

## 2020 HSC Mathematics Standard 2 Marking Guidelines

### Section I

#### Multiple-choice Answer Key

Question	Answer
1	C
2	D
3	C
4	B
5	A
6	D
7	A
8	A
9	B
10	D
11	C
12	D
13	A
14	A
15	B

## Section II

### Question 16 (a)

Criteria	Marks
• Provides correct solution	2
• Uses the correct trigonometric ratio, or equivalent merit	1

**Sample answer:**

$$\tan \theta = \frac{8}{10}$$

$$\theta = 39^\circ \quad (\text{nearest degree})$$

### Question 16 (b)

Criteria	Marks
• Provides correct solution	2
• Attempts to use a relevant trigonometric ratio or attempts to use Pythagoras' Theorem	1

**Sample answer:**

$$x^2 = 10^2 + 8^2$$

$$x^2 = 164$$

$$x = \sqrt{164}$$

$$x = 12.8 \quad (\text{one decimal place})$$

### Question 17

Criteria	Marks
• Provides correct solution	2
• Provides correct area of the block of land, or equivalent merit	1

**Sample answer:**

$$\frac{8}{5 \times 5} = \frac{x}{1000 \times 1000} \quad \text{where } x \text{ is the required number of trees}$$

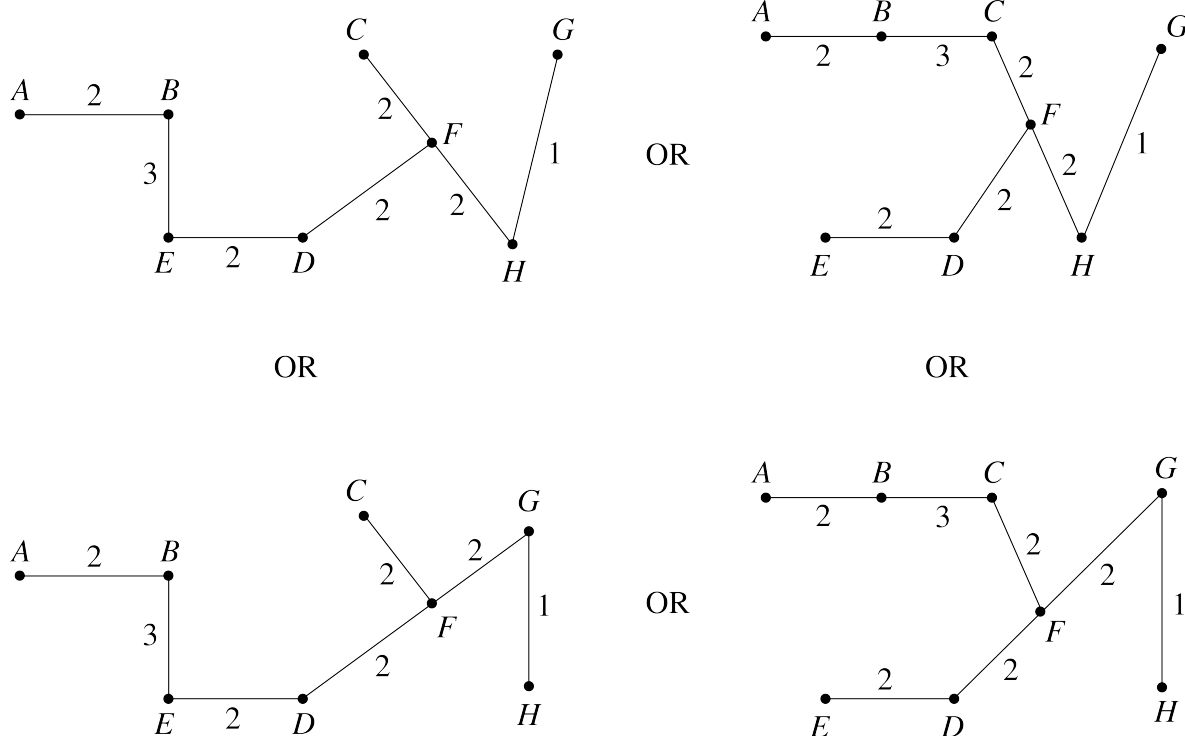
$$\therefore x = \frac{8\,000\,000}{25}$$

$$= 320\,000$$

### Question 18 (a)

Criteria	Marks
• Draws a minimum spanning tree and states minimum length	3
• Draws a spanning tree (which is not minimum) and calculates its length	2
• Provides correct length based on the diagram drawn	1

**Sample answer:**



The length of the minimum spanning tree is 14.

### Question 18 (b)

Criteria	Marks
• Adds 10 to the length found in part (a)	1

**Sample answer:**

$$14 + 10 = 24$$

### Question 19 (a)

Criteria	Marks
• Provides the correct answer	1

**Sample answer:**

200

### Question 19 (b)

Criteria	Marks
• Provides correct values for $x$ and $y$	2
• Provides correct value for $x$ , or equivalent merit	1

**Sample answer:**

$$x = 150$$

$$3x + 2y = 900$$

$$3(150) + 2y = 900$$

$$2y = 450$$

$$y = 225$$

### Question 19 (c)

Criteria	Marks
• Provides correct solution	1

**Sample answer:**

$$A = xy$$

$$= 150 \times 225$$

$$= 33\,750 \text{ m}^2$$

## Question 20

Criteria	Marks
• Provides correct solution	3
• Provides correct calculation of tax, or equivalent merit	2
• Makes some progress towards calculating the tax payable, or equivalent merit	1

**Sample answer:**

$$\begin{aligned}\text{Tax} &= 20\,797 + 0.37(122\,680 - 90\,000) \\ &= \$32\,888.60\end{aligned}$$

$$\begin{aligned}\text{PAYG tax} &= 3000 \times 12 \\ &= \$36\,000\end{aligned}$$

$$\begin{aligned}\text{Refund} &= 36\,000 - 32\,888.60 \\ &= \$3111.40\end{aligned}$$

## Question 21

Criteria	Marks
• Provides correct solution	2
• Attempts to use the compound interest formula, or equivalent merit	1

**Sample answer:**

$$\begin{aligned}&\frac{122}{1 + 0.02} \\ &= \$119.61\end{aligned}$$

## Question 22

Criteria	Marks
• Provides correct solution	3
• Applies the compound interest formula correctly, or equivalent merit	2
• Attempts to apply the compound interest formula, or equivalent merit	1

**Sample answer:**

$$\begin{aligned}\text{Amount owing} &= 500\left(1 + \frac{0.17}{365}\right)^{15} - 250 \\ &= \$253.50\end{aligned}$$

### Question 23 (a)

Criteria	Marks
• Provides correct solution	2
• Identifies a relevant ratio, or equivalent merit	1

**Sample answer:**

$$1 \text{ part of pineapple juice} = \frac{3}{15} \text{ L}$$

4 parts of orange juice are required.

$$\therefore 4 \times \frac{3}{15}$$

$$= 0.8 \text{ L or } 800 \text{ mL of orange juice required}$$

### Question 23 (b)

Criteria	Marks
• Provides correct solution	3
• Provides correct capacity of the container and attempts to calculate the amount of mango juice required	2
• Provides correct volume of the container, or equivalent merit	1

**Sample answer:**

Capacity of container

$$= 40 \times 20 \times 35$$

$$= 28\,000 \text{ cm}^3$$

$$= 28 \text{ L}$$

Total number of parts

$$= 15 + 9 + 4$$

$$= 28$$

Amount of mango juice required

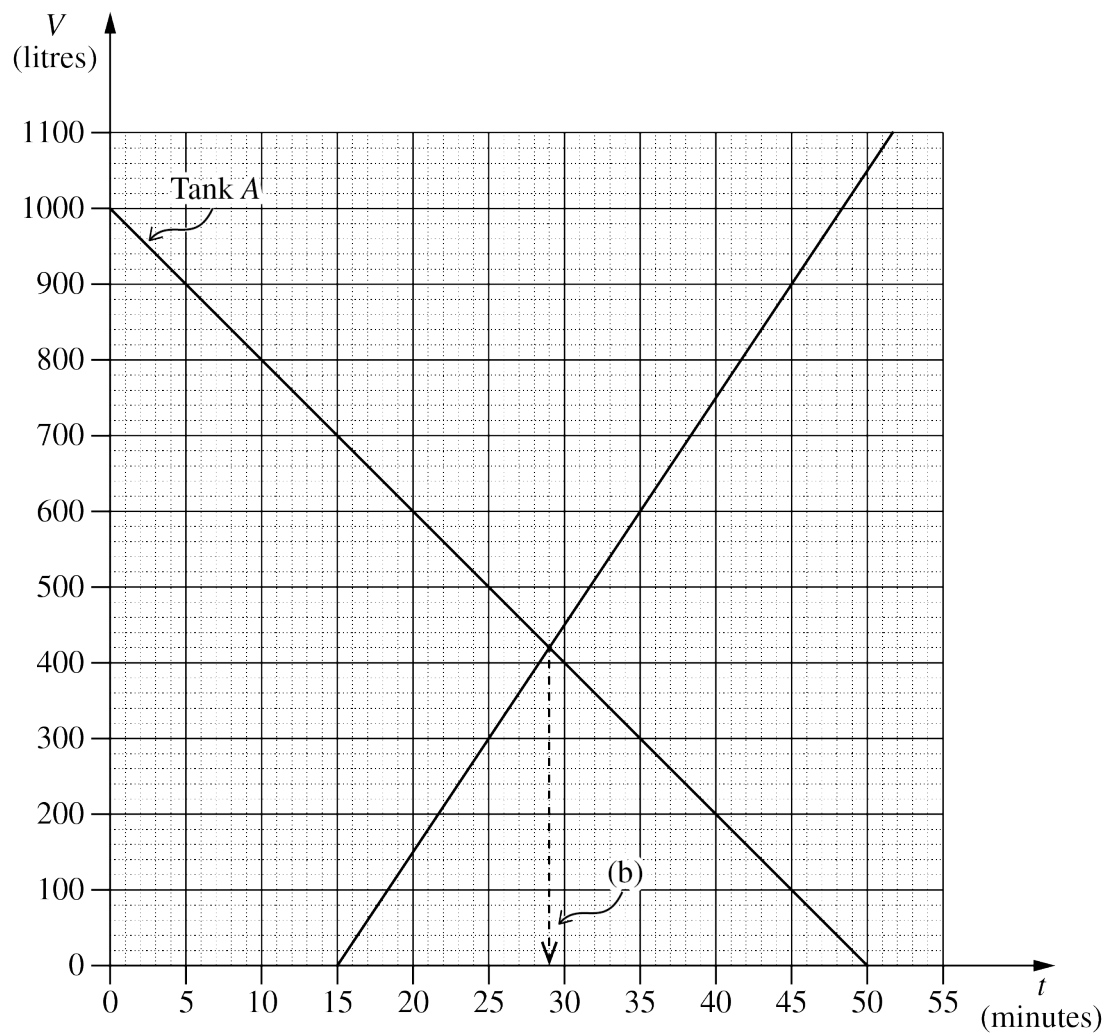
$$= \frac{9}{28} \times 28$$

$$= 9 \text{ L}$$

## Question 24 (a)

Criteria	Marks
<ul style="list-style-type: none"> <li>Provides the correct solution</li> </ul>	1

**Sample answer:**



### Question 24 (b)

Criteria	Marks
• Provides the correct solution	2
• Draws the graph of volume for tank $B$ , or equivalent merit	1

**Sample answer:**

29 minutes

### Question 24 (c)

Criteria	Marks
• Provides the correct answer	1

**Sample answer:**

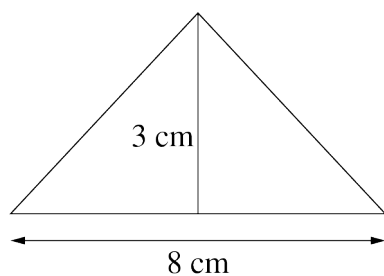
45 minutes



## Question 25

Criteria	Marks
• Provides correct solution	3
• Calculates the area of two different relevant faces, or equivalent merit	2
• Calculates the area of one relevant face, or equivalent merit	1

**Sample answer:**



Height of triangle  
 $= 11 - 8 = 3$

$$\begin{aligned} \text{Five square faces} &= 8^2 \times 5 \\ &= 320 \end{aligned}$$

$$\begin{aligned} \text{Two triangular faces} &= \frac{3 \times 8}{2} \times 2 \\ &= 24 \end{aligned}$$

$$\begin{aligned} \text{Two rectangular faces} &= 5 \times 8 \times 2 \\ &= 80 \end{aligned}$$

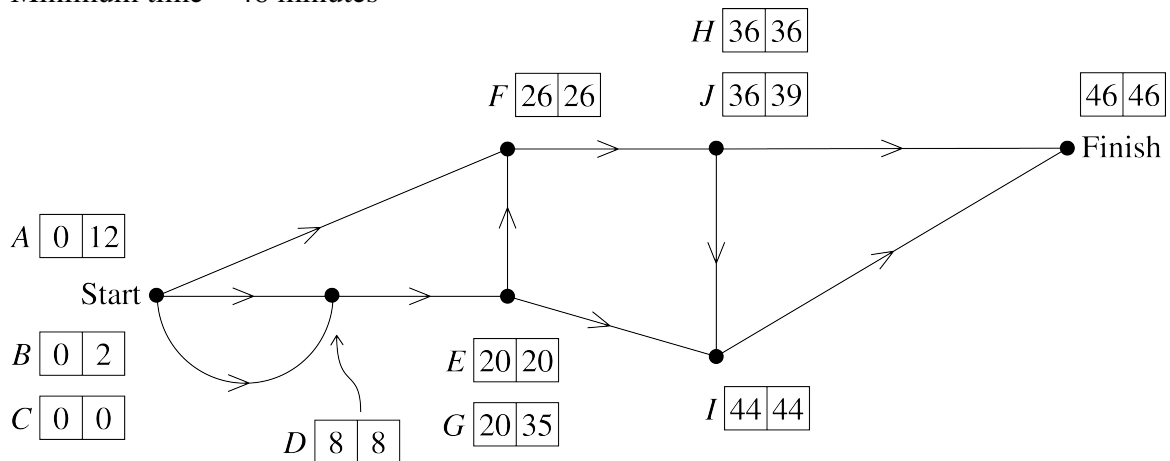
$$\begin{aligned} \text{Total surface area} &= 320 + 24 + 80 \\ &= 424 \text{ cm}^2 \end{aligned}$$

### Question 26 (a)

Criteria	Marks
• Provides correct answer	1

**Sample answer:**

Minimum time = 46 minutes



### Question 26 (b)

Criteria	Marks
• Provides correct sequence of activities	2
• Provides a sequence of activities from start to finish	1

**Sample answer:**

$C - D - E - F - H - I$

### Question 26 (c)

Criteria	Marks
• Provides correct solution	2
• Provides two correct values, or equivalent merit	1

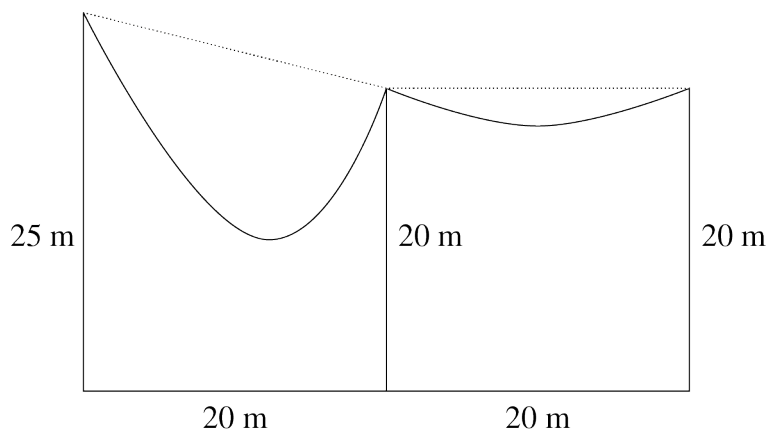
**Sample answer:**

Activity	Earliest start time	Float time
A	0	12
G	20	15

### Question 27 (a)

Criteria	Marks
• Provides correct solution	3
• Provides calculation with incorrect scale, or equivalent merit	2
• Provides calculation of the area of a trapezium, or equivalent merit	1

**Sample answer:**



$$\frac{20}{2}(25 + 20) + \frac{20}{2}(20 + 20)$$

$$= 850 \text{ m}^2$$

### Question 27 (b)

Criteria	Marks
• Provides correct answer with reason	2
• Provides correct answer, or equivalent merit	1

**Sample answer:**

More than the actual area because the trapezia include the area of the garden as well as some area not in the garden, ie the area bounded by the (invisible) side of each trapezium and the curved part of the garden edge, as shown in the diagram in part (a).

## Question 28

Criteria	Marks
• Provides correct solution	4
• Calculates the mean and median of the first dataset and the mean of the second dataset, or equivalent merit	3
• Calculates mean and median of first dataset, or equivalent merit	2
• Calculates median of first dataset, or equivalent merit	1

### **Sample answer:**

Mean of first set of data = 8

Mean of second set of data =  $\frac{40 + x}{6}$

Median of first set of data = 9

Median of second set of data = 9.5

$$\frac{40 + x}{6} - 8 = 10(9.5 - 9)$$

$$\frac{40 + x}{6} - 8 = 5$$

$$\frac{40 + x}{6} = 13$$

$$40 + x = 13 \times 6$$

$$= 78$$

$$x = 38$$

### Question 29

Criteria	Marks
• Provides correct solution	3
• Provides correct dividend for $XYZ$ , or equivalent merit	2
• Calculates the dividend for $ABC$ , or equivalent merit	1

**Sample answer:**

Total dividend from company  $ABC$

$$= 200 \times 0.06 \times 5.5$$

$$= 66$$

$$\begin{aligned} \text{Dividend for } XYZ &= 149.52 - 66 \\ &= 83.52 \end{aligned}$$

$$(\text{Number of shares in } XYZ) \times (0.04) \times (6) = 83.52$$

$$\therefore 348 \text{ shares in } XYZ$$

### Question 30 (a)

Criteria	Marks
• Provides correct solution	2
• Identifies a cut, or equivalent merit	1

**Sample answer:**

The minimum cut passes through  $BD$ ,  $BE$ ,  $CE$  and  $CF$ .

$$\therefore \text{Maximum flow} = 275$$

### Question 30 (b)

Criteria	Marks
• Provides correct solution	1

**Sample answer:**

$$\begin{aligned} \text{Weight of cut} &= 200 + 75 + 50 \\ &= 325 \end{aligned}$$

This is not equal to the value of the maximum flow. Hence the cut is not a minimum cut.

### Question 31 (a)

Criteria	Marks
• Provides the correct solution	1

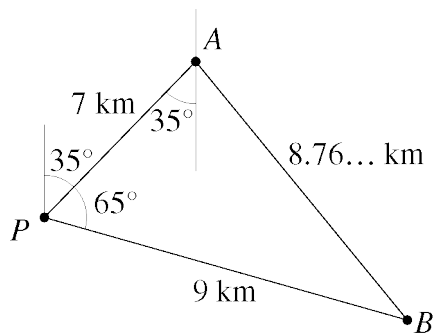
**Sample answer:**

$$100^\circ - 35^\circ = 65^\circ$$

### Question 31 (b)

Criteria	Marks
• Provides the correct solution	2
• Attempts to use the cosine rule to find the distance $AB$	1

**Sample answer:**



$$\begin{aligned} AB^2 &= 7^2 + 9^2 - 2 \times 7 \times 9 \cos 65^\circ \\ &= 76.75... \end{aligned}$$

$$AB = 8.76 \text{ km}$$

### Question 31 (c)

Criteria	Marks
• Provides the correct solution	2
• Finds another angle in $\triangle APB$ , or equivalent merit	1

**Sample answer:**

$$\frac{\sin A}{9} = \frac{\sin 65^\circ}{8.76...}$$

$$A = 68.6...$$

$$\doteq 69^\circ$$

$$\begin{aligned} \text{Bearing} &= 180^\circ - (69^\circ - 35^\circ) \\ &= 146^\circ \end{aligned}$$

## Question 32

Criteria	Marks
• Provides a correct solution	4
• Calculates area of $\triangle AOB$ , or equivalent merit	3
• Finds $OA$ , or equivalent merit	2
• Finds $AB$ , or equivalent merit	1

**Sample answer:**

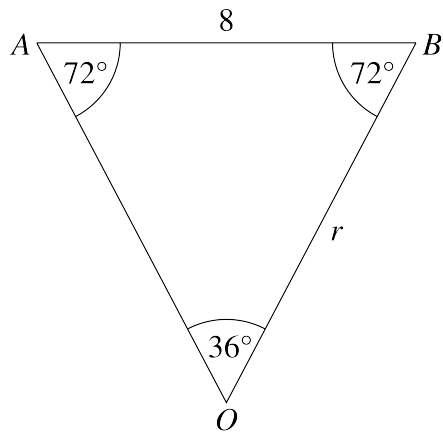
$$AB = 80 \div 10$$

$$= 8 \text{ cm}$$

$$\angle AOB = 360^\circ \div 10 = 36^\circ$$

$$\angle OAB = \frac{180^\circ - 36^\circ}{2}$$

$$= 72^\circ$$



$$\frac{r}{\sin 72^\circ} = \frac{8}{\sin 36^\circ}$$

$$r = 12.944\dots$$

$$\text{Area} = 10 \times \frac{1}{2} \times (12.944\dots)^2 \times \sin 36^\circ$$

$$\doteq 492.4 \text{ cm}^2$$

### Question 33 (a)

Criteria	Marks
<ul style="list-style-type: none"> <li>Provides correct answer</li> </ul>	1

**Sample answer:**

4000 bacteria

### Question 33 (b)

Criteria	Marks
<ul style="list-style-type: none"> <li>Provides correct solution</li> </ul>	2
<ul style="list-style-type: none"> <li>Substitutes a value for <math>b</math> into an appropriate formula, or equivalent merit</li> </ul>	1

**Sample answer:**

$$2000 = 1000 \times b^{20}$$

After trial and error

$$1000(1.03)^{20} = 1806.11$$

$$1000(1.04)^{20} = 2191.12$$

$\therefore$  lower estimate = 1.03, upper estimate = 1.04



### Question 34 (a)

Criteria	Marks
• Provides the correct solution	2
• Finds the value of $A_1$ , or equivalent merit	1

**Sample answer:**

$$\begin{aligned} A_1 &= 60\,000(1.005) - 800 \\ &= \$59\,500 \end{aligned}$$

$$\begin{aligned} A_2 &= 59\,500(1.005) - 800 \\ &= \$58\,997.50 \end{aligned}$$

$$\begin{aligned} A_3 &= 58\,997.50(1.005) - 800 \\ &\div \$58\,492.49 \end{aligned}$$

### Question 34 (b)

Criteria	Marks
• Provides the correct solution	2
• Finds by how much the balance is reduced, or equivalent merit	1

**Sample answer:**

Total withdrawals after 3 months

$$\begin{aligned} &= 800 \times 3 \\ &= \$2400 \end{aligned}$$

Balance is reduced by

$$\begin{aligned} &= 60\,000 - 58\,492.49 \\ &= \$1507.51 \end{aligned}$$

Interest

$$\begin{aligned} &= \$2400 - \$1507.51 \\ &= \$892.49 \end{aligned}$$

### Question 35 (a)

Criteria	Marks
• Provides correct solution	2
• Demonstrates that 97.5% relates to 2 standard deviations above the mean, or equivalent merit	1

**Sample answer:**

128 corresponds to 2 standard deviations above the mean

$\therefore \frac{5\%}{2} = 2.5\%$  have an IQ score higher than Yin's.

### Question 35 (b)

Criteria	Marks
• Provides correct solution	2
• Demonstrates Yin is 1 standard deviation above the mean in City B, or equivalent merit	1

**Sample answer:**

Mean of City B = 112

1 standard deviation above the mean for City B  
 $= 112 + 16$   
 $= 128$

So Yin's IQ score is 1 standard deviation above the mean of IQ scores in City B.

$\therefore$  percentage of population that have IQ score lower than Yin's is  $50\% + \frac{1}{2} \times 68\% = 84\%$

$\therefore$  expected number of adults  $= 1\,000\,000 \times 0.84$   
 $= 840\,000$

**Question 35 (c)**

Criteria	Marks
• Provides correct solution	3
• Provides correct equation linking City A with City B	2
• Provides correct expression for the z-score for City A or City B, or equivalent merit	1

**Sample answer:**

Let  $x$  be Simon's IQ score.

$$z\text{-score in City A} = \frac{x - 108}{10}$$

$$z\text{-score in City B} = \frac{x - 112}{16}$$

$$\frac{x - 108}{10} = \frac{x - 112}{16}$$

$$16(x - 108) = 10(x - 112)$$

$$16x - 1728 = 10x - 1120$$

$$16x - 10x = 1728 - 1120$$

$$6x = 608$$

$$x \doteq 101.3$$

### Question 36

Criteria	Marks
• Provides the correct solution	5
• Finds value of $b$ , or equivalent merit	4
• Substitutes $\bar{x}$ and $\bar{y}$ into the regression equation, or equivalent merit	3
• Finds the value of $\bar{x}$ and $\bar{y}$ , or equivalent merit	2
• Finds the value of $\bar{x}$ or $\bar{y}$ or the median of the temperature, or equivalent merit	1

**Sample answer:**

$$\bar{x} = 22 - 0.525$$

$$= 21.475$$

$$\bar{y} = \frac{684}{20}$$

$$= 34.2$$

Substituting  $(\bar{x}, \bar{y})$  into the regression equation, we have

$$34.2 = -10.6063 + b(21.475)$$

$$\frac{44.8063}{21.475} = b$$

$$b = 2.08644\dots$$

When  $x = 19$ ,  $y = -10.6063 + 2.08644\dots \times 19$

$$= 29.03606\dots$$

$\therefore$  29 chirps are expected.

### Question 37

Criteria	Marks
• Provides correct solution	3
• Provides calculation for the value of the \$1000 annuity for 20 years, or equivalent merit	2
• Identifies an appropriate annuity factor, or equivalent merit	1

**Sample answer:**

Present value of \$1000 annuity for 20 years

$$16.351 \times 1000$$

$$= \$16\,351$$

Present value of \$3000 annuity for 30 years

$$22.396 \times 3000$$

$$= \$67\,188$$

Present value of \$3000 annuity for 20 years

$$16.351 \times 3000$$

$$= \$49\,053$$

$$\text{Present value} = 16\,351 + 67\,188 - 49\,053$$

$$= \$34\,486$$

Alternate solution

$$\text{Present value of \$3000 annuity for the last 10 years} = \frac{3000 \times 8.983}{(1 + 0.02)^{20}}$$

$$\begin{aligned} \text{Total present value} &= 16.351 \times 1000 + \frac{3000 \times 8.983}{(1 + 0.02)^{20}} \\ &= \$34\,486.90 \end{aligned}$$

# 2020 HSC Mathematics Standard 2

## Mapping Grid

### Section I

Question	Marks	Content	Syllabus outcomes
1	1	MS-A4 Types of Relationships	MS2-12-1
2	1	MS-M1 Applications of Measurement	MS11-3
3	1	MS-M7 Rates and Ratios	MS2-12-6
4	1	MS-F4 Investments and Loans	MS2-12-5
5	1	MS-M1 Applications of Measurement	MS11-3
6	1	MS-A2 Linear Relationships	MS11-6
7	1	MS-S1 Data Analysis	MS11-10
8	1	MS-S5 The Normal Distribution	MS2-12-7
9	1	MS-N2 Network Concepts	MS2-12-8
10	1	MS-A2 Linear Relationships	MS11-6
11	1	MS-F4 Investments and Loans	MS2-12-5
12	1	MS-S4 Bivariate Data Analysis	MS2-12-2
13	1	MS-A1 Formulae and Equations	MS11-6
14	1	MS-F5 Annuities	MS2-12-5
15	1	MS-S2 Relative Frequency and Probability	MS11-8

### Section II

Question	Marks	Content	Syllabus outcomes
16 (a)	2	MS-M6 Non-right-angled Trigonometry	MS2-12-4
16 (b)	2	MS-M6 Non-right-angled Trigonometry	MS2-12-4
17	2	MS-M7 Rates and Ratios	MS2-12-1
18 (a)	3	MS-N2 Network Concepts	MS2-12-8
18 (b)	1	MS-N2 Network Concepts	MS2-12-8
19 (a)	1	MS-A4 Types of Relationships	MS2-12-6
19 (b)	2	MS-A4 Types of Relationships	MS2-12-6
19 (c)	1	MS-A4 Types of Relationships	MS2-12-1
20	3	MS-F1 Money Matters	MS11-5
21	2	MS-F4 Investments And Loans	MS2-12-5
22	3	MS2-F4 Investments and Loans	MS2-12-5

Question	Marks	Content	Syllabus outcomes
23 (a)	2	MS-M7 Rates and Ratios	MS2-12-3
23 (b)	3	MS-M7 Rates and Ratios	MS2-12-4
24 (a)	1	MS-A2 Linear Relationships	MS11-2
24 (b)	2	MS-A4 Types of Relationships	MS2-12-6
24 (c)	1	MS-A4 Types of Relationships	MS2-12-6
25	3	MS-M1 Applications of Measurement	MS11-4
26 (a)	1	MS-N3 Critical Path Analysis	MS2-12-8
26 (b)	2	MS-N3 Critical Path Analysis	MS2-12-8
26 (c)	2	MS-N3 Critical Path Analysis	MS2-12-8
27 (a)	3	MS-M7 Rates and Ratios	MS2-12-4
27 (b)	2	MS-M7 Rates and Ratios	MS2-12-4
28	4	MS-S1 Data Analysis	MS11-7
29	3	MS-F4 Investments and Loans	MS2-12-5
30 (a)	2	MS-N2 Network Concepts	MS2-12-8
30 (b)	1	MS-N2 Network Concepts	MS2-12-8
31 (a)	1	MS-M6 Non-right-angled Trigonometry	MS2-12-4
31 (b)	2	MS-M6 Non-right-angled Trigonometry	MS2-12-4
31 (c)	2	MS-M6 Non-right-angled Trigonometry	MS2-12-4
32	4	MS-M6 Non-right-angled Trigonometry	MS2-12-4
33 (a)	1	MS-A4 Types of Relationships	MS2-12-6
33 (b)	2	MS-A4 Types of Relationships	MS2-12-6
34 (a)	2	MS-F5 Annuities	MS2-12-5
34 (b)	2	MS-F5 Annuities	MS2-12-5
35 (a)	2	MS-S5 The Normal Distribution	MS2-12-7
35 (b)	2	MS-S5 The Normal Distribution	MS2-12-7
35 (c)	3	MS-S5 The Normal Distribution	MS2-12-7
36	5	MS-S4 Bivariate Data Analysis	MS2-12-7
37	3	MS-F5 Annuities	MS2-12-5