Neap

Final Examination 2023

NSW Year 11 Mathematics Standard

Solutions and Marking Guidelines

SECTION I

Answer and explanation	Syllabus content, outcomes and targeted performance bands
Question 1 **B** Superannuation is deducted directly from an individual's gross pay and paid into their superannuation fund for retirement. It is not an allowable tax deduction.	MS–F1 Money Matters MS11–5 Bands 1–2
Question 2 **A** The sample space defines the set of possible outcomes in a chance experiment. There are three different colours that can be obtained when this 20-sided die is rolled. Therefore, the sample space is {blue, red, yellow} and contains three elements.	MS–S2 Relative Frequency and Probability MS11–8 Bands 1–2
Question 3 **C** **C** is correct. The mode is the most common score; it is never affected by the removal of an outlier because outliers are positioned at each end of the data set. **A** is incorrect. The mean will be affected as it is calculated by adding each score in the data set, then dividing by the total number of scores. If the outlier is removed, these values would change. **B** is incorrect. The median could be affected as the removal of the outlier may cause the position of the middle score(s) to shift slightly. **D** is incorrect. The range will be affected as it is calculated by finding the difference between the highest and lowest scores. In this scenario, the removal of the outlier (40) would cause the lowest score to become 71, which would significantly alter the range.	MS–S1 Data Analysis MS11–7 Bands 1–2
Question 4 **C** Using the straight-line method of depreciation formula gives: $S = V_0 - Dn$ $3000 = V_0 - 750 \times 7$ $3000 = V_0 - 5250$ $V_0 = 8250$	MS–F1 Money Matters MS11–5 Bands 2–3
Question 5 **C** Each 15° of longitude represents a 1-hour difference in time. Coordinated Universal Time (UTC) is calculated from the 0° longitude (that is, UTC+0) and locations west of this point are behind in time. The city's longitude is 135°W, which means it is $\frac{135°}{15°} = 9$ hours behind UTC+0. Therefore, the UTC of this city is UTC–9.	MS–M2 Working with Time MS11–3 Bands 2–3

Answer and explanation	Syllabus content, outcomes and targeted performance bands
Question 6 A The total amount of tax Claire owes to the Australian Taxation Office is the sum of the income tax and Medicare levy. PAYG is the amount of money that Claire's employer has already paid to the Australian Taxation Office on her behalf. Finding the difference between the total amount of tax and the PAYG paid gives: ($5472 + $465) – $5612 = $325 As the amount of tax due is greater than the amount of PAYG paid, Claire still owes the Australian Taxation Office $325.	MS–F1 Money Matters MS11–5 Bands 2–3
Question 7 C Given that the rectangular picture frame has a length twice its width, $l = 2w$. The perimeter is 48 cm, so $P = 48$. Substituting these values into the formula gives: $P = 2l + 2w$ $48 = 2 \times 2w + 2w$ $48 = 4w + 2w$ $48 = 6w$ $w = 8$ Substituting $w = 8$ into $l = 2w$ to find the length of the frame gives: $l = 2w$ $= 2 \times 8$ $= 16$ cm	MS–A1 Formulae and Equations MS11–1 Bands 2–3
Question 8 D Andy's wage can be calculated by finding the difference between the 'total earned' from any two rows of the table; for example, between 4:00 pm and 6:00 pm, he earned $72 – $48 = $24. As this occurred over two hours, it equates to an hourly wage of $\frac{24}{2} = \$12$. Byron's wage can be calculated using the equation $p = 24t$, which is a linear relationship with a gradient of 24. In this case, the gradient represents the amount of money paid for each hour worked. This means Byron's hourly wage is $24. Therefore, Andy's hourly wage is half of Byron's hourly wage.	MS–A2 Linear Relationships MS11–1 Bands 3–4

Answer and explanation	Syllabus content, outcomes and targeted performance bands
Question 9 **B** A cube is made up of six square faces. If each square has the side length s, the surface area of the cube can be represented by the equation SA = $6s^2$. Substituting SA = 121.5 gives: $121.5 = 6s^2$ $20.25 = s^2$ $s = \sqrt{20.25}$ $s = 4.5$ m	MS–M1 Applications of Measurement MS11–4 Bands 3–4
Question 10 **C** Finding the 4-day mean gives: $\frac{126+113+130+135}{4} = 126$ Finding the 5-day mean gives: $\frac{126+113+130+135+116}{5} = 124$ Therefore, the 5-day mean has decreased by 2.	MS–S1 Data Analysis MS11–7 Bands 3–4
Question 11 **C** The graph line has a negative gradient. Two points that lie on the line are (0, 7) and (2, 4). $\text{gradient} = \frac{\text{rise}}{\text{run}}$ $= -\frac{3}{2}$	MS–A2 Linear Relationships MS11–2 Bands 3–4
Question 12 **D** The principal is x. The interest rate is 4% or 0.04. The term of the loan is 18 months or 1.5 years. Substituting these values into the simple interest formula gives: $I = Prn$ $= x \times 0.04 \times 1.5$ The total amount Luka owes is the principal plus the interest charged by the lender. Therefore, the total amount owed is $\$(x + (x \times 0.04 \times 1.5))$.	MS–F1 Money Matters MS11–5 Bands 4–5

Answer and explanation	Syllabus content, outcomes and targeted performance bands
Question 13 **B** If the pyramid's base is a square with edges measuring b units, $A = b^2$. Substituting $b = 2h$ gives: $A = (2h)^2$ $= 2h \times 2h$ $= 4h^2$ Substituting $A = 4h^2$ into $V = \frac{1}{3}Ah$ gives: $V = \frac{1}{3} \times 4h^2 \times h$ $= \frac{4}{3}h^3$	MS–A1 Formulae and Equations MS11–1 Bands 5–6
Question 14 **B** Using Pythagoras' theorem, the hypotenuse of the right-angled triangle is $\sqrt{6^2 + 8^2} = 10$. In this instance, the hypotenuse of the triangle is also the diameter of the circle. Therefore: $c = \pi d$ $= 10\pi$ $= 31.4159$ ≈ 31 cm	MS–M1 Applications of Measurement MS11–3 Bands 5–6

Answer and explanation	Syllabus content, outcomes and targeted performance bands
Question 15 **A** An array can be used to visualise the sample space. The outcomes that correspond to each option are shown below.	MS–S2 Relative Frequency and Probability MS11–8 Bands 5–6

	1	*2*	*3*	*4*	*5*	*6*
1	C	B	D	A, B	–	B
2	B	C	A, B	D	B	–
3	D	A, B	C	B	D	B
4	A, B	D	B	C	B	D
5	–	B	D	B	C	B
6	B	–	B	D	B	C

Finding the probability of option **A** gives:

$$\begin{aligned} P(\text{sum of 5}) &= \frac{4}{36} \\ &= \frac{1}{9} \\ &= 11.1\% \end{aligned}$$

Finding the probability of option **B** gives:

$$\begin{aligned} P(\text{one odd, one even}) &= \frac{18}{36} \\ &= \frac{1}{2} \\ &= 50\% \end{aligned}$$

Finding the probability of option **C** gives:

$$\begin{aligned} P(\text{same number}) &= \frac{6}{36} \\ &= \frac{1}{6} \\ &= 16.6\% \end{aligned}$$

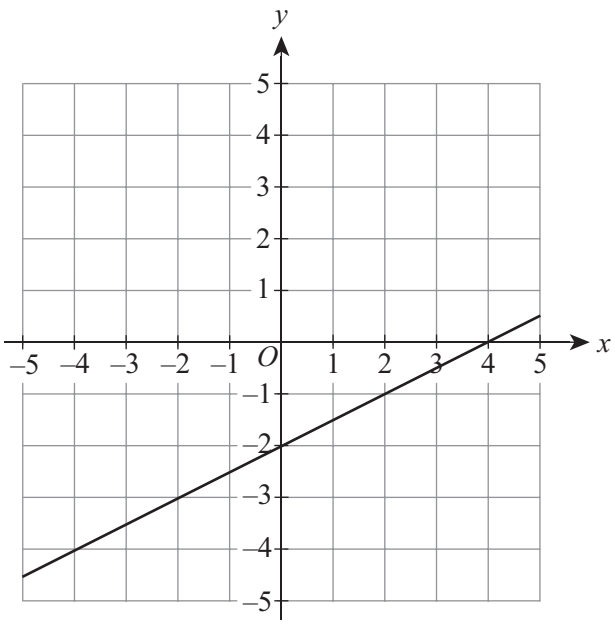
Finding the probability of option **D** gives:

$$\begin{aligned} P(\text{differ by 2}) &= \frac{8}{36} \\ &= \frac{2}{9} \\ &= 22.2\% \end{aligned}$$

SECTION II

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 16	
Since Seiya has had two claim-free years, he is eligible for a 6% discount on his insurance premium. fortnightly savings $= 0.06 \times \$76.81$ $= \$4.6086$ annual savings $= \$4.6086 \times 26$ $\approx \$119.82$	MS–F1 Money Matters MS11–5 Bands 1–2 • Provides the correct solution . . . . . 2 • Calculates the fortnightly savings . . 1
Question 17	
(a) 3.795×10^3 is written in scientific notation.	MS–M1 Applications of Measurement MS11–3 Bands 1–2 • Provides the correct solution 1
(b) $\frac{3.795 \times 10^3}{1000} = 3.795$ km 3.795 km $\approx$ 4 km	MS–M1 Applications of Measurement MS11–3 Bands 2–3 • Provides the correct solution . . . . . 2 • Converts the measurement into kilometres without rounding to one significant figure 1
Question 18	
(a) City *A* is ahead in time.	MS–M2 Working with Time MS11–3 Bands 1–2 • Provides the correct solution 1
(b) Given that city *B* has a time difference of 5 hours, the difference in longitude is $15° \times 5 = 75°$. City *B* lies to the west of City *A*; therefore, its longitude is $20° + 75° = 95°$W.	MS–M2 Working with Time MS11–3 Bands 2–3 • Provides the correct solution . . . . . 2 • Calculates the difference in longitude 1
Question 19	
(a) annual cost $= 384 \times \$0.3221$ $= \$123.69$	MS–M1 Applications of Measurement MS11–3 Bands 1–2 • Provides the correct solution 1

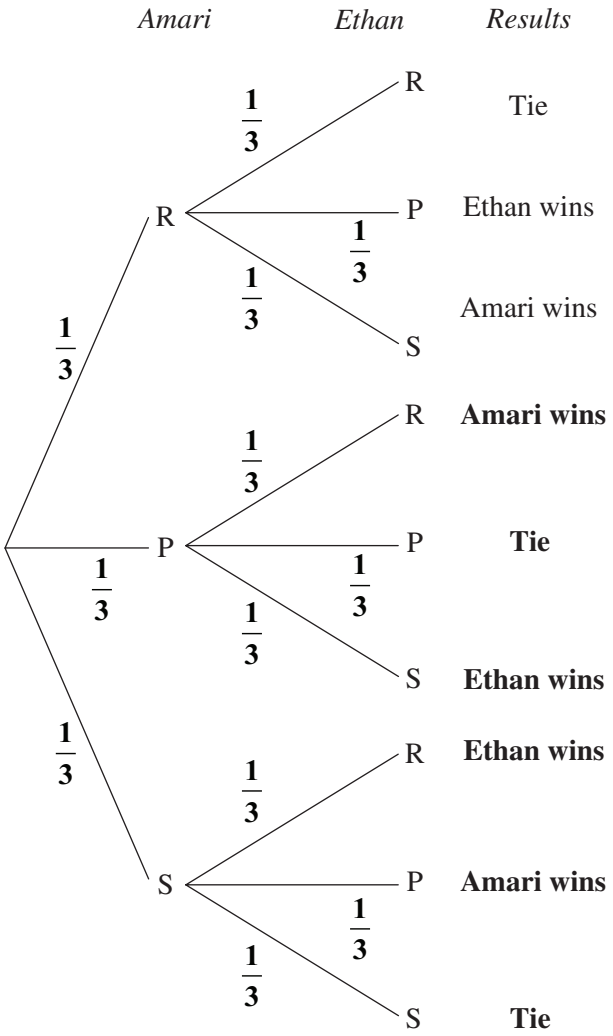
Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
(b) **Method 1:** difference in energy consumption $= 384 - 153$ $= 231$ kWh cost of difference $= 231 \times \$0.3221$ $= \$74.41$ percent decrease $= \dfrac{74.41}{123.69} \times 100\%$ $\approx 60\%$ *Note: Consequential on answer to **Question 19(a)**.* **Method 2:** Calculating the percentage decrease in energy consumption gives: percentage decrease $= \dfrac{231}{384} \times 100\%$ $\approx 60\%$	MS–M1 Applications of Measurement MS11–3 Bands 2–3 • Provides the correct solution . . . . . 2 • Provides some relevant working . . . 1
Question 20	
(a) weekly income $= \dfrac{3998.40 \times 12}{52}$ $= \$922.71$	MS–F1 Money Matters MS11–5 Bands 2–3 • Provides the correct solution 1
(b) **Method 1:** annual leave loading $= 0.175 \times (4 \times \$922.71)$ $= \$645.90$ total holiday pay $= (4 \times \$922.71) + \$645.90$ $= \$4336.74$ **Method 2:** total holiday pay $= 1.175 \times (4 \times \$922.71)$ $= \$4336.74$ *Note: Consequential on answer to **Question 20(a)**.*	MS–F1 Money Matters MS11–5 Bands 2–3 • Provides the correct solution . . . . . 2 • Provides some relevant working . . . 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 21	
(a) $\text{gradient} = \frac{1}{2}$ y-intercept $= -2$	MS–A2 Linear Relationships MS11–2 Bands 1–2 • Identifies the gradient AND y-intercept . . . . . 2 • Identifies the gradient OR y-intercept 1
(b) 	MS–A2 Linear Relationships MS11–2 Bands 2–3 • Provides the correct solution . . . . . 2 • Sketches a line with the correct gradient OR y-intercept 1
(c) For the line to be twice as steep, the gradient must be doubled. Therefore: $m = 2 \times \frac{1}{2}$ $= 1$ As the y-intercept is –2, the equation of the line is $y = x - 2$.	MS–A2 Linear Relationships MS11–2 Bands 2–3 • Provides the correct solution 1
(d) The equation found in part (c) does not represent direct variation as it does not pass through the origin (0, 0). *Note: Consequential on answer to* ***Question 21(c)****.*	MS–A2 Linear Relationships MS11–10 Bands 2–3 • Determines that the equation does not represent direct variation 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 22	
Method 1: Let the original cost of the sneakers be x. $\$112.50 = 125\% \times x$ $x = \dfrac{112.50}{125\%}$ $= \$90$ **Method 2:** Using the unitary method gives: $\$112.50 = 125\%$ $\dfrac{\$112.50}{125} = 1\%$ $100\% = \dfrac{\$112.50}{125} \times 100$ $= 90$	MS–F1 Money Matters MS11–5 Bands 3–4 • Provides the correct solution . . . . . 2 • Determines that \$112.50 is 125% of the original cost 1
Question 23	
(a) $\text{surface area} = \dfrac{250}{2}(240 + 310) + \dfrac{250}{2}(310 + 0)$ $= 107\ 500\ \text{m}^2$	MS–M1 Applications of Measurement MS11–4 Bands 3–4 • Provides the correct solution . . . . . 2 • Provides some relevant working . . . 1
(b) $\text{volume} = 107\ 500 \times 0.8$ $= 86\ 000\ \text{m}^3$ As 1 m^3 = 1 kL, the capacity of the pond is 86 000 kL.	MS–M1 Applications of Measurement MS11–4 Bands 4–5 • Provides the correct solution . . . . . 2 • Calculates the volume of the pond without converting the depth of the pond into metres 1
Question 24	
(a) numerical data	MS–S1 Data Analysis MS11–7 Bands 1–2 • Provides the correct solution 1
(b) negatively skewed	MS–S1 Data Analysis MS11–7 Bands 1–2 • Provides the correct solution 1

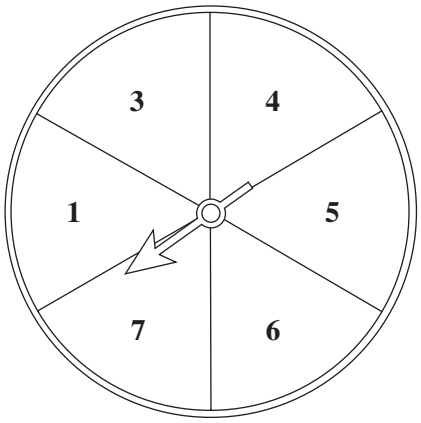
	Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
(c)	five-number summary: {210, 250, 370, 420, 490} $\text{interquartile range (IQR)} = 420 - 250$ $= 170$	MS–S1 Data Analysis MS11–7 Bands 2–3 • Finds the five-number summary AND the IQR . . . . . 2 • Finds the five-number summary OR the IQR 1
(d)	The lower quartile is 250; therefore, 75% of the muffins contain more than 250 calories. 75% × 20 = 15 muffins	MS–S1 Data Analysis MS11–7 Bands 3–4 • Provides the correct solution 1
(e)	**Method 1:** $\text{energy in the muffin} = 490 \times 4.184$ $= 2050.16 \text{ kJ}$ $\text{energy burned by Gavin in an hour} = 60 \times 21 \times 2$ $= 2520 \text{ kJ/h}$ $\text{hours of jogging} = \dfrac{\text{energy in muffin}}{\text{energy burned by Gavin}}$ $= \dfrac{2050.16}{2520}$ $= 0.8135$ $\text{number of minutes} = 0.8135 \times 60$ ≈ 49 **Method 2:** $\text{energy burned by Gavin per minute} = \dfrac{60 \times 21}{30}$ $= 42 \text{ kJ/min}$ $\text{energy in the muffin} = 490 \times 4.184$ $= 2050.16 \text{ kJ}$ $\text{minutes of jogging} = \dfrac{\text{energy in muffin}}{\text{energy burned by Gavin}}$ $= \dfrac{2050.16}{42}$ ≈ 49	MS–M1 Applications of Measurement MS11–3 Bands 4–5 • Provides the correct solution . . . . . 3 • Calculates the energy contained in the muffin and Gavin's rate of energy burn . . . . . 2 • Provides some relevant working . . . 1

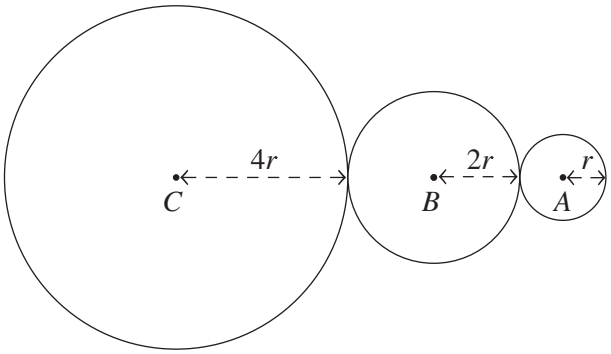
Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 25	
(a) $A = \pi rs + \pi r^2$ $A - \pi r^2 = \pi rs$ $s = \dfrac{A - \pi r^2}{\pi r}$	MS–A1 Formulae and Equations MS11–1 Bands 4–5 • Provides the correct solution . . . . . 2 • Moves πr^2 to the other side of the equation 1
(b) $s = \dfrac{A - \pi r^2}{\pi r}$ $= \dfrac{270 - \pi \times 4.8^2}{\pi \times 4.8}$ ≈ 13.1 cm *Note: Consequential on answer to* ***Question 25(a)****.*	MS–A1 Formulae and Equations MS11–1 Bands 1–2 • Substitutes into the formula obtained in part (a). 1
Question 26	
(a) Substituting the point (15, 27) into the equation gives: $C = kF$ $27 = k \times 15$ $k = \dfrac{27}{15}$ $= 1.8$	MS–A2 Linear Relationships MS11–2 Bands 3–4 • Provides the correct solution 1
(b) k is the constant of proportionality (gradient); in this context, it represents the cost of fuel per litre.	MS–A2 Linear Relationships MS11–10 Bands 4–5 • Provides the correct explanation . . . 1
(c) $C = 1.8F$ $54 = 1.8F$ $F = \dfrac{54}{1.8}$ $= 30$ L *Note: Consequential on answer to* ***Question 26(a)****.*	MS–A1 Formulae and Equations MS11–1 Bands 1–2 • Provides the correct solution 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 27	
(a) 	MS–S2 Relative Frequency and Probability MS11–8 Bands 2–3 • Provides the correct solution . . . . . 2 • Completes some parts of the probability tree. 1
(b) RP, PS, SR	MS–S2 Relative Frequency and Probability MS11–10 Bands 1–2 • Provides the correct solution 1
(c) Finding the probability that Ethan wins gives: $P(\text{RP, PS, SR}) = \left(\frac{1}{3}\times\frac{1}{3}\right)+\left(\frac{1}{3}\times\frac{1}{3}\right)+\left(\frac{1}{3}\times\frac{1}{3}\right)$ $=\frac{1}{3}$ Therefore: $\text{expected number of wins} = \frac{1}{3}\times 30$ $=10$	MS–S2 Relative Frequency and Probability MS11–8 Bands 2–3 • Provides the correct solution . . . . . 2 • Calculates the probability of Ethan winning 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 28	
(a) Converting the interest rate of 3.5% into a decimal gives 0.035; thus, $r = 0.035$. Taj's deposit remains in the account for five years; thus, $t = 5$. Interest is compounded every three months, which is four times per year; thus, $n = 4$. Substituting these values into the formula gives: $A = 1000\left(1 + \frac{0.035}{4}\right)^{4\times5}$ $= \$1190.34$ $\text{interest earned} = \$1190.34 - \$1000$ $= \$190.34$	MS–A1 Formulae and Equations MS11–1 Bands 4–5 • Provides the correct solution . . . . . 3 • Demonstrates that interest is the difference between the amount of money in the account and the principal. OR • Substitutes the correct values of r, t and n into the formula . . . . . 2 • Provides some relevant working . . . 1
(b) $I = \$190.34$ $P = \$1000$ $n = 5$ Substituting these values into the simple interest formula $I = Prn$ gives: $190.34 = 1000 \times r \times 5$ $r = \frac{190.34}{5000}$ $\approx 0.038\ldots$ $= 3.8\%$ *Note: Consequential on answer to* ***Question 28(a)****.*	MS–F1 Money Matters MS11–5 Bands 4–5 • Provides the correct solution 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 29	
(a) volume of original juice box $= 2.5 \times 5 \times 16$ $= 200 \text{ cm}^3$ volume of new juice box $= 200 \times 120\%$ $= 240 \text{ cm}^3$ Let the new juice box's height be h. $240 = 2.5 \times 5 \times h$ $240 = 12.5h$ $h = \frac{240}{12.5}$ $= 19.2$ Therefore, the new product's height will be 19.2 cm.	MS–M1 Applications of Measurement MS11–4 Bands 4–5 • Provides the correct solution . . . . . 3 • Calculates the volume of the new juice box . . . . . 2 • Calculates the volume of the original juice box 1
(b) As 1 cm^2 = 1 mL, there is 240 mL of juice in the new juice box. Given that the juice box costs \$7.50 per litre, each juice box would cost: $\frac{750}{1000} \times 240 = \$1.80$ Applying 10% GST to the price of the new juice box gives: 1.80 × 1.1 = \$1.98 *Note: Consequential on answer to* ***Question 29(a)****.*	MS–M1 Applications of Measurement MS11–3 Bands 4–5 • Provides the correct solution . . . . . 2 • Finds the cost of the new juice box before GST is applied 1
Question 30	
Finding the commission earned through option A gives: $C = 0.075 \times \$10\,000$ $= \$750$ Finding the commission earned through option B gives: $C = 0.08 \times x + 0.06 \times (\$10\,000 - x)$ Equating both commissions to determine the value of x that earns the same commission gives: $0.08 \times x + 0.06 \times (\$10\,000 - x) = 750$ $0.08x + 600 - 0.06x = 750$ $0.02x = 150$ $x = \frac{150}{0.02}$ $= 7500$	MS–F1 Money Matters MS11–5 Bands 5–6 • Provides the correct solution . . . . . 4 • Makes significant progress towards solving the equation . . . . . 3 • Forms an equation to represent the commission earned through option B . . . . . 2 • Calculates the commission earned through option A 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 31	
(a) The following table shows the implications of each piece of information provided. *Information* / *Implication* The probability of spinning a number less than 8 is 1. — Only numbers 1 to 7 can appear on the spinner. The probability of spinning a multiple of 3 is $\frac{1}{3}$. — Two sectors on the spinner are labelled 3 and 6. The probability of spinning a multiple of 4 is $\frac{1}{6}$. — One sector on the spinner is a 4. The probability of spinning an odd number is $\frac{2}{3}$. — Four sectors on the spinner are labelled 1, 3, 5 and 7. Therefore, the completed spinner is:  *Note: Accept spinners that place the numbers in a different order. Responses are not required to show working in order to obtain full marks.*	MS–S2 Relative Frequency and Probability MS11–8 Bands 4–5 • Provides the correct solution . . . . . 2 • Creates a spinner that satisfies THREE pieces of information 1
(b) The relative frequency of spinning a multiple of 4 or an odd number is $\frac{1}{6}+\frac{2}{3}=\frac{5}{6}$. $\text{expected frequency} = \text{relative frequency} \times \text{number of trials}$ $120=\frac{5}{6}\times n$ $n=\frac{120}{\frac{5}{6}}$ $=144$	MS–S2 Relative Frequency and Probability MS11–8 Bands 5–6 • Provides the correct solution 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 32	
To find the length of AC, the radius of circle A must be found.  Using the circumference of a circle formula to find r gives: $2\pi r + 2\pi \times 2r + 2\pi \times 4r = 42\pi$ $2\pi r + 4\pi r + 8\pi r = 42\pi$ $14\pi r = 42\pi$ $r = \frac{42\pi}{14\pi}$ $= 3$ Using $r = 3$ to find the length of AC gives: $AC = 4r + 2r + 2r + r$ $= 9r$ $= 9 \times 3$ $= 27$	MS–M1 Applications of Measurement MS11–3 Bands 5–6 • Provides the correct solution . . . . . 4 • Forms the equation and makes significant progress towards finding the length of AC . . . . . 3 • Applies the circumference formula. . . . . 2 • Makes some progress. 1