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HSC Trial Examination 2020
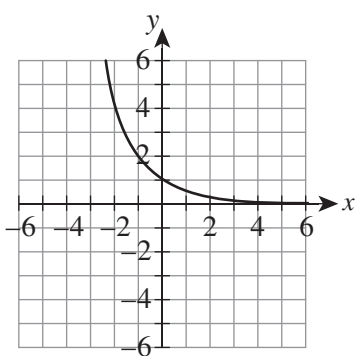
Mathematics Standard 2
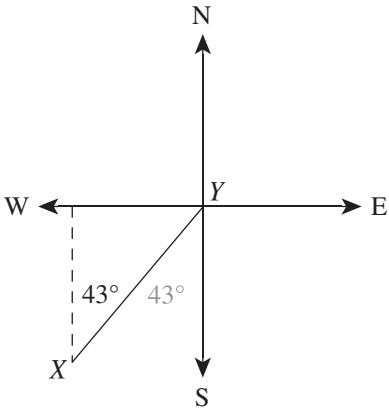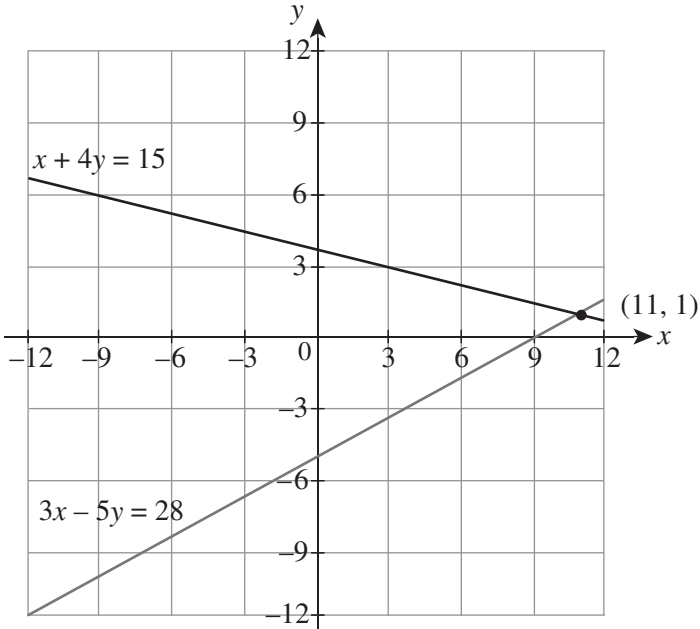
Solutions and marking guidelines
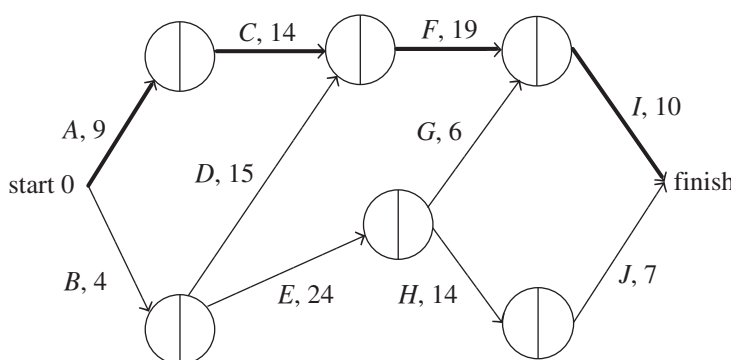
Section I

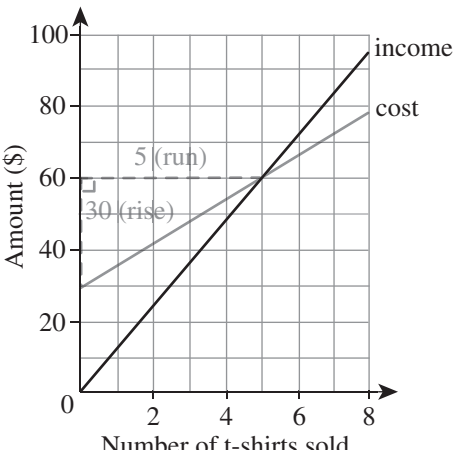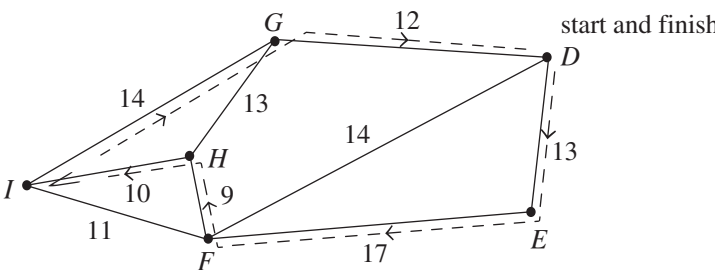| Answer and explanation	Syllabus content, outcomes and targeted performance bands	
Question 1 **D** The travel route is a walk (a connected sequence of edges showing a route between vertices and edges). The travel route is not a cycle nor a path since the vertices are repeated, so **A** and **B** are incorrect. It is not a trail since the edges are repeated, so **C** is incorrect.	MS–N2 Network Concepts MS2–12–8	Bands 1–2
Question 2 **A** fuel used = 7 L for 100 km $\quad= \dfrac{7}{100}$ for 1 km $\quad= \dfrac{7}{100} \times 382$ $\quad= 26.74$ L	MS–M7 Rates and Ratios MS2–12–3	Bands 1–2
Question 3 **C** $z = \dfrac{x - \bar{x}}{s} \qquad\qquad z = \dfrac{x - \bar{x}}{s}$ $\quad= \dfrac{66 - 72}{6} \qquad\qquad = \dfrac{78 - 72}{6}$ $\quad= -1 \qquad\qquad\qquad = 1$ 68% of scores have a z-score between -1 and 1.	MS–S5 The Normal Distribution MS2–12–7	Bands 2–3
Question 4 **B** There are 30 scores. The median is the average of the 15th (33) and 16th (34) score. Therefore, the median is 33.5.	MS–S1 Data Analysis MS–11–4	Bands 2–3
Question 5 **D** $\dfrac{CE}{\sin 127°} = \dfrac{25.8}{\sin 18°}$ $\quad CE = \dfrac{25.8 \times \sin 127°}{\sin 18°}$ $\qquad\quad = 66.6785 \ldots$ $\qquad\quad \approx 67$	MS–M6 Non-right-angled Trigonometry MS2–12–3	Bands 2–3
Question 6 **C** earnings $= 2 \times 8 \times 19.20 + 6 \times 1.5 \times 19.20$ $\qquad\quad = \$480$ Evelyn earned \$480 in total for working Thursday, Friday and Saturday.	MS–F1 Money Matters MS–11–5	Bands 3–4

Answer and explanation	Syllabus content, outcomes and targeted performance bands	
Question 7 **B** $FV = PV(1 + r)^n$ $\qquad = 1600 \times \left(1 + \dfrac{0.08}{4}\right)^{3 \times 4}$ $\qquad \approx \$2029.19$ $I = FV - PV$ $\quad = \$2029.19 - \$1600$ $\quad = \$429.19$ Liam will receive \$429.19 compound interest.	MS–F4 Investments and Loans MS2–12–5	Bands 3–4
Question 8 **B** The relationship is a strong positive correlation (small amount of scatter and a line with a positive gradient).	MS–S4 Bivariate Data Analysis MS2–12–7	Bands 2–3
Question 9 **A** $y = 2^{-x}$ is an exponential function. Check (0, 1) and (–1, 2) on each graph. 	MS–A4 Types of Relationships MS2–12–6	Bands 3–4
Question 10 **B** $\dfrac{170}{p} = \dfrac{10}{32}$ $10p = 5440$ $\quad p = 544$ The estimate of the parrot population is approximately 544.	MS–M7 Rates and Ratios MS2–12–3	Bands 4–5
Question 11 **C**	MS–S1 Data Analysis MS–11–4	Bands 3–4

Question 11 table:

Hours per week	Class centre	Frequency
0–4	2	5
5–9	7	10
10–14	12	3
15–19	17	2

$\text{mean} = \dfrac{\Sigma fx}{n}$

$\qquad\quad = \dfrac{2 \times 5 + 7 \times 10 + 12 \times 3 + 17 \times 2}{20}$

$\qquad\quad = 7.5 \text{ hours}$

Answer and explanation	Syllabus content, outcomes and targeted performance bands
Question 12 **C** $$r = \frac{2\%}{2} = 1\%$$ $n = 2 \times 2 = 4$ The intersection value is 4.0604. $$FV = 4.0604 \times 80\ 000$$ $$= \$324\ 832$$	MS–F5 Annuities MS2–12–5 Bands 3–4
Question 13 **D** S43°W	MS–M6 Non-right-angled Trigonometry MS2–12–3 Bands 4–5
Question 14 **A** The graphs of the two equations are as follows. Alternatively, substitute each answer into the equations. So **A** (11, 1): $$x + 4y = 15$$ $$11 + 4 \times 1 = 15$$ $$3x - 5y = 28$$ $$3 \times 11 - 5 \times 1 = 28$$	MS–A4 Types or Relationships MS2–12–6 Bands 4–5
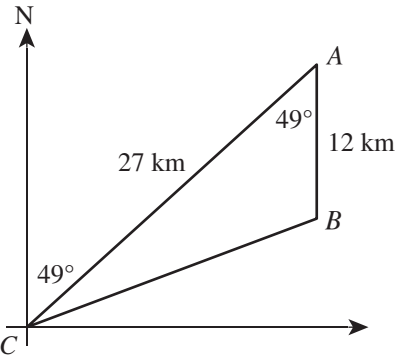
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Answer and explanation	Syllabus content, outcomes and targeted performance bands
Question 15　　**D** The critical path is $A \rightarrow C \rightarrow F \rightarrow I$. The minimum completion time is 52.	MS–N3 Critical Path Analysis MS2–12–8　　　　　　　　Bands 5–6
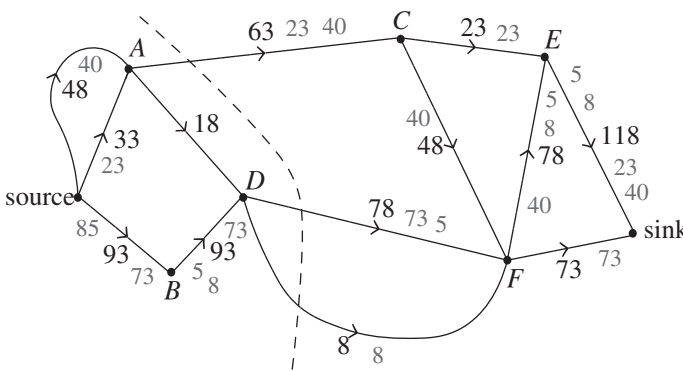
Section II

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 16	
$$\tan 49° = \frac{h}{7.3}$$ $$h = 7.3 \times \tan 49°$$ $$= 8.3976 \ldots$$ $$\approx 8.4 \text{ m}$$ The difference in height is 8.4 metres.	MS–M6 Non-right-angled Trigonometry MS2–12–3 Bands 1–2 • Gives the correct answer. . . . . 2 • Shows some understanding of the problem. 1
Question 17	
$$V = Ah$$ $$= 26 \times 15 \times 0.015$$ $$= 5.85 \text{ m}^3$$ V in litres $= 5.58 \times 1000$ $$= 5850 \text{ L}$$ The volume of water collected by the water tank is 5850 litres.	MS–M7 Rates and Ratios MS2–12–3 Bands 1–2 • Gives the correct answer. . . . . 2 • Finds the volume of water in cubic metres 1
Question 18	
(a) $$m = \frac{\text{rise}}{\text{run}} = \frac{60}{5} = 12$$ The y-intercept of the income received line is $0. $$y = mx + c$$ $$I = 12n$$	MS–A4 Types of Relationships MS2–12–6 Bands 2–3 • Gives the correct answer. 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
(b) $m = \dfrac{\text{rise}}{\text{run}} = \dfrac{30}{5} = 6$ The y-intercept of the cost line is \$30. $y = mx + c$ $C = 6n + 30$	MS–A4 Types of Relationships MS2–12–6 Bands 2–3 • Gives the correct answer 1
(c) profit = $(12 \times 7) - (6 \times 7 + 30)$ = \$12	MS–A4 Types of Relationships MS2–12–6 Bands 2–3 • Gives the correct answer 1
(d) $n = 5$ t-shirts (the point of intersection on the graph)	MS–A4 Types of Relationships MS2–12–6 Bands 1–2 • Gives the correct answer 1

Question 19

  The shortest path is $D \rightarrow E \rightarrow F \rightarrow H \rightarrow I \rightarrow G \rightarrow D$. length = $13 + 17 + 9 + 10 + 14 + 12$ = 75 min The shortest average completion time is 75 minutes.	MS–N2 Network Concepts MS2–12–8 Bands 4–5 • Gives the correct answer 3
	• Makes significant progress 2
	• Shows understanding of the shortest path 1
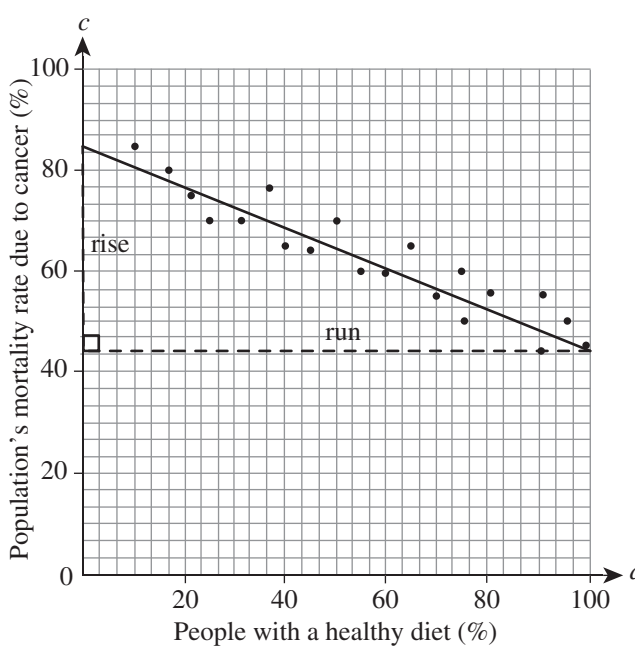
Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 20	
$S = V_0(1 + r)$ $= 19\,990\,(1 - 0.18)^4$ $= 9037.9139 \ldots$ $\approx \$9038$ The salvage value after four years is $9038.	MS–F4 Investments and Loans MS2–12–5 Bands 1–2 • Gives the correct answer. . . . . 2 ―――――――――――――――― • Substitutes TWO correct values into the declining-balance formula 1
Question 21	

(a)   Leaking at 0.25 litres per minute, $m = -0.25$.
     Initially, at $t = 0$, $V = 10$ L.
 	
     $y = mx + c$
     $V = mt + c$
       $= -0.25t + 10$
	MS–A4 Types of Relationships
	MS2–12–6 Bands 2–3
	• Gives the correct answer. 1

(b) $t = 90$s or 1.5 min
    $V = -0.25t + 10$
       $= -0.25 \times 1.5 + 10$
       $= 9.625$ L
There are 9.625 litres of water remaining.
	MS–A4 Types of Relationships
	MS2–12–6 Bands 2–3
	• Gives the correct answer. 1

(c)   All the water leaks out when $V = 0$.
     $V = -0.25t + 10$
     $0 = -0.25t + 10$
   $0.25t = 10$
       $t = 40$ min
It would take 40 minutes for all the water to leak out.
	MS–A4 Types of Relationships
	MS2–12–6 Bands 3–4
	• Gives the correct answer. 2
	――――――――――――――――
	• Shows some understanding of the problem. 1

Question 22	
$BAC_{\text{Female}} = \dfrac{10N - 7.5H}{5.5M}$ $= \dfrac{10 \times (2 \times 0.8 + 3 \times 1.5) - 7.5 \times 5}{5.5 \times 66}$ $= 0.0647\ldots$ ≈ 0.065 Alexis' blood alcohol content (BAC) at midnight is 0.065.	MS–A1 Formulae and Equations MS–11–6 Bands 2–3 • Gives the correct answer. . . . . 2 ―――――――――――――――― • Substitutes TWO correct values into the BAC formula 1
Question 23	

(a) $t = \dfrac{k}{n}$ $t = \dfrac{21}{n}$
 	
   $7 = \dfrac{k}{3}$ $= \dfrac{21}{4}$
 	
   $k = 21$ $= 5.25$ days
It would take 5.25 days for four workers to lay the timber floor.
	MS–A4 Types of Relationships
	MS2–12–6 Bands 3–4
	• Gives the correct answer. 2
	――――――――――――――――
	• Uses the sine rule with at least ONE correct value 1

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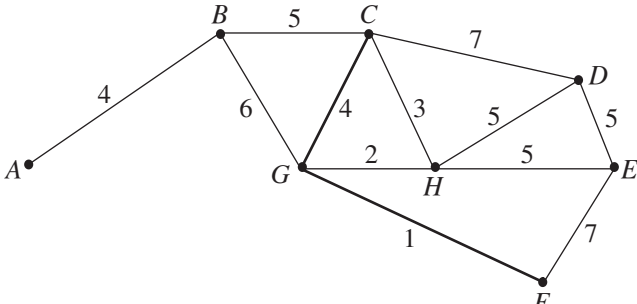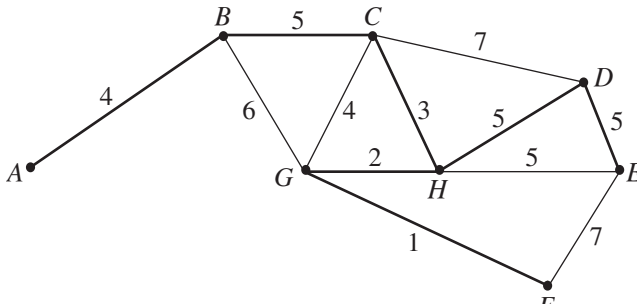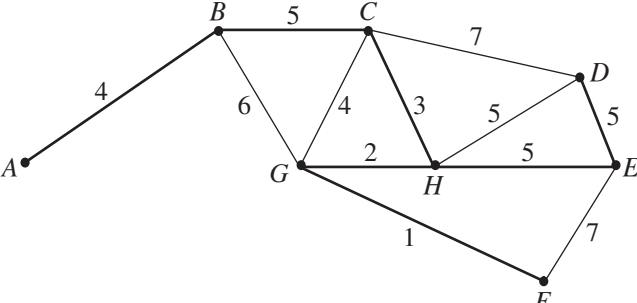| Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
(b) $t = \dfrac{21}{n}$ $1 = \dfrac{21}{n}$ $n = 21$ workers Twenty-one workers would be required to lay the timber floor in one day.	MS–A4 Types of Relationships MS2–12–6 Bands 3–4 • Gives the correct answer 1
Question 24	
(a) The precision or limit of reading is 100 kg.	MS–M1 Applications of Measurement MS–11–7 Bands 1–2 • Gives the correct answer 1
(b) absolute error $= \dfrac{1}{2} \times$ precision $= \dfrac{1}{2} \times 100$ $= 50$ kg	MS–M1.1 Practicalities of measurement MS–11–7 Bands 2–3 • Gives the correct answer 1
(c) upper bound = measurement + absolute error $= 1800 + 50$ $= 1850$ kg lower bound = measurement – absolute error $= 1800 - 50$ $= 1750$ kg	MS–M1.1 Practicalities of measurement MS–11–7 Bands 2–3 • Gives the correct answer 1
(d) percentage error $= \pm\dfrac{50}{1800} \times 100$ $= \pm 2.777$ $\approx \pm 2.8\%$	MS–M1.1 Practicalities of measurement MS–11–7 Bands 3–4 • Gives the correct answer 1
Question 25	
(a) AB is parallel to north direction. Therefore, $\angle CAB = 49°$. (Alternate angles are equal when two lines are parallel.)	MS–M6 Non-right-angled Trigonometry MS2–12–3 Bands 1–2 • Gives the correct answer 1

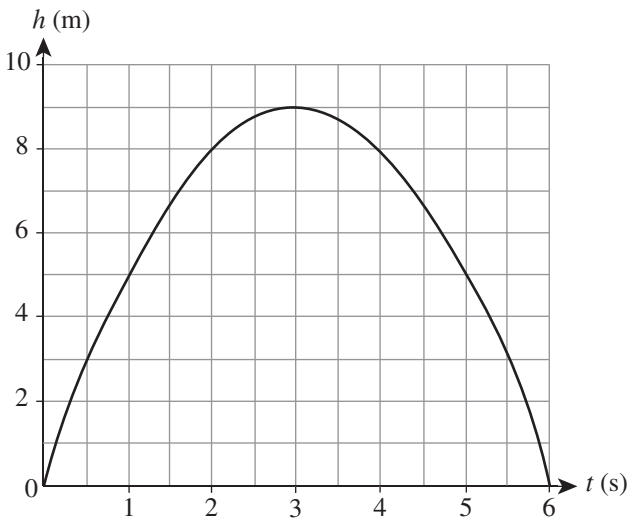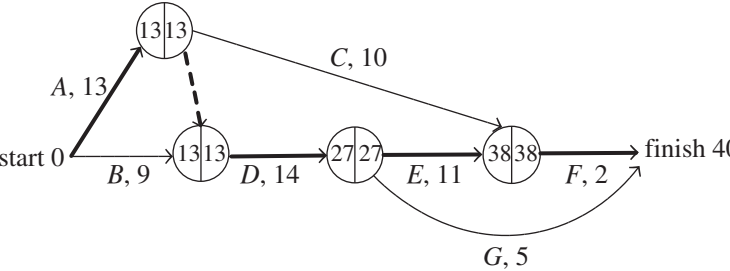| **Sample answer**	**Syllabus content, outcomes, targeted performance bands and marking guide**
(b) $a^2 = b^2 + c^2 - 2bc\cos A$ $BC^2 = 27^2 + 12^2 - 2 \times 27 \times 12 \times \cos 49°$ $BC = 21.1630\ldots$ ≈ 21.2 km The distance from B to C is 21.2 km.	MS–M6 Non-right-angled Trigonometry MS2–12–3　　　　　　　　Bands 3–4 • Gives the correct answer . . . . 2 • Uses the cosine rule with at least ONE correct value 1
(c) Use the sine rule to find $\angle ACB$. $\dfrac{\sin \angle ACB}{12} = \dfrac{\sin 49°}{21.1630\ldots}$ $\sin \angle ACB = \dfrac{12 \sin 49°}{21.1630\ldots}$ $\angle ACB = 25.3369\ldots$ $\approx 25°$ The true bearing of B from C is 074°T (49° + 25°).	MS–M6 Non-right-angled Trigonometry MS2–12–3　　　　　　　　Bands 4–5 • Gives the correct answer . . . . 2 • Uses the sine rule with at least ONE correct value 1
Question 26	
$N = 1000(2.1^t)$ $= 1000 \times 2.1^5$ $= 40\ 841.01$ $\approx 40\ 841$ After five years, the population of the town is 40 841.	MS–4 Types of relationships MS2–12–6　　　　　　　　Bands 1–2 • Gives the correct answer 1
Question 27	
(a) inflow for vertex E = 23 + 78 = 101 L possible outflow for vertex E = 118 L The inflow is less than the possible outflow. Therefore, the outflow for vertex E is 101 L.	MS–N3 Critical Path Analysis MS2–12–8　　　　　　　　Bands 3–4 • Gives the correct answer 1
(b)	MS–N3 Critical Path Analysis MS2–12–8　　　　　　　　Bands 4–5 • Gives the correct answer . . . . 2 • Shows some understanding of the problem 1
(c) Maximum flow equals the minimum cut. maximum flow = 63 + 78 + 8 $= 149$ L The maximum flow of the network is 149 litres.	MS–N3 Critical Path Analysis MS2–12–8　　　　　　　　Bands 3–4 • Gives the correct answer 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 28	
maximum heart rate (MHR) = 220 – age (years) $= 220 - 18.25$ $= 201.75$ heart rate when Maya begins exercising $= 0.58 \times 201.75$ $= 117.015$ ≈ 117 bpm Maya's heart rate is estimated to be 117 bpm when she begins exercising.	MS–M7 Rates and Ratios MS–11–8 Bands 2–3 • Gives the correct answer . . . . 2 • Finds the MHR. 1
Question 29	
daily interest rate $= \dfrac{15.7}{365}$ $= 0.043013\ldots$ $\approx 0.0430\%$ interest $= 1240 \times 0.0403 \times 12$ $= 6.4004\ldots$ $\approx \$6.40$ total paid $= 1240 + 6.40$ $= \$1246.40$ The total amount paid is \$1246.40.	MS–F4 Investments and Loans MS2–12–5 Bands 3–4 • Gives the correct answer . . . . 3 • Calculates the interest . . . . 2 • Shows some understanding of the problem 1
Question 30	
expected frequency $= np$ $= 0.6 \times 200$ $= 120$ seeds	MS–S2 Relative Frequency and Probability MS–11–8 Bands 2–3 • Gives the correct answer . . . . 2 • Shows some understanding of the problem 1
Question 31	
(a) The intersection value is 3.7908 (10% and 5 years). $PV = 3.7908 \times 15\ 000$ $= \$56\ 862$	MS–F5 Annuities MS2–12–5 Bands 1–2 • Gives the correct answer 1
(b) The intersection value is 3.9020 (1% and 4 years). $PV = 3.9020 \times 10\ 000$ $= \$39\ 020$	MS–F5 Annuities MS2–12–5 Bands 3–4 • Gives the correct answer 1
(c) The intersection value is 2.5771 (8% and 3 years). $52\ 217 = x \times 2.5771$ $x = \dfrac{52\ 217}{2.5771}$ $= 20\ 261.9223\ldots$ $\approx \$20\ 262$ The value of the annuity is \$20 262 per year.	MS–F5 Annuities MS2–12–5 Bands 4–5 • Gives the correct answer 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 32	
time $= \dfrac{4000 \text{ L}}{5 \text{ min}}$ $= 800 \text{ min}$ $= \dfrac{800}{60} \text{ h}$ $= 13.3333\ldots\text{h}$ $= 13 \text{ h } 20 \text{ min}$ The tank will be emptied in 13 hours 20 minutes.	MS−M7 Rates and Ratios MS2−12−3 Bands 2–3 • Gives the correct answer. . . . . 2 • Shows some understanding of the problem. 1
Question 33	
(a) Tens Units The sample space is {34, 35, 43, 45, 53, 54}.	MS−S2 Relative Frequency and Probability MS−11−8 Bands 3–4 • Gives the correct answer. . . . . 2 • Constructs ONE stage of the tree diagram correctly OR lists the sample space 1
(b) $P(55) = 0$ (Numbers are not repeated.)	MS−S2 Relative Frequency and Probability MS−11−8 Bands 1–2 • Gives the correct answer. 1
(c) $P(35) = \dfrac{n(35)}{n(S)} = \dfrac{1}{6}$	MS−S2 Relative Frequency and Probability MS−11−8 Bands 2–3 • Gives the correct answer. 1
(d) The sample space is {33, 34, 35, 43, 44, 45, 53, 54, 55}. $P(35) = \dfrac{1}{9}$	MS−S2 Relative Frequency and Probability MS−11−8 Bands 3–4 • Gives the correct answer. 1
Question 34	
$c = \bar{y} - m\bar{x}$ $= 85 - 0.4 \times 60$ $= 61$ The y-intercept is 61.	MS−S4 Bivariate Data Analysis MS2−12−7 Bands 3–4 • Gives the correct answer. 1
Question 35	
(a) The standard deviation is 10 kg.	MS−S5 The Normal Distribution MS2−12−7 Bands 2–3 • Gives the correct answer. 1
(b) Sixty-eight percent of scores have a z-score between −1 and 1 (or from 60 kg to 80 kg). region A $= \dfrac{68\%}{2} = 34\%$	MS−S5 The Normal Distribution MS2−12−7 Bands 3–4 • Gives the correct answer. 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
(c) A student with a z-score of –2 is two standard deviations below the mean $70 - (2 \times 10) = 50$. The weight of the student would be 50 kg.	MS–S5 The Normal Distribution MS2–12–7 Bands 3–4 • Gives the correct answer 1
(d) $z = \dfrac{x - \bar{x}}{s} = \dfrac{100 - 70}{10} = 3$ The percentage of scores less than a z-score of 3 is 99.85%. number of students $= 99.85\% \times 500$ $ = 499.25$ $ = 499$ There are 499 students with a mass less than 100 kg.	MS–S5 The Normal Distribution MS2–12–7 Bands 5–6 • Gives the correct answer . . . . 2 • Finds the z-score OR shows some understanding of the problem 1
Question 36	
(a) $m = \dfrac{\text{rise}}{\text{run}}$ $ = -\dfrac{40}{100}$ $ = -0.4$ The gradient is –0.4	MS–S4 Bivariate Data Analysis MS2–12–7 Bands 2–3 • Gives the correct answer 1
(b) The y-intercept is 85. $y = mx + c$ $c = -0.4d + 85$	MS–S4 Bivariate Data Analysis MS2–12–7 Bands 3–4 • Gives the correct answer 1
(c) The correlation coefficient is approximately –0.8 (small amount of scatter and a line with a negative gradient). *Note: Any value between –0.9 and –0.7 is acceptable.*	MS–S4 Bivariate Data Analysis MS2–12–7 Bands 1–2 • Gives the correct answer 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 37	
Use *z*-scores to compare results. $z = \dfrac{x - \bar{x}}{s} \qquad\qquad z = \dfrac{x - \bar{x}}{s}$ $= \dfrac{71 - 83}{6} \qquad\qquad = \dfrac{66 - 76}{10}$ $= -2 \qquad\qquad\qquad = -1$ We can determine that Samuel's performance improved because his *z*-score increased.	MS–S5 The Normal Distribution MS2–12–7 Bands 4–5 • Gives the correct answer. . . . . 2 • Finds the *z*-score OR shows some understanding of the problem 1
Question 38	

(a)   total amount repaid = monthly repayment ×
                   number of repayments
             = 3318 × 20 × 12
             = \$796 320
 	
The total amount to be repaid if the loan were taken over 20 years is \$796 320.
	MS–F4 Investments and Loans
	MS2–12–5 Bands 2–3
	• Gives the correct answer. 1

(b)   total amount repaid = monthly repayment ×
                   number of repayments
             = 3034 × 25 × 12
             = \$910 200
 	
extra amount to be repaid = \$910 200 – \$796 320
                       = \$113 880
 	
The extra amount to be repaid would be \$113 880.
	MS–F4 Investments and Loans
	MS2–12–5 Bands 3–4
	• Gives the correct answer. 2
	
	• Finds the total amount to be repaid if the loan were taken over 25 years 1

Question 39	

(a)   The intersection value is 3.3744 (12% per year for 3 years).
 	
$FV = 3.3744 \times \$17\,200$
      $= \$58\,039.68$
      $\approx \$58\,040$
	MS–F5 Annuities
	MS2–12–5 Bands 1–2
	• Gives the correct answer. 1

(b)   The intersection value is 5.1010 (1% per month for 5 months).
 	
$FV = 5.1010 \times 900$
      $= \$4590.90$
      $\approx \$4591$
	MS–F5 Annuities
	MS2–12–5 Bands 3–4
	• Gives the correct answer. 1

Question 40	
(a) distance = 4 + 5 + 7 + 5 = 21 km The distance to travel *ABCDE* is 21 km.	MS–N2 Network Concepts MS2–12–3 Bands 3–4 • Gives the correct answer. 1
(b) The vertices with an even degree are *C, F, G* and *H*.	MS–N2 Network Concepts MS2–12–3 Bands 1–2 • Gives the correct answer. 1

Sample answer	**Syllabus content, outcomes, targeted performance bands and marking guide**
(c) shortest distance = 4 + 1 = 5 km The shortest distance to travel from *C* to *F* is 5 km.	MS–N3 Critical path analysis MS2–12–3 Bands 4–5 • Gives the correct answer 1
(d) length = 4 + 5 + 3 + 2 + 1 + 5 + 5 = 25 km The length of the spanning tree is 25 km. *Note: The following is an alternative solution.* 	MS–N3 Critical path analysis MS2–12–3 Bands 5–6 • Gives the correct answer . . . . 3 • Finds the minimum spanning tree . . . . . . 2 • Calculates the correct length from an incorrect spanning tree 1
Question 41	
(a) 	*t*	0	1	2	3	4	5	6
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h	0	5	8	9	8	5	0		MS–A4 Types of Relationships MS2–12–6 Bands 3–4 • Gives the correct answer 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
(b)	MS−A4 Types of Relationships MS2−12−6 Bands 3−4 • Gives the correct answer. 1
(c) From the graph, the maximum height reached is 9 metres.	MS−A4 Types of Relationships MS2−12−6 Bands 2−3 • Gives the correct answer. 1
(d) From the graph, the maximum height is reached at 3 seconds.	MS−A4 Types of Relationships MS2−12−6 Bands 2−3 • Gives the correct answer. 1
Question 42	
(a) electricity = $160 \times 24 \times 7$ = 26 880 Wh = 26.88 kWh $\approx$ 27 kWh The refrigerator uses 27 kWh.	MS−M7 Rates and Ratios MS2−12−3 Bands 1−2 • Gives the correct answer. 1
(b) cost = 26.88×0.41 = 11.0208 $\approx$ \$11.02 The cost of using the refrigerator is \$11.02.	MS−M7 Rates and Ratios MS2−12−3 Bands 3−4 • Gives the correct answer. 1
Question 43	
(a)	MS−N3 Critical Path Analysis MS2−12−8 Bands 5−6 • Gives the correct answer. . . . . 2 • Connects THREE vertices correctly OR equivalent merit 1
(b) The minimum time for the project is 40 hours.	MS−N3 Critical Path Analysis MS2−12−8 Bands 4−5 • Gives the correct answer. 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
(c) float time = LST – EST = 35 – 27 = 8 h The float time for activity *G* is 8 hours.	MS–N3 Critical Path Analysis MS2–12–8 Bands 4–5 • Gives the correct answer 1