**HIGHER SCHOOL CERTIFICATE
TRIAL EXAMINATION
2019**

Mathematics Standard 2

Section I
Multiple Choice Questions

15 marks
Attempt Questions 1-15 (pages 1-7)
Allow about 25 minutes for this section

Instructions
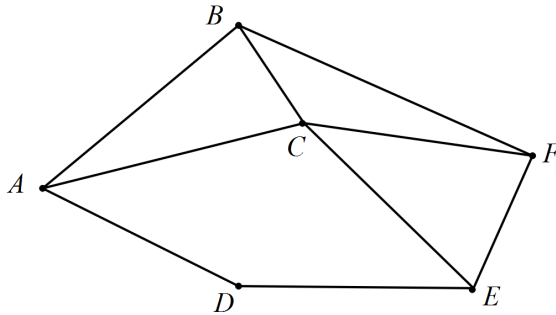- Answer on the multiple choice answer sheet provided.
- Use pencil for questions 1-15

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SECTION I

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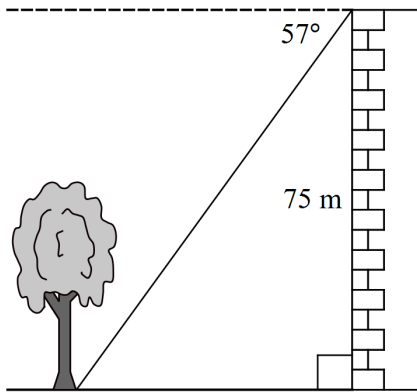**Use the multiple-choice answer sheet for Questions 1-15.**

1

Which of the following represents a cycle in the above network diagram?

(A) D-A-C-F-D

(B) C-F-E-D-C

(C) B-A-D-E-C-B

(D) E-F-C-A-B-E

2 The angle of depression of the base of the tree from the top of the building is 57°. The height of the building is 75 metres.

What is the distance from the base of the building to the base of the tree, correct to the nearest metre?

(A) 49 m

(B) 57 m

(C) 63 m

(D) 115 m

3 Jake's watering can is initially filled with 10 litres of water. However, the watering can has a small hole in the base and is leaking at a rate of 0.7 litres per minute.
What linear equation describes this situation?

(A) $V = -0.7t + 10$

(B) $V = -0.7t - 10$

(C) $V = 0.7t + 10$

(D) $V = 0.7t - 10$

4 Shaun earns a salary of $125 400 and has allowable tax deductions of $2 148.
Use the table below to calculate how much income tax Shaun should pay, not including the Medicare levy.

Taxable income	Tax on this income
0 – $18 200	Nil
$18 201 – $37 000	19c for each $1 over $18 200
$37 001 – $90 000	$3572 plus 32.5c for each $1 over $37 000
$90 001 – $180 000	$20 797 plus 37c for each $1 over $90 000
$180 001 and over	$54 097 plus 45c for each $1 over $180 000

(A) $31 603.90

(B) $31 747.00

(C) $33 100.24

(D) $33 895.00

5   The following graph shows a comparison of petrol consumption for two vehicles with the same fuel tank capacity.

Petrol Consumption

The petrol consumption of the vehicles is measured in Litres/100 km. What is the approximate difference in petrol consumption for the two vehicles?

(A)   4 L/100 km

(B)   4.8 L/100 km

(C)   20.2 L/100 km

(D)   25 L/100 km

6   Sarah has 2 packets of jellybeans. Each packet contains one black and 5 yellow jelly beans.
Sarah takes one jelly bean from each packet without looking.
What is the probability that both of the jelly beans are black?

(A) $\dfrac{1}{36}$

(B) $\dfrac{1}{12}$

(C) $\dfrac{1}{6}$

(D) $\dfrac{1}{3}$

7   The pulse rates of a large group of 18-year-old students are approximately normally distributed with a mean of 75 beats/minute and a standard deviation of 11 beats/minute.
What percentage of 18-year-old students have pulse rates less than 75 beats/minute?

(A)   32%

(B)   50%

(C)   68%

(D)   84%

8   Lucy owns a holiday park and has been quoted $45 per metre to provide connecting paths to each of the cabins, as shown below. All measurements are in metres.

What is the least it will cost Lucy to provide each cabin with at least one path that connects all the cabins?

(A) $6435

(B) $6885

(C) $7470

(D) $8820

9   What is the smallest share if $798 is divided in the ratio 1 : 3 : 2?

(A) $133

(B) $266

(C) $399

(D) $532

10 In $\triangle JKL$, $JK = 95$ cm, $JL = 54$ cm and $KL = 60$ cm.
What is the value of θ?

Not to Scale
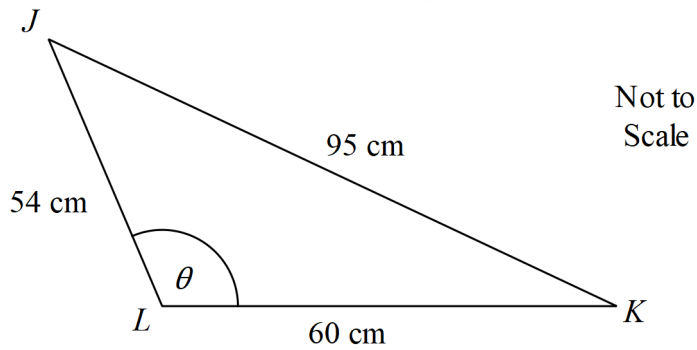
(A) 67°

(B) 113°

(C) 132°

(D) 138°

11 The following table shows the fortnightly repayments required to repay a personal loan at 11.5% p.a. for terms from 2 to 5 years.

Amount borrowed	2 years	3 years	4 years	5 years
$12 000	$269	$190	$151	$127
$16 000	$358	$253	$201	$170
$20 000	$447	$316	$251	$212
$24 000	$536	$379	$301	$254
$28 000	$581	$411	$326	$275
$32 000	$670	$474	$376	$317

Isabelle borrows $28 000 over 5 years. How much interest does she pay?

(A) $7750

(B) $11 500

(C) $16 500

(D) $35 750

12 Torey lists the costs of running his car:

- o Registration $378 annually
- o CTP insurance $546.00 annually
- o Comprehensive Insurance $460.00 annually
- o Mechanical Service/Repairs $450.00 every three months
- o Petrol and Consumables $40.00 weekly

He wants to put money into an account each week to cover these costs and allow an extra 10% contingency in case of unforeseen expenses.
How much (to the nearest dollar) should he deposit each week?

(A) $89

(B) $101.00

(C) $102.00

(D) $111.00

13 Below is a sketch of a sector of a circle.

10 cm Arc length is 12 cm

θ Not to
Scale
10 cm
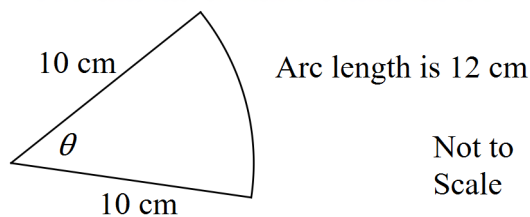
What is the value of θ to the nearest degree?

(A) 47°

(B) 48°

(C) 68°

(D) 69°

14 Henry borrows $420 000 to buy a house. Interest is charged at 7.2% p.a. compounded monthly. At the end of the first month, he makes a $4000 payment. How much does he now owe?

(A) $410 240

(B) $418 496

(C) $418 520

(D) $445 952

15

What is the equation of the graph shown above?

(A) $y = -2.25x$

(B) $y = -9x$

(C) $y = 2.25x$

(D) $y = 9x$

End of Section I

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HIGHER SCHOOL CERTIFICATE
TRIAL EXAMINATION
2019

Mathematics Standard 2

Section II
Answer Booklet

85 marks
Attempt Questions 16-40 (pages 11-28)
Allow about 2 hours and 5 minutes for this section

Instructions

- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of your response.

- Write using black or blue pen. Black is preferred.

- Erasable pens are **not** to be used.

- Your responses should include relevant mathematical reasoning and/or calculations.

- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.

STAFF USE ONLY

	Sub Total	Teacher's Initials
Pages 11-14	/16	
Pages 15-18	/19	
Pages 19-22	/18	
Pages 23-25	/16	
Pages 26-28	/16	
Total Section II	/85	

85 marks
Attempt all questions

Answer the questions in the spaces provided.
Your responses should include relevant mathematical reasoning and/or calculations.
Extra writing space is provided at the back of the examination paper.

| **Question 16** | **Marks** |

(a)   Draw the minimum cut on the network diagram below.   **1**

(b)   What is the maximum flow for the network diagram?   **1**

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Question 17   **Marks**

A software company has produced a new game which will be sold on a disc. Each disc
will be sold for $42. If the company produces n discs in a month, their fixed costs
are $3000 and their variable costs are $12.00 per disc.

(a)   Write down the income equation for this company.   **1**

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(b)   Write down the cost equation if n discs are produced.   **1**

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(c)   Graph the above two equations below. Add appropriate labels to the graph.   **2**

(d)   How many discs must be produced and sold for the company to make a profit?   **1**

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Question 18

A computer originally purchased for $6000 is depreciated each year using the declining balance method. If the computer is valued at $2000 after 3 years, what is the annual rate of depreciation closest to the nearest whole number?

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Question 19

The intensity of light (l) on a moving screen varies inversely with the distance (d) from the projector to the screen. If the illumination when the projector is 40 m from the screen is 25 units, what is the illumination when the projector is placed 50 m from the screen?

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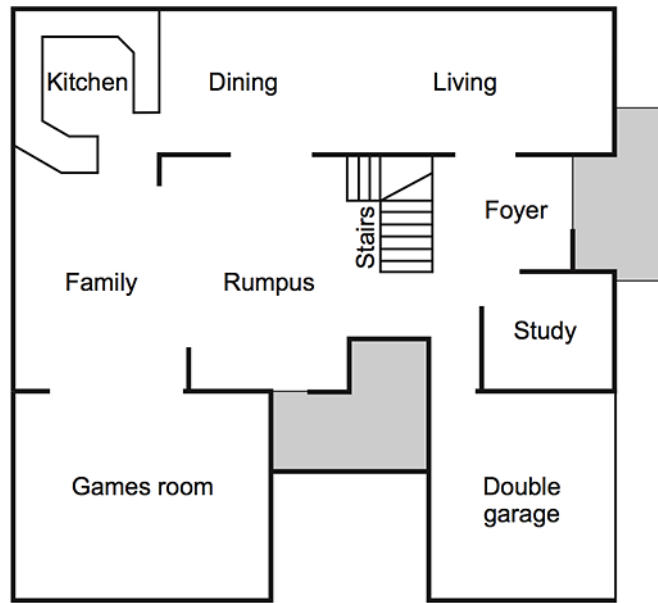
Question 20 **Marks**

The house plan of a ground floor is drawn to scale below. The scale is 1:150.

(a) What is the cost of carpeting the dining and living rooms, if carpet costs $110 per square metre installed? Include GST of 10% in your calculations. **3**

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(b) To conserve water, the owners of the house, have installed a custom-built cylindrical water tank with a base radius of 3.8 metres that stands 3.3 metres tall. Calculate the volume of the tank, correct to the nearest cubic metre. **2**

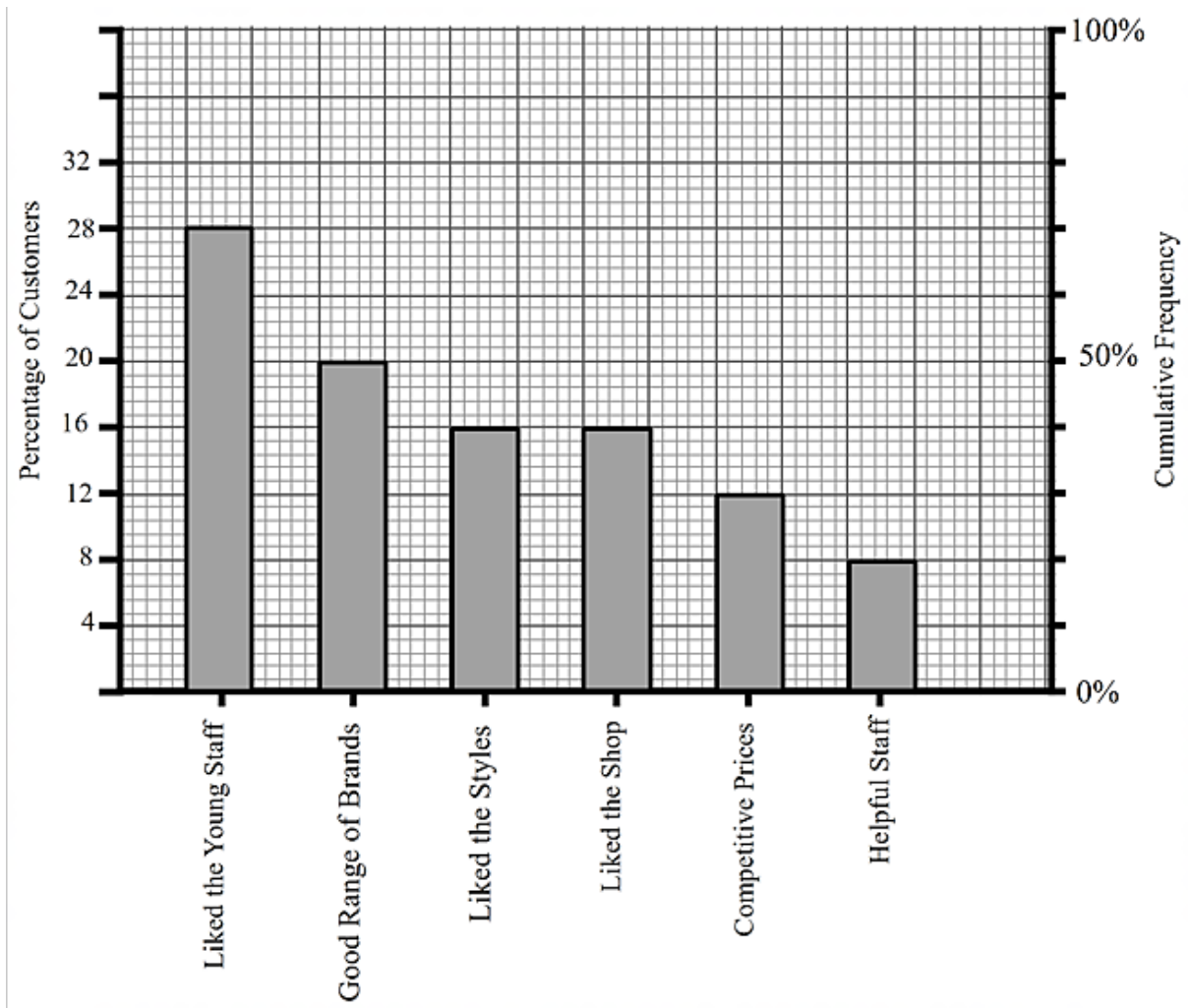..

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Question 21

The chart below shows the reasons that 25 customers gave for shopping at a local clothing store.

After completing appropriate calculations, draw the Pareto line on the chart above.

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Question 22   **Marks**

The scores of three students on their Mathematics and Physics assessments are given below, along with the course mean and standard deviation of each subject.

Subject	Xavier	Yasmin	Zara	$\bar{x}$	s
Mathematics	72	66	85	60	12
Physics	67	72	63	55	8

(a) Convert Yasmin's Mathematics and Physics marks to z-scores and determine which result was better in comparison to the other students in the course.   **2**

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(b) What percentage of students scored higher marks than Zara on the Physics assessment?   **2**

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(c) The top 2.5% of students on each assessment are invited to a talented student's day. Which students would be invited, and on which result would their invitation be based? Justify your answer mathematically.   **2**

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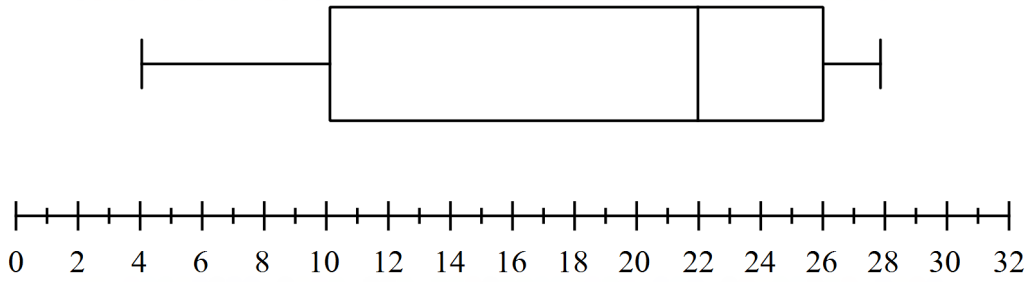
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Question 23

The box plot below shows the distribution of class sizes (number of students) in a school which has 64 separate classes.

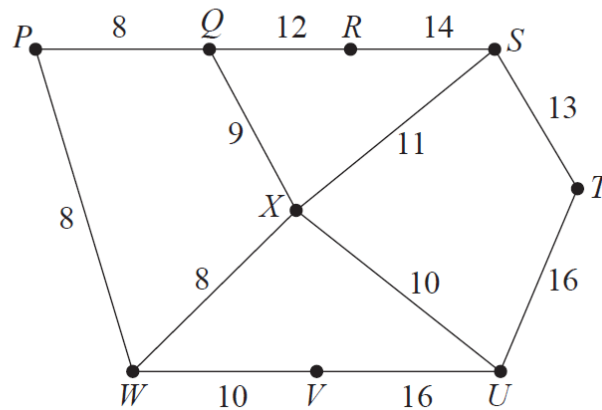(a) How many classes had a size greater than 22 students?

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(b) How many classes had a size between 10 students and 22 students?

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Question 24

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The network diagram shows the time (in minutes) taken to travel between towns.

Find the shortest time it would take to travel from P to T.

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Question 25   **Marks**

North

Aimee leaves her home (*H*) at 8:15 am and travels
on a true bearing of 240˚T arriving at a beach *(B)*
at 9:00 am the same morning to meet friends.
Aimee averaged a speed of 60 km/h travelling
from her home to the beach.

Later in the day, Aimee and her friends
travel due north for 52 km arriving at a motel (*M*).

M

H

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B
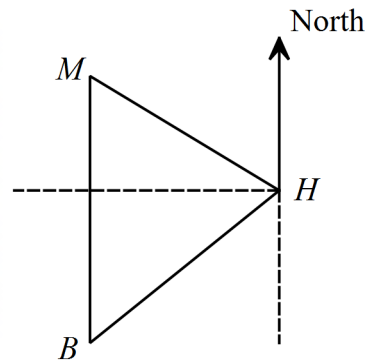
(a)   How far is the beach (*B*) from Aimee's home (*H*)?   **1**

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(b)   Show that $\angle HBM = 60°$.   **1**

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(c)   Find the distance to the motel (*M*) from Aimee's home (*H*).   **2**
       Answer correct to the nearest kilometre.

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(d)   Calculate the size of $\angle MHB$ to the nearest degree.   **2**

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(e)   What is the bearing of the motel from Aimee's home?   **1**

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Question 26 **Marks**

Amelia has this ruler in her pencil case.
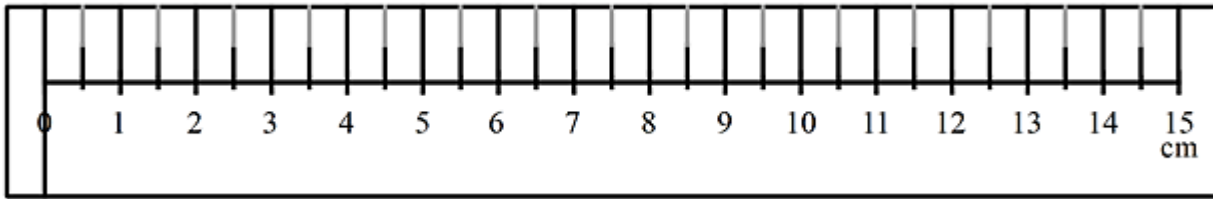
(a)   What was the absolute error when using this ruler?   **1**

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(b)   Amelia used the ruler to measure the width of a rectangle as 12.5 cm.   **1**
      What is the percentage error in this measurement?

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Question 27

Belinda lives in Dubbo, NSW, which is in the Eastern Standard Time zone of UTC + 10.
Felicity lives in Denver, Colorado which is in the time zone of UTC – 7.

(a)   What is the time difference between Dubbo and Denver?   **1**
      (Include which city is ahead, in your answer).

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(b)   If Belinda makes a call to Felicity at 7.30 am on Friday 5th July (Dubbo time), what   **2**
      will be the local date and time in Denver when Felicity receives the call?

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The table below gives the future value of an annuity of $1 per period for various periods and interest rates.

Table of Future Value Interest Factors

r	0.0025	0.0030	0.0035	0.0040	0.0045	0.0050	0.0055	0.0060
53	56.5961	57.3530	58.1230	58.9063	59.7033	60.5141	61.3391	62.1785
54	57.7376	58.5250	59.3264	60.1419	60.9719	61.8167	62.6765	63.5516
55	58.8819	59.7006	60.5340	61.3825	62.2463	63.1258	64.0212	64.9329
56	60.0291	60.8797	61.7459	62.6280	63.5264	64.4414	65.3733	66.3225
57	61.1792	62.0624	62.9620	63.8786	64.8123	65.7636	66.7329	67.7204
58	62.3322	63.2485	64.1824	65.1341	66.1040	67.0924	68.0999	69.1267
59	63.4880	64.4383	65.4070	66.3946	67.4014	68.4279	69.4744	70.5415
60	64.6467	65.6316	66.6359	67.6602	68.7047	69.7700	70.8565	71.9647
61	65.8083	66.8285	67.8692	68.9308	70.0139	71.1189	72.2463	73.3965
62	66.9729	68.0290	69.1067	70.2065	71.3290	72.4745	73.6436	74.8369
63	68.1403	69.2331	70.3486	71.4874	72.6499	73.8368	75.0487	76.2859
64	69.3106	70.4408	71.5948	72.7733	73.9769	75.2060	76.4614	77.7436
65	70.4839	71.6521	72.8454	74.0644	75.3098	76.5821	77.8820	79.2101
66	71.6601	72.8670	74.1004	75.3607	76.6487	77.9650	79.3103	80.6854

(a)   Shaun invests $450 per month in an annuity which pays 3.6% p.a. compounding   **1**
        monthly. What will be the value of the annuity after 62 months?

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(b)   An annuity has a value of $64 000 after being invested for four and a half years at   **2**
        a rate of 6.6% p.a. compounded monthly.
        How much was invested in the annuity each month?

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Find the area of the above triangle. Answer correct to one decimal place.

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Question 30

The project plan for the implementation of a new IT system is shown below.
Time is measured in days.

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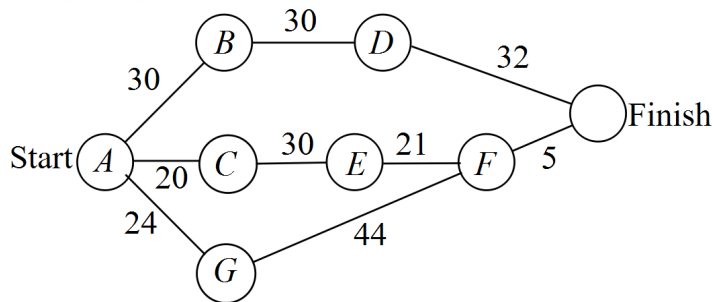
Find the earliest completion time.

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Question 31

Marks

The mass of 500 sloths is normally distributed. The mean is 4.5 kilograms and standard deviation 500 grams.

(a) What is the *z*-score of a sloth weighing 5.5 kg?

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(b) What percentage of the sloths are more than 5.5 kg?

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(c) How many sloths will have a weight between 3 kg and 5 kg?

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Question 32

Amelia uses an 1800 W dishwasher for a total of 21 hours during the week. What is the cost of using the dishwasher for a week, if electricity is $0.24 per kWh?

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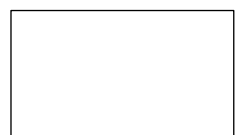
Question 33 **Marks**

Jack has a night out with friends. How many standard drinks can he have in 3 hours to stay under a *BAC* of 0.05 if he weighs 83 kg? **2**

$$BAC \text{ male} = \frac{10N - 7.5H}{6.8M} \quad \text{where}$$

N = number of standard drinks consumed

H = number of hours consuming alcohol

M = mass in kg

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Question 34

Using Young's formula, calculate the adult dose if the child's dose is 20 ml and the child is 3 years 4 months old? **2**

Young's Formula:

$$\text{child dosage} = \frac{yA}{y+12}, \text{ where } A \text{ is the adult dosage and } y \text{ is the child's age in years.}$$

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Question 35

The future value of an investment is $2500 after 4 years. If the interest rate is 8% p.a., calculate the present value of the investment. Answer correct to the nearest cent.

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Question 36

Jessica buys 3 shirts for $29.95 each, a jacket for $299.99 and a pair of shoes for $175 on her credit card.

(a)   How much does Jessica owe on her credit card?

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(b)   This amount stays on her credit card for 72 days. If the compound interest rate is 14.6% p.a. calculate how much Jessica owes altogether on her purchases. There is no interest free period. Answer to the nearest cent.

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Question 37

The table below contains the activities that make up a particular project and their durations, in months.

Activity	Duration (months)	Immediate predecessor
A	3	–
B	4	–
C	5	–
D	6	A
E	5	B, F
F	8	C
G	18	D
H	8	E
J	6	E

(a)   Draw a network diagram for this table.   **2**

(b)   Find the earliest starting times (EST) and latest starting times (LST) for all activities. Show your answers on your network diagram for part (a).   **3**

(c)   What is the critical path for this network?   **1**

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(d)   What is the float time for activity *J*?   **1**

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Question 38   **Marks**

Mr Way has 20 ties in a drawer. There are 12 blue ties and 8 red ties in this drawer.

(a)   Complete the probability tree below.   **2**

(b)   Mr Way reaches into his drawer and pulls out two ties. What is the probability   **1**
that he has pulled out 2 red ties?

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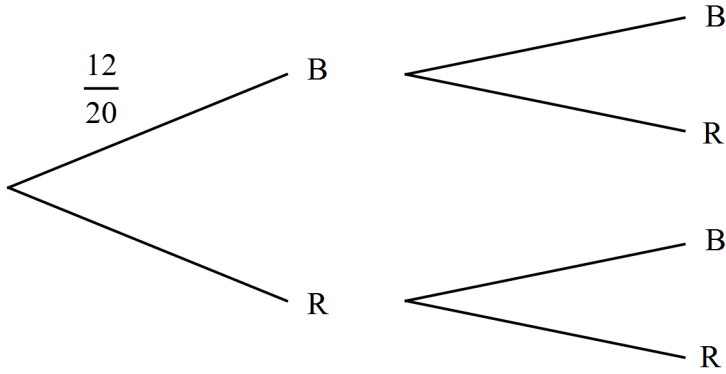
Question 39

A ball is thrown into the air. The relationship between the height, h, above the ground (in metres) and the time, t, for it to fall to that height (in seconds) is given by the formula $h = 32t - 8t^2$.

(a) Complete the table of values for t and h. **2**

t	0	1	2	3	4
h					

(b) Draw the graph of $h = 32t - 8t^2$. **2**
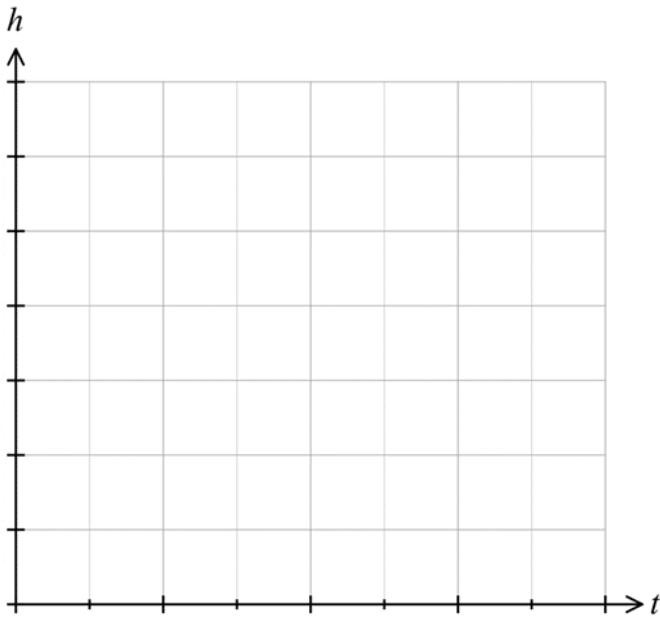
(c) What is the greatest height reached by the ball? **1**

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(d) How long did it take for the ball to hit the ground? **1**

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(e) When did the ball travel the greatest height? **1**

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Question 40   **Marks**

The network diagram below shows a park with 5 gardens that are joined by paths to the gate. The numbers show the distance along the paths in metres.
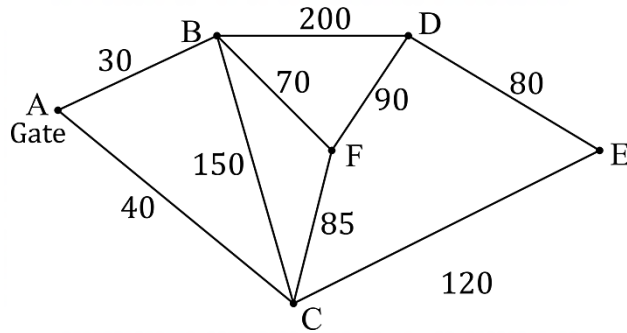
(a)   What is the degree of each vertex?   **2**

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(b)   What is the minimum distance a person would have to walk to visit every garden, starting and ending at the gate?   **2**

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(c)   Each garden needs to be connected by a water pipe located along a path. Draw a minimum spanning tree to indicate the location of the water pipes.   **2**

End of Paper

Section II extra writing space

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Section II extra writing space

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TRIAL EXAMINATION
2019

Mathematics Standard 2

Section I
Multiple Choice Questions

15 marks
Attempt Questions 1-15 (pages 1-7)
Allow about 25 minutes for this section

Instructions
- Answer on the multiple choice answer sheet provided.
- Use pencil for questions 1-15

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SECTION I

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

1

Which of the following represents a cycle in the above network diagram?

(A) D-A-C-F-D

(B) C-F-E-D-C

(C) B-A-D-E-C-B

(D) E-F-C-A-B-E

2   The angle of depression of the base of the tree from the top of the building is 57°. The height of the building is 75 metres.

What is the distance from the base of the building to the base of the tree, correct to the nearest metre?

(A) 49 m

(B) 57 m

(C) 63 m

(D) 115 m

$$\tan 57° = \frac{75}{x}$$

$$x = \frac{75}{\tan 57°}$$

$$x = 48.70556\ldots$$

1

3 Jake's watering can is initially filled with 10 litres of water. However, the watering can has a small hole in the base and is leaking at a rate of 0.7 litres per minute.
What linear equation describes this situation?

(A) $V = -0.7t + 10$

(B) $V = -0.7t - 10$

(C) $V = 0.7t + 10$

(D) $V = 0.7t - 10$

4 Shaun earns a salary of $125 400 and has allowable tax deductions of $2 148.
Use the table below to calculate how much income tax Shaun should pay, not including the Medicare levy.

Taxable income	Tax on this income
0 – $18 200	Nil
$18 201 – $37 000	19c for each $1 over $18 200
$37 001 – $90 000	$3572 plus 32.5c for each $1 over $37 000
$90 001 – $180 000	$20 797 plus 37c for each $1 over $90 000
$180 001 and over	$54 097 plus 45c for each $1 over $180 000

(A) $31 603.90

(B) $31 747.00

(C) $33 100.24

(D) $33 895.00

$125400 - 2148$
$= 123252$

$Tax = 20797 + 0.37 \times (123252 - 90000)$
$= 33100.24$

5   The following graph shows a comparison of petrol consumption for two vehicles with the same fuel tank capacity.

Petrol Consumption

The petrol consumption of the vehicles is measured in Litres/100 km. What is the approximate difference in petrol consumption for the two vehicles?

(A)   4 L/100 km

(B)   4.8 L/100 km

(C)   20.2 L/100 km

(D)   25 L/100 km

6   Sarah has 2 packets of jellybeans. Each packet contains one black and 5 yellow jelly beans. Sarah takes one jelly bean from each packet without looking.
What is the probability that both of the jelly beans are black?

(A) $\dfrac{1}{36}$ $\dfrac{1}{6} \times \dfrac{1}{6}$

(B) $\dfrac{1}{12}$

(C) $\dfrac{1}{6}$

(D) $\dfrac{1}{3}$

3

7 The pulse rates of a large group of 18-year-old students are approximately normally distributed with a mean of 75 beats/minute and a standard deviation of 11 beats/minute.
What percentage of 18-year-old students have pulse rates less than 75 beats/minute?

(A) 32%

(B) 50%

(C) 68%

(D) 84%

8 Lucy owns a holiday park and has been quoted $45 per metre to provide connecting paths to each of the cabins, as shown below. All measurements are in metres.
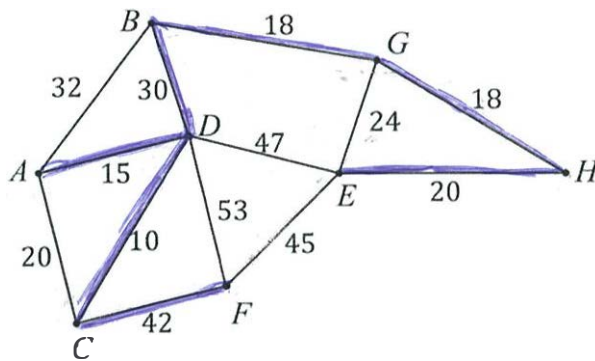
153 × 45

What is the least it will cost Lucy to provide each cabin with at least one path that connects all the cabins?

Minimum spanning tree
⤷ use Kruskal's / Prim's

(A) $6435

(B) $6885

(C) $7470

(D) $8820

9 What is the smallest share if $798 is divided in the ratio 1 : 3 : 2?

6 parts

(A) $133

(B) $266

(C) $399

(D) $532

6 parts = $798

1 part = $133

10 In $\triangle JKL$, $JK = 95\,\text{cm}$, $JL = 54\,\text{cm}$ and $KL = 60\,\text{cm}$.
What is the value of θ?

Not to Scale
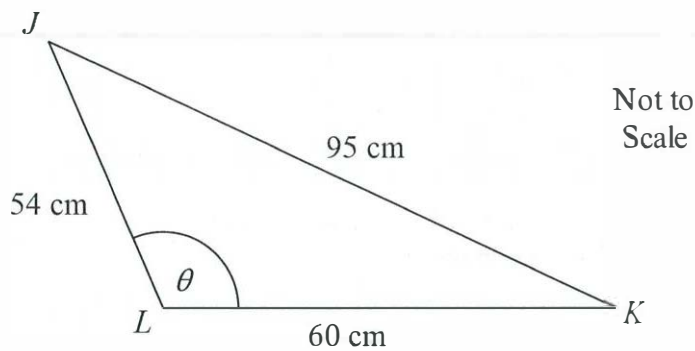
(A) 67°

(B) 113°

(C) 132°

(D) 138°

$$\cos\theta = \frac{54^2 + 60^2 - 95^2}{2(54)(60)}$$

11 The following table shows the fortnightly repayments required to repay a personal loan at 11.5% p.a. for terms from 2 to 5 years.

Amount borrowed	2 years	3 years	4 years	5 years
$12 000	$269	$190	$151	$127
$16 000	$358	$253	$201	$170
$20 000	$447	$316	$251	$212
$24 000	$536	$379	$301	$254
$28 000	$581	$411	$326	$275
$32 000	$670	$474	$376	$317

Isabelle borrows $28 000 over 5 years. How much interest does she pay?

(A) $7750

(B) $11 500

(C) $16 500

(D) $35 750

$5 \times 26 \times \$275$
$= \$35750$

$I = 35750 - 28000$
$= 7750$

5

12 Torey lists the costs of running his car:

handwritten: Weekly

- o Registration $378 annually — *$7.2692*
- o CTP insurance $546.00 annually — *$10.5*
- o Comprehensive Insurance $460.00 annually — *$8.8461538* } *× 1.1*
- o Mechanical Service/Repairs $450.00 every three months — *$34.61538*
- o Petrol and Consumables $40.00 weekly — *$40*

He wants to put money into an account each week to cover these costs and allow
an extra 10% contingency in case of unforeseen expenses.
How much (to the nearest dollar) should he deposit each week?

(A) $89

(B) $101.00

(C) $102.00

(D) $111.00 *(circled)*

13 Below is a sketch of a sector of a circle.

10 cm   Arc length is 12 cm

θ

10 cm   Not to Scale

handwritten:
$$l = \frac{\theta}{360} \times 2\pi r$$
$$12 = \frac{\theta}{360} \times 2\pi (10)$$
$$\theta = 68.7549$$

What is the value of θ to the nearest degree?

(A) 47°

(B) 48°

(C) 68°

(D) 69° *(circled)*

14 Henry borrows $420 000 to buy a house. Interest is charged at 7.2% p.a. compounded
monthly. At the end of the first month, he makes a $4000 payment. How much does he
now owe?

(A) $410 240

(B) $418 496

(C) $418 520 *(circled)*

(D) $445 952

handwritten:
$$P + I - R$$
$$= 420000 + 420000 \times \frac{7.2\%}{12} - 4000$$
$$= 418520$$

15

What is the equation of the graph shown above?

(A) $y = -2.25x$

(B) $y = -9x$

(C) $y = 2.25x$

(D) $y = 9x$

End of Section I

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Mathematics Standard 2

Section II
Answer Booklet

85 marks
Attempt Questions 16-40 (pages 11-28)
Allow about 2 hours and 5 minutes for this section

Instructions

- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of your response.

- Write using black or blue pen. Black is preferred.

- Erasable pens are **not** to be used.

- Your responses should include relevant mathematical reasoning and/or calculations.

- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.

STAFF USE ONLY

	Sub Total	Teacher's Initials
Pages 11-14	/16	
Pages 15-18	/19	
Pages 19-22	/18	
Pages 23-25	/16	
Pages 26-28	/16	
Total Section II	/85	

SECTION II

85 marks
Attempt all questions

Answer the questions in the spaces provided.
Your responses should include relevant mathematical reasoning and/or calculations.
Extra writing space is provided at the back of the examination paper.

Question 16   **Marks**

(a)   Draw the minimum cut on the network diagram below.   **1**
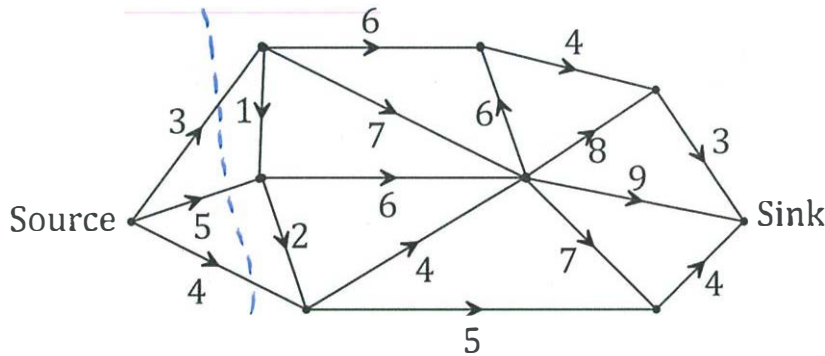
Clear drawing of the minimum cut — ①

(If drew multiple cuts, need to label which is minimum)

(b)   What is the maximum flow for the network diagram?   *Value of Min cut = max flow*   **1**

Minimum Cut = 12
∴ Maximum flow = 12

①

11

Question 17

Marks

A software company has produced a new game which will be sold on a disc. Each disc will be sold for \$42. If the company produces n discs in a month, their fixed costs are \$3000 and their variable costs are \$12.00 per disc.

(a) Write down the income equation for this company.   1

$$I = 42n$$

(b) Write down the cost equation if n discs are produced.   1

$$C = 3000 + 12n$$

(c) Graph the above two equations below. Add appropriate labels to the graph.   2

$I = 42n$

$C = 3000 + 12n$

Need
* *labelled equations*
* *straight lines*
* *correct gradients*

−1 for each error
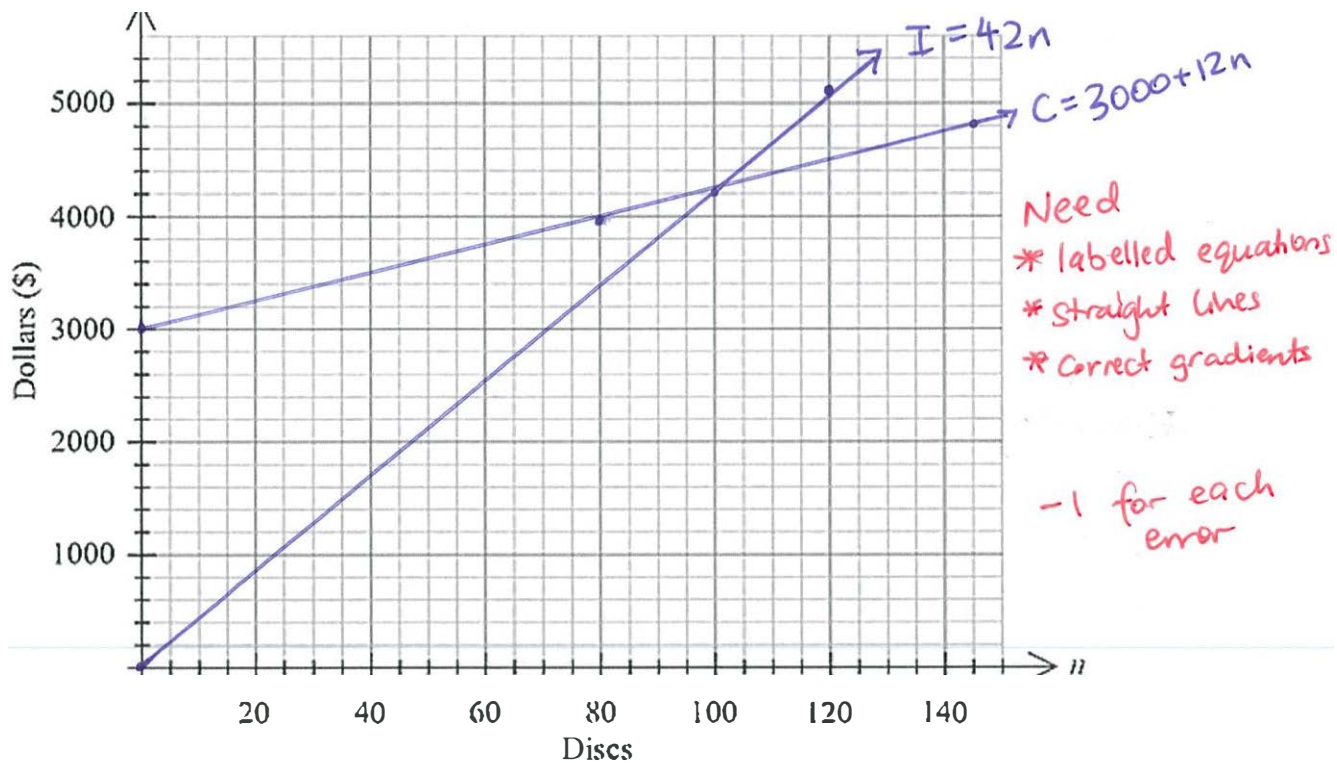
(d) How many discs must be produced and sold for the company to make a profit?   1

More than 100 discs   (accept any number over 100)

12

Question 18

Marks

A computer originally purchased for $6000 is depreciated each year using the declining balance method. If the computer is valued at $2000 after 3 years, what is the annual rate of depreciation closest to the nearest whole number?

2

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

$$2000 = 6000(1-r)^3$$

$$\frac{2000}{6000} = (1-r)^3$$

need this line.

$$\sqrt[3]{\frac{2000}{6000}} = 1-r \quad ①$$

$$1-r = 0.693361274\ldots$$

$$r = 1 - 0.693361274\ldots$$

$$r = 0.306638725\ldots \quad ①$$

$$\therefore \text{Annual rate} = 31\% \text{ (to nearest whole number)}$$

Question 19

The intensity of light (I) on a moving screen varies inversely with the distance (d) from the projector to the screen. If the illumination when the projector is 40 m from the screen is 25 units, what is the illumination when the projector is placed 50 m from the screen?

2

$$I = \frac{k}{d}$$

When $d = 40$, $I = 25$.

$$25 = \frac{k}{40}$$

$$k = 1000 \quad ①$$

$$\boxed{I = \frac{1000}{d}}$$

When $d = 50$, $I = \frac{1000}{50}$

$$= 20$$

$$\therefore \text{Intensity is 20 units} \quad ①$$

Question 20

The house plan of a ground floor is drawn to scale below. The scale is 1:150.

6cm

2cm (accept 1.9cm)

Kitchen   Dining   Living

This drawing
is to scale.

Foyer

Stairs

Family   Rumpus

Study

Games room

Double
garage
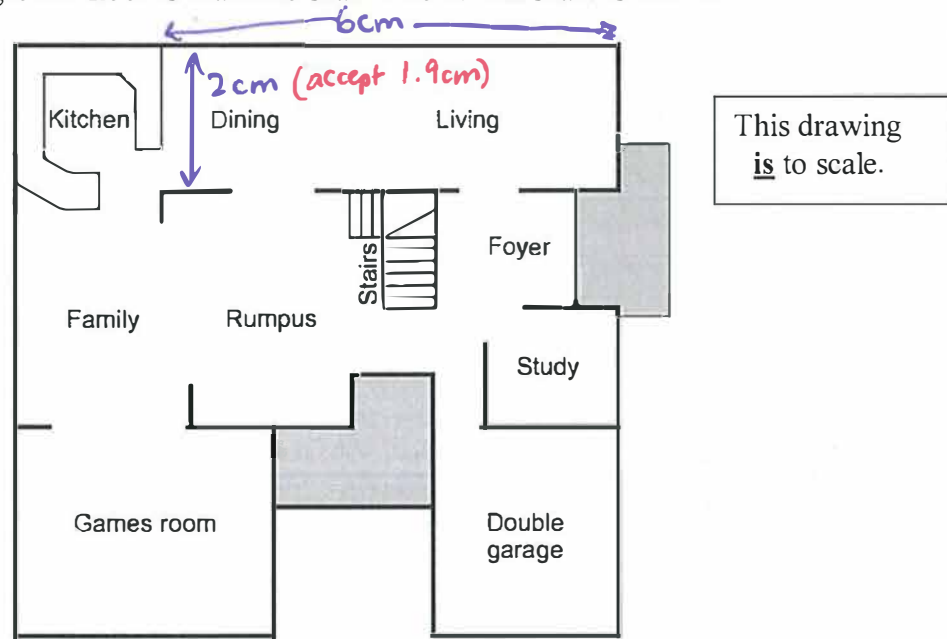
(a) What is the cost of carpeting the dining and living rooms, if carpet costs $110 **3**
per square metre installed? Include GST of 10% in your calculations.

On diagram, length = 6cm
width = 2cm   ①

Actual distances, length = 6×150 = 900cm = 9m
width = 2×150 = 300cm = 3m   ①

Aa of dining/living rooms = 3×9
= 27m²

Cost = 27×110 ×110%
= $3267   ①

(b) To conserve water, the owners of the house, have installed a custom-built **2**
cylindrical water tank with a base radius of 3.8 metres that stands 3.3 metres
tall. Calculate the volume of the tank, correct to the nearest cubic metre.

$V = \pi r^2 h$
$= \pi \times 3.8^2 \times 3.3$ ①
$= 149.7031731...$
$= 150m^3$ (to nearest m^3)   rounding ①

Question 21

Marks

2

The chart below shows the reasons that 25 customers gave for shopping at a local clothing store.

Handwritten annotations on chart:
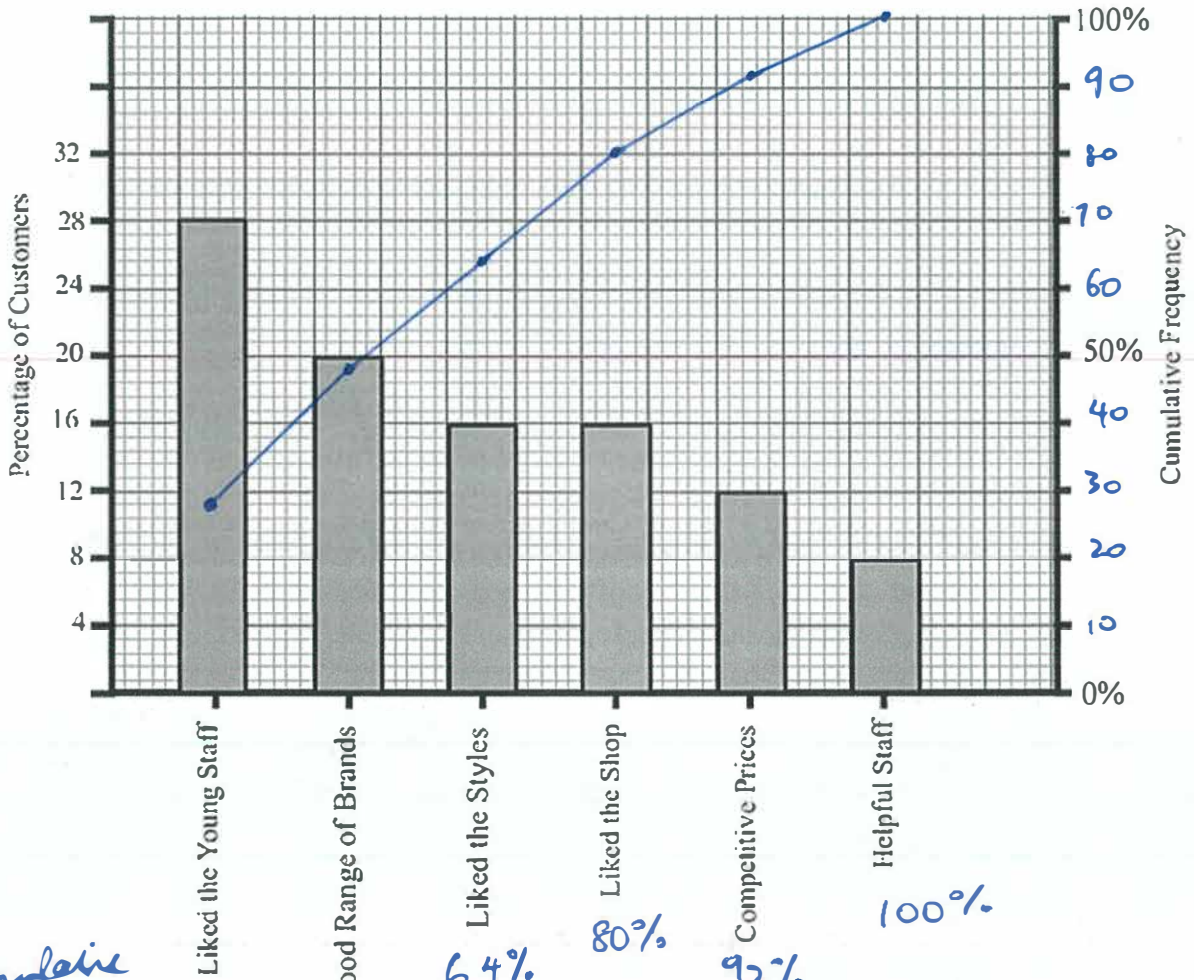
Cumulative frequency (percentage): 28%.

48%

64%

80%

92%

100%

After completing appropriate calculations, draw the Pareto line on the chart above.

Handwritten marking notes (red):
Correct cumulative values —①
Correct plotting & joined line —①

15

Question 22   **Marks**

The scores of three students on their Mathematics and Physics assessments are given below, along with the course mean and standard deviation of each subject.

Subject	Xavier	Yasmin	Zara	$\bar{x}$	s
Mathematics	72	66	85	60	12
Physics	67	72	63	55	8

(a)   Convert Yasmin's Mathematics and Physics marks to z-scores and determine   **2**
which result was better in comparison to the other students in the course.

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

Maths   Physics   Correct z-scores —①
$$z = \frac{66-60}{12}$$ $$z = \frac{72-55}{8}$$ Correct conclusion —①

$$= 0.5$$ $$= 2.125$$

∴ Yasmin did better in Physics compared to other students.

(b)   What percentage of students scored higher marks than Zara on the Physics   **2**
assessment?
$$z = \frac{63-55}{8}$$

$$= 1$$ ①

50% - 34%
$$= 16\%$$ ①

∴ 16% of students scored higher marks than Zara on Physics assessment.

(c)   The top 2.5% of students on each assessment are invited to a talented student's day. **2**
Which students would be invited, and on which result would their invitation be
based? Justify your answer mathematically.

Top 2.5% is the same as having z-score
of 2 and higher.

Maths : need a score of $60 + 2 \times 12$
$$= 84$$
Physics: need a score of $55 + 2 \times 8$
$$= 71$$

∴ Yasmin invited for Physics, Zara invited for Maths

① mathematical justification (z score > 2 or show using diagram)

① correct solution

16

The box plot below shows the distribution of class sizes (number of students) in a school which has 64 separate classes.
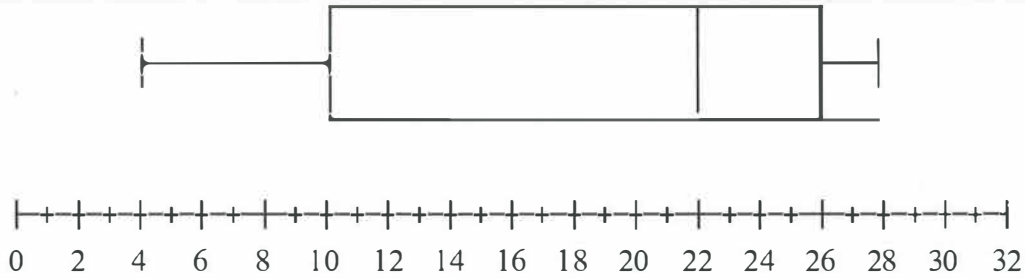
(a) How many classes had a size greater than 22 students?   1

50% of 64 = 32 classes

(b) How many classes had a size between 10 students and 22 students?   1

25% of 64 = 16 classes

Question 24   2

The network diagram shows the time (in minutes) taken to travel between towns.
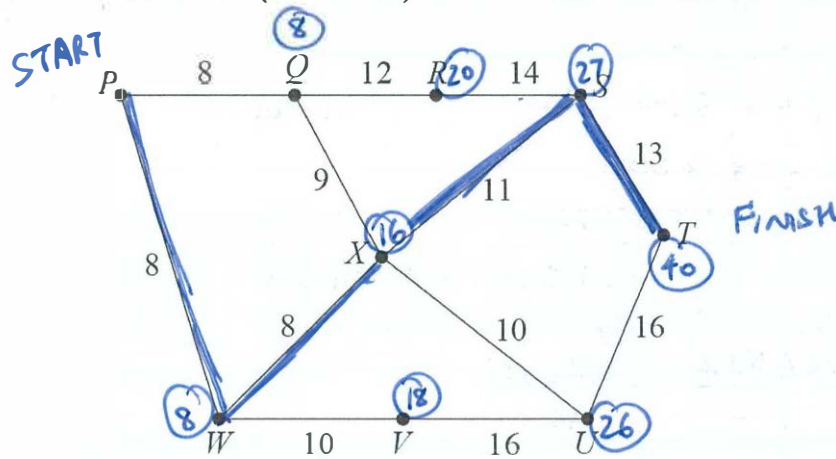
Find the shortest time it would take to travel from P to T.

Shortest path = PW X ST

Correct route ①
Correct time ①

Shortest time = 8 + 8 + 11 + 13

= 40 minutes

Question 25   **Marks**

Aimee leaves her home (*H*) at 8:15 am and travels
on a true bearing of 240°T arriving at a beach (*B*)
at 9:00 am the same morning to meet friends.
Aimee averaged a speed of 60 km/h travelling
from her home to the beach.

Later in the day, Aimee and her friends
travel due north for 52 km arriving at a motel (*M*).
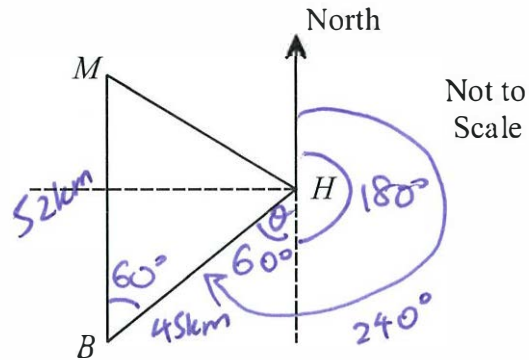
(a) How far is the beach (*B*) from Aimee's home (*H*)?   1

$$\frac{45}{60} \times 60$$

$$= 45 km$$

(b) Show that $\angle HBM = 60°$.   1

Bearing of B from H = 240°

θ on diagram = 240° - 180° = 60°

$\angle HBM = 60°$ (alternate angles on parallel lines)

(c) Find the distance to the motel (*M*) from Aimee's home (*H*).   2
Answer correct to the nearest kilometre.

$$c^2 = a^2 + b^2 - 2ab \cos C$$

$$c^2 = 52^2 + 45^2 - 2(52)(45) \cos 60°$$

$$c^2 = 2389$$

$$c = 48.877397...$$

$$\therefore Distance = 49 km \text{ (to nearest km)}$$
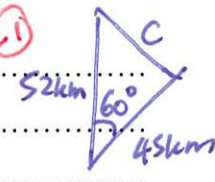
(d) Calculate the size of $\angle MHB$ to the nearest degree.   2

$$\frac{\sin \angle MHB}{52} = \frac{\sin 60°}{48.8773}$$

(or
Cosine
rule)

$$\sin \angle MHB = 0.9213545142...$$

$$\angle MHB = \sin^{-1}(0.9213545...)$$

$$\angle MHB = 67.1249...$$

$$= 67° \text{ (to nearest degree)}$$
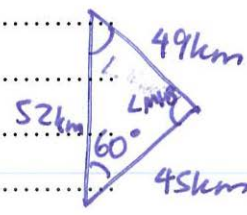
(e) What is the bearing of the motel from Aimee's home?   1

Bearing = 240° + $\angle MHB$

$= 307°$

Question 26

Marks

Amelia has this ruler in her pencil case.
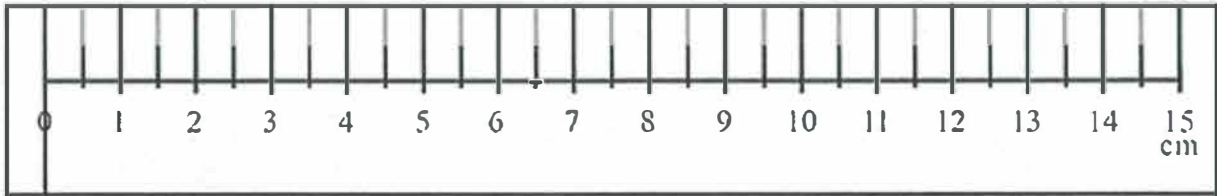
(a) What was the absolute error when using this ruler? **1**

$$\frac{1}{2} \times 0.5 \text{ cm}$$
$$= 0.25 \text{ cm} ✓$$

I | Correct answer
Must include "cm".

(b) Amelia used the ruler to measure the width of a rectangle as 12.5 cm. **1**
What is the percentage error in this measurement?

$$\text{Percentage error} = \frac{0.25}{12.5} \times 100 ✓$$
$$= 2\%$$

I | Correct working
(ecf)

Question 27

Belinda lives in Dubbo, NSW, which is in the Eastern Standard Time zone of UTC + 10.
Felicity lives in Denver, Colorado which is in the time zone of UTC − 7.

(a) What is the time difference between Dubbo and Denver? **1**
(Include which city is ahead, in your answer).

17 hours difference, Dubbo ahead. ✓

I | Correct hours
Correct town.

(b) If Belinda makes a call to Felicity at 7.30 am on Friday 5th July (Dubbo time), what **2**
will be the local date and time in Denver when Felicity receives the call?

Denver = 17 hours behind 7:30am on Fri 5th . July

7.30 am Friday
✓ −12 ↳ 7:30 pm Thursday
−5 ↳ 2:30 pm Thursday

∴ 2:30pm Thursday, 4th July in Denver ✓

I · Subtract hours
2 | Correct answer.

Note: No **ecf** if (a) answer was small → Made easier.

19

Question 28 Marks

The table below gives the future value of an annuity of $1 per period for various periods and interest rates.

	r	0.0025	0.0030	0.0035	0.0040	0.0045	0.0050	0.0055	0.0060
					Table of Future Value Interest Factors				
53		56.5961	57.3530	58.1230	58.9063	59.7033	60.5141	61.3391	62.1785
54		57.7376	58.5250	59.3264	60.1419	60.9719	61.8167	62.6765	63.5516
55		58.8819	59.7006	60.5340	61.3825	62.2463	63.1258	64.0212	64.9329
56		60.0291	60.8797	61.7459	62.6280	63.5264	64.4414	65.3733	66.3225
57		61.1792	62.0624	62.9620	63.8786	64.8123	65.7636	66.7329	67.7204
58		62.3322	63.2485	64.1824	65.1341	66.1040	67.0924	68.0999	69.1267
59		63.4880	64.4383	65.4070	66.3946	67.4014	68.4279	69.4744	70.5415
60		64.6467	65.6316	66.6359	67.6602	68.7047	69.7700	70.8565	71.9647
61		65.8083	66.8285	67.8692	68.9308	70.0139	71.1189	72.2463	73.3965
62		66.9729	68.0290	69.1067	70.2065	71.3290	72.4745	73.6436	74.8369
63		68.1403	69.2331	70.3486	71.4874	72.6499	73.8368	75.0487	76.2859
64		69.3106	70.4408	71.5948	72.7733	73.9769	75.2060	76.4614	77.7436
65		70.4839	71.6521	72.8454	74.0644	75.3098	76.5821	77.8820	79.2101
66		71.6601	72.8670	74.1004	75.3607	76.6487	77.9650	79.3103	80.6854

0.3% per month = 0.003

(a) Shaun invests $450 per month in an annuity which pays 3.6% p.a. compounding monthly. What will be the value of the annuity after 62 months? **1**

$$450 \times 68.0290 \checkmark$$
$$= \$30613.05$$

1. | Correct working

(b) An annuity has a value of $64 000 after being invested for four and a half years at a rate of 6.6% p.a. compounded monthly. How much was invested in the annuity each month? **2**

4½ × 12 = 54 months

= 0.55% per month
= 0.0055

Monthly investment $\checkmark$
$$= 64000 \div 62.6765 \checkmark$$
$$= 1021.11637\ldots$$
$$= \$1021.12 \ (2 \ d.p.)$$

1. | Correct IF

2 | Correct working

Note: Always easier to use the provided table. This is an Annuity question → Don't use a Compound Interest formula.

20

Question 29

B
70°   Not to Scale

5 km

8 km

C

A
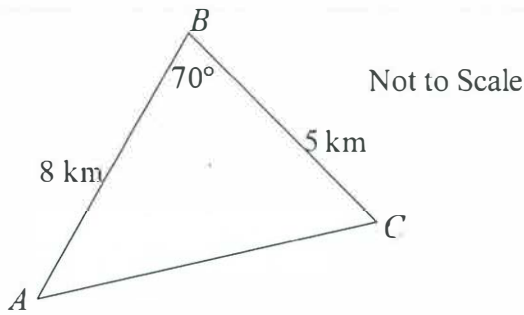
Find the area of the above triangle. Answer correct to one decimal place.

$$Area = \frac{1}{2}ab \sin C$$
$$= \frac{1}{2} \times 8 \times 5 \times \sin 70° ✓$$
$$= 18.79385... ✓$$
$$= 18.8 km^2 \quad (1 d.p.)$$

1 | Correct subst. into $A = \frac{1}{2}ab \sin c$
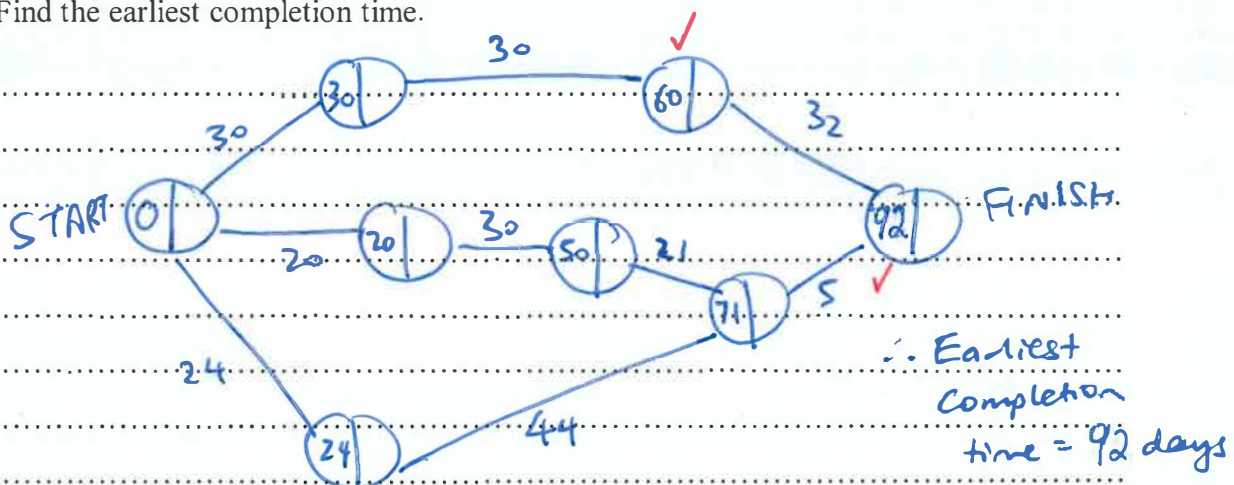*2 | Correct answer (Ignore rounding)*

Question 30

The project plan for the implementation of a new IT system is shown below. Time is measured in days.

2

B ── 30 ── D
30   32
Start A   Finish
20 C ── 30 ── E ── 21 ── F ── 5
24   44
G
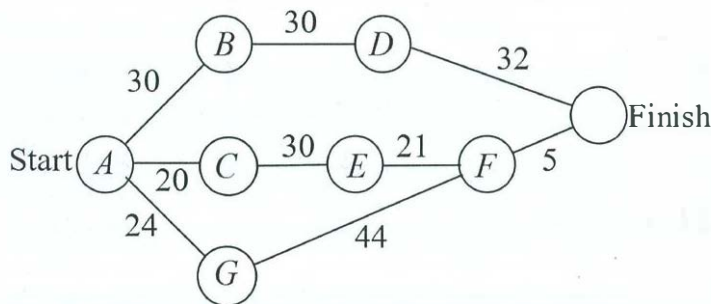
1 | Correct working for EST's.
2 | Correct EST at "finish."

Find the earliest completion time.

START (0)

30 → (30) → 30 → (60) → 32

20 → (20) → 30 → (50) → 21

(74) → 5

24 → (24) → 44

(92) FINISH

∴ Earliest Completion time = 92 days

21

Question 31   **Marks**

The mass of 500 sloths is normally distributed. The mean is 4.5 kilograms and
standard deviation 500 grams. ~ 0.5 kg

(a) What is the z-score of a sloth weighing 5.5 kg?   **1**

$$z = \frac{5.5 - 4.5}{0.5}$$

$$= 2 \quad \checkmark$$

1 | Correct answer

(b) What percentage of the sloths are more than 5.5 kg?   **1**

$$\frac{1}{2}(100\% - 95\%)$$

$$= 2.5\% \quad \checkmark$$

1 | Correct answer

-3 -2 -1 0 1 2 3
                        z
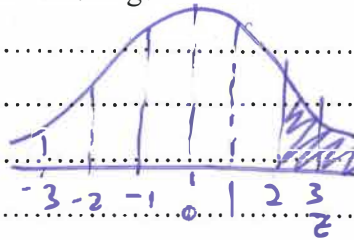
(c) How many sloths will have a weight between 3 kg and 5 kg?   **2**

Note:
RTQ!

3 kg = z-score of -3
5 kg = z-score of 1

99.7%/2   34%

Percentage = 83.85% ✓

83.85% × 500
   = 419.25 ✓
   ≈ 419 sloths

-3 -2 -1 0 1 2 3 z
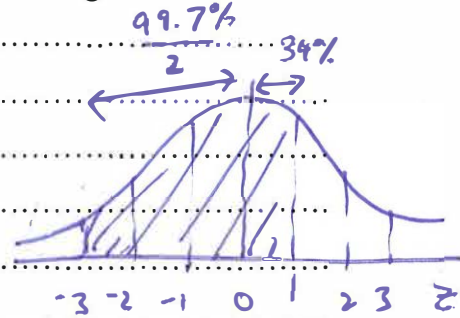
1 | Correct 83.85%
2 | Correct % of 500
* = 419.25.*
                                                                                      2

Question 32

Amelia uses an 1800 W dishwasher for a total of 21 hours during the week. What is
the cost of using the dishwasher for a week, if electricity is $0.24 per kWh?

Energy used = 1800 × 21
            = 37800 Wh
            = 37.8 kWh ✓

1 | Correct kWh
2 | Correct cost.(ecf)

Cost = 0.24 × 37.8 ✓
     = $9.072

Note: Show working.

Question 33

Jack has a night out with friends. How many standard drinks can he have in 3 hours to stay under a *BAC* of 0.05 if he weighs 83 kg?

N = number of standard drinks consumed

$$BAC \text{ male} = \frac{10N - 7.5H}{6.8M} \quad \text{where} \quad H = \text{number of hours consuming alcohol}$$

M = mass in kg

$$0.05 = \frac{10N - 7.5 \times 3}{6.8 \times 83} \quad ①$$

$$28.22 = 10N - 7.5 \times 3$$

$$10N = 50.72$$

$$N = 5.072 \quad ①$$

$\therefore$ He can have up to 5 standard drinks.

Question 34

Using Young's formula, calculate the adult dose if the child's dose is 20 ml and the child is 3 years 4 months old?

$\underbrace{\qquad}_{} 3\frac{1}{3}$ years

Young's Formula:

child dosage = $\dfrac{yA}{y+12}$, where A is the adult dosage and y is the child's age in years.

$$20 = \frac{3\frac{1}{3} \times A}{3\frac{1}{3} + 12} \quad ①$$

$$306\frac{2}{3} = 3\frac{1}{3} \times A$$

$$A = 92 \quad ①$$

$\therefore$ Adult dosage = 92mL

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Question 35

The future value of an investment is $2500 after 4 years. If the interest rate is 8% p.a., calculate the present value of the investment. Answer correct to the nearest cent.

2

$$FV = PV(1+r)^n$$

$$2500 = PV(1+8\%)^4$$

$$PV = \frac{2500}{(1+8\%)^4}$$

$$PV = 1837.574632\ldots$$

∴ Present value = $1837.57

Question 36

Jessica buys 3 shirts for $29.95 each, a jacket for $299.99 and a pair of shoes for $175 on her credit card.

(a) How much does Jessica owe on her credit card?

1

$$\$29.95 \times 3 + \$299.99 + \$175$$

$$= \$564.84$$

(b) This amount stays on her credit card for 72 days. If the compound interest rate is 14.6% p.a. calculate how much Jessica owes altogether on her purchases. There is no interest free period. Answer to the nearest cent.

2

$$FV = PV(1+r)^n$$

$$= 564.84\left(1 + \frac{14.6\%}{365}\right)^{72}$$

$$= \$581.34055\ldots$$

∴ Jessica owes $581.34

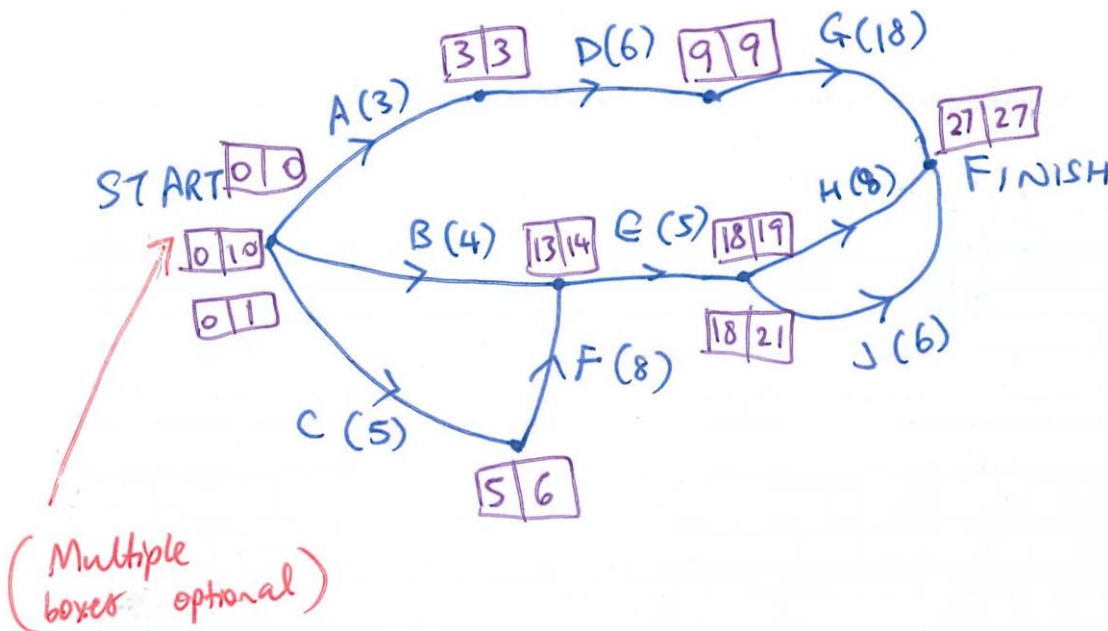**Question 37**   **Marks**

The table below contains the activities that make up a particular project and their durations, in months.

Activity	Duration (months)	Immediate predecessor
A	3	--
B	4	–
C	5	–
D	6	A
E	5	B, F
F	8	C
G	18	D
H	8	E
J	6	E

(a) Draw a network diagram for this table.   **2**

Need
* *Correct edges*
* *labelled vertices*
* *labelled durations*
* *arrows*
* *sink*
(*-1 for each error*)

(*Multiple boxes optional*)

(b) Find the <u>earliest starting times (EST)</u> and <u>latest starting times (LST)</u> for all   *-1 for*   **3**
activities. Show your answers on your network diagram for part (a).   *each error of EST/ LST*

(c) What is the critical path for this network?   ① *if all EST*   **1**
.... A → D → G ....

(d) What is the float time for activity J?   **1**
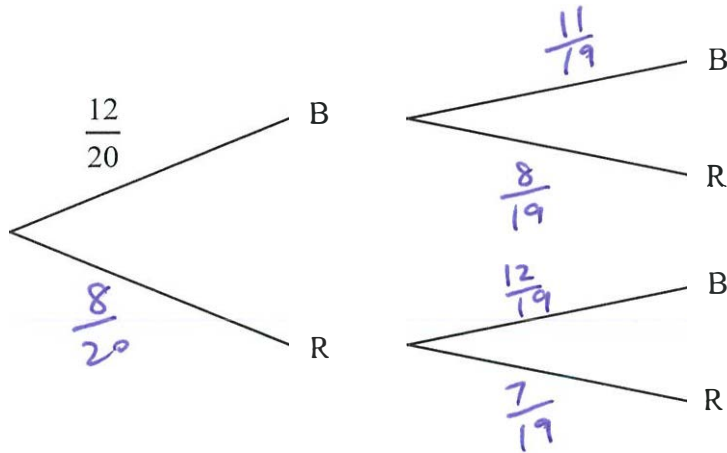.............. 21 - 18 - 3 months ....

Question 38

Mr Way has 20 ties in a drawer. There are 12 blue ties and 8 red ties in this drawer.

(a) Complete the probability tree below. 2

$\dfrac{12}{20}$ B

$\dfrac{11}{19}$ B

$\dfrac{8}{19}$ R

$\dfrac{8}{20}$ R

$\dfrac{12}{19}$ B

$\dfrac{7}{19}$ R

−1 for each error

(b) Mr Way reaches into his drawer and pulls out two ties. What is the probability 1
that he has pulled out 2 red ties?

$$P(R,R) = \frac{8}{20} \times \frac{7}{19}$$
$$= \frac{14}{95}$$

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Question 39 **Marks**

A ball is thrown into the air. The relationship between the height, h, above the ground (in metres) and the time, t, for it to fall to that height (in seconds) is given by the formula $h = 32t - 8t^2$.
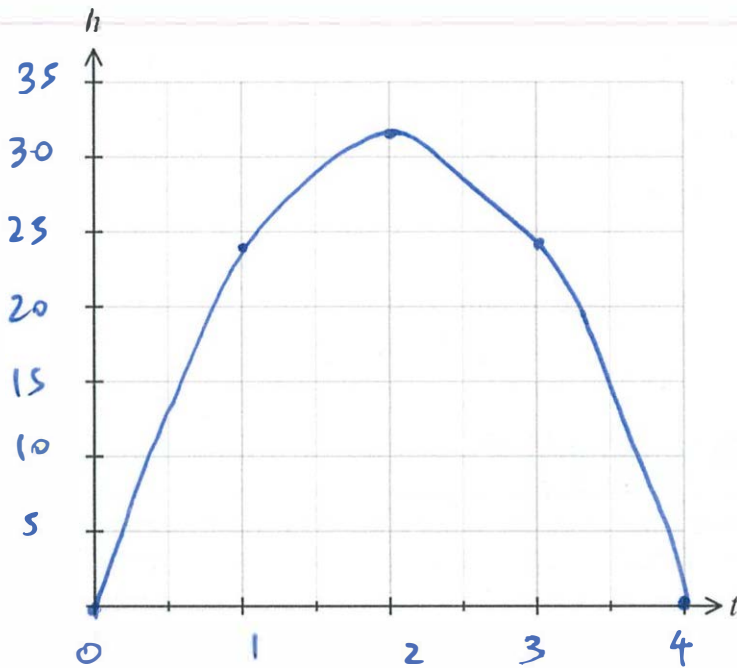
(a) Complete the table of values for t and h.

-1 for each error   **2**

t	0	1	2	3	4
h	0	24	32	24	0

(b) Draw the graph of $h = 32t - 8t^2$.   **2**

curved and smooth —①

even scale, numbers & points plotted —①

(c) What is the greatest height reached by the ball?   **1**

32m

(d) How long did it take for the ball to hit the ground?   **1**

4 seconds

(e) When did the ball travel the greatest height?   **1**

At 2 seconds.

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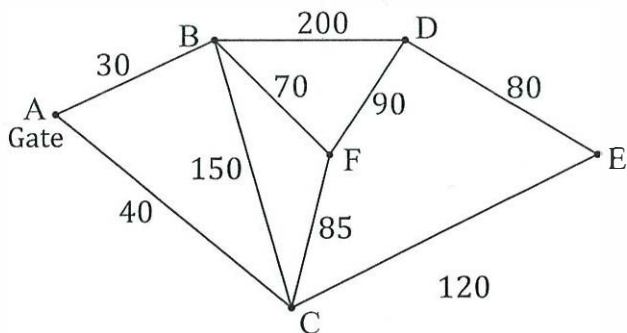**Question 40**   **Marks**

The network diagram below shows a park with 5 gardens that are joined by paths to the gate. The numbers show the distance along the paths in metres.

(a)   What is the degree of each vertex?   2

$A = 2$ $D = 3$ −1 for
$B = 4$ $E = 2$ each error
$C = 4$ $F = 3$

(b)   What is the minimum distance a person would have to walk to visit   2
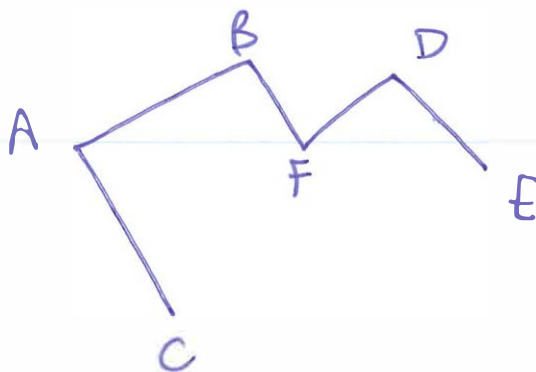every garden, starting and ending at the gate?   ABFDECA

By inspection, minimum distance
                = 30 + 70 + 90 + 80 + 120 + 40   Correct route −①
                = 430m   Correct dist −①

(c)   Each garden needs to be connected by a water pipe located along a path.   2
Draw a minimum spanning tree to indicate the location of the water pipes.

a Spanning tree −①
Correct one −①

−1 if shape is not
similar to original.

End of Paper

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