5 marks)**

A sector of a circle of radius $40$ cm is shown below.



(a) Show that the perimeter of the sector is $230$ cm, when rounded to the nearest cm.

 (3 marks)

(b) Determine the area of the sector. (2 marks)

**Question 10 (7 marks)**

(a) Calculate the value of $f$ given that $f=1 \overline{d} $ and $d=1 \overline{d\_{1}} +1 \overline{d\_{2}} $ when $d\_{1}=0.52$ and $d\_{2}=2.86$.

 (2 marks)

(b) The future value, $F$, of an annuity can be calculated using the formula below.

$F=\frac{C}{r}\left(\left(1+\frac{r}{n}\right)^{nt}-1\right)$

 Consider an annuity with values $C=\$2 500, r=0.035, n=4$ and $t=5$.

(i) Calculate the future value, rounding your answer to the nearest dollar. (3 marks)

(ii) Calculate the change in $F$ when the value of $n$ is changed from $4$ to $12$. (2 marks)

**Question 11 (8 marks)**

(a) A triangle has sides of length $72$ cm,$ 97$ cm and $65$ cm. State, with reasons, whether the triangle is right-angled. (2 marks)

(b) A $2.5$ m long ladder leans against a $1.8$ m tall wall with the foot of the ladder $0.8$ m away from the base of the wall on level ground.

(i) Draw a two-dimensional sketch of this situation, showing the ladder extending beyond the top of the wall. (2 marks)

(ii) Calculate the distance the ladder extends beyond the top of the wall. (2 marks)

(iii) The foot of the ladder is moved along the ground and away from the base of the wall until the top of the ladder is just touching the top of the wall. Determine how far the foot of the ladder was moved. (2 marks)

**Question 12 (6 marks)**

A researcher at a weather station uses the following formula to calculate $A$, the absolute humidity of the air, where$ H$ is the relative humidity and $T$ is the air temperature.

$A=\frac{12.7×H×\left(1.07\right)^{T}}{T+273}$

(a) Calculate $A$ when $H=55$ and $T=30$. (2 marks)

The formula for $A$ was used to create the spreadsheet below for various values of $H$ and $T$.

| $A$ | $H$ |
| --- | --- |
| $40$ | $50$ | $60$ | $70$ | $80$ |
| $T$ | $-10$ | $0.98$ | $1.23$ | $1.47$ | $1.72$ | $P$ |
| $0$ | $1.86$ | $2.33$ | $2.79$ | $3.75$ | $3.72$ |
| $10$ | $3.53$ | $4.41$ | $5.30$ | $6.18$ | $7.06$ |
| $20$ | $Q$ | $8.39$ | $10.06$ | $11.74$ | $13.42$ |

(b) Calculate the value of the entries $P$ and $Q$ shown in the spreadsheet. (2 marks)

(c) One of the entries in the spreadsheet is incorrect. State the value of $T$ and the value of $H$ for the cell in which the incorrect value lies and calculate the correct value of $A$. (2 marks)

**Question 13 (6 marks)**

A bakery sells a specialty cake in the shape of a square-based pyramid. The sides of the square are all $32$ cm and the vertex of the pyramid, $V$, lies $21$ cm directly above the centre of the square base, $C$. The mid-point of one of the sides of the square is $M$.



(a) Determine the volume of the cake. (2 marks)

(b) Calculate the length $VM$. (2 marks)

(c) The four triangular faces are iced at a cost of $1.4$ cents per square cm. Determine the cost of icing the cake, in dollars and cents. (2 marks)

**Question 14 (9 marks)**

The weekly sales of Sumsang phones (the Ten, Plus and Note models) at retail outlets $A$, $B$ and $C$ is shown in matrix $M$.

$ A B C M= \left[60 25 36 42 32 28 55 30 34 \right] Ten Plus Note $

(a) In total, how many Note models were sold? (1 mark)

(b) What does the element $m\_{21}$ in matrix $M$ represent? (1 mark)

(c) Determine the matrix $Q$, where $Q=\left[1 1 1 \right]×M$, and explain what $Q$ shows. (2 marks)

(d) Determine the matrix $N$, where $N=M×\left[1 1 1 \right]$, and explain what $N$ shows. (2 marks)

(e) The Ten, Plus and Note models are sold for $\$899$, $\$949$ and $\$1 149$ respectively.

(i) Use this information to write matrix $P$ that can be multiplied by matrix $N$ to yield a sensible result. (1 mark)

(ii) Multiply matrices $P$ and $N$ together and explain what the result shows. (2 marks)

**Question 15 (7 marks)**

A shop sold three sizes of the same brand of soy sauce. The $225$ mL bottle cost $\$2.70$, the $375$ mL bottle cost $\$4.35$ and the $660$ mL bottle cost $\$8.25$.

Retail laws require the shop to display the price per $100$ mL for each bottle, to the nearest cent.

(a) Calculate the price per $100$ mL for all three sizes of soy sauce. (3 marks)

(b) Use the unit prices to list the bottle sizes in order of value, from best to worst. (1 mark)

(c) Determine the maximum price, to the nearest cent, for a $525$ mL bottle of the same sauce if the shop wanted it to be better value than the other three sizes in terms of unit price.

 (2 marks)

(d) Suggest one reason that a shopper may prefer a size other than that which offers the best value in terms of unit price. (1 mark)

**Question 16 (6 marks)**

A wood turner crafted solid shape $S$ as shown below - a hemisphere of radius $15$ cm atop a cylinder with the same radius and height $18$ cm.



(a) The wood turner started out with a block of wood in the shape of a rectangular prism with dimensions $40×35×35$ cm. Determine the volume of wood that was removed from this block to end up with shape $S$. (3 marks)

(b) Shape $S$ was then cut vertically into two congruent halves. Determine the area of one of the cut faces. (3 marks)

**Question 17 (12 marks)**

A spreadsheet to track a monthly car budget is shown below, with all amounts in dollars. The figures for months 1, 2 and 3 show the actual expenditure for each item.

| Item | Monthly Budget  | Month 1 | Month 2 | Month 3 | 3-Month Total |
| --- | --- | --- | --- | --- | --- |
| Loan payment | $405$ | $405$ | $405$ | $405$ | $1215$ |
| Insurance | $225$ | $225$ | $225$ | $225$ | $R$ |
| Maintenance | $108$ | $0$ | $458$ | $45$ | $503$ |
| Fuel | $162$ | $215$ | $174$ | $Q$ | $582$ |
| Total | $P$ | $845$ | $1262$ | $868$ | $S$ |

(a) Determine the values of $P, Q, R$ and $S$ in the spreadsheet. (3 marks)

(b) A motoring organisation recommends allocating no more than $15\%$ of a person's monthly income to running a car. Would a person on a salary of $\$67 500$ pa and using the total monthly budget figure above meet this target? Justify your answer. (3 marks)

(c) Over the three months shown, the total actual expenditure for two items exceeded their budgeted figures.

(i) Which items were these? (1 mark)

(ii) Determine which of these two items exceeded their budgeted figure by the largest percentage. (3 marks)

(d) The monthly budget figure for insurance includes a $10\%$ tax. Determine the cost of the insurance without this tax. (2 marks)

**Question 18 (8 marks)**

Single people aged between $18$ and $21$, living at home and looking for work qualify for the youth allowance of $\$304.40$ per fortnight, unless they earn more than $\$668.17$ in that time, in which case no allowance is paid.

In any fortnight that they earn between $\$143$ and $\$250$, the allowance will be reduced by $50$ cents in the dollar for earnings over $\$143$.

In any fortnight that they earn between $\$250$ and $\$668.17$, the allowance will be reduced by $\$53.50$ plus $60$ cents in the dollar for earnings over $\$250$.

Determine, with justification, the fortnightly youth allowance paid to each of the following.

(a) Alex, who earns $\$66$ per week. (2 marks)

(b) Bay, who has a part time job paying $\$15.25$ per hour for $12$ hours each fortnight. (3 marks)

(c) Cara, who is paid $\$16.40$ per hour for working $6$ hours a day for $3$ days a week.

 (3 marks)

**Question 19 (8 marks)**

A right-triangular prism has dimensions shown in the diagram below.



(a) Determine the total surface area of the prism. (3 marks)

(b) An eighth-size model is made of the prism, i.e. using a scale of $1:8$. Calculate the total surface area of this model. (2 marks)

(c) Determine the volume of the original prism. (1 mark)

(d) Another scale model is made of the prism, so that the dimensions of the sloping face are now $3.6$ cm by $4$ cm. Calculate the volume of this scale model. (2 marks)

**Question 20 (8 marks)**

(a) An investor pays $\$57 250$ into a new account offering interest of $2.85\%$ pa, with interest payable every $90$ days. The investor closes the account and withdraws the principal and interest just after the first interest payment.

 Calculate the amount they withdraw. (3 marks)

(b) Another person invested $\$4 000$ with a bank that offered an interest rate of $5.2\%$ pa.

(i) Determine the **value of the investment** after two years when interest is compounded annually. (2 marks)

(ii) The person was advised that they would be better off after two years if they invested the same sum with another bank that was offering an interest rate of $5.1\%$ pa compounded monthly. State, with justification, whether this was good advice.

 (3 marks)

**Question 21 (8 marks)**

The washer shown below is made of plastic and has an internal radius of $9$ mm, an external radius of $23$ mm and is $4$ mm thick.



(a) The plastic used to make the washers costs $75$ cents per litre. Given that one litre is $1 000$ cubic centimetres, determine the cost of making $5 000$ of the washers. (4 marks)

(b) Calculate the total surface area of one washer, giving your answer in mm2. (4 marks)

Supplementary page

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

Supplementary page

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

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