



Ascham School

Year 12 Mathematics Standard 2

TRIAL EXAMINATION

Date: 2 August 2019

Time: 2½ hours

General Instructions

- Reading time – 10 minutes.
- Working time – 2½ hours.
- Write using black pen.
- Approved calculators may be used.
- A formulae sheet is provided.

Result

Total marks - 100

Section I 15 Marks

- Attempt Questions 1-15.
- Allow about 25 minutes for this section.
- Record your answers on the multiple choice answer sheet.

Section II 85 Marks

- Attempt Questions 16-21.
- Allow about 2 hours 5 minutes for this section.
- Answer in the space provided.

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

Section I

15 marks

Attempt Questions 1-15

Allow about 25 minutes for this section

Use the multiple-choice answer sheet for Questions 1-15.

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample $2 + 4 =$ (A) 2 (B) 6 (C) 8 (D) 9

A B C D

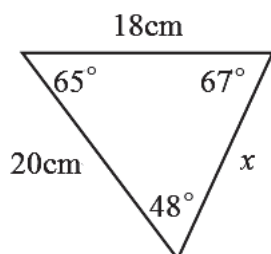
If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A B C D

If you have changed your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and drawing an arrow as follows:

A B C D
correct

- 1 Which statement is true for the given triangle?



(A) $x^2 = 20^2 - 18^2$

(B) $x^2 = 20^2 - 18^2 + 2 \times 20 \times 18 \times \cos 65^\circ$

(C) $\frac{x}{\sin 65^\circ} = \frac{18}{\sin 48^\circ}$

(D) $x = \frac{1}{2} \times 20 \times 18 \times \sin 65^\circ$

- 2 The results of Mathematics exam were normally distributed.

Betty gained a z-score of -2 .

What percentage of students scored better than Betty?

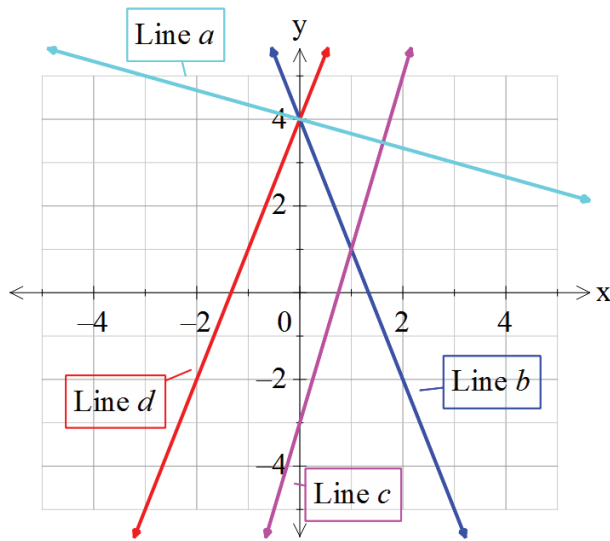
(A) 84%

(B) 97.5%

(C) 95%

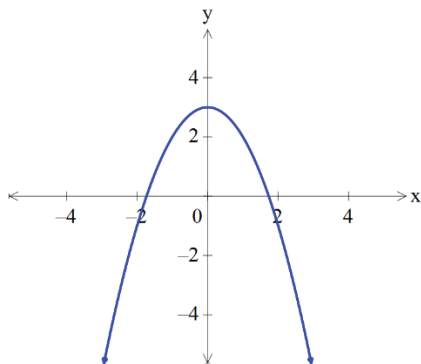
(D) 2.5%

3 Which line below has the equation $y = 4 - 3x$?



- (A) Line a
- (B) Line b
- (C) Line c
- (D) Line d

4 The equation of the graph below is:

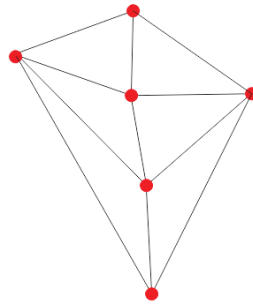


- (A) $y = 3 - x^2$
- (B) $y = -x^2$
- (C) $y = x^2 - 3$
- (D) $y = x^2 + 3$

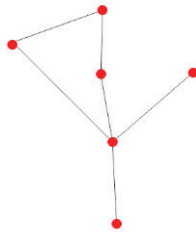
5 Grant wins \$500 and invests it 4 years at 8% p.a. interest compounded quarterly. To calculate the amount of interest earned on the investment, Grant would use:

- | | |
|----------------------------------|-------------------------------|
| (A) $500 \times 1.02^{16} - 500$ | (B) $500 \times 0.8 \times 4$ |
| (C) $500 \times (1 + 0.02)^{16}$ | (D) $500 \times 1.08^4 - 500$ |

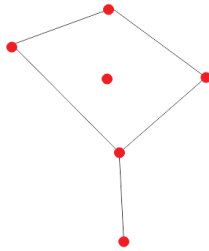
6 Which of the following is the spanning tree of the network below?



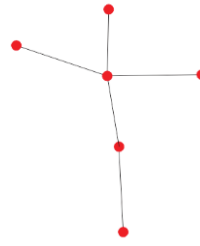
(A)



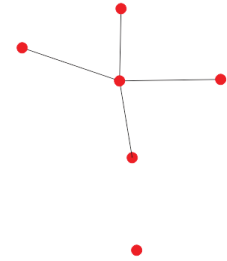
(B)



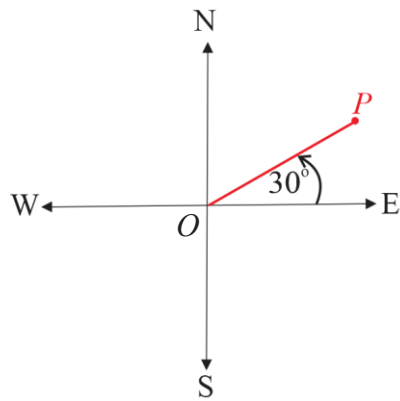
(C)



(D)



7 What is the compass bearing of P from O ?



(A) E30°N

(B) N30°E

(C) S120°E

(D) N60°E

8 Which of the following is the fastest speed?

(A) 20 m/s

(B) 60 km/h

(C) 100 m/min

(D) 25 000 m/h

12 Convert 8.5 m^2 to cm^2 ?

(A) 85

(B) 8 500

(C) 850

(D) 85 000

13 The Whitney Hotel in London offers the following menu options for its Christmas Lunch.



How many 3-course selections are possible?

(A) 3

(B) 24

(C) 10

(D) 36

- 14 What is the effect of a 40% increase, followed by a 40% decrease on a sum of money?
- (A) An overall increase on the original amount.
- (B) An overall decrease on the original amount.
- (C) No change to the original amount.
- (D) Not enough information has been provided.
- 15 Rachel measures the length of a window to be 250 cm, correct to the nearest centimetre. What is the percentage error in her measurement?
- (A) $\pm 0.002\%$ (B) $\pm 0.004\%$
- (C) $\pm 0.2\%$ (D) $\pm 0.4\%$

End of Section I

Section II

85 marks

Attempt all questions

Allow about 2 hours and 5 minutes for this section

Answer each question in the space provided.

Show all relevant working in questions involving calculations.

Additional writing space is available at the back of this booklet.

Question 16 (15 marks)

- a) Allison uses a dishwasher with a rating of 800 W for 2.5 hours each day. Find the daily cost of electricity for using the dishwasher if electricity is charged at a rate of 21.40 cents per kWh. [2]

- b) Maddie and Annie made a seesaw as per diagram below. It is known that the weight of a person, w , varies inversely to the distance of a person to the middle of the seesaw, d .

The equation $w = \frac{k}{d}$, where k is a constant, models this situation.



- i) Given that Maddie weighs 65 kg and is sitting 1.20m away from the middle of the seesaw, find the value of the constant, k and state the equation of the relationship. [2]

- ii) Annie weighs 40 kg. Find the distance at which she needs to sit for the seesaw to work. [2]

- d) Monique purchased new appliances after renovating her home. The appliances depreciate at a rate of 15% per annum. After the three years, the appliances are worth \$19 770.

What was the original purchase price of the appliances? Give your answer correct to the nearest dollar. [2]

- e) There are 2 480 phone numbers on a list. Every 8th number is phoned.

What type of sampling is this? [1]

End of Question 16

Question 17 (15 marks)

- a) A three-digit number is made up of the digits 4, 5 and 8. If the digits are not repeated, what is the probability that the number:

i) is even? [1]

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ii) ends in 5? [1]

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- b) Given $BAC_{MALE} = \frac{10N - 7.5H}{6.8M}$ calculate the BAC for a 95 kilogram male who has consumed 3 standard drinks between 7 pm and 9.30 pm. [1]

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- c) Mel leaves Darwin (UTC +9.5) at 1.40 pm on Monday and arrives in Singapore (UTC +8) at 4.50 pm on Monday. How long is Mel's direct flight from Darwin to Singapore? [2]

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d) For a data set that is normally distributed and z is the standardised score, find the following using the table of standard normal distribution below:

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.50000	.50399	.50798	.51197	.51595	.51994	.52392	.52790	.53188	.53586
0.1	.53983	.54380	.54776	.55172	.55567	.55966	.56360	.56749	.57142	.57535
0.2	.57926	.58317	.58706	.59095	.59483	.59871	.60257	.60642	.61026	.61409
0.3	.61791	.62172	.62552	.62930	.63307	.63683	.64058	.64431	.64803	.65173
0.4	.65542	.65910	.66276	.66640	.67003	.67364	.67724	.68082	.68439	.68793
0.5	.69146	.69497	.69847	.70194	.70540	.70884	.71226	.71566	.71904	.72240
0.6	.72575	.72907	.73237	.73565	.73891	.74215	.74537	.74857	.75175	.75490
0.7	.75804	.76115	.76424	.76730	.77035	.77337	.77637	.77935	.78230	.78524
0.8	.78814	.79103	.79389	.79673	.79955	.80234	.80511	.80785	.81057	.81327
0.9	.81594	.81859	.82121	.82381	.82639	.82894	.83147	.83398	.83646	.83891
1.0	.84134	.84375	.84614	.84849	.85083	.85314	.85543	.85769	.85993	.86214
1.1	.86433	.86650	.86864	.87076	.87286	.87493	.87698	.87900	.88100	.88298
1.2	.88493	.88686	.88877	.89065	.89251	.89435	.89617	.89796	.89973	.90147
1.3	.90320	.90490	.90658	.90824	.90988	.91149	.91308	.91466	.91621	.91774
1.4	.91924	.92073	.92220	.92364	.92507	.92647	.92785	.92922	.93056	.93189
1.5	.93319	.93448	.93574	.93699	.93822	.93943	.94062	.94179	.94295	.94408

i) $P(z > 1.43)$ [2]

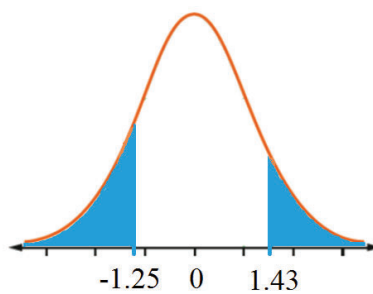
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ii) What is the probability that a randomly chosen score has a z-score that falls into the shaded areas on the diagram below?



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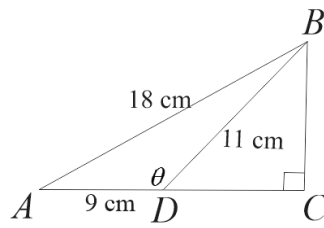
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e) Consider the diagram below.



i) Use the cosine rule to show that $\theta = 128^\circ$, correct to the nearest degree. [2]

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ii) What is the angle of elevation of B from D . [1]

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iii) Find the bearing of D from B . [1]

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iv) Find the length of AC , correct to one decimal place. [2]

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End of Question 17

Question 18 (15 marks)

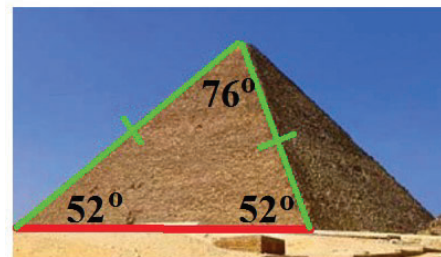
- a) The side of the square base of one of the smaller pyramids in Giza has length of 1.4 cm on the map.



The scale used is 1:15000.

- i) What is the actual length of the side of the pyramid's base in metres? [1]

- ii) Each side of the pyramid forms an isosceles triangle as per diagram on the right. Find the actual length of the slant edge of the pyramid.



[2]

- iii) The ratio of base edges of the smaller to larger pyramids are in the ratio 7:13. Find the area of the square base of the larger pyramid.



[2]

b) The volume of a sphere is 4988.92 cm^3 . Find, correct to 1 decimal place, the sphere's:

i) radius.

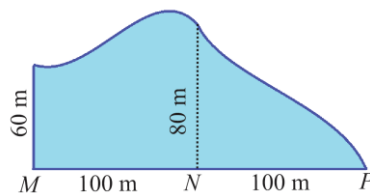
[2]

ii) surface area.

[1]

c) i) Use the Trapezoidal rule to estimate the area of the reservoir in the diagram below. Answer correct to the nearest square metre.

[2]



ii) What is the capacity of the reservoir in ML, if it is 2.4 m deep?

[2]

d) The table below shows the future value of an annuity with a contribution of \$1.

Period	Interest rate per period									
	2%	2.5%	3%	3.5%	4%	4.5%	5%	5.5%	6%	8%
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0200	2.0250	2.0300	2.0350	2.0400	2.0450	2.0500	2.0550	2.0600	2.0800
3	3.0604	3.0756	3.0909	3.1062	3.1216	3.1370	3.1525	3.1680	3.1836	3.2464
4	4.1216	4.1525	4.1836	4.2149	4.2465	4.2782	4.3101	4.3423	4.3746	4.5061
5	5.2040	5.2563	5.3091	5.3625	5.4163	5.4707	5.5256	5.5811	5.6371	5.8666
6	6.3081	6.3877	6.4684	6.5502	6.6330	6.7169	6.8019	6.8881	6.9753	7.3359
7	7.4343	7.5474	7.6625	7.7794	7.8983	8.0192	8.1420	8.2669	8.3938	8.9228
8	8.5830	8.7361	8.8923	9.0517	9.2142	9.3800	9.5491	9.7216	9.8975	10.6366
9	9.7546	9.9545	10.1591	10.3685	10.5828	10.8021	11.0266	11.2563	11.4913	12.4876
10	10.9497	11.2034	11.4639	11.7314	12.0061	12.2882	12.5779	12.8754	13.1808	14.4866
11	12.1687	12.4835	12.8078	13.1420	13.4864	13.8412	14.2068	14.5835	14.9716	16.6455
12	13.4121	13.7956	14.1920	14.6020	15.0258	15.4640	15.9171	16.3856	16.8699	18.9771
15	17.2934	17.9319	18.5989	19.2957	20.0236	20.7841	21.5786	22.4087	23.2760	27.1521
18	21.4123	22.3863	23.4144	24.4997	25.6454	26.8551	28.1324	29.4812	30.9057	37.4502
20	24.2974	25.5447	26.8704	28.2797	29.7781	31.3714	33.0660	34.8683	36.7856	45.7620

i) Angela is saving for a holiday by contributing \$500 into an annuity that pays interest at the rate of 8% p.a., compounded quarterly. Use the table above to find how much she will have in 2 years' time.

[1]

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ii) Milla is saving for the same trip and needs \$7000 in total. How much more than Angela does she need to contribute each quarter, using the same annuity, if she wishes to have enough money in 2 years' time?

[2]

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End of Question 18

Question 19 (15 marks)

- a) Belinda wishes to invest her savings into shares and is considering two suitable options.

Option 1: 1500 shares which have a market price of \$2.15 each, with dividend yield of 15% and brokerage of 3%.

Option 2: 1000 shares which have a market price of \$3.45 each and pay dividend of 32 cents per share. Brokerage is 2.5%.

- i) Which option will cost less in terms of brokerage? [1]

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- ii) Which option is cheaper in terms of total cost of purchasing shares? [2]

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- iii) Belinda chose Option 2. Find her expected dividend yield. [1]

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- iv) Belinda suddenly needs to cash in her shares. She managed to sell them at the market price of \$3.55, but had to pay a higher brokerage fee of 2.9%. [2]

Did she made a profit or loss with this sale? Calculate this amount.

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- 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

Section I

15 marks

Attempt Questions 1-15

Allow about 25 minutes for this section

Use the multiple-choice answer sheet for Questions 1-15.

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample $2 + 4 =$ (A) 2 (B) 6 (C) 8 (D) 9

A B C D

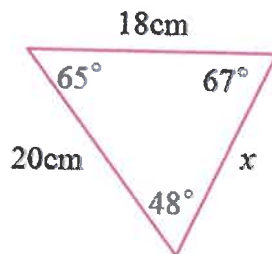
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A B C D

If you have changed your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and drawing an arrow as follows:

A B ^{correct} C D

- 1 Which statement is true for the given triangle?



(A) $x^2 = 20^2 - 18^2$

(B) $x^2 = 20^2 - 18^2 + 2 \times 20 \times 18 \times \cos 65^\circ$

(C) $\frac{x}{\sin 65^\circ} = \frac{18}{\sin 48^\circ}$

(D) $x = \frac{1}{2} \times 20 \times 18 \times \sin 65^\circ$

- 2 The results of Mathematics exam were normally distributed. Betty gained a z-score of -2 . What percentage of students scored better than Betty?

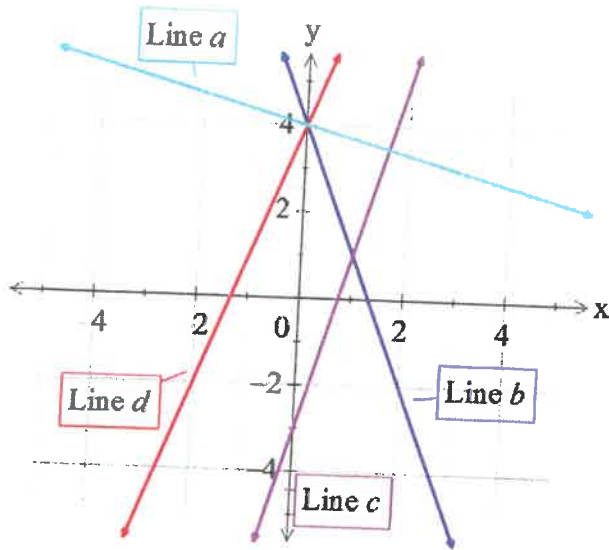
(A) 84%

(B) 97.5%

(C) 95%

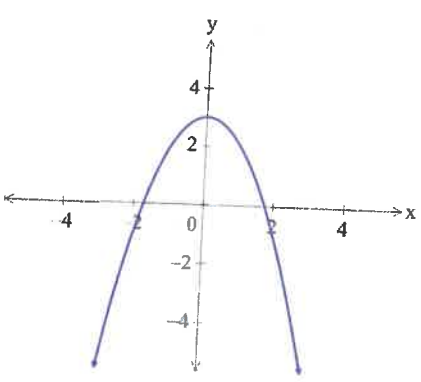
(D) 2.5%

3 Which line below has the equation $y = 4 - 3x$?



- (A) Line a
- (B) Line b**
- (C) Line c
- (D) Line d

4 The equation of the graph below is:

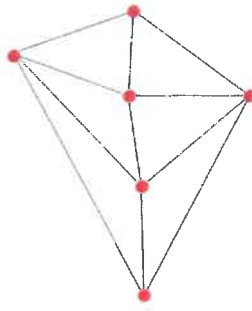


- (A) $y = 3 - x^2$**
- (B) $y = -x^2$
- (C) $y = x^2 - 3$
- (D) $y = x^2 + 3$

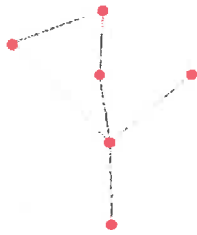
5 Grant wins \$500 and invests it 4 years at 8% p.a. interest compounded quarterly. To calculate the amount of interest earned on the investment, Grant would use:

- (A) $500 \times 1.02^{16} - 500$**
- (B) $500 \times 0.8 \times 4$
- (C) $500 \times (1 + 0.02)^{16}$
- (D) $500 \times 1.08^4 - 500$

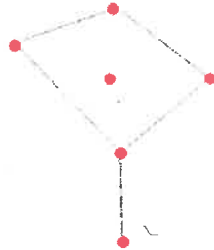
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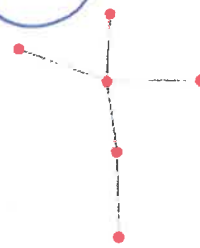
(A)



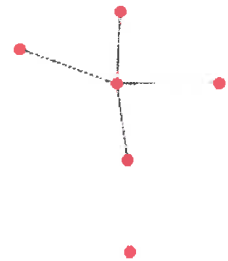
(B)



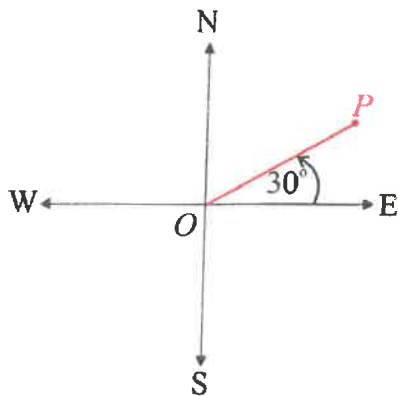
(C)



(D)



7 What is the compass bearing of P from O ?



(A) $E30^\circ N$

(B) $N30^\circ E$

(C) $S120^\circ E$

(D) $N60^\circ E$

8 Which of the following is the fastest speed?

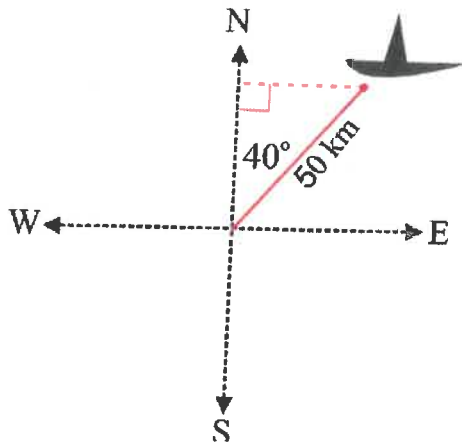
(A) 20 m/s

(B) 60 km/h

(C) 100 m/min

(D) 25 000 m/h

- 9 A ship sails a distance of 50 km on a bearing of 040° .
Which expression can be used to find how far east the ship travelled?



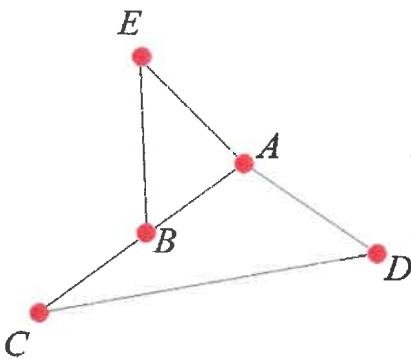
(A) $50 \times \cos 40^\circ$

(B) $50 \times \sin 40^\circ$

(C) $\frac{50}{\sin 40^\circ}$

(D) $50 \times \tan 40^\circ$

- 10 For the network below, *BADCBEA* represents:



(A) A path

(B) An Eulerian Circuit

(C) An Eulerian Trail

(D) A cycle

- 11 If it is 10:35 am in Vancouver (UTC -8) what is the local time in Paris (UTC +1)?

(A) 1:35 am

(B) 5:35 pm

(C) 3:35 am

(D) 7:35 pm

12 Convert 8.5 m^2 to cm^2 ?

(A) 85

(B) 8 500

(C) 850

(D) 85 000

13 The Whitney Hotel in London offers the following menu options for its Christmas Lunch.

Starters

HOMEMADE CARROT AND CORIANDER SOUP
Served with a warm, crusty roll and butter

PRAWN COCKTAIL
Imported prawns served with a baby leaf salad, Marie Rose sauce, brown bread and butter

HOMEMADE DUCK AND PORK TERRINE
Served with a crusty roll and our chef's own recipe special plum chutney

Mains

CHRISTMAS DINNER
Roasted Turkey and all the traditional trimmings

ROAST SALMON
Served in a creamy white wine, asparagus, chive, and lobster reduction

BEEF MEDALLIONS
Pan fried in a jus sauce of wild mushrooms and cream

VEGETARIAN NUT ROAST
Nut roast with all the trimmings

Desserts

CHRISTMAS PUDDING WITH BRANDY SAUCE

HOMEMADE STICKY TOFFEE PUDDING & A RICH TOFFEE SAUCE

HOMEMADE LEMON CHEESECAKE WITH MIXED FRUIT COULIS

How many 3-course selections are possible?

(A) 3

(B) 24

(C) 10

(D) 36

14 What is the effect of a 40% increase, followed by a 40% decrease on a sum of money?

(A) An overall increase on the original amount.

(B) An overall decrease on the original amount.

(C) No change to the original amount.

(D) Not enough information has been provided.

15 Rachel measures the length of a window to be 250 cm, correct to the nearest centimetre. What is the percentage error in her measurement?

(A) $\pm 0.002\%$

(B) $\pm 0.004\%$

(C) $\pm 0.2\%$

(D) $\pm 0.4\%$

End of Section I

Section II

85 marks

Attempt all questions

Allow about 2 hours and 5 minutes for this section

Answer each question in the space provided.

Show all relevant working in questions involving calculations.

Additional writing space is available at the back of this booklet.

Question 16 (15 marks)

- a) Allison uses a dishwasher with a rating of 800 W for 2.5 hours each day. Find the daily cost of electricity for using the dishwasher if electricity is charged at a rate of 21.40 cents per kWh. [2]

$$800\text{W} = 0.8\text{ kW}$$

$$\begin{aligned}\text{Energy used} &= 0.8 \times 2.5 \\ &= 2\text{ kWh}\end{aligned}$$

$$\begin{aligned}\text{Daily cost} &= 2 \times 0.214 \\ &= 0.428 \\ &= \$0.43 \text{ (nearest c)}\end{aligned}$$

- b) Maddie and Annie made a seesaw as per diagram below. It is known that the weight of a person, w , varies inversely to the distance of a person to the middle of the seesaw, d .

The equation $w = \frac{k}{d}$, where k is a constant, models this situation.



- i) Given that Maddie weighs 65 kg and is sitting 1.20m away from the middle of the seesaw, find the value of the constant, k and state the equation of the relationship. [2]

$$65 = \frac{k}{1.20}$$

$$\therefore k = 78$$

$$\therefore w = \frac{78}{d}$$

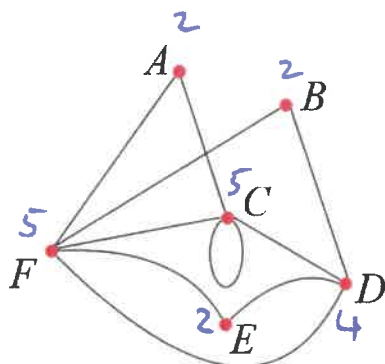
- ii) Annie weighs 40 kg. Find the distance at which she needs to sit for the seesaw to work. [2]

For $w = 40$, find d .

$$40 = \frac{78}{d}$$

$$\begin{aligned}40d &= 78 \\ \therefore d &= \frac{78}{40} \\ &= 1.95\text{ m}\end{aligned}$$

c) Consider the network below.



i) State the number of edges in the network. [1]

10

ii) Find the sum of the degrees of the vertices in the network? [1]

$$\begin{aligned} \text{Sum of degrees} &= 2 + 2 + 5 + 5 + 2 + 4 \\ &= 20 \end{aligned}$$

iii) Write one path that includes all of the vertices. [1]

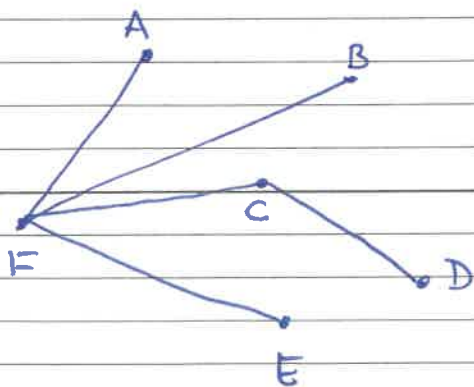
A path is a walk that doesn't visit any vertex more than once.

eg. ACDEFB

iv) Does this network have an Eulerian trail? Explain why. [2]

Yes, as this network has exactly two odd vertices F and C.

v) Find one spanning tree for this network. [1]



- d) Monique purchased new appliances after renovating her home. The appliances depreciate at a rate of 15% per annum. After the three years, the appliances are worth \$19 770.

What was the original purchase price of the appliances? Give your answer correct to the nearest dollar. [2]

$$S = V_0 (1 - r)^n$$

$S = \$19\,770$
 $r = 0.15$
 $n = 3$
Find V_0

$$19\,770 = V_0 (1 - 0.15)^3$$
$$\therefore V_0 = \frac{19\,770}{(1 - 0.15)^3}$$
$$= 32\,192.14329$$
$$= \$32\,192 \text{ (nearest \$)}$$

- e) There are 2 480 phone numbers on a list. Every 8th number is phoned.

What type of sampling is this?

Systematic sampling [1]

End of Question 16

Question 17 (15 marks)

- a) A three-digit number is made up of the digits 4, 5 and 8. If the digits are not repeated, what is the probability that the number:

i) ^{even} is odd? There are 6 possible outcomes: [1]

458, 485, 548, 584, 845, 854

$$P(\text{even}) = \frac{4}{6} \\ = \frac{2}{3}$$

ii) ends in 5? [1]

$$P(\text{ends in 5}) = P(485 \text{ or } 845) \\ = \frac{2}{6} \\ = \frac{1}{3}$$

- b) Given $BAC_{\text{MALE}} = \frac{10N - 7.5H}{6.8M}$ calculate the BAC for a 95 kilogram male who has consumed 3 standard drinks between 7pm and 11.30pm. [1]

$$N = 3 \\ M = 95 \text{ kg} \\ H = 2.5$$

$$BAC = \frac{10 \times 3 - 7.5 \times 2.5}{6.8 \times 95}$$

$$= 0.017412...$$

$$\approx 0.02 \text{ (2d.p.)}$$

- c) Mel leaves Darwin (UTC +9.5) at 1.40 pm on Monday and arrives in Singapore (UTC +8) at 4.50 pm on Monday. How long is Mel's direct flight from Darwin to Singapore? [2]

Mel left Darwin at 12.10 Singapore time

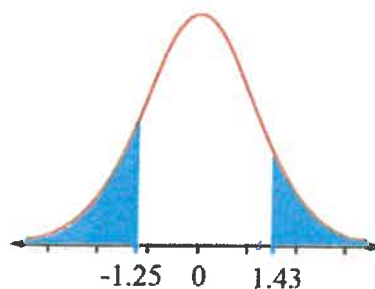
From 12.10 PM to 4.50 PM : 4.40 min

- b) For a data set that is normally distributed and z is the standardised score, find the following using the table of standard normal distribution below:

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.50000	.50399	.50798	.51197	.51595	.51994	.52392	.52790	.53188	.53586
0.1	.53983	.54380	.54776	.55172	.55567	.55966	.56360	.56749	.57142	.57535
0.2	.57926	.58317	.58706	.59095	.59483	.59871	.60257	.60642	.61026	.61409
0.3	.61791	.62172	.62552	.62930	.63307	.63683	.64058	.64431	.64803	.65173
0.4	.65542	.65910	.66276	.66640	.67003	.67364	.67724	.68082	.68439	.68793
0.5	.69146	.69497	.69847	.70194	.70540	.70884	.71226	.71566	.71904	.72240
0.6	.72575	.72907	.73237	.73565	.73891	.74215	.74537	.74857	.75175	.75490
0.7	.75804	.76115	.76424	.76730	.77035	.77337	.77637	.77935	.78230	.78524
0.8	.78814	.79103	.79389	.79673	.79955	.80234	.80511	.80785	.81057	.81327
0.9	.81594	.81859	.82121	.82381	.82639	.82894	.83147	.83398	.83646	.83891
1.0	.84134	.84375	.84614	.84849	.85083	.85314	.85543	.85769	.85993	.86214
1.1	.86433	.86650	.86864	.87076	.87286	.87493	.87698	.87900	.88100	.88298
1.2	.88493	.88686	.88877	.89065	.89251	.89435	.89617	.89796	.89973	.90147
1.3	.90320	.90490	.90658	.90824	.90988	.91149	.91308	.91466	.91621	.91774
1.4	.91924	.92073	.92220	.92364	.92507	.92647	.92785	.92922	.93056	.93189
1.5	.93319	.93448	.93574	.93699	.93822	.93943	.94062	.94179	.94295	.94408

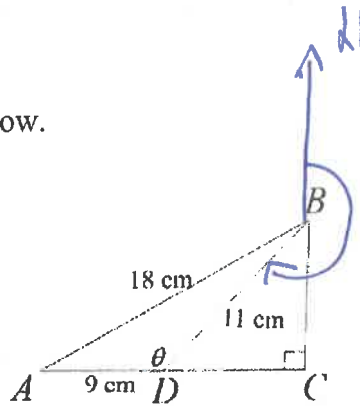
i) $P(z > 1.43)$ $P(z > 1.43) = 1 - P(z < 1.43)$ [2]
 $= 1 - 0.92364$
 $= 0.07636$

- ii) What is the probability that a randomly chosen score has a z -score that falls into the shaded areas on the diagram below?



$P(z < -1.25 \text{ or } z > 1.43) = P(z < -1.25) + P(z > 1.43)$ [2]
 $= P(z > 1.25) + P(z > 1.43)$
 $= 1 - P(z < 1.25) + P(z > 1.43)$
 $= 1 - 0.89435 + 0.07636$
 $= 0.18201$

c) Consider the diagram below.



i) Use the cosine rule to show that $\theta = 128^\circ$, correct to the nearest degree. [2]

$$\begin{aligned} \cos \theta &= \frac{AD^2 + BD^2 - AB^2}{2 \times AD \times BD} & \therefore \theta &= 128.036\dots \\ &= \frac{9^2 + 11^2 - 18^2}{2 \times 9 \times 11} & &\approx 128^\circ \\ &= -0.6161\dots \end{aligned}$$

ii) What is the angle of elevation of B from D . [1]

Angle of elevation of B from D is $\angle BDC$

$$\begin{aligned} \angle BDC &= 180^\circ - \theta & \text{(Angles on a straight line add up to } 180^\circ\text{)} \\ &= 180^\circ - 128^\circ \\ &\approx 52^\circ \end{aligned}$$

iii) Find the bearing of D from B . [1]

$$\begin{aligned} \angle DBC &= 180^\circ - 90^\circ - 52^\circ & \text{Bearing of } D \text{ from } B &= 180^\circ + \angle DBC \\ &\approx 38^\circ & &= 180^\circ + 38^\circ \\ & & &= 218^\circ \end{aligned}$$

iv) Find the length of AC . [2]

$$AC = AD + DC \quad \rightarrow \text{To find}$$

$$\text{In } \triangle BCD: \sin \angle DBC = \frac{DC}{BD}$$

$$\begin{aligned} \therefore DC &= \sin \angle DBC \times BD \\ &= \sin 38^\circ \times 11 \\ &= 6.772276\dots \end{aligned}$$

$$\begin{aligned} \therefore AC &= 9 + 6.8 \\ &= 15.8 \text{ cm} \end{aligned}$$

End of Question 17

Question 18 (15 marks)

- a) The side of the square base of one of the smaller pyramids in Giza has length of 1.4 cm on the map.

The scale used is 1:15000.



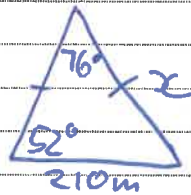
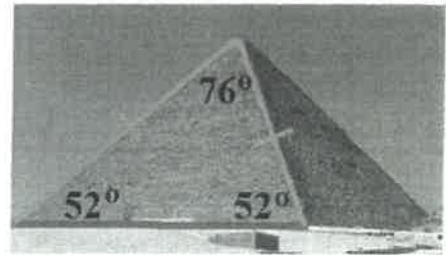
- i) What is the actual length of the side of the pyramid's base in metres? [1]

$$1 : 15000 = \text{Scaled} : \text{Actual} (= 1.4 \text{ cm} : \text{Actual } L)$$

$$\begin{aligned} \therefore \text{Actual } L &= 15000 \times 1.4 \text{ cm} \\ &= 21000 \text{ cm} \\ &= 210 \text{ m} \end{aligned}$$

- ii) Each side of the pyramid forms an isosceles triangle as per diagram on the right.

Find the actual length of the slant edge of the pyramid.



$$\text{Sine rule : } \frac{x}{\sin 52^\circ} = \frac{210}{\sin 76^\circ}$$

$$\begin{aligned} \therefore x &= \frac{210 \times \sin 52^\circ}{\sin 76^\circ} \\ &= 170.5482 \\ &= 170.5 \text{ m (1 d.p.)} \end{aligned}$$

- iii) The ratio of base edges of the smaller to larger pyramids are in the ratio 7:13.

Find the area of the square base of the larger pyramid.



First find larger edge.

$$\text{Small : Large} = 7 : 13 = 210 : \text{Large}$$

$$\begin{aligned} \text{Large} &= \frac{13 \times 210}{7} \\ &= 390 \text{ m} \end{aligned}$$

$$A = s^2$$

$$= 390^2$$

$$= 152100 \text{ m}^2$$

- b) The volume of a sphere is 4988.92 cm^3 . Find, correct to 1 decimal place, the sphere's:

i) radius. $V = 4988.92 \text{ cm}^3$ [2]

$$V = \frac{4}{3}\pi r^3$$

$$\therefore r^3 = \frac{V}{\frac{4}{3}\pi}$$

$$= \frac{4988.92}{\frac{4}{3}\pi}$$

$$= 1191.0169\dots$$

$$\therefore r = \sqrt[3]{1191.0169\dots}$$

$$= 10.6 \text{ cm (1 d.p.)}$$

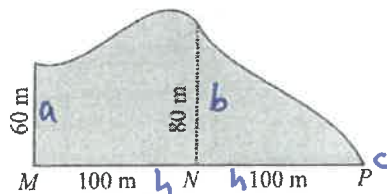
ii) surface area. $A = 4\pi r^2$, $r = 10.6 \text{ cm}$ [2]

$$\therefore A = 4\pi \times 10.6^2$$

$$= 1411.957\dots$$

$$= 1412.0 \text{ cm}^2 \text{ (1 d.p.)}$$

- c) i) Use the Trapezoidal rule to estimate the area of the reservoir in the diagram below. Answer correct to the nearest square metre. [2]



$$A = \frac{(a+b)h}{2} + \frac{(b+c)h}{2}$$

$$= \frac{(60+80)100}{2} + \frac{(80+0)100}{2}$$

$$= 11000 \text{ m}^2$$

- ii) What is the capacity of the reservoir in ML, if it is 2.4 m deep? [2]

$$V = A \times \text{Depth}$$

$$= 11000 \times 2.4$$

$$= 26400 \text{ m}^3$$

$$1 \text{ m}^3 = 1000 \text{ L}$$

$$\text{Capacity} = 26400 \times 1000 \text{ L}$$

$$= 26.4 \text{ ML}$$

- d) The table below shows the future value of an annuity with a contribution of \$1.

Period	Interest rate per period									
	2%	2.5%	3%	3.5%	4%	4.5%	5%	5.5%	6%	8%
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0200	2.0250	2.0300	2.0350	2.0400	2.0450	2.0500	2.0550	2.0600	2.0800
3	3.0604	3.0756	3.0909	3.1062	3.1216	3.1370	3.1525	3.1680	3.1836	3.2464
4	4.1216	4.1525	4.1836	4.2149	4.2465	4.2782	4.3101	4.3423	4.3746	4.5061
5	5.2040	5.2563	5.3091	5.3625	5.4163	5.4707	5.5256	5.5811	5.6371	5.8666
6	6.3081	6.3877	6.4684	6.5502	6.6330	6.7169	6.8019	6.8881	6.9753	7.3359
7	7.4343	7.5474	7.6625	7.7794	7.8983	8.0192	8.1420	8.2669	8.3938	8.9228
8	8.5830	8.7361	8.8923	9.0517	9.2142	9.3800	9.5491	9.7216	9.8975	10.6366
9	9.7546	9.9545	10.1591	10.3685	10.5828	10.8021	11.0266	11.2563	11.4913	12.4876
10	10.9497	11.2034	11.4639	11.7314	12.0061	12.2882	12.5779	12.8754	13.1808	14.4866
11	12.1687	12.4835	12.8078	13.1420	13.4864	13.8412	14.2068	14.5835	14.9716	16.6455
12	13.4121	13.7956	14.1920	14.6020	15.0258	15.4640	15.9171	16.3856	16.8699	18.9771
15	17.2934	17.9319	18.5989	19.2957	20.0236	20.7841	21.5786	22.4087	23.2760	27.1521
18	21.4123	22.3863	23.4144	24.4997	25.6454	26.8551	28.1324	29.4812	30.9057	37.4502
20	24.2974	25.5447	26.8704	28.2797	29.7781	31.3714	33.0660	34.8683	36.7856	45.7620

- i) Angela is saving for a holiday by contributing \$500 into an annuity that pays interest at the rate of 8% p.a., compounded quarterly. Use the table above to find how much she will have in 2 years' time.

[1]

$$\begin{aligned} \text{Period} &= 2 \times 4 \\ &= 8 \end{aligned}$$

$$\begin{aligned} FV &= a \times X \\ &= \$500 \times 8.5830 \\ &= \$4291.50 \end{aligned}$$

$$\begin{aligned} \text{Rate} &= 8\% \text{ p.a.} \\ &= 2\% \text{ p. quarter} \end{aligned}$$

- ii) Milla is saving for the same trip and needs \$7000 in total. How much more than Angela does she need to contribute each quarter, using the same annuity, if she wishes to have enough money in 2 years' time?

[2]

$$\begin{aligned} FV &= \$7000 \\ X &= 8.5830 \\ \text{Find } a. \end{aligned}$$

$$\begin{aligned} FV &= a \times X \\ \therefore a &= \frac{FV}{X} \\ &= 815.5656... \\ &= \$815.57 \text{ (nearest c)} \end{aligned}$$

$$\begin{aligned} \text{More than Angela} &= \$815.57 - \$500 \\ &= \$315.57 \end{aligned}$$

End of Question 18

Question 19 (15 marks)

- a) Belinda wishes to invest her savings into shares and is considering two suitable options.

Option 1: 1500 shares which have a market price of \$2.15 each, with dividend yield of 15% and brokerage of 3%.

Option 2: 1000 shares which have a market price of \$3.45 each and pay dividend of 32 cents per share. Brokerage is 2.5%.

- i) Which option will cost less in terms of brokerage? [1]

$$\begin{aligned} \text{Brokerage 1} &= 3\% \times 1500 \times 2.15 \\ &= \$96.75 \end{aligned}$$

$$\begin{aligned} \text{Brokerage 2} &= 2.5\% \times 1000 \times 3.45 \\ &= \$86.25 \end{aligned}$$

Option 2 is cheaper in terms of brokerage.

- ii) Which option is cheaper in terms of total cost of purchasing shares? [2]

$$\begin{aligned} \text{Total cost 1} &= \text{Brokerage 1} + \text{Cost of shares} \\ &= 96.75 + 1500 \times 2.15 \\ &= \$3321.75 \end{aligned}$$

$$\begin{aligned} \text{Total cost 2} &= \text{Brokerage 2} + \text{Cost of shares} \\ &= 86.25 + 1000 \times 3.45 \\ &= \$3536.25 \end{aligned}$$

Option 1 is cheaper in terms of total cost.

- iii) Belinda chose Option 2. Find her expected dividend yield. [1]

$$\begin{aligned} \text{Dividend yield} &= \frac{\text{Dividend}}{\text{Market price}} \times 100\% \\ &= \frac{0.32}{3.45} \times 100\% \\ &= 9.2753\% \\ &= 9.28\% \quad (\text{2 d.p.}) \end{aligned}$$

- iv) Belinda suddenly needs to cash in her shares. She managed to sell them at the market price of \$3.55, but had to pay a higher brokerage fee of 2.9%. [2]

Did she made a profit or loss with this sale? Calculate this amount.

$$\begin{aligned} \text{Amount obtained} &= \text{Selling income} - \text{Brokerage} \\ &= 1000 \times 3.55 - 2.9\% \times 1000 \times 3.55 \\ &= \$3447.05 \end{aligned}$$

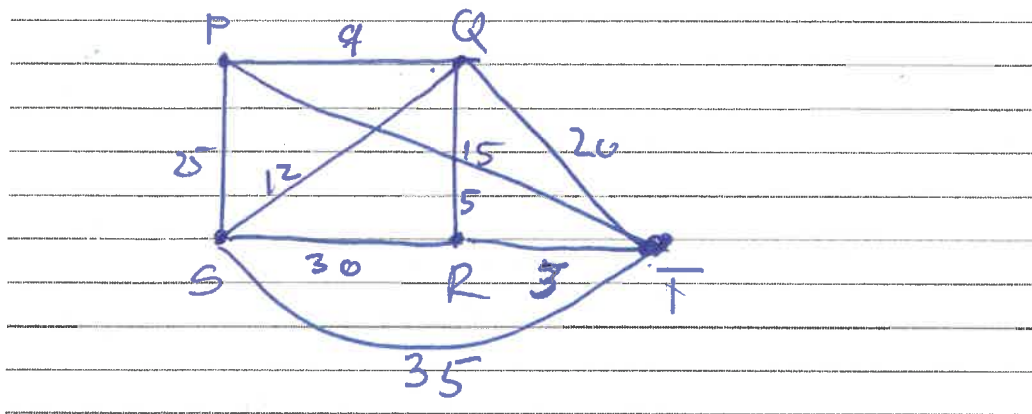
Amount obtained < Total cost of shares
∴ she made a loss

$$\begin{aligned} \text{Loss} &= 3536.25 - 3447.05 \\ &= \$89.20 \end{aligned}$$

b) The table below is used to represent a network.

		TO				
		P	Q	R	S	T
FROM	P	-	9	-	25	15
	Q	9	-	5	12	20
	R	-	5	-	30	3
	S	25	12	30	-	35
	T	15	20	3	35	-

i) Draw a weighted network that is represented by the given table. [2]

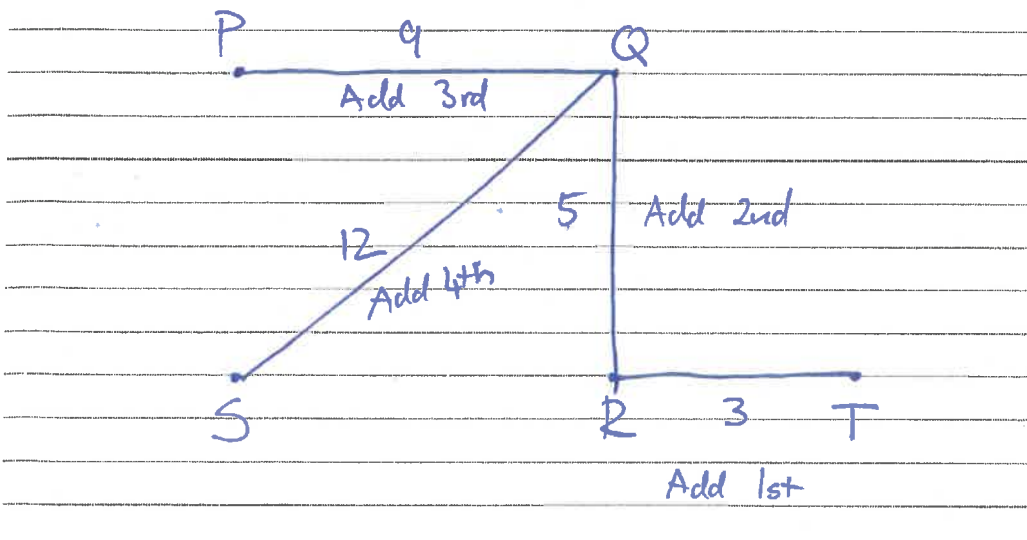


ii) Find the minimum spanning tree. [2]

You can use Kruskal's or Prim's algorithm.
 Kruskal's algorithm: List the edge weights.

RT	QR	PQ	QS	PT	QT	SP	RS	ST
3	5	9	12	15	20	25	30	35

Choose all of the vertices and add edges so they don't form a cycle.



- d) Tilly owns a car which she uses both in the city and in the country.

The fuel consumption rate in the city is 10.5L/100 km.

When she was last in the country, she used 28L of petrol and travelled 350 kilometres.

- i) Show that the fuel consumption rate in the country is 8L/100km. [1]

$$\begin{aligned}\text{Country Fuel consumpt. rate} &= \frac{28\text{L}}{350\text{km}} \\ &= 0.08\text{L}/\text{km} \\ &= 0.08 \times 100\text{L}/100\text{km} \\ &= 8\text{L}/100\text{km}\end{aligned}$$

- ii) Last year, Tilly drove 14 000 km in the city and 20 000 km in the country. [2]
How much fuel did she use in total?

$$\begin{aligned}\text{Amount of fuel} &= \frac{14000}{100} \times 10.5 + \frac{20000}{100} \times 8 \\ &= 3070\text{L}\end{aligned}$$

- iii) Tilly spends an average of \$4 500 on fuel per year. [2]
She is considering switching to a cheaper fuel that costs \$1.30/L. How much money she would have saved last year if she had used this cheaper fuel?

$$\begin{aligned}\text{New fuel cost} &= 3070 \times 1.30 \\ &= \$3991\end{aligned}$$

$$\begin{aligned}\text{Amount saved} &= \$4500 - \$3991 \\ &= \$509\end{aligned}$$

End of Question 19

Question 20 (15 marks)

- a) The cost of catering is related to the number of people attending an event, as per table below.

Number of people - n	5	10	15	20	25	30	35	40	45	50
Cost - C	65	92	110	119	143	162	175	190	204	240

- i) Find, correct to 4 decimal places, Pearson's correlation coefficient, r . [1]

$$r = 0.9946392\dots$$

$$= 0.9946 \text{ (4 d.p.)}$$

- ii) Calculate the mean and standard deviation of the number of people, \bar{x}_n and σ_n . [1]

$$\bar{x}_n = 27.50$$

$$\sigma_n = 14.3614\dots$$

$$= 14.36 \text{ (2 d.p.)}$$

- iii) Calculate the mean and standard deviation of the cost, \bar{x}_c and σ_c . [1]

$$\bar{x}_c = 150$$

$$\sigma_c = 51.5596\dots$$

$$= 51.56 \text{ (2 d.p.)}$$

- iv) Show that the equation of the least-squares line of best fit is given by $C = 3.57n + 51.83$. [2]

$$C = \text{gradient} \times n + y\text{-intercept}$$

$$\text{Gradient} = r \times \frac{\sigma_c}{\sigma_n}$$

$$= 3.5711\dots$$

$$= 3.57 \text{ (2 d.p.)}$$

$$y\text{-intercept} = \bar{x}_c - (\text{Gradient} \times \bar{x}_n)$$

$$= 51.825$$

$$= 51.83 \text{ (2 d.p.)}$$

$$\therefore C = 3.57n + 51.83$$

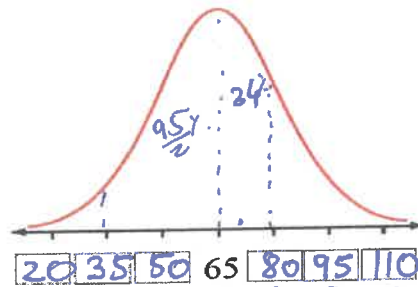
- v) Use the equation to calculate the cost of catering for a hundred people. [1]

$$\text{For } n=100, C = 3.57 \times 100 + 51.83$$

$$= \$408.83$$

- b) A speed camera on the road in outback records car speeds and the results are normally distributed with mean speed of 65 km/h and standard deviation of 15 km/h.

Complete the diagram below by entering the appropriate values in the red boxes.

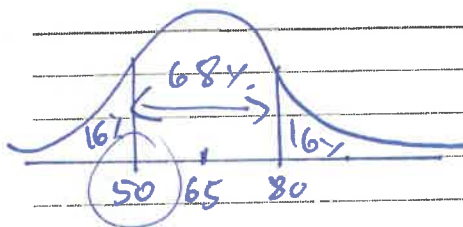


- i) What percentage of drivers drive at a speed between 35 km/h and 80 km/h? [1]

$$P(35 < \text{Score} < 80) = \frac{95}{2}\% + 34\%$$

$$= 81.5\%$$

- ii) Millie was faster than 16% of all drivers. What was her speed? [1]



Millie's speed was 1 st. dev below the mean
 \therefore 50 km/h

- iii) Given that the speed limit is 70 km/h, what percentage of drivers recorded will be fined for exceeding the speed limit? [3]

$$x = 70$$

Find z .

$$z = \frac{x - \bar{x}}{s}$$

$$= \frac{70 - 65}{15}$$

$$= 0.33$$

$$P(z > 0.33) = 1 - P(z < 0.33)$$

$$= 1 - 0.62930$$

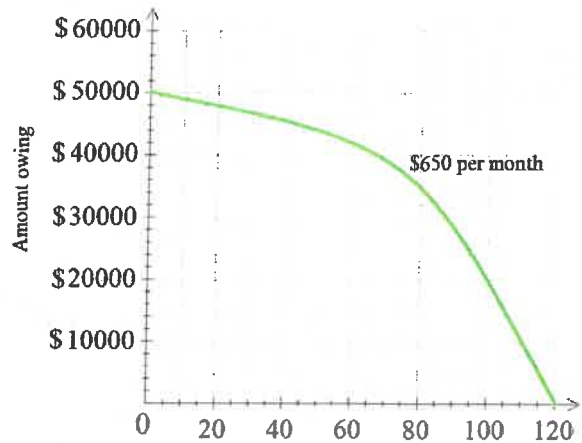
$$= 0.3707$$

$$= 37.07\%$$

z -score for the speed limit is 0.33

c) Ella is considering options for a personal loan of \$50 000.

Option 1: The graph shows the amount owing on her personal loan over a period of time and monthly repayments.



Option 2: Monthly reducible personal loan taken as per table below over the period of 15 years at 7.75% p.a.

Monthly repayment per \$1000 borrowed							
Term in years	7%	7.25%	7.5%	7.75%	8%	8.25%	8.5%
5	\$19.8012	\$19.9194	\$20.0379	\$20.1570	\$20.2765	\$20.3963	\$20.5164
10	\$11.6108	\$11.7401	\$11.8702	\$12.0011	\$12.1328	\$12.2653	\$12.3985
15	\$8.9883	\$9.1286	\$9.2701	\$9.4128	\$9.5566	\$9.7014	\$9.8474
20	\$7.7530	\$7.9036	\$8.0559	\$8.2095	\$8.3644	\$8.5207	\$8.6782
25	\$7.0678	\$7.2281	\$7.3899	\$7.5533	\$7.7182	\$7.8875	\$8.0522
30	\$6.6530	\$6.8218	\$6.9921	\$7.1641	\$7.3377	\$7.5127	\$7.6891

[4]

Find which option is better for Ella by considering the total amount of interest charged and the total Ella can save over the term of the loan.

Option 1:	Option 2:
Loan amount = \$50 000	Loan amount \$50 000
Total repayments = $120 \times \$650$ = \$78 000	Total repayments = 50×9.4128 $\times 15 \times 12$ = \$84 715.20
Interest charged = $78 000 - 50 000$ = \$28 000	Interest charged = \$34 715.20

Option 1 is better as the interest charged is lower.

Amount saved = $34 715.20 - 28 000$
= \$6 715.20

End of Question 20

Question 21 (10 marks)

- a) Sophie wishes to purchase a holiday home at a price of \$340 000. She has a deposit of \$70 000. She will take the loan over 25 years at 9.6% p.a. compounding monthly.

For the first 5 years she wishes to reduce her expenses by making interest only repayments.

- i) Find Sophie's monthly repayment for the first five years of the loan period. [2]

$$\begin{aligned} \text{Loan amount} &= \text{Price} - \text{Deposit} & r &= 9.6\% \text{ p.a.} \\ &= 340\,000 - 70\,000 & &= 0.096 \text{ p.a.} \\ &= 270\,000 & &= 0.096 \div 12 \text{ p.monthly} \\ & & &= 0.008 \end{aligned}$$
$$\text{Interest only repayment} = 0.008 \times 270\,000 = \$2160$$

- ii) Find Sophie's monthly repayment for the remaining loan period. [2]

$n = 20 \text{ years} = 240 \text{ months}$
 $r = 0.008$
 $PV = 270\,000$

PV formula

$$270\,000 = a \left[\frac{(1 + 0.008)^{240} - 1}{0.008 (1 + 0.008)^{240}} \right]$$
$$a = \$2534.41 \quad (2 \text{ d.p.})$$

- iii) Calculate the total amount of interest Sophie pays over the loan period. [2]

$$\begin{aligned} \text{Total paid} &= \text{Interest only period} + \text{Normal period} \\ &= 5 \times 12 \times 2160 + 20 \times 12 \times 2534.41 \\ &= \$737858.40 \end{aligned}$$

$$\begin{aligned} \text{Interest} &= \text{Total paid} - \text{Loan amount} \\ &= 737858.40 - 270\,000 \\ &= \$467858.40 \end{aligned}$$

- b) The annual interest rate on a credit card is 21.5% p.a.
 There is an interest-free period of 55 days for purchases and a 1.5% fee for cash advances (added on at the end of the month).
 Assume there is no interest-free period remaining on the opening balance.

March Statement		
Date	Details	Amount (\$)
1 Mar	Opening balance	450
7 Mar	Purchase	230
12 Mar	Cash advance	100
20 Mar	Payment	-500
25 Mar	Purchase	350

Calculate the balance on this credit card at the end of March.

[4]

$$r = 21.5\% \div 365$$

$$= 0.0589... \%$$

$$= 0.000589 \text{ (6 d.p.)}$$

①

INTEREST BEARING TRANSACTIONS:

* Period: 1 to 6 March (6 days)

$$PV = 450 \quad n = 6$$

$$FV = 450 (1 + 0.000589)^6$$

$$= \$451.59 \text{ (2 d.p.)}$$

* Period: 7th to 11 March (5 days)

$$PV = 451.59 \quad n = 5$$

$$FV = 451.59 (1 + 0.000589)^5$$

$$= \$452.92 \text{ (2 d.p.)}$$

* Period: 12 to 19 March (8 days)

$$PV = 452.92 + 100 \quad n = 8$$

$$= 552.92$$

$$FV = 552.92 (1 + 0.000589)^8$$

$$= \$555.53 \text{ (2 d.p.)}$$

* Period: 20 to 24 March (5 days)

$$PV = 555.53 - 500 \quad n = 5$$

$$= 55.53$$

$$FV = 55.53 (1 + 0.000589)^5$$

$$= \$55.69 \text{ (2 d.p.)}$$

* Period 25 to 31 March (7 days)
PV = 55.69 n = 7

$$FV = 55.69 (1 + 0.000589)^7 \\ = \$55.92 \text{ (2 d.p.)}$$

② CASH ADVANCE FEE:

$$\text{Cash advance fee} = 1.5\% \text{ of } \$100 \\ = \frac{1.5}{100} \times 100 \\ = \$1.5$$

③ INTEREST FREE PURCHASES:

$$\text{Int. free purchases} = 230 + 350 \\ = \$580$$

$$\text{TOTAL BALANCE} = \text{①} + \text{②} + \text{③} \\ = 55.92 + 1.5 + 580 \\ = \$637.42$$

END OF EXAMINATION