NSW Education Standards Authority

2023 HSC Mathematics Standard 2 Marking Guidelines

Section I

Multiple-choice Answer Key

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

Section II

Question 16 (a)

Criteria	Marks
• Provides correct answer	1

Sample answer:

120 bpm

Question 16 (b)

Criteria	Marks
• Provides correct answer	1

Sample answer:

10:30 am

Question 17 (a)

Criteria	Marks
• Completes the network diagram	2
• Provides a diagram that is substantially correct	1

Sample answer:
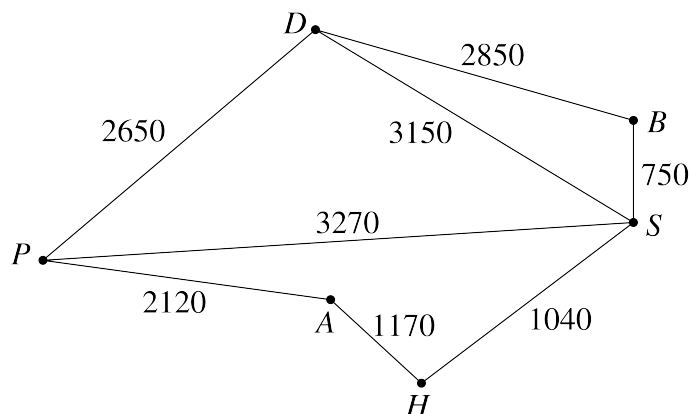
Question 17 (b)

Criteria	Marks
• Provides correct answer	1

Sample answer:

Kilometres travelled $=$ 1040 km + 3150 km

$\qquad\qquad\qquad = 4190$ km

Question 18

Criteria	Marks
• Provides two correct features	2
• Provides one correct feature	1

Sample answer:

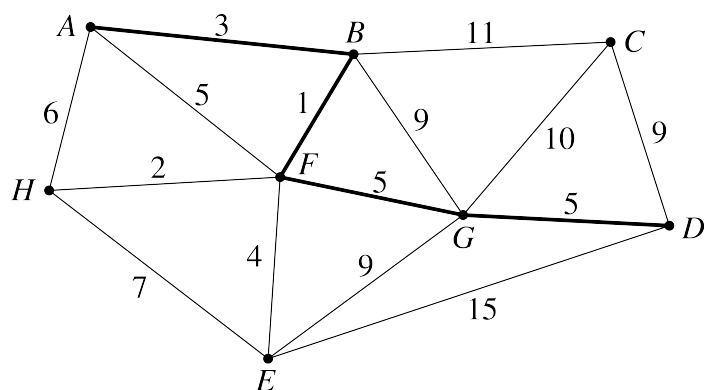The histogram is symmetrical.
The histogram is unimodal.

Question 19 (a)

Criteria	Marks
• Provides correct answer	2
• Provides a path from *A* to *D*, or equivalent merit	1

Sample answer:

Path *ABFGD*

Answers could include:

Question 19 (b)

Criteria	Marks
• Provides correct answer with a correct reason	2
• Provides an explanation or spanning tree, or equivalent merit	1

Sample answer:

It is not a minimum spanning tree as *BC* is not the shortest path to join *C* to the tree.

Question 20 (a)

Criteria	Marks
• Provides correct answer	1

Sample answer:

Maximum height reached = 24 m

Question 20 (b)

Criteria	Marks
• Provides correct answers	2
• Calculates $\dfrac{3}{4}$ of the maximum height, or equivalent merit	1

Sample answer:

$24 \times \dfrac{3}{4} = 18$ m

The ball reached 18 m at 1 second and 3 seconds.

Question 21 (a)

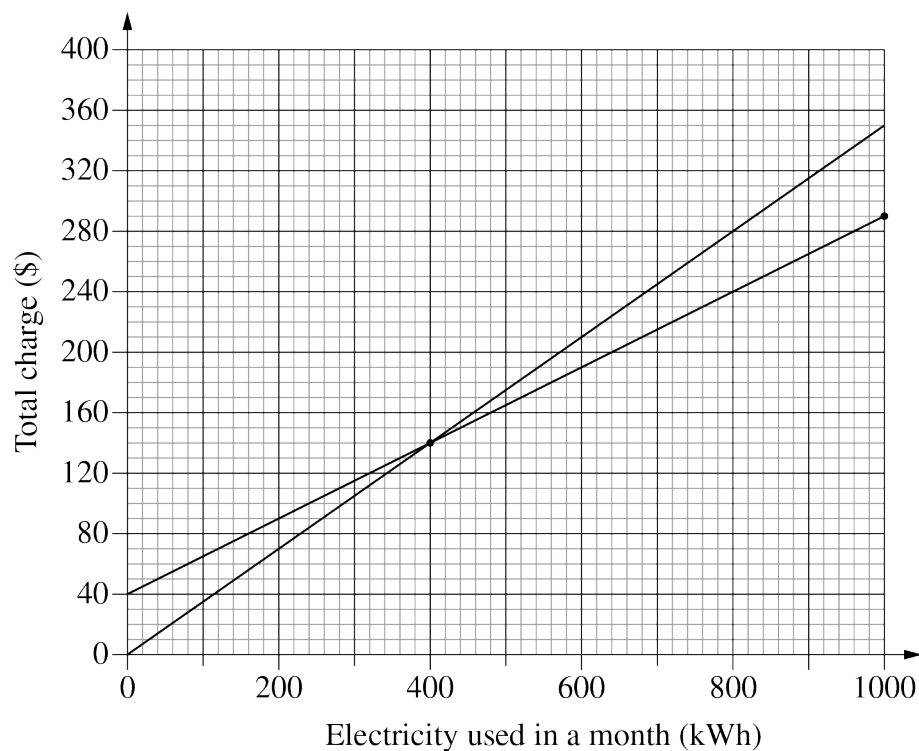| Criteria	Marks
• Completes the table correctly	1

Sample answer:

Electricity used in a month (kWh)	0	400	1000
Monthly charge ($)	40	**140**	290

Question 21 (b)

Criteria	Marks
• Graphs Provider A's charges	1

Sample answer:

Question 21 (c)

Criteria	Marks
• Provides correct answer	1

Sample answer:

They charge the same amount at 400 kWh.

Question 21 (d)

Criteria	Marks
• Provides correct solution	2
• Demonstrates some progress towards identifying the cheaper option, or equivalent merit	1

Sample answer:

Provider *B* at 800 kWh charges $280

Provider *A* at 800 kWh charges $240

∴ Provider *A* would be the cheaper option by $40.

Question 22 (a)

Criteria	Marks
• Provides correct solution	2
• Correctly substitutes values into the formula, or equivalent merit	1

Sample answer:

$$\text{Braking distance} = k \times (\text{speed})^2$$
$$20 = k \times (50)^2$$
$$k = \frac{20}{(50)^2}$$
$$k = 0.008$$

Question 22 (b)

Criteria	Marks
• Provides correct answer	1

Sample answer:

$$\text{Braking distance} = k \times (\text{speed})^2$$
$$= 0.008 \times 90^2$$
$$= 64.8 \text{ m}$$

Question 23

Criteria	Marks
• Provides correct answer	2
• Calculates the probability that Hazel wins the first prize, or equivalent merit	1

Sample answer:

$$P(\text{wins both prizes}) = \frac{5}{100} \times \frac{4}{99}$$
$$= \frac{20}{9900}$$
$$= \frac{1}{495}$$

Question 24 (a)

Criteria	Marks
• Provides correct solution	2
• Attempts to use the trapezoidal rule	1

Sample answer:

$$A = \frac{4.0}{2}(1.9 + 2.7) + \frac{4.0}{2}(2.7 + 1.7)$$

$$= 18 \text{ m}^2$$

Question 24 (b)

Criteria	Marks
• Provides correct solution to two significant figures	3
• Provides the weight of concrete (unrounded), or equivalent merit	2
• Provides the volume of the wall, or equivalent merit	1

Sample answer:

$$V = 18 \times 0.8$$

$$= 14.4 \text{ m}^3$$

$$\text{Tonnes of concrete } = 14.4 \times 3.52 \text{ tonnes}$$
$$= 50.688 \text{ tonnes}$$
$$= 51 \text{ tonnes} \qquad \text{(2 significant figures)}$$

Question 25 (a)

Criteria	Marks
• Provides correct solution	2
• Identifies the correct factor from the table	1

Sample answer:

$$\text{Amount} = \frac{\$450\,000}{13.181}$$

$$= \$34\,140 \qquad \text{(to the nearest dollar)}$$

Question 25 (b)

Criteria	Marks
• Provides correct solution	3
• Provides the correct interest rate and the correct number of periods, or equivalent merit	2
• Multiplies a factor from the table by $8535, or equivalent merit	1

Sample answer:

$$r = \frac{6}{4}\%$$

$$= 1.5\%$$

$$n = 10 \times 4$$

$$= 40$$

$$\text{Amount} = \$8535 \times 54.268$$

$$= \$463\,177.38$$

Question 26 (a)

Criteria	Marks
• Calculates the correct area of the path	2
• Attempts to calculate the area of the path, or equivalent merit	1

Sample answer:

Area of path $\quad = (3\text{ m} \times 8\text{ m}) - (7\text{ m} \times 2.5\text{ m})$
$\qquad\qquad = 6.5\text{ m}^2$

Question 26 (b)

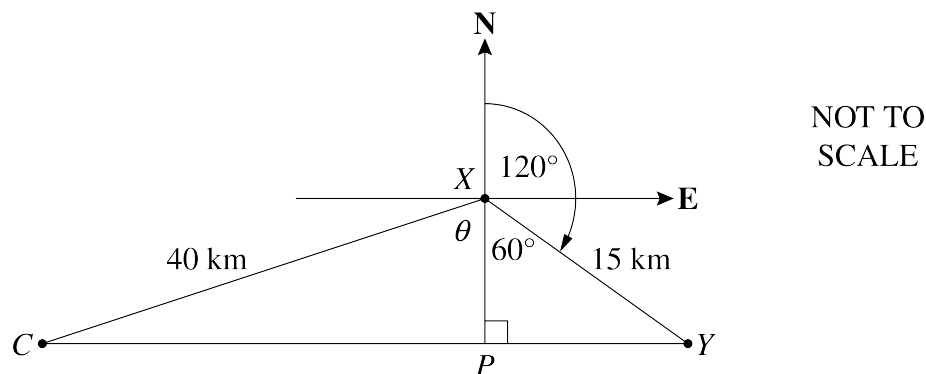| Criteria	Marks
• Calculates the number of bags of cement required	3
• Calculates the weight of cement required, or equivalent merit	2
• Identifies the proportion of cement in the mixture, or equivalent merit	1

Sample answer:

R   S   C
4 : 2 : 1

Amount of cement $= \dfrac{1}{7} \times 2.1$ tonnes

$\qquad\qquad\qquad = 0.3$ tonnes

$\qquad\qquad\qquad = 300$ kg

Number of bags $\quad = \dfrac{300}{15}$

$\qquad\qquad\qquad = 20$ bags

Question 27 (a)

Criteria	Marks
• Provides the correct solution	2
• Identifies an angle in triangle *PXY*, or equivalent merit	1

Sample answer:

$\angle PXY = 180° - 120°$

$\qquad = 60°$

$XP = 15 \text{ km} \times \cos 60°$

$\quad = 7.5 \text{ km}$

Question 27 (b)

Criteria	Marks
• Provides the correct solution	2
• Calculates one of the acute angles in the triangle *CXP*, or equivalent merit	1

Sample answer:

Let $\theta = \angle CXP$

$\cos\theta = \dfrac{7.5}{40}$

$\theta = 79°12'$

$\therefore$ Bearing of $C = 180° + 79°12'$

$\qquad\qquad\qquad = 259°12'$

$\qquad\qquad\qquad = 259°$ (to the nearest degree)

Question 28

Criteria	Marks
• Provides the correct solution	3
• Correctly calculates the salvage value using the declining-balance method, or equivalent merit	2
• Attempts to calculate the salvage value using the declining-balance method, or equivalent merit	1

Sample answer:

Straight-line method:
$$S = V_0 - D_n$$
$$= \$60\,000 - \$3500 \times 3$$
$$= \$49\,500$$

Declining-balance method:
$$S = V_0(1 - r)^n$$
$$= \$60\,000\,(1 - 12\%)^3$$
$$= \$60\,000\,(0.88)^3$$
$$= \$40\,888.32$$

$\therefore$ Declining-balance method would provide a lower salvage value.

Question 29 (a)

Criteria	Marks
• Provides correct solution	3
• Calculates the monthly repayment, or equivalent merit	2
• Identifies the correct factor from the table, or equivalent merit	1

Sample answer:

Amount repaid per month $= (\$520\,000 \div 1000) \times 7.72$

$= \$4014.40$

Total amount repaid $= \$4014.40 \times 12 \times 25$

$= \$1\,204\,320$

Question 29 (b)

Criteria	Marks
• Provides correct answer	1

Sample answer:

Amount borrowed $= (\$3596 \div 8.99) \times 1000$

$= \$400\,000$

Question 30

Criteria	Marks
• Provides the correct solution	3
• Calculates the difference between the total and the amount on which GST is charged, or equivalent merit	2
• Calculates the amount on which GST is charged, or equivalent merit	1

Sample answer:

$$10\% \times n = 3.86$$
$$n = \$38.60$$

$$\text{Value of goods without GST} = \$124.87 - \$38.60 - \$3.86$$
$$= \$82.41$$

Question 31 (a)

Criteria	Marks
• Correctly identifies TWO critical paths	2
• Identifies a critical path, or equivalent merit	1

Sample answer:

Critical paths are H, I, G, C and
H, I, K

Question 31 (b)

Criteria	Marks
• Provides correct answer	2
• Shortens a task on the critical path by 3 hours, or equivalent merit	1

Sample answer:

Decrease one task by 3 hours.

H and I are common.

H is only 2 hours.

So task I should take 4 hours.

Question 32 (a)

Criteria	Marks
• Provides correct answer	2
• Substitutes some correct values into the compound interest formula, or equivalent merit	1

Sample answer:

$$\text{Full amount on card } = \$450\left(1 + \frac{13.5}{365}\%\right)^{21}$$

$$= \$453.51$$

$$\therefore \text{ Interest charged } = \$453.51 - \$450$$

$$= \$3.51$$

Question 32 (b)

Criteria	Marks
• Provides correct percentage	2
• Attempts to do a percentage calculation, or equivalent merit	1

Sample answer:

$$\text{Percentage } = \frac{\$3.51}{\$453.51} \times 100$$

$$= 0.77\%$$

Question 33

Criteria	Marks
• Provides correct solution	4
• Calculates the arc length AND the length of line segment *PQ*, or equivalent merit	3
• Calculates the arc length OR the length of line segment *PQ*, or equivalent merit	2
• Attempts to calculate the perimeter of the shape by adding some appropriate portions, or equivalent merit	1

Sample answer:

$$\text{Arc length } PQ = \frac{110}{360} \times 2 \times \pi \times 2.1$$

$$= 4.03171\ldots$$

$$\text{Length } PQ = \sqrt{2.1^2 + 2.1^2 - 2 \times 2.1 \times 2.1 \times \cos 110°}$$

$$= 3.4404\ldots$$

$$\text{Total perimeter} = (3.6 \times 2) + 8.0 + (8.0 - 3.4404) + 4.0317$$

$$= 23.7913$$

$$= 23.8 \text{ m}$$

Question 34 (a)

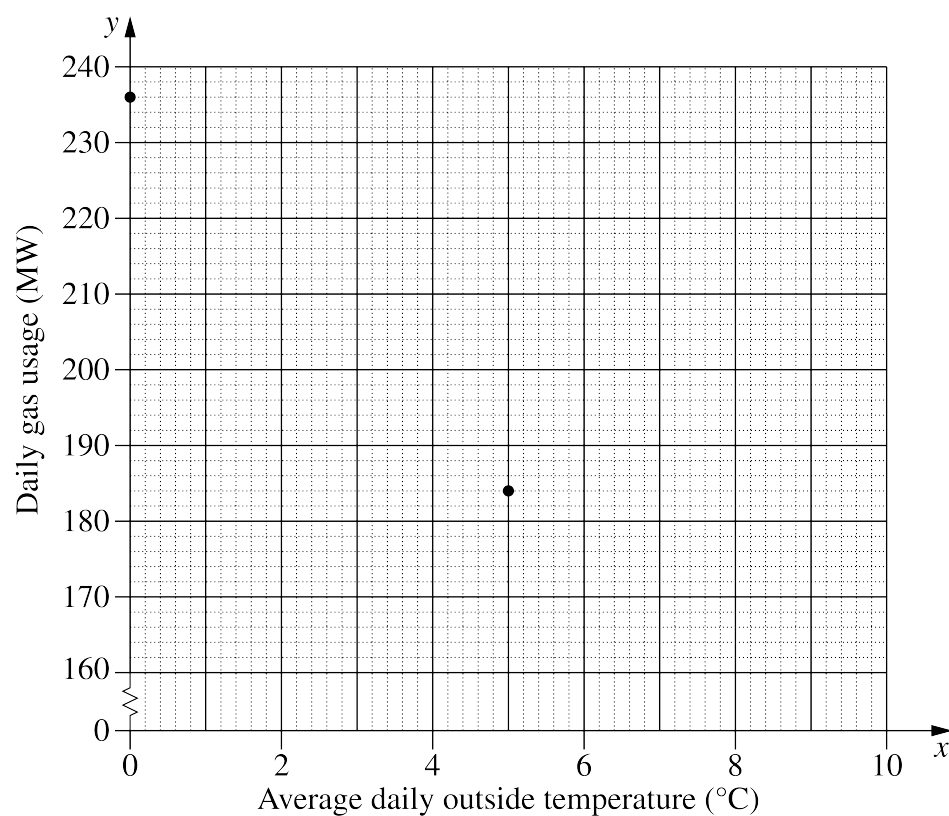| Criteria	Marks
• Correctly plots both points on the graph	3
• Calculates $\bar{x}$ and $\bar{y}$, and plots this point on the grid, or equivalent merit	2
• Calculates $\bar{x}$ or $\bar{y}$, or equivalent merit	1

Sample answer:

$$\bar{x} = \frac{0+0+0+2+5+7+8+9+9+10}{10}$$

$$= 5$$

$$\bar{y} = \frac{1840}{10}$$

$$= 184$$

$$\therefore \left(\bar{x}, \bar{y}\right) = (5, 184)$$

Question 34 (b)

Criteria	Marks
• Provides correct solution	2
• Finds the slope of the regression line, or equivalent merit	1

Sample answer:

Slope of regression line $= \dfrac{184 - 236}{5}$

$\qquad\qquad\qquad\qquad\quad = -10.4$

Gas usage $= 236 - 10.4 \times$ temperature

ie $y = 236 - 10.4x$

Question 34 (c)

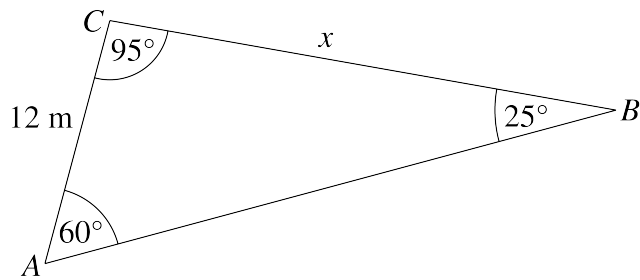| Criteria	Marks
• Identifies one problem with predicting using the regression line	1

Sample answer:

When temperature is 23°C, the regression equation provides a negative answer, which is not physically possible (negative gas usage).

Question 35

Criteria	Marks
• Finds correct solution	3
• Uses the sine rule to find a missing side, or equivalent merit	2
• Attempts to use the sine rule, or equivalent merit	1

Sample answer:

$$\frac{x}{\sin 60°} = \frac{12}{\sin 25°}$$

$$x = \frac{12 \times \sin 60°}{\sin 25°}$$

$$x = 24.59$$

$$\text{Area} = \frac{1}{2} ab \sin C$$

$$= \frac{1}{2} \times 12 \times 24.59 \times \sin 95°$$

$$= 146.98 \text{ m}^2$$

$$= 147 \text{ m}^2 \quad (\text{to nearest m}^2)$$

Question 36

Criteria	Marks
• Provides correct solution	4
• Finds the correct value of H	3
• Attempts to solve for H	2
• Substitutes values into the *BAC* formula, or equivalent merit	1

Sample answer:

$$BAC_{male} = \frac{10N - 7.5H}{6.8M}$$

$$0.02 = \frac{(10 \times 3) - (7.5 \times H)}{(6.8 \times 75)}$$

$$10.2 = 30 - (7.5 \times H)$$

$$H = \frac{30 - 10.2}{7.5}$$

$$H = 2.64 \text{ hours}$$

$$H = 2 \text{ h } 38 \text{ min}$$

9:00 pm − 2 h 38 min = 6:22 pm

∴ Cameron began drinking at 6:22 pm.

Question 37

Criteria	Marks
• Provides correct solution	3
• Finds the amount to which *X* cents applies, or equivalent merit	2
• Calculates 25.8% of 90 000, or equivalent merit	1

Sample answer:

$\$90\,000 \times 25.8\% = \$23\,220$

$\text{Amount over } \$78\,800 = \$90\,000 - \$78\,800$

$\qquad\qquad\qquad\quad = \$11\,200$

$\text{Additional tax paid for amount over } \$78\,800 = \$23\,220 - \$18\,292$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad = \$4928$

$\$11\,200 \times \boxed{X} = \$4928$

$\boxed{X} = \dfrac{\$4928}{\$11\,200}$

$\boxed{X} = \$0.44$

$\therefore X = 44 \text{ cents}$

Question 38

Criteria	Marks
• Provides correct solution	4
• Finds the correct proportion of the group of koalas, or equivalent merit	3
• Finds the correct probability from the table, or equivalent merit	2
• Calculates the correct *z* value, or equivalent merit	1

Sample answer:

$$z = \frac{x - \mu}{\sigma}$$

$$= \frac{11.93 - 10.40}{1.15}$$

$$= 1.33 \qquad \text{(2 decimal places)}$$

$\therefore$ Probability from table $= 0.9082$

$P(\text{more than } 11.93) = 1 - 0.9082$
$$= 0.0918$$

Number of koalas $= 0.0918 \times 400$
$$= 36.72$$
$$= 36 \qquad \text{(accept 37 as well)}$$

2023 HSC Mathematics Standard 2 Mapping Grid

Section I

Question	Marks	Content		Syllabus outcomes
1	1	MS-F1	Money Matters	MS11-5
2	1	MS-S5	The Normal Distribution	MS2-12-7
3	1	MS-S4	Bivariate Data Analysis	MS2-12-2
4	1	MS-F1	Money Matters	MS11-10
5	1	MS-M7	Rates and Ratios	MS2-12-10
6	1	MS-F1	Money Matters	MS11-10
7	1	MS-M2	Working with Time	MS11-4
8	1	MS-S2	Relative Frequency and Probability	MS11-8
9	1	MS-M1	Applications of Measurement	MS11-3
10	1	MS-F4	Investments and Loans	MS2-12-5
11	1	MS-M7	Rates and Ratios	MS2-12-3
12	1	MS-M1	Applications of Measurement	MS11-3
13	1	MS-F1	Money Matters	MS11-5
14	1	MS-N3	Critical Path Analysis	MS2-12-10
15	1	MS-S1	Data Analysis	MS11-7

Section II

Question	Marks	Content		Syllabus outcomes
16 (a)	1	MS-M7	Rates and Ratios	MS2-12-3
16 (b)	1	MS-M7	Rates and Ratios	MS2-12-3
17 (a)	2	MS-N2	Network Concepts	MS2-12-8
17 (b)	1	MS-N2	Network Concepts	MS2-12-8
18	2	MS-S5	The Normal Distribution	MS2-12-10
19 (a)	2	MS-N2	Network Concepts	MS2-12-8
19 (b)	2	MS-N2	Network Concepts	MS2-12-8
20 (a)	1	MS-A4	Types of Relationships	MS2-12-6
20 (b)	2	MS-A4	Types of Relationships	MS2-12-6
21 (a)	1	MS-A4	Types of Relationships	MS2-12-6
21 (b)	1	MS-A4	Types of Relationships	MS2-12-6
21 (c)	1	MS-A4	Types of Relationships	MS2-12-6
21 (d)	2	MS-A4	Types of Relationships	MS2-12-10
22 (a)	2	MS-A4	Linear Relationships	MS2-12-6
22 (b)	1	MS-A4	Linear Relationships	MS2-12-6
23	2	MS-S2	Relative Frequency and Probability	MS11-8
24 (a)	2	MS-M1	Applications of Measurement	MS11-4
24 (b)	3	MS-M1	Applications of Measurement	MS11-3

Question	Marks	Content		Syllabus outcomes
25 (a)	2	MS-F5	Annuities	MS2-12-5
25 (b)	3	MS-F5	Annuities	MS2-12-5
26 (a)	2	MS-M1	Applications of Measurement	MS11-4
26 (b)	3	MS-M7	Rates and Ratios	MS2-12-10
27 (a)	2	MS-M6	Non-right-angled Trigonometry	MS2-12-4
27 (b)	2	MS-M6	Non-right-angled Trigonometry	MS2-12-4
28	3	MS-F4	Investments and Loans	MS2-12-10
29 (a)	3	MS-F4	Investments and Loans	MS2-12-5
29 (b)	1	MS-F4	Investments and Loans	MS2-12-5
30	3	MS-F1	Money Matters	MS11-5
31 (a)	2	MS-N3	Critical Path Analysis	MS2-12-10
31 (b)	2	MS-N3	Critical Path Analysis	MS2-12-10
32 (a)	2	MS-F4	Investments and Loans	MS2-12-5
32 (b)	2	MS-F4	Investments and Loans	MS2-12-9
33	4	MS-M1 MS-M6	Applications of Measurement Non-right-angled Trigonometry	MS2-12-4
34 (a)	3	MS-S4	Bivariate Data Analysis	MS2-12-2
34 (b)	2	MS-S4	Bivariate Data Analysis	MS2-12-2
34 (c)	1	MS-S4	Bivariate Data Analysis	MS2-12-10
35	3	MS-M6	Non-right-angled Trigonometry	MS2-12-4
36	4	MS-A1	Formulae and Equations	MS11-6
37	3	MS-F1	Money Matters	MS11-6
38	4	MS-S5	The Normal Distribution	MS2-12-7