![International Grammar School logo]

Student Number

Year 12

Mathematics General 2

Trial HSC Examination

2015

General Instructions

- Reading time – 5 minutes
- Working time – 2 ½ hours
- Write using black or blue pen
- Board-approved calculators may be used
- A formula sheet is provided in this booklet
- In Questions 26 - 30, show relevant mathematical reasoning and/or calculations

Total marks – 100

Section I

25 marks

- Attempt Questions 1 – 25
- Allow about 35 minutes for this section.

Section II

75 marks

- Attempt Questions 26-30
- Allow about 1 hour and 55 minutes for this section

DO NOT REMOVE THIS PAPER FROM THE EXAMINATION ROOM

Section I

25 marks
Attempt Questions 1–25
Allow about 35 minutes for this section

Use the multiple-choice answer sheet for Questions 1–25.

1 Abigail collected data about the amount of rain that fell over a day in Sydney. This data can be best described as being:

(A) Discrete quantitative data

(B) Continuous quantitative data

(C) Nominal categorical data

(D) Nominal ordinal data

2 Expand and simplify $3(1 - 2x) - 2(x + 1)$.

(A) $1 - 4x$
(B) $5 - 4x$
(C) $1 - 8x$
(D) $5 - 8x$

3 Mika pays 24% of her gross pay in tax. If Mika pays $153.12 in tax each week, find her gross weekly pay.
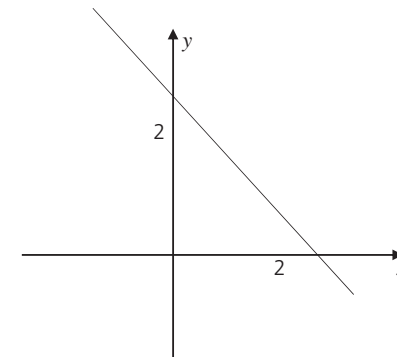
(A) $36.75

(B) $177.12

(C) $612.48

(D) $638

4 Lexie plans to wear jeans with a T-shirt and a jumper. She has two pairs of jeans, four T-shirts and three jumpers. How many different outfits can she wear?

(A) 9

(B) 12

(C) 18

(D) 24

5 Convert 0.6 km^2 to hectares.
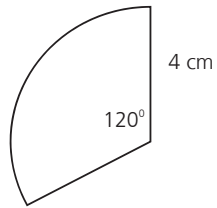
(A) 6 ha

(B) 60 ha

(C) 600 ha

(D) 6000 ha

6 Find the equation of this straight line.

(A) $y = 2x$

(B) $y = -2x$

(C) $y = x + 2$

(D) $y = 2 - x$

7 Find the perimeter of this sector of a circle of radius 4 cm, in exact form.

4 cm

NOT TO SCALE

120^0

(A) $\dfrac{8\pi}{3}$ cm

(B) $\dfrac{8\pi}{3} + 8$ cm

(C) $\dfrac{16\pi}{3}$ cm

(D) $\dfrac{16\pi}{3} + 8$ cm

8 Solve $\dfrac{3x-1}{5} = x + 2$

(A) $x = 5\dfrac{1}{2}$

(B) $x = -5\dfrac{1}{2}$

(C) $x = 1\dfrac{1}{2}$

(D) $x = -1\dfrac{1}{2}$

9 The stamp duty on a car is calculated using the table below.

| Car value	Stamp duty
$900 or less	2.5%
$901 to $ 30 000	3%
$30 001 to $55 000	$950 plus 8% of the amount over $30 000
$55 001 and over	4%

Calculate the stamp duty that Aidan needs to pay when he buys a $35 000 car.

(A) $1050

(B) $1350

(C) $1400

(D) $1550

10 Which of the following is *not* equal to $12a^3b^2$?

(A) $5a^3b^2 + 7a^3b^2$

(B) $3a^2b \times 4ab$

(C) $\dfrac{24a^5b^2}{2a^2b}$

(D) $24a^3b^2 - 12a^3b^2$

11 A plane takes off from an airport, A, at 11 am and flies on a bearing of 140° at a speed of 800 km/h. How far due south of the airport A is the plane at 1:30 pm? Answer to the nearest kilometre.
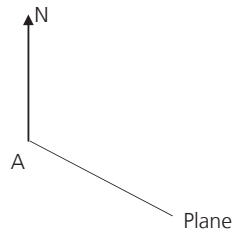
(A) 514 km

(B) 613 km

(C) 1286 km

(D) 1532 km

12 Karen rolls a die. If she rolls a one, she wins $12, but if she rolls an even number she loses $4. What is her financial expectation?

(A) $0

(B) $2

(C) $4

(D) $8

13 This box-and-whisker plot shows the rainfall over the month of September.
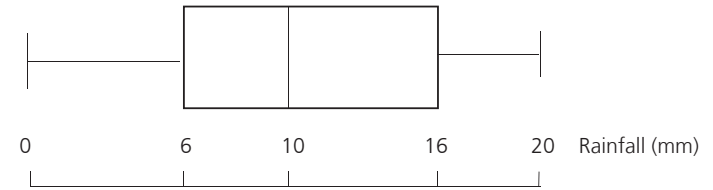
Which statement is correct?

(A) The median is 10 mm and the interquartile range is 20 mm.

(B) The median is 10 mm and the interquartile range is 10 mm.

(C) The range is 20mm and it rained more than 10 mm for 25% of the days.

(D) The range is 10 mm and it rained more than 10 mm for half the days.

14 Find the base length x cm of this square pyramid if the volume is 12 cm^3, and the height is 4 cm.

4 cm

NOT TO SCALE

x cm

(A) 2 cm

(B) 3 cm

(C) 4 cm

(D) 6 cm

15 Which is a correct calculation to find the length x m in the diagram below?

NOT TO SCALE

(A) $x^2 = 3.5^2 + 2.8^2 - 3.5 \times 2.8 \times \cos 58^o$

(B) $x^2 = 3.5^2 + 2.8^2 - 2 \times 3.5 \times 2.8 \times \cos 58^o$

(C) $x^2 = 2.8^2 + 3.5^2 - 2.8 \times 3.5 \times \cos 73^o$

(D) $x^2 = 2.8^2 + 3.5^2 - 2 \times 2.8 \times 3.5 \times \cos 49^o$

16 The length of child's foot increases until they reach adulthood. What is the best description for the relationship between foot length and a child's age?

(A) Positive correlation

(B) Negative correlation

(C) Extrapolation

(D) Interpolation

17 Chloe is an ecologist who is concerned about the cane toad population in the local community. She collects 280 cane toads and tags them. A couple of months later she collects 80 cane toads and found 32 of them were tagged. What is her estimate of the cane toad population using the capture-recapture method?

(A) 112

(B) 312

(C) 360

(D) 700

18 A factory produces boxes of matches with a mean of 50 matches in each box and a standard deviation of 1 match. If the number of matches in each box is normally distributed, and boxes with less than 48 matches are rejected, how many boxes will be rejected on a day when 20 000 boxes are produced?

(A) 250 boxes

(B) 500 boxes

(C) 1600 boxes

(D) 3200 boxes

19 A car was travelling at 60 km/h. The driver, Anna, suddenly saw a puppy dash out onto the road in front of her. The car travelled 35.6 m from the time she saw the puppy until she started braking. What was her reaction time in seconds to 2 decimal places?

(A) 1.68 s

(B) 1.69 s

(C) 2.13 s

(D) 2.14 s

20 Ben draws a graph showing how the journey time (T) varies inversely with the speed (S) of the car. Which of the following could be the correct graph?

(A)

(B)

(C)

(D)
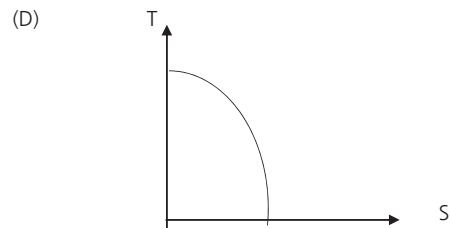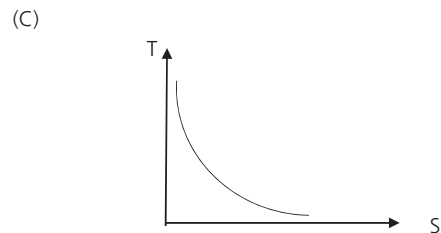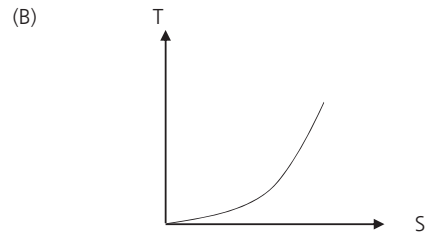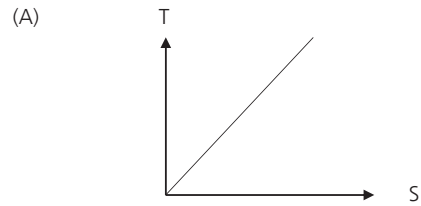
21 Ben is driving to visit his family in the country. The journey time, T, varies inversely with the speed, S, of the car. At a speed of 60 km/h, the trip takes 2 hours. How fast does Ben need to go to reach his family's house in 100 minutes?

(A)   72 km/h

(B)   80 km/h

(C)   90 km/h

(D)   100 km/h

22 Six years from now, Sean needs $12 000 towards a new car. How much should he invest now, at 7.2% p.a. (compounded monthly)?

(A) $6225

(B) $7800

(C) $7907

(D) $8150

23 The time, T seconds, it takes a pendulum to swing back and forth once is $T = 2\pi\sqrt{\dfrac{L}{g}}$, where L is the length of the pendulum in metres and g is a constant.
Make L the subject of the formula.

(A) $L = 2\pi\sqrt{\dfrac{T}{g}}$

(B) $L = \dfrac{gT^2}{2\pi}$

(C) $L = \dfrac{gT^2}{2\pi^2}$

(D) $L = \dfrac{gT^2}{4\pi^2}$

24 Liam had an average mark of 72% after 5 tests. What mark will he need to get for his next test so that his average will be 75%?

(A) 75%

(B) 80%

(C) 90%

(D) 95%

25 The table below gives the present value (in dollars) of an annuity with a contribution of $1 per period.

Period	Interest rate per period			
	3%	4%	5%	6%
4	3.7171	3.6299	3.5460	3.4651
5	4.5797	4.4518	4.3295	4.2124
6	5.4172	5.2421	5.0757	4.9173
7	6.2303	6.0021	5.7864	5.5824
8	7.0197	6.7327	6.4632	6.2098

Callie borrowed $2800 at 12% p.a. repayable quarterly over 18 months. How much will she repay per quarter?

(A) $398.88

(B) $450.90

(C) $516.87

(D) $569.42

END OF SECTION I

Section II

75 marks
Attempt Questions 26–30
Allow about 1 hour 55 minutes for this section

In Questions 26–30, your responses should include relevant mathematical reasoning and/or calculations.

Question 26 (15 marks)

(a) The table below shows the arm spam of five students.

Name	Ava	Ben	Chris	Dan	Eve
Arm span (cm)	176	162	161	190	170

(i) Calculate the population mean. **1**

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(ii) A sample of two people is chosen at random. How many samples are possible? **1**

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(b) Jared downloaded a 355 kilobit JPEG image using dial-up at 56 600 bps.
How long did the download take to the nearest second? **2**

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(c) A post casts a shadow of 8.4 m long at the same time that a 30 cm ruler casts a shadow of 20 cm. Find the height, x, of the post in metres. **2**

NOT TO SCALE

x

8.4 m

30 cm

20 cm

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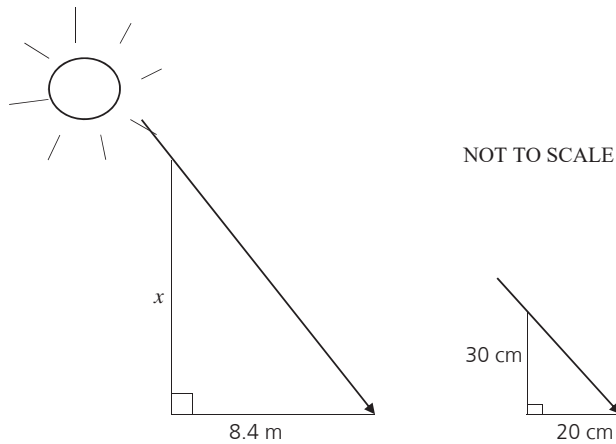
(d) The Earth has a radius of approximately 6400 km (to the nearest 10 km).

(i) Find the percentage error of this radius, correct to 3 significant figures. **2**

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(ii) Use this radius to calculate the circumference of the Earth to the nearest kilometre. **1**

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(e) A water tank in the shape of a cylinder is being constructed. It has a diameter of 3.2 m and a volume of 16.7 m^3.

h

3.2 m

(i) Show that the height (h) of the water tank is 2.1 m, to 1 decimal place. **2**

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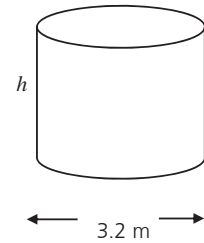
(ii)   Find the capacity of the water tank in litres.   **1**

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(iii)   The water tank is filled at the rate of 12 L/s. How long will it take to fill
the tank? Answer in minutes and seconds, to the nearest second.   **2**

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(iv)   If water usage is charged at $2.355/kL, how much will it cost to fill the
tank?   **1**

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End of Question 26

Question 27 (15 marks)

(a)   Students in a class were asked how many mobile phones they had owned. The
results are shown on the cumulative frequency histogram below.
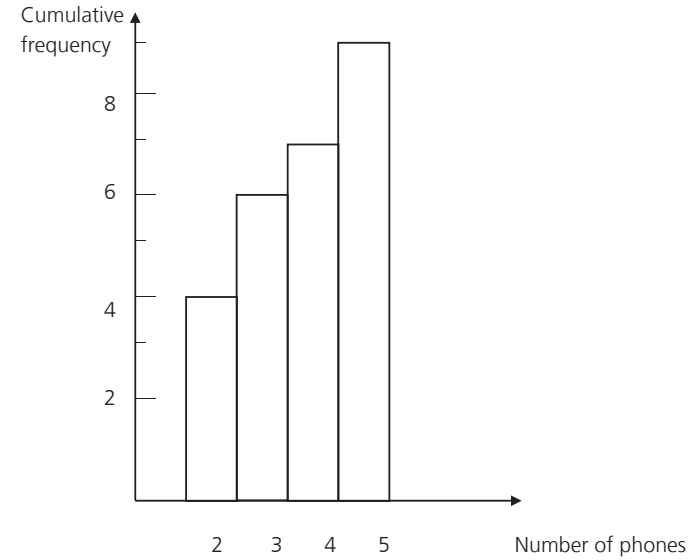
(i)   Complete the frequency distribution table using this histogram.   **3**

Number of Phones (x)	Frequency (f)	Cumulative frequency	fx
2			
3			
4		7	
5		9	

(ii)   Calculate the

(α) mean, correct to 1 decimal place   **2**

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(β) population standard deviation, correct to 1 decimal place   **1**

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(b)   A surveyor sketched a diagram of a garden bed in a rectangular field. All measurements are in metres.

i)   Using Simpson's rule twice estimate the area of PDCQ   **2**

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ii)   The surveyor calculated the area of the shaded region ABQP to be 156m². What is the estimated area of the garden bed?   **1**
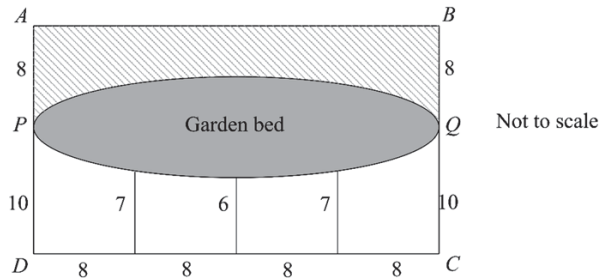
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(c)   A box contained 4 hard centred chocolates and 3 soft centred chocolates.

Kirsty chose 2 chocolates at random.

(i)   Complete the probability tree diagram below and list the outcomes.   **2**
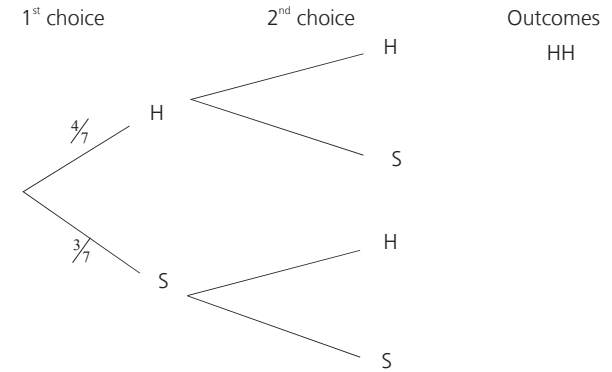
(ii)   Kirsty prefers soft centred chocolates. What is the probability that she chose two soft centred chocolates?   **1**

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(iii)   Find the probability that Kirsty picked one hard and one soft centred chocolate.   **2**

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(iv)   Jack ate one hard centred chocolate. Kirsty then also ate a hard chocolate.

What is the probability that Kirsty's second choice will be soft?   **1**

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End of Question 27

Question 28 (15 marks)

(a) Travis started from home (H) and walked 1.7 km due West to a point I. He then turned and walked on a bearing of 285° until he was 3.5 km from his home (point J).

(i) Write this information on the diagram below. **2**

NOT TO SCALE

(ii) Show that $\angle HIJ = 165^o$. **1**

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(iii) Find Travis's bearing at *J* from home, to the nearest degree. **2**

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(b) Emily decided to buy a new car. The car cost $18 570 and Emily paid $4570 deposit and borrowed the remaining $14 000. The interest rate was 12% p.a. and her monthly repayment was $950.

(i) Complete the following table. **2**

Month	Principal (P)	Interest (I)	Amount owing (P + I)	Amount owing after repayment (P + I – R)
1	$14 000.00	$140.00	$14 140.00	$13 190.00
2	$13 190.00	$131.90	$133 21.90	$12 371.90
3				
4				

(ii) Find the total interest paid in four months. **1**

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(iii) Emily wants to work out the best time to sell her car in the future. Using the declining balance method of depreciation, calculate the value of her car at the end of 6 years if the depreciation rate is 15% p.a. **2**

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(iv) After how many years (to the nearest year) will Emily's car be worth
$3656? Use the guess and check method. **2**

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(c) A survey was conducted asking a group of people whether they smoked or not.
The results are shown in this table below.

	Female	Male
Smoker	1560	2250
Non-smoker	4780	6020

(i) How many people were surveyed altogether? **1**

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(ii) Calculate, correct to 1 decimal place, the percentage of males who
were smokers. **2**

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End of Question 28

Question 29 (15 marks)

(a) Liam weighs 83 kg. He was at a party for 5 hours and consumed 6 standard
drinks during that time.

(i) Show that his BAC (blood alcohol content), correct to 2 decimal
places, is 0.04 at the end of 5 hours. **2**

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(ii) Liam's BAC decreases over time according to the formula
$B = 0.04 - 0.014H$, where H is time after drinking in hours.
Complete this table of values using the formula. **2**

H (hours)	0	0.5	1	1.5	2	2.5
B (BAC)		0.033		0.019		

(iii) Use the formula $B = 0.04 - 0.014H$ to calculate at what time Liam's
BAC is zero if he stopped drinking at midnight on Saturday night. **2**

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(iv) Sketch the graph of the function $B = 0.04 - 0.014H$, using the completed table of values in part (ii) and your answer for part (iii). **2**
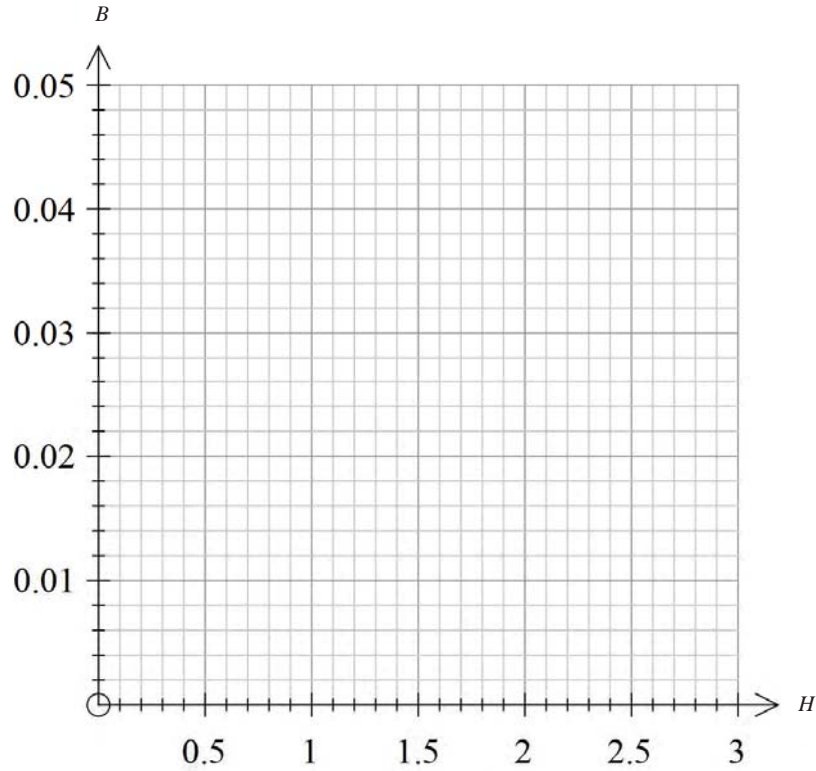
(v) Use the graph to estimate how long it takes Liam's BAC to drop to 0.01 after he stops drinking. **1**

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(b) A class of students sat an algebra test worth 20 marks. The marks were normally distributed. The mean was 11 and the standard deviation was 1.5.

(i) Calculate Alison's z-score if her mark was 8. **1**

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(ii) If Trevor's z-score was 3, calculate his actual mark. **1**

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(iii) Daniel sat the test a few days later, but didn't study for it. His mark was only 2 out of 20. Comment on how the mean and standard deviation would change if Daniel's mark is included in the calculations. **2**

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(iv) With Daniel's mark included in the calculations, it was found that
the upper quartile was 13 and the lower quartile was 8. Is Daniel's
mark an outlier? Support your answer with appropriate calculations. **2**

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End of Question 29

Question 30 (15 marks)

(a) A hacker introduced a virus to a computer network in a large company at 3 am
one Monday morning. The number of computers, C, affected by this virus after t
hours can be found using the formula $C = 8(2.07)^t$.

(i) Complete this table of values using the formula, rounding C to a whole
number.   **2**

t (hours)	0	1	2	3	4
C (computers)				71	

(ii) Sketch the graph of $C = 8(2.07)^t$ **2**
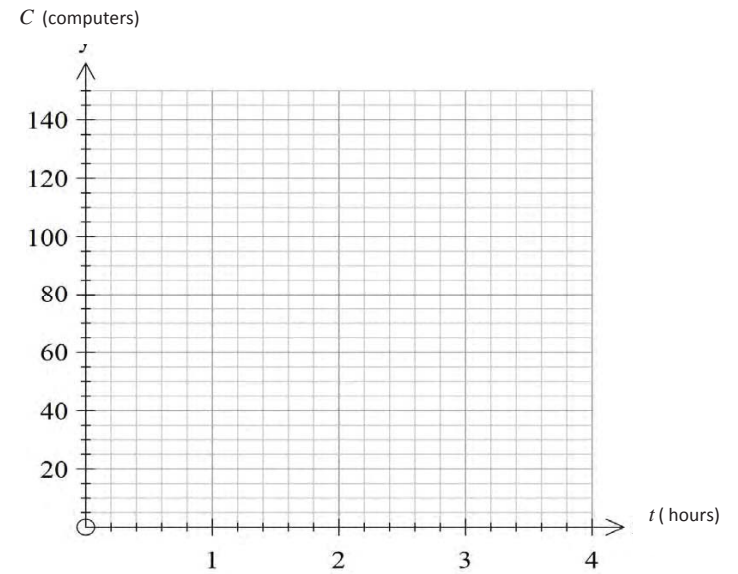
C (computers)

(iii) What type of graph is this? **1**

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(iv) What value is the vertical intercept and what does it represent? **2**

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(b) After 8 hours had passed, IT specialists worked out a way to stop the virus and started to clean up the affected computers. This graph shows the number of repaired computers, C, after t hours.
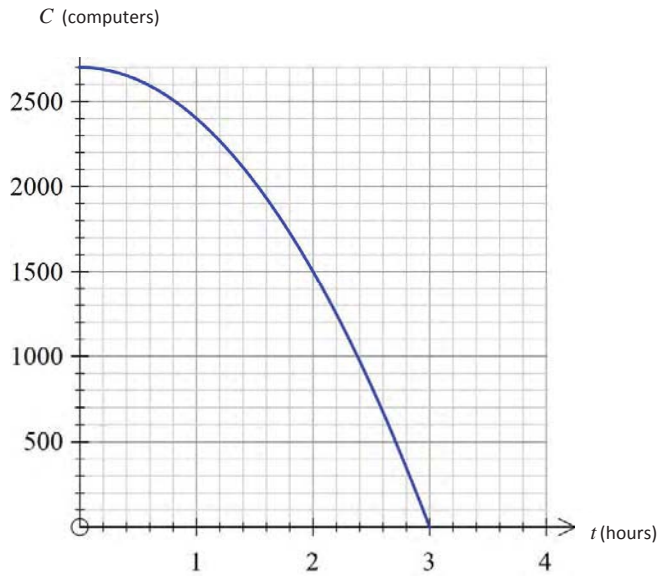
C (computers)

(i) At what time were all the computers fixed? **1**

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(ii) The equation of the graph drawn is in the form $C = a - kt^2$, where a and k are constants. Find the values of a and k. **2**

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(c) Simplify $\left(4a^3b^2\right)^2$ **2**

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(d) Solve these equations simultaneously to find the value of x and y. **3**

$$2x + y = 4$$

$$3x + 2y = 2$$

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End of Examination

Section II extra writing space

If you use this space, clearly indicate which question you are answering.

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International Grammar School

Student Number

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Worked Solutions

Year 12

Mathematics General 2

Trial HSC Examination

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(Section II)

75 marks

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4 Lexie plans to wear jeans with a T-shirt and a jumper. She has two pairs of jeans, four T-shirts and three jumpers. How many different outfits can she wear?

$2 \times 4 \times 3$

(A) 9

(B) 12

(C) 18

(D) 24

5 Convert 0.6 km² to hectares.

formula sheet

$1ha = 100 \times 100 \ (= 10000 m^2$

$= 0.1 \times 0.1 \ km^2$

$= 0.01$

(A) 6 ha

(B) 60 ha

(C) 600 ha

(D) 6000 ha

6 Find the equation of this straight line.

$-1 \qquad +2.$

$y = mx + c$

(A) $y = 2x$

(B) $y = -2x$

(C) $y = x + 2$

(D) $y = 2 - x$

7 Find the perimeter of this sector of a circle of radius 4 cm, in exact form.

4 cm

120°

NOT TO SCALE

$arc = \frac{2\pi r}{3}$

$\frac{2\pi r}{3} + 2 \times radius = \frac{8}{3}\pi + 8$

(A) $\frac{8\pi}{3}$ cm

(B) $\frac{8\pi}{3} + 8$ cm

(C) $\frac{16\pi}{3}$ cm

(D) $\frac{16\pi}{3} + 8$ cm

8 Solve $\frac{3x-1}{5} = x + 2$

$3x - 1 = 5x + 10$

$2x = -11$

$x = -5.5$

(A) $x = 5\frac{1}{2}$

(B) $x = -5\frac{1}{2}$

(C) $x = 1\frac{1}{2}$

(D) $x = -1\frac{1}{2}$

9 The stamp duty on a car is calculated using the table below.

Car value	Stamp duty
$900 or less	2.5%
$901 to $ 30 000	3%
$30 001 to $55 000	$950 plus 8% of the amount over $30 000
$55 001 and over	4%

Calculate the stamp duty that Aidan needs to pay when he buys a $35 000 car.

(A) $1050 $950 + 400$

(B) $1350

(C) $1400

(D) $1550

10 Which of the following is *not* equal to $12a^3b^2$?

(A) $5a^3b^2 + 7a^3b^2$

(B) $3a^2b \times 4ab$

(C) $\dfrac{24a^5b^2}{2a^2b}$ $= 12a^3b$

(D) $24a^3b^2 - 12a^3b^2$

11 A plane takes off from an airport, A, at 11 am and flies on a bearing of 140° at a speed of 800 km/h. How far due south of the airport A is the plane at 1:30 pm? Answer to the nearest kilometre.

2.5 hours × 800 km/h
= 2000 km

$x = 2000 \cos 40$

(A) 514 km

(B) 613 km

(C) 1286 km

(D) 1532 km

12 Karen rolls a die. If she rolls a one, she wins $12, but if she rolls an even number she loses $4. What is her financial expectation?

(A) $0 $\dfrac{1}{6} \times 12 - \dfrac{1}{2} \times 4$

(B) $2 $= 2 - 2 = 0$

(C) $4

(D) $8

6

7

13 This box-and-whisker plot shows the rainfall over the month of September.

0   6   10   16   20   Rainfall (mm)

Which statement is correct?

(A)   The median is 10 mm and the interquartile range is 20 mm.

(B)   The median is 10 mm and the interquartile range is 10 mm.

(C)   The range is 20mm and it rained more than 10 mm for 25% of the days.

(D)   The range is 10 mm and it rained more than 10 mm for half the days.

14   Find the base length x cm of this square pyramid if the volume is 12 cm³, and the height is 4 cm.

4 cm

NOT TO SCALE

x cm

$vol = \frac{1}{3}Ah$

$12 = \frac{1}{3}x^2 \times 4$

$\frac{36}{4} = x^2$

(A)   2 cm

(B)   3 cm

(C)   4 cm

(D)   6 cm

8

15   Which is a correct calculation to find the length x m in the diagram below?

49°

x m   3.5 m

122   NOT TO SCALE

73°   58°

2.8 m

(A) $x^2 = 3.5^2 + 2.8^2 - 3.5 \times 2.8 \times \cos 58°$

(B) $x^2 = 3.5^2 + 2.8^2 - 2 \times 3.5 \times 2.8 \times \cos 58°$

(C) $x^2 = 2.8^2 + 3.5^2 - 2.8 \times 3.5 \times \cos 73°$

(D) $x^2 = 2.8^2 + 3.5^2 - 2 \times 2.8 \times 3.5 \times \cos 49°$

16   The length of child's foot increases until they reach adulthood. What is the best description for the relationship between foot length and a child's age?

(A)   Positive correlation

(B)   Negative correlation

(C)   Extrapolation

(D)   Interpolation

Length

age

17   Chloe is an ecologist who is concerned about the cane toad population in the local community. She collects 280 cane toads and tags them. A couple of months later she collects 80 cane toads and found 32 of them were tagged. What is her estimate of the cane toad population using the capture-recapture method?

(A)   112

(B)   312

(C)   360

(D)   700

$\frac{280}{pop.} = \frac{32}{80}$

population $= 280 \times \frac{80}{32}$

$= 700$

or $\frac{32}{80} \times 100\% = 40\%$

$280 = 40\%$

$7 = 1\% \therefore 100\% = 700$

9

18 A factory produces boxes of matches with a mean of 50 matches in each box and a standard deviation of 1 match. If the number of matches in each box is normally distributed, and boxes with less than 48 matches are rejected, how many boxes will be rejected on a day when 20 000 boxes are produced?

(A) 250 boxes

(B) 500 boxes

(C) 1600 boxes

(D) 3200 boxes

$\frac{1}{2}5\%$

$\frac{2\delta}{48}$ 50

$2.5\% \times 20,000$

19 A car was travelling at 60 km/h. The driver, Anna, suddenly saw a puppy dash out onto the road in front of her. The car travelled 35.6 m from the time she saw the puppy until she started braking. What was her reaction time in seconds to 2 decimal places?

(A) 1.68 s

(B) 1.69 s

(C) 2.13 s

(D) 2.14 s
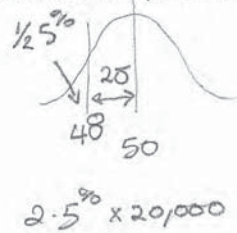
$60,000 \text{ m/h}$

$= \frac{60,000}{60} \text{ m/min}$

$= \frac{1000}{60} \text{ m/s}$

$35.6 \times \frac{60}{1000} = 2.136 \text{ s}$

20 Ben draws a graph showing how the journey time (T) varies inversely with the speed (S) of the car. Which of the following could be the correct graph?

(A)

(B)

(C)

(D)
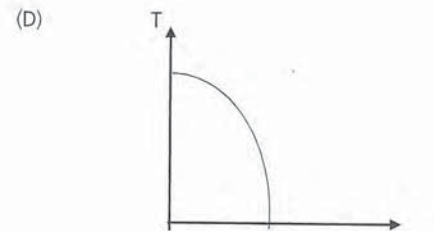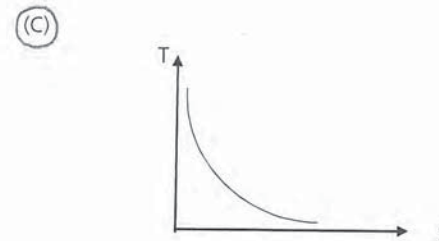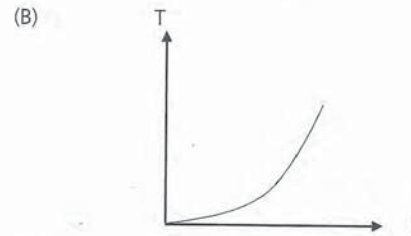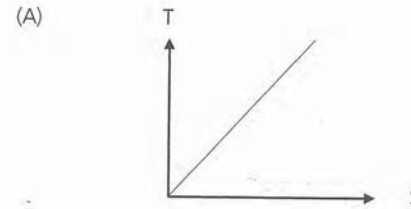
21 Ben is driving to visit his family in the country. The journey time, T, varies inversely with the speed, S, of the car. At a speed of 60 km/h, the trip takes 2 hours. How fast does Ben need to go to reach his family's house in 100 minutes?

(A) 72 km/h

(B) 80 km/h

(C) 90 km/h

(D) 100 km/h

$S = \dfrac{k}{T}$

120 min

$60 = \dfrac{k}{120}$ $K = 60 \times 120$

$S = \dfrac{60 \times 120}{100} = 72$

22 Six years from now, Sean needs \$12 000 towards a new car. How much should he invest now, at 7.2% p.a. (compounded monthly)?

(A) \$6225

(B) \$7800

(C) \$7907

(D) \$8150

$12000 = X\left(1 + \dfrac{0.072}{12}\right)^{6 \times 12}$

$X = \dfrac{12000}{1.5383\ldots} = 7800 \cdot 575 \ldots$

23 The time, T seconds, it takes a pendulum to swing back and forth once is $T = 2\pi\sqrt{\dfrac{L}{g}}$, where L is the length of the pendulum in metres and g is a constant.

Make L the subject of the formula.

(A) $L = 2\pi\sqrt{\dfrac{T}{g}}$

(B) $L = \dfrac{gT^2}{2\pi}$

(C) $L = \dfrac{gT^2}{2\pi^2}$

(D) $L = \dfrac{gT^2}{4\pi^2}$

$\left(\dfrac{T}{2\pi}\right)^2 = \dfrac{L}{g}$

$L = g\left(\dfrac{T}{2\pi}\right)^2$

24 Liam had an average mark of 72% after 5 tests. What mark will he need to get for his next test so that his average will be 75%?

(A) 75%

(B) 80%

(C) 90%

(D) 95%

$\dfrac{0.72 \times 5 + x}{6} = 0.75$

$x = 0.75 \times 6 - 0.72 \times 5$

$= 0.90$

25 The table below gives the present value (in dollars) of an annuity with a contribution of \$1 per period.

Period	Interest rate per period			
	3%	4%	5%	6%
4	3.7171	3.6299	3.5460	3.4651
5	4.5797	4.4518	4.3295	4.2124
6	5.4172	5.2421	5.0757	4.9173
7	6.2303	6.0021	5.7864	5.5824
8	7.0197	6.7327	6.4632	6.2098

Callie borrowed \$2800 at 12% p.a. repayable quarterly over 18 months. How much will she repay per quarter?

(A) \$398.88

(B) \$450.90

(C) \$516.87

(D) \$569.42

0.03

$1.5 \times 4 = 6$

$\dfrac{2800}{} = 516.872$

END OF SECTION I

Section II

75 marks
Attempt Questions 26–30
Allow about 1 hour 55 minutes for this section

In Questions 26–30, your responses should include relevant mathematical reasoning and/or calculations.

Question 26 (15 marks)

(a) The table below shows the arm spam of five students.

Name	Ava	Ben	Chris	Dan	Eve
Arm span (cm)	176	162	161	190	170

    (i)   Calculate the population mean.   **1**

$$mean = (176+162+161+190+170) \div 5$$

$$= \frac{859}{5} = 171\cdot8 \checkmark$$

    (ii)   A sample of two people is chosen at random.
How many samples are possible?   **1**

$$\frac{5 \times 4 \times}{2 \times 1} = 10 \checkmark$$

(b) Jared downloaded a 355 kilobit JPEG image using dial-up at 56 600 bps.
How long did the download take to the nearest second?   **2**

$$\frac{355000}{56600} = 6\cdot272 \checkmark$$

$$= 6 secs \ (nearest \ sec) \checkmark$$

(c) A post casts a shadow of 8.4 m long at the same time that a 30 cm ruler casts a shadow of 20 cm. Find the height, x, of the post in metres.   **2**

NOT TO SCALE

x 8.4 m   30 cm   20 cm
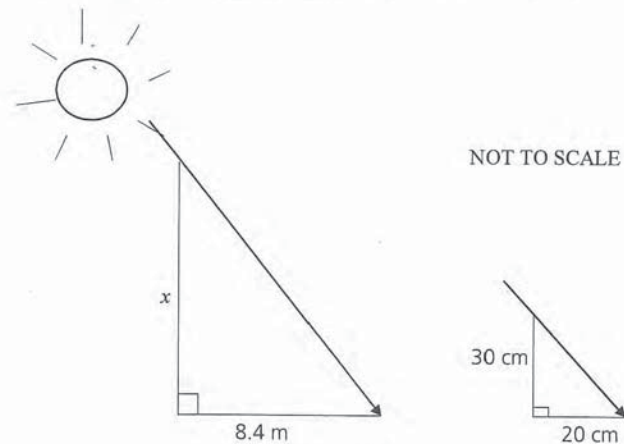
$$\frac{8\cdot4}{20} = \frac{x}{30} \checkmark$$

$$x = \frac{30 \times 8\cdot4}{20} = 12\cdot6 m \checkmark$$

±5

(d) The Earth has a radius of approximately 6400 km (to the nearest 10 km).

(i) Find the percentage error of this radius, correct to 3 significant
figures. **2**

$$\frac{5}{6400} \times 100 = \frac{5}{64} \% \checkmark$$

$$= 0.078125$$

$$= 0.0781 \ (3 \text{ s.f.}) \checkmark$$

(ii) Use this radius to calculate the circumference of the Earth to the nearest
kilometre. **1**

$$\text{circumference} = 2\pi r = 40212.38\text{---}$$

$$= 40212 \text{ km.} \left(\begin{array}{c}\text{nearest} \\ \text{km}\end{array}\right) \checkmark$$

(e) A water tank in the shape of a cylinder is being constructed. It has a diameter of
3.2 m and a volume of 16.7 m³.
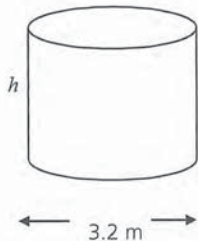
$$V = A \times h$$

$$h = \frac{V}{A} = \frac{16.7}{\pi r^2} = \frac{16.7}{\pi \times 1.6^2} \checkmark$$

$$= 2.0764 \checkmark$$

$$= 2.1 \text{ m} \ (1 \text{ d.p})$$

(i) Show that the height (h) of the water tank is 2.1 m, to 1 decimal place. **2**

(ii) Find the capacity of the water tank in litres. **1**

$$16.7\text{m}^3 = 16.7\text{kL} = 16700 \text{ L} \checkmark$$

(iii) The water tank is filled at the rate of 12 L/s. How long will it take to fill
the tank? Answer in minutes and seconds, to the nearest second. **2**

$$\frac{16700}{12} = 1391\tfrac{2}{3}\text{s} \checkmark = 23 \text{mins } 11\tfrac{2}{3}\text{s}$$

$$= 23 \text{mins } 12\text{s} \ (\text{nearest sec}) \checkmark$$

(iv) If water usage is charged at $2.355/kL, how much will it cost to fill the
tank? **1**

$$2.355 \times 16.7 = \$39.3285$$

$$= \$39.33\text{c} \checkmark$$

End of Question 26

16

17

Question 27 (15 marks)

(a) Students in a class were asked how many mobile phones they had owned. The results are shown on the cumulative frequency histogram below.
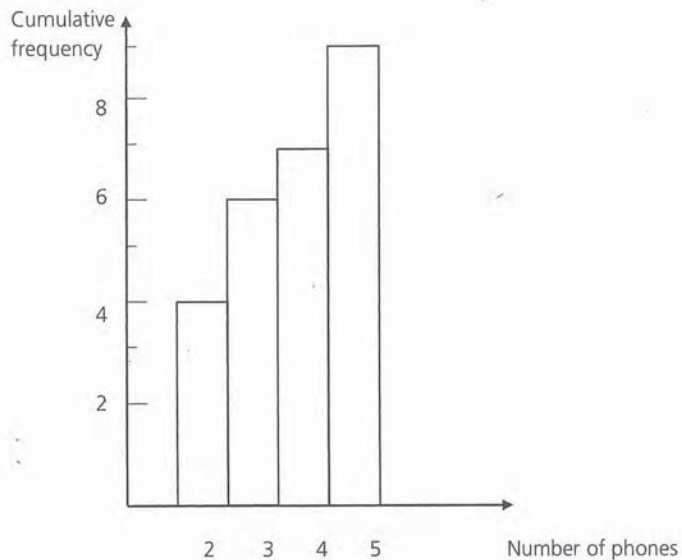
(i) Complete the frequency distribution table using this histogram. **3**

Number of Phones (x)	Frequency (f)	Cumulative frequency	fx
2	4	4	8
3	2	6	6
4	1	7	4
5	2	9	10
	9		28

18

(ii) Calculate the

(α) mean, correct to 1 decimal place **2**

$$\alpha = \frac{28}{9} = 3 \cdot 1$$

(β) population standard deviation, correct to 1 decimal place **1**

$\bar{x}$ and f in calculator

$$\beta = 1 \cdot 1967 = 1 \cdot 2 \text{ (1 d.p.)}$$

(b) A surveyor sketched a diagram of a garden bed in a rectangular field. All measurements are in metres.

i) Using Simpson's rule twice estimate the area of PDCQ **2**

$A = \frac{h}{3}(d_f + 4d_m + d_L)$ Total area = $A_1 + A_2$

Total area = $\frac{8}{3}(10 + 4\times7 + 6) + \frac{8}{3}(6 + 4\times7 + 10)$

$= \frac{8}{3} \times (44 + 44) = 234\frac{2}{3}m^2$ or 234·7
235
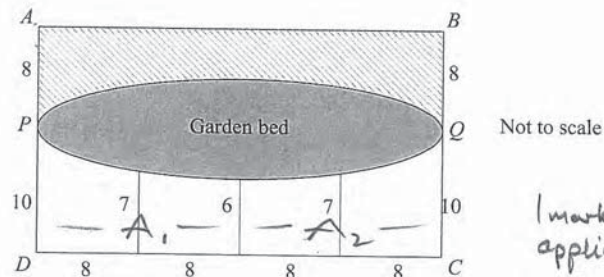
1 mark for 1 correct application of Simpsons rule.

ii) The surveyor calculated the area of the shaded region ABQP to be 156m². What is the estimated area of the garden bed? **1**

Rectangle = $32 \times 18 = 576 m^2$

Garden = $576 - 156 - 235$ (or answer i)

$= 185 m^2$

19

(c) A box contained 4 hard centred chocolates and 3 soft centred chocolates.

Kirsty chose 2 chocolates at random.

(i) Complete the probability tree diagram below and list the outcomes. **2**

| 1st choice | 2nd choice | Outcomes |

$\frac{3}{6}$ H — HH

H

$\frac{3}{6}$ ✓

S — HS

$\frac{4}{7}$

$\frac{3}{7}$

$\frac{4}{6}$ H — SH ✓

S

$\frac{2}{6}$ S — SS
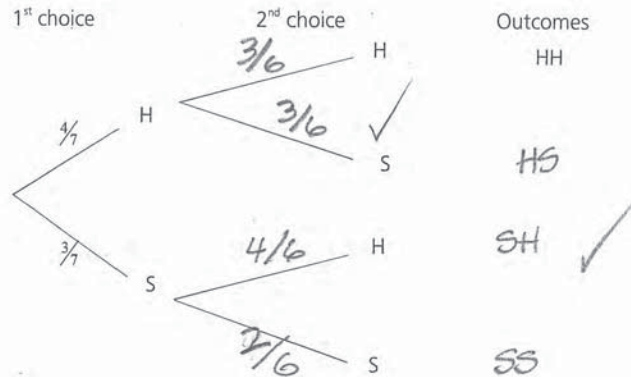
(ii) Kirsty prefers soft centred chocolates. What is the probability that she chose two soft centred chocolates? **1**

$$\frac{3}{7} \times \frac{2}{6} = \frac{6}{42} = \frac{1}{7} \checkmark$$

(iii) Find the probability that Kirsty picked one hard and one soft centred chocolate. **2**

$$\frac{4}{7} \times \frac{3}{6} + \frac{3}{7} \times \frac{4}{6} = \frac{28}{42} = \frac{4}{7} \checkmark$$

1 mark for part correct

(iv) Jack ate one hard centred chocolate. Kirsty then also ate a hard chocolate.

What is the probability that Kirsty's second choice will be soft? **1**

hard = 2 soft = 3 $P(S) = \frac{3}{5}$ ✓

End of Question 27

20

Question 28 (15 marks)

(a) Travis started from home (H) and walked 1.7 km due West to a point I. He then turned and walked on a bearing of 285° until he was 3.5 km from his home (point J).

(i) Write this information on the diagram below. **2**
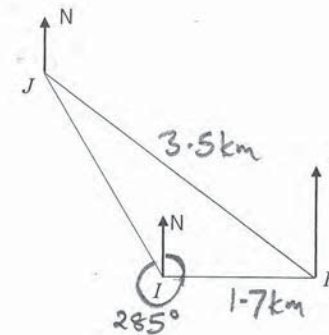
NOT TO SCALE

I mark angle marked
I mark distances marked

(ii) Show that $\angle HIJ = 165°$. **1**

$$\angle HIJ = 360 - 285 + 90$$
$$= 75 + 90 = 165 \checkmark$$

(iii) Find Travis's bearing at J from home, to the nearest degree. **2**

$$\frac{\sin 165}{3.5} = \frac{\sin J}{1.7}$$

$$\sin J = \frac{1.7 \sin 165}{3.5}$$

$$\angle J = \sin^{-1} 0.1257 = 7.22°$$

$$\angle H = 180 - 7.22 - 165 = 7.78°$$

bearing from H $= 270 + 7.78$

$$= 278° \text{ (nearest deg.)} \checkmark$$

21

(b) Emily decided to buy a new car. The car cost $18 570 and Emily paid $4570 deposit and borrowed the remaining $14 000. The interest rate was 12% p.a. and her monthly repayment was $950.

(i) Complete the following table. $r = 0.01/\text{month}$ **2**

Month	Principal (P)	Interest (I)	Amount owing (P + I)	Amount owing after repayment (P + I − R)
1	$14 000.00	$140.00	$14 140.00	$13 190.00
2	$13 190.00	$131.90	$133 21.90	$12 371.90
3	12371·90	123·72	12495·62	11545·62 ✓
4	11545·62	115·46	11661·08	10711·08 ✓

1 mark for 1 row or column.

(ii) Find the total interest paid in four months. **1**

$140 + 131·90 + 123·72 + 115·46$
$= \$511·08$ ✓

(iii) Emily wants to work out the best time to sell her car in the future. Using the declining balance method of depreciation, calculate the value of her car at the end of 6 years if the depreciation rate is 15% p.a. **2**

$S = V_0(1-r)^n = 18570(0.85)^6$ ✓

$= \$7003·666$

$= \$7003·67$ ✓

(iv) After how many years (to the nearest year) will Emily's car be worth $3656? Use the guess and check method. **2**

$3656 = 18570(0.85)^x$ ✓
$(0.85)^x = 0.196876\cdots$

$x = 8 \Rightarrow 0.272$
$x = 10 \Rightarrow 0.196874$
$x = 11 \Rightarrow 0.1673$

closest is 10 years ✓

(c) A survey was conducted asking a group of people whether they smoked or not. The results are shown in this table below.

	Female	Male	
Smoker	1560	2250	3810
Non-smoker	4780	6020	10800
	6340	8270	14610

(i) How many people were surveyed altogether? **1**

14610 ✓

(ii) Calculate, correct to 1 decimal place, the percentage of males who were smokers. **2**

$\dfrac{2250}{8270} = 0.27206\cdots$ ✓
$= 27·2 \% \quad (1 d.p.)$ ✓

End of Question 28

22

23

Question 29 (15 marks)

,M   ,H   ,N

(a) Liam weighs 83 kg. He was at a party for 5 hours and consumed 6 standard drinks during that time.

(i)   Show that his BAC (blood alcohol content), correct to 2 decimal places, is 0.04 at the end of 5 hours. **2**

formula sheet →

$$BAC = \frac{10N - 7.5H}{6.8M} \quad (male) = \frac{60 - 7.5 \times 5}{6.8 \times 83} \checkmark$$

$$= \frac{22.5}{564.4} = 0.039865.. = 0.04 \ (2 \ d.p.) \checkmark$$

(ii) Liam's BAC decreases over time according to the formula $B = 0.04 - 0.014H$, where H is time after drinking in hours. Complete this table of values using the formula. **2**

H (hours)	0	0.5	1	1.5	2	2.5
B (BAC)	0.04	0.033	0.026	0.019	0.012	0.005

(iii) Use the formula $B = 0.04 - 0.014H$ to calculate at what time Liam's BAC is zero if he stopped drinking at midnight on Saturday night. **2**

$$0 = 0.04 - 0.014H \qquad H = \frac{0.04}{0.014} \checkmark$$

$$= 2.857 \ hours = 2 \ hours \ 51 \ mins$$

∴ time is 2:51 am sunday ✓

or 2:51 sunday morning

(iv) Sketch the graph of the function $B = 0.04 - 0.014H$, using the completed table of values in part (ii) and your answer for part (iii). **2**

✓✓

I mark partly correct (no line or <4 pts wrong)
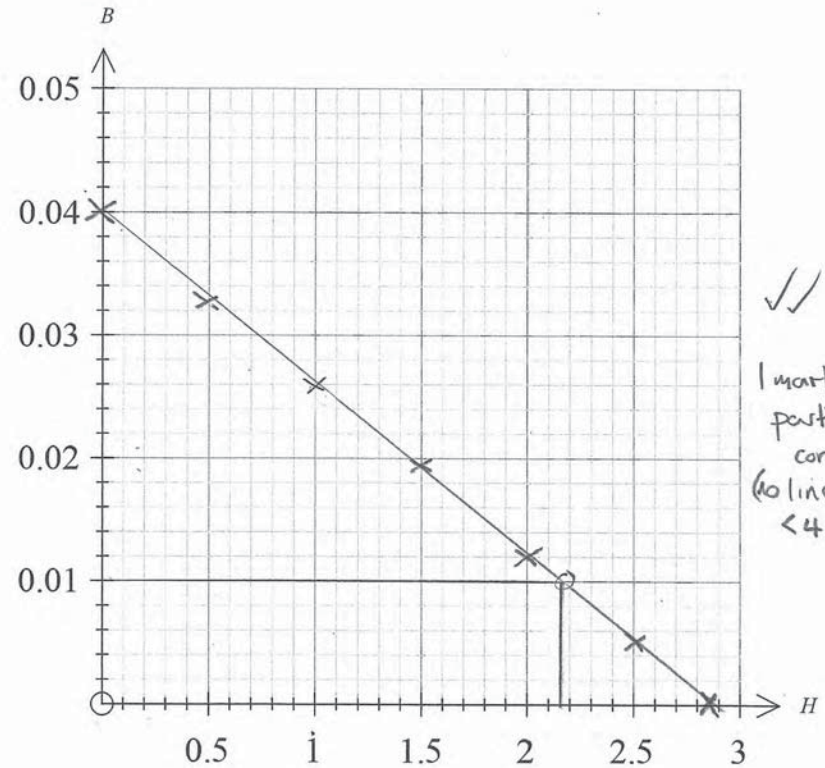
(v) Use the graph to estimate how long it takes Liam's BAC to drop to 0.01 after he stops drinking. **1**

2.15 hours ✓ or 2 hours 9 mins (from graph)

decimal or hours and mins.

(b) A class of students sat an algebra test worth 20 marks. The marks were normally distributed. The mean was 11 and the standard deviation was 1.5.

(i) Calculate Alison's z-score if her mark was 8.   1

$$z = \frac{8-11}{1.5} = -2 \checkmark$$

(ii) If Trevor's z-score was 3, calculate his actual mark.   1

$$z = 3 = \frac{x-11}{1.5} \qquad x - 11 = 4.5$$
$$x = 15.5 \checkmark$$

(iii) Daniel sat the test a few days later, but didn't study for it. His mark was only 2 out of 20. Comment on how the mean and standard deviation would change if Daniel's mark is included in the calculations.   2

The mean would fall because 2 is lower than the current mean. The σ would rise $\checkmark$ because 2 is outside 1σ of mean. The amount would depend on n, the number of scores.

(iv) With Daniel's mark included in the calculations, it was found that the upper quartile was 13 and the lower quartile was 8. Is Daniel's mark an outlier? Support your answer with appropriate calculations.   2

$$IQR = 13 - 8 = 5$$
$$Q_1 - 1.5 \times IQR = 8 - 7.5 = 0.5 \checkmark$$

A score of 2 is within this range, so no, it is not an outlier.

End of Question 29

Question 30 (15 marks)

(a)   A hacker introduced a virus to a computer network in a large company at 3 am one Monday morning. The number of computers, C, affected by this virus after t hours can be found using the formula $C = 8(2.07)^t$.

   (i)   Complete this table of values using the formula, rounding C to a whole number.   **2**

t (hours)	0	1	2	3	4
C (computers)	8	17	34	71	147

correct and correctly rounded ✓✓

I mark for partly correct.

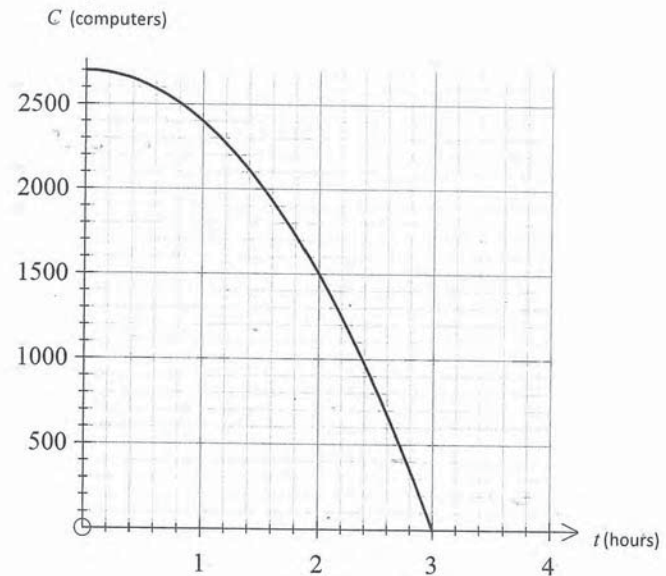   (ii)   Sketch the graph of $C = 8(2.07)^t$ **2**

C (computers)

✓✓
correct
points

correct
curve
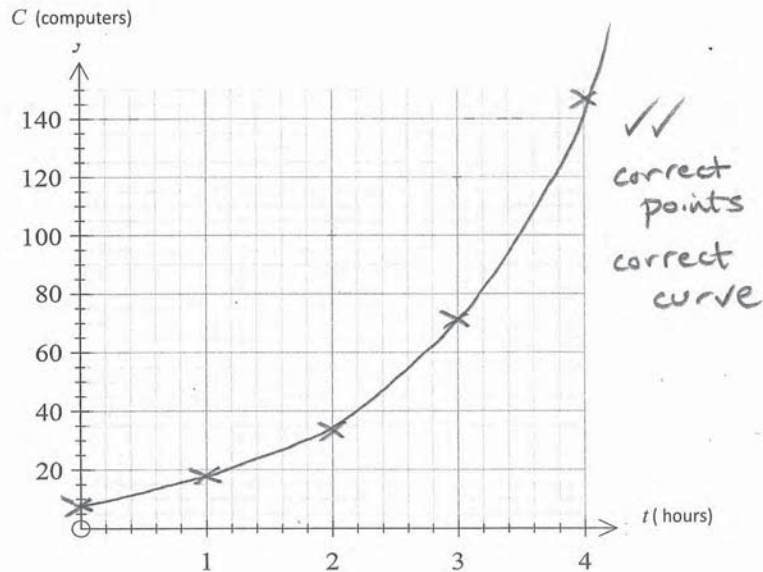
(iii)   What type of graph is this?   **1**

.... Exponential ✓ ....

(iv)   What value is the vertical intercept and what does it represent?   **2**

8 ✓   The number of computers initially infected. ✓

(b)   After 8 hours had passed, IT specialists worked out a way to stop the virus and started to clean up the affected computers. This graph shows the number of repaired computers, C, after t hours.

C (computers)

28

29

(i) At what time were all the computers fixed?   **1**

$$\text{After } 3 \text{ hours}$$
$$\Rightarrow 3am + 8hours + 3hours$$
$$= 2pm \checkmark$$

(ii) The equation of the graph drawn is in the form $C = a - kt^2$, where a and k are constants. Find the values of a and k.   **2**

$$0 = a - 9k \qquad a = 2700 \checkmark \text{ vertical intercept}$$

$$9k = 2700 \qquad k = \frac{2700}{9} = 300 \checkmark$$

(c) Simplify $\left(4a^3b^2\right)^2$ $\checkmark$ $\checkmark$ **2**

$$16a^6 b^4$$

1 mark for one. incorrect indices or coefficient.

(d) Solve these equations simultaneously to find the value of x and y.   **3**

$$2x + y = 4 \quad —— (1)$$
$$3x + 2y = 2 \quad ——(2)$$

(1)×2 $4x + 2y = 8 \quad —— (3)$
(2) $3x + 2y = 2 \checkmark$
(3)-(2) $x = 6 \checkmark$
substitute in (1) $6 + y = 4 \quad y = -2 \checkmark$

Solution $x = 6$ when $y = -2$ or $(6, -2)$

End of Examination

30

Section I Multiple-Choice Answer Sheet

1.   A ○   B ●   C ○   D ○
2.   A ○   B ○   C ●   D ○
3.   A ○   B ○   C ○   D ●
4.   A ○   B ○   C ○   D ●
5.   A ○   B ●   C ○   D ○
6.   A ○   B ○   C ○   D ●
7.   A ○   B ●   C ○   D ○
8.   A ○   B ●   C ○   D ○
9.   A ○   B ●   C ○   D ○
10.   A ○   B ○   C ●   D ○
11.   A ○   B ○   C ○   D ●
12.   A ●   B ○   C ○   D ○
13.   A ○   B ●   C ○   D ○
14.   A ○   B ●   C ○   D ○
15.   A ○   B ●   C ○   D ○
16.   A ●   B ○   C ○   D ○
17.   A ○   B ○   C ○   D ●
18.   A ○   B ●   C ○   D ○
19.   A ○   B ○   C ○   D ●
20.   A ○   B ○   C ●   D ○
21.   A ●   B ○   C ○   D ○
22.   A ○   B ●   C ○   D ○
23.   A ○   B ○   C ○   D ●
24.   A ○   B ○   C ●   D ○
25.   A ○   B ○   C ●   D ○