

HIGHER SCHOOL CERTIFICATE EXAMINATION

1998

MATHEMATICS IN SOCIETY

2 UNIT

*Time allowed—Two hours and a half
(Plus 5 minutes reading time)*

DIRECTIONS TO CANDIDATES

- Only Board-approved calculators are to be used.
- Show all necessary working for Section II and Section III.
- Marks may be deducted for careless or badly arranged work.
- You may ask for extra Writing Booklets if you need them.
- The mark out of 80 will be converted to a mark out of 100.

Section I (20 marks)

- This Section contains 20 multiple-choice questions.
- Attempt ALL questions.
- All questions are of equal value.
- Complete your answers in blue or black pen, or in pencil on the Answer Sheet provided.
- Allow about 45 minutes for this Section.

Section II (36 marks)

- Attempt ALL questions.
- Each question is worth 12 marks.
- Answer each question in a SEPARATE Writing Booklet.
- Allow about one hour for this Section.

Section III (24 marks)

- Attempt TWO questions.
- Each question is worth 12 marks.
- Answer each question in a SEPARATE Writing Booklet.
- Allow about 45 minutes for this Section.

SECTION I

Attempt ALL questions.

All questions are of equal value.

Select the alternative A, B, C or D that best answers the question.

Complete your answers in blue or black pen, or in pencil on the Answer Sheet provided

1. Use the formula $s = ut + \frac{1}{2}at^2$ to find s if $u = 8$, $t = 5$, $a = 10$.

(A) 90 (B) 165 (C) 665 (D) 1290

2. In which set of scores is the mode greater than the median?

(A) 3, 4, 4, 5, 5, 6, 6, 6, 7

(B) 3, 4, 4, 5, 5, 5, 6, 6, 7

(C) 3, 4, 4, 4, 5, 5, 6, 6, 7

(D) 2, 2, 2, 2, 3, 4, 4, 5, 6

3. The front wheel of Walter's bike has a circumference of 215 cm.

Walter rides his bike a distance of 2.3 km. Approximately how many revolutions does the front wheel make during this journey?

(A) 93 (B) 107 (C) 495 (D) 1070

4. Solve the equation $\frac{3x-1}{2} = 7$.

(A) $x = \frac{13}{3}$ (B) $x = 5$ (C) $x = \frac{16}{3}$ (D) $x = 12$

5. Jason, Vicki and Savka won a Lotto prize. They shared the prize in the ratio 3 : 2 : 4. Savka's share of the prize was \$4650.

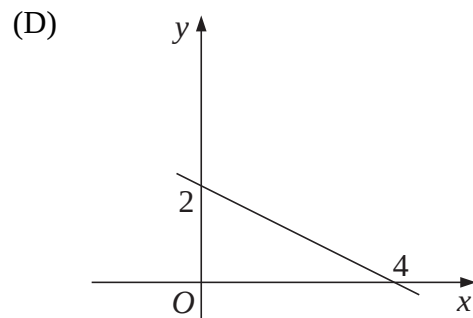
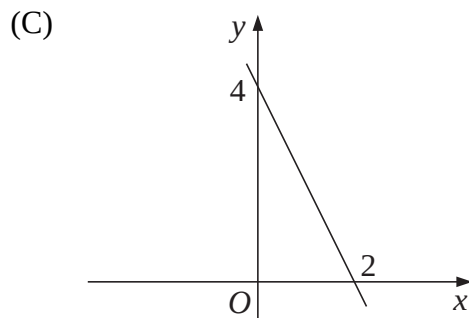
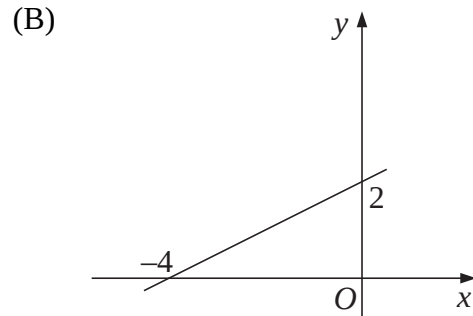
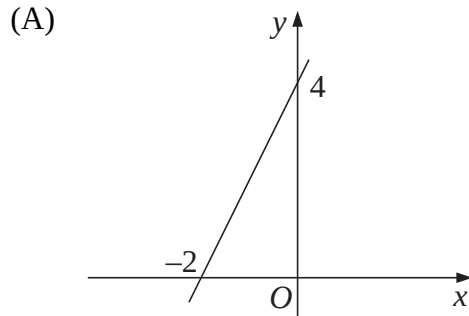
What was Jason's share?

(A) \$1162.50 (B) \$2325.00 (C) \$3487.50 (D) \$10 462.50

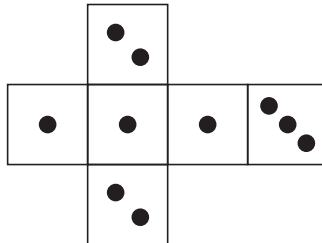
6. The following table shows ordered pairs for the equation $y = 2x + 4$.

x	-1	0	1
y	2	4	6

Which of the following graphs represents the equation $y = 2x + 4$?



7.



A die is made from the net illustrated. The die is rolled twice.

What is the probability of obtaining a one on the first roll and a two on the second roll?

- (A) $\frac{1}{36}$ (B) $\frac{1}{6}$ (C) $\frac{1}{3}$ (D) $\frac{5}{6}$

8. Sarah's car uses 9 litres of petrol to travel 100 km. Petrol costs 72 cents per litre.

How far (to the nearest kilometre) can Sarah drive using \$30 worth of petrol?

- (A) 194 km (B) 240 km (C) 375 km (D) 463 km

9. The recipe below serves 6 people.

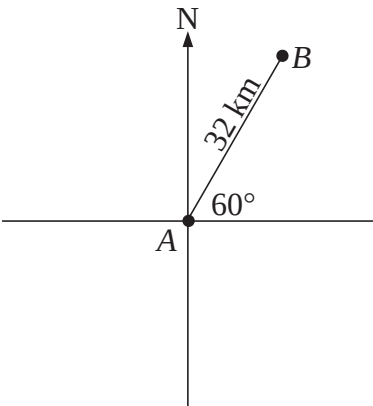
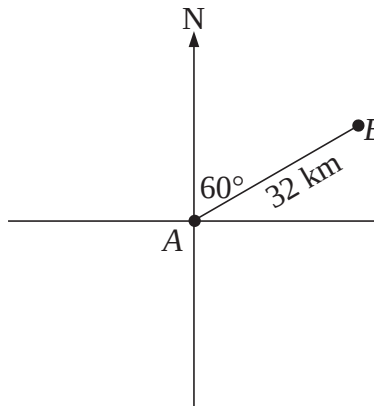
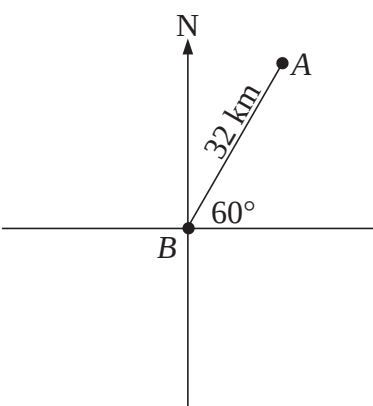
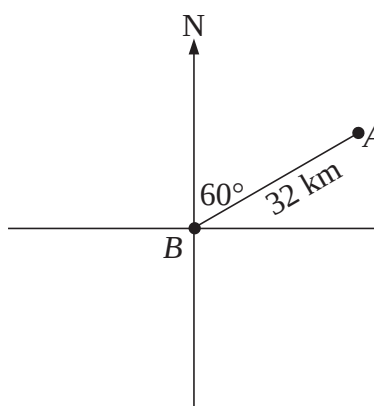
3 small eggplants
 salt
 1 tablespoon oil
 1 onion, finely chopped
 1 clove garlic, crushed
 250 g minced beef
 2 tablespoons tomato paste

If this recipe has to be adjusted to serve 15 people, how many tablespoons of tomato paste are needed?

- (A) 0.8 (B) 2 (C) 5 (D) 6

10. A woman walks 32 kilometres from B to A on a bearing of 060° .

Which diagram best illustrates this information?

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

11. Bart made two errors in his solution to the following equation.

$$2(x + 5) - 5(x - 5) = 27$$

$$2x + 10 - 5x - 25 = 27 \text{ Line 1}$$

$$-3x - 15 = 27 \text{ Line 2}$$

$$-3x = 42 \text{ Line 3}$$

$$x = 14 \text{ Line 4}$$

Which lines DO NOT follow correctly from the previous line?

- (A) Line 1 and Line 4 (B) Line 1 and Line 3
(C) Line 2 and Line 4 (D) Line 2 and Line 3
-
12. Some Year 12 students were asked how many cups of coffee they drank on a particular day.

The results are shown in the table.

<i>Cups of coffee</i>	<i>Number of students</i>
0	4
1	5
2	12
3	8
4	4
5	2

What is the total number of cups of coffee drunk by the students on this particular day?

- (A) 15 (B) 35 (C) 79 (D) 83
-
13. The length of a rectangle is 4 cm more than its width. The width is w cm.

What is the area of the rectangle?

- (A) $(w^2 + 4w) \text{ cm}^2$ (B) $(w^2 + 4) \text{ cm}^2$
(C) $4w \text{ cm}^2$ (D) $(4w + 8) \text{ cm}^2$
-

14. The mean height of five Sydney Flames basketball players at the start of a game is 1.88 m. During the game, a player who is 1.74 m tall is injured and is replaced by a player who is 1.94 m tall.

What is the mean height of the 5 players now?

- (A) 1·89 m (B) 1·91 m (C) 1·92 m (D) 2·08 m

15. Simplify $\frac{x^3}{3x^2} \div x$.

- (A) $\frac{1}{3}$ (B) $\frac{1}{x^2}$ (C) $\frac{x^2}{3}$ (D) 3

- 16.** Sally received a 60% discount as a 'no claim bonus' on her car insurance. She paid \$480 to insure her car.

What would she have paid without the ‘no claim bonus’?

- (A) \$672 (B) \$768 (C) \$800 (D) \$1200

- 17.** In a normal distribution:

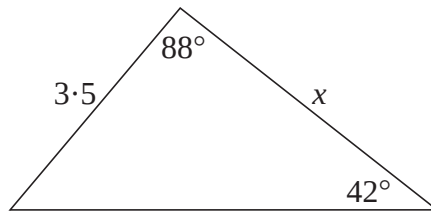
- 68% of the population lies within 1 standard deviation of the mean.
- 95% of the population lies within 2 standard deviations of the mean.
- 99% of the population lies within 3 standard deviations of the mean.

In Mathsville, the age of the population is normally distributed. The mean age is 43 years and the standard deviation is 14 years.

The percentage of the population between the ages of 43 and 71 is closest to

- (A) 34 (B) 47.5 (C) 68 (D) 95

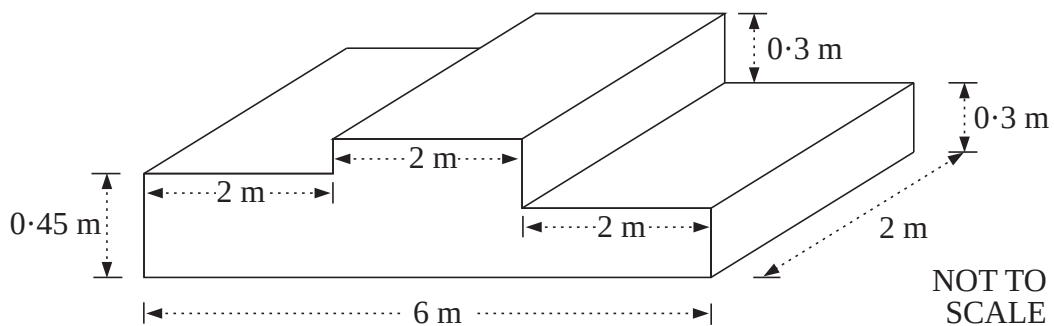
18.



Which expression gives the correct value for x ?

- (A) $\frac{3.5 \sin 88^\circ}{\sin 42^\circ}$ (B) $\frac{3.5 \sin 50^\circ}{\sin 42^\circ}$ (C) $\frac{3.5 \sin 42^\circ}{\sin 50^\circ}$ (D) $\frac{3.5 \sin 42^\circ}{\sin 88^\circ}$

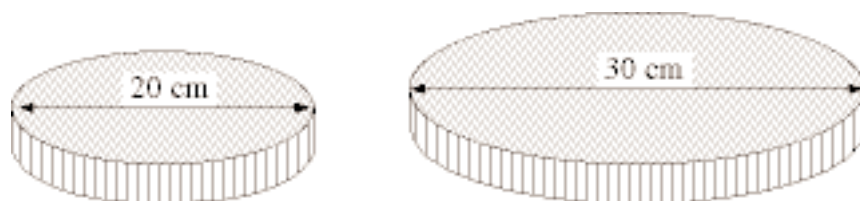
19. This podium is being built for the Olympic Games.



What is the surface area of this podium (including its base)?

- (A) 4.8 m^2 (B) 5.4 m^2 (C) 31.5 m^2 (D) 31.8 m^2

20. 'Yummee Cheesecakes' come in two sizes as shown. Each size is the same thickness. The smaller cake will serve 8 people.



How many serves of the same quantity are in the larger cheesecake?

- (A) 8 (B) 12 (C) 18 (D) 27

SECTION II

Attempt ALL questions.

Each question is worth 12 marks.

Show all necessary working.

QUESTION 21. Use a SEPARATE Writing Booklet.

- (a) At the Winter Wonderland Ski Resort the probability that it snows on any particular day in winter is 0.8.
- (i) What is the probability that it does NOT snow on any particular day in winter at Winter Wonderland?
 - (ii) Zelda has a three-day winter holiday at Winter Wonderland. What is the probability that it snows on the first day of her holiday, but not on the second day, nor on the third day?
 - (iii) What is the probability that it snows on at least one of the days of Zelda's holiday?
- (b) A cylindrical tank contains oil to a depth of 2 metres. The volume of oil in the tank is 15 000 litres.
- (i) Find the radius of the tank. ($V = \pi r^2 h$; $1000 \text{ L} = 1 \text{ m}^3$)
 - (ii) The tank has a small hole, and oil is leaking out at the rate of 20 mL per minute. The leaking oil drips into a 10 L container.

How long will it take before the container is completely full?

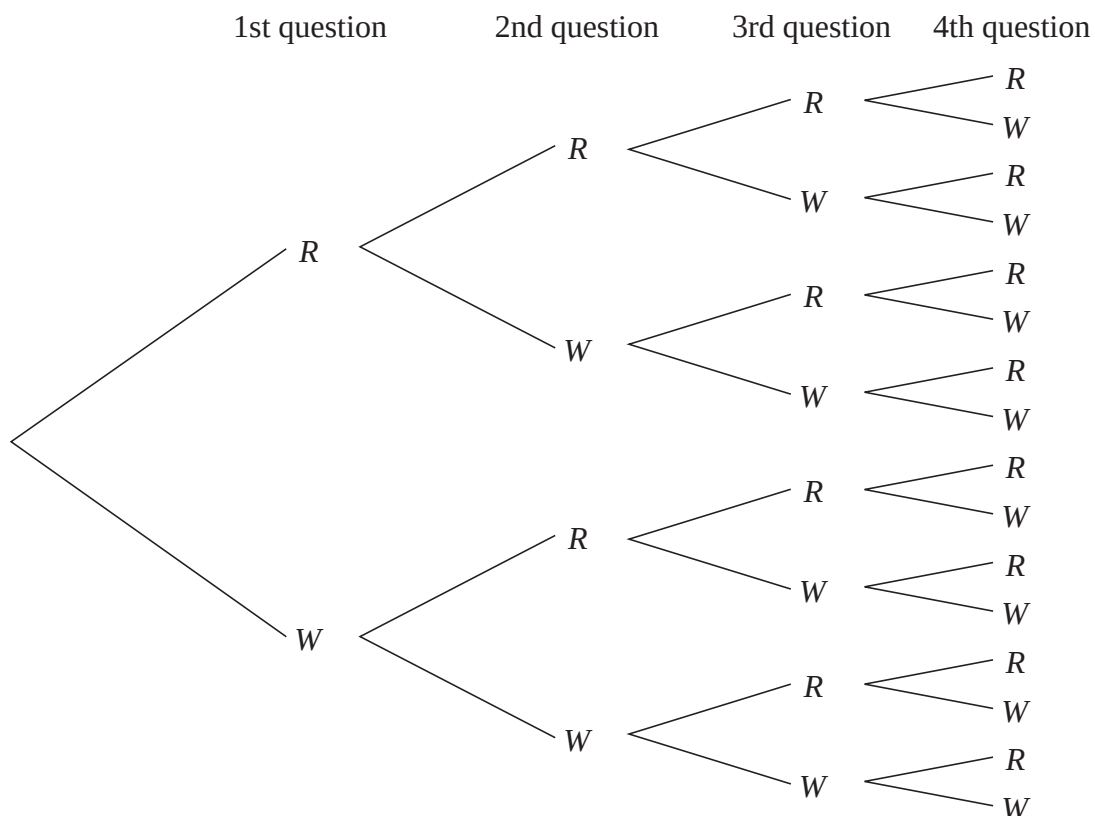
(Give your answer in hours and minutes.)

Question 21 continues on page 9

QUESTION 21. (Continued)

- (c) In a test, there are four questions to be answered true or false. Each correct answer is worth one mark. The chance that a student will guess the correct answer to any one of the questions is $\frac{1}{2}$.

In the following tree diagram, R indicates a right answer and W a wrong answer.



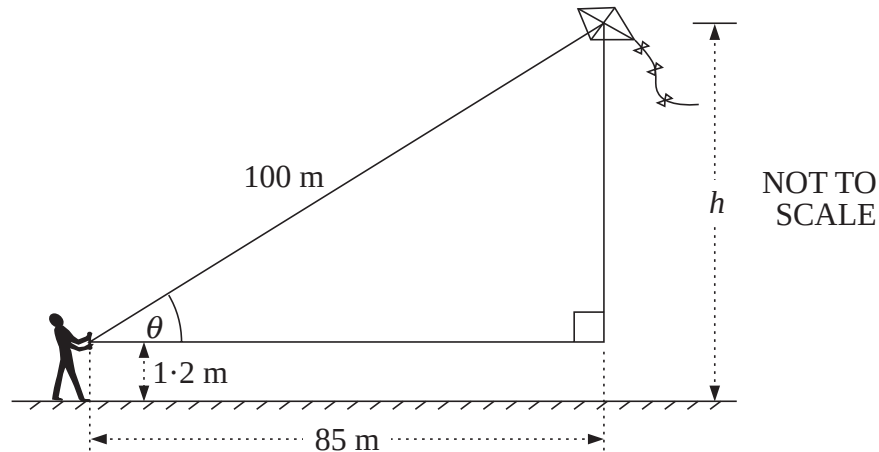
Use the tree diagram to answer the following questions.

- Tzi-keng guesses the answers to all four questions. What is the probability that he will get four right?
- What is the most likely mark for Tzi-keng on this test? Explain your answer.
- Annamaria answers the first two questions correctly, and guesses the answers to the last two. What is the probability that she will get four right?

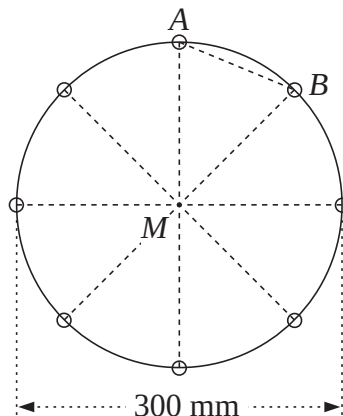
QUESTION 22. Use a SEPARATE Writing Booklet.

(a) Solve the equation $\frac{1}{P-2} = \frac{5}{3P}$.

- (b) Karel has let out 100 metres of kite string. The kite is directly above the park entrance which is 85 metres away.



- (i) Find θ , the angle of elevation of the kite from Karel's hand.
- (ii) Find h , the height of the kite above the ground. Give your answer correct to 1 decimal place.
- (c) A carpenter drills eight equally spaced holes around the circumference of a circle as shown in the diagram.



The diameter of the circle is 300 mm. M is the centre of the circle. A and B are the centres of two adjacent holes.

- (i) Explain why $\angle AMB$ is 45° .
- (ii) Find the length of the straight line AB . (Cosine rule: $a^2 = b^2 + c^2 - 2bc \cos A$)

QUESTION 22. (Continued)

(d) A yacht sails 20 km from point X to point Y on a course $S34^\circ W$. From point Y it sails due west to reach point Z . The distance XZ is 40 km.

(i) In your Writing Booklet, draw a neat sketch showing all the above information.

(ii) Find $\angle XZY$. (Sine rule: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$)

Please turn over

QUESTION 23. Use a SEPARATE Writing Booklet.

- (a) In an experiment, the intensity of light from a particular light source was measured at various distances and the following data were collected.

d (distance in metres)	1.0	1.5	2.0	2.5	3.0
I (intensity of light in watts per square metre)	1.30	0.58	0.33	0.21	0.14

- (i) Plot the data from the table on the graph paper provided on page 25.
- (ii) Draw the curve of best fit through the plotted points.
- (iii) Use your curve of best fit to estimate the light intensity at a distance of 2.2 metres.
- (iv) Draw the tangent to the curve at the point where $d = 1.5$.
- (v) Use the slope of your tangent to estimate the rate of change of the intensity when $d = 1.5$.

Question 23 continues on page 13

QUESTION 23. (Continued)

- (b) The Cavetto Pasta Company employs seventy people.

The annual income of the employees is shown in the frequency distribution table below.

<i>Annual income</i> (\$)	<i>Class centre</i> x	<i>Number of employees</i> f	fx
10 000 – 19 999	15 000	16	240 000
20 000 – 29 999	25 000	24	600 000
30 000 – 39 999	35 000	11	A
40 000 – 49 999	45 000	9	405 000
50 000 – 59 999	55 000	7	385 000
60 000 – 69 999	65 000	3	195 000
		$\Sigma f = 70$	$\Sigma fx =$

- (i) Calculate the value of A in the fx column.
- (ii) Calculate Σfx .
- (iii) Determine the mean annual income.
- (iv) In which annual income class does the median of this distribution lie?
- (v) Using the information in the table and your calculator, find the standard deviation of this distribution.
- (vi) Cavetto Pasta wishes to employ another eight people. Four of these new employees will earn \$15 000 p.a. each, and the other four will earn \$65 000 p.a. each.

What will be the effect of these new employees on the standard deviation of income distribution at Cavetto Pasta? Give a brief reason for your answer.

SECTION III

Attempt TWO questions.

Each question is worth 12 marks.

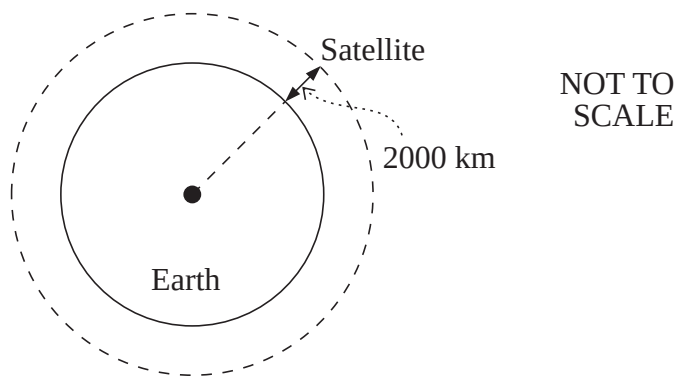
Show all necessary working.

QUESTION 24. Space Mathematics. Use a SEPARATE Writing Booklet.

- (a) Light travels at 3×10^5 km/s.

What is 2.3 light years in kilometres?

- (b) A satellite follows a circular path, orbiting Earth at a height of 2000 km.



The radius of Earth is 6400 km.

- (i) What is the radius of the orbit of the satellite?
 - (ii) What is the length of the orbit?
 - (iii) The satellite remains directly above Broken Hill during its orbit. (This means that the period of its orbit is 24 hours.) At what speed is the satellite travelling?
 - (iv) What is the eccentricity of this orbit? $\left(e^2 = 1 - \frac{b^2}{a^2} \right)$
- (c)
- (i) It took the Mars Explorer 8.5 minutes to send a signal to Earth. The signal travelled at 3×10^5 kilometres per second. What is the approximate distance from Earth to Mars?
 - (ii) When observed from Earth, Mars subtends an angle of 0.0026° . Use your answer from part (i) to find the diameter of Mars.

QUESTION 24. (Continued)

- (d) (i) 1 astronomical unit (AU) is 1.49×10^8 km. The distance from Earth to its Moon is 384 000 km.

What is this distance in astronomical units? Give your answer correct to two significant figures.

- (ii) The mass M of a planet, in kilograms, can be calculated using the formula

$$M = \frac{6 \times 10^{24} \times R^3}{T^2}$$

where R is the radius of the orbit of a moon in AU and T is the period of the orbit in years.

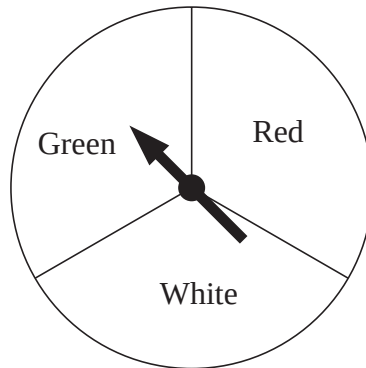
Using your answer from part (d) (i), calculate the mass of Earth if the period of the Moon's orbit is 0.08 years. Give your answer in scientific notation.

Please turn over

QUESTION 25. Mathematics of Chance and Gambling.

Use a SEPARATE Writing Booklet.

- (a) Sasha and Jamie play a game using the spinner shown in the diagram.



The rules of this game are:

1st spin: If the arrow points to red, Sasha wins.
If the arrow points to white or green, it is spun again.

2nd spin: If the arrow points to red, Sasha wins.
If the arrow points to white or green, Jamie wins.

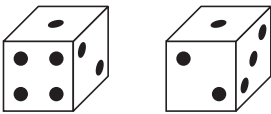
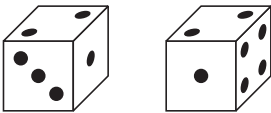
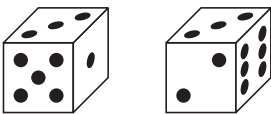
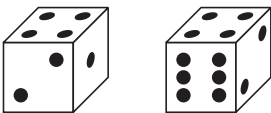
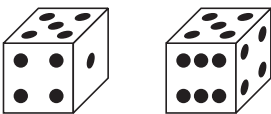
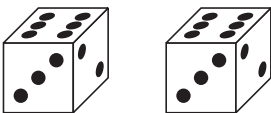
- (i) What is the probability that Sasha wins on the first spin?
 - (ii) What is the probability that Jamie wins?
- (b) Seven horses are to run in a race.

<i>Horse</i>	<i>Odds</i>
Archimedes	2 / 1
Boole	2 / 1 ON
Cantor	100 / 1
Descartes	7 / 2
Euclid	9 / 2
Gauss	20 / 1
Hypatia	3 / 1

- (i) Based on these odds, what is the probability (as a fraction) that Descartes wins the race?
- (ii) Brian places a bet on Euclid and hopes to win \$180. How much does he bet?
- (iii) Rochelle bets \$10 on Boole. How much would Rochelle collect from the bookmaker if Boole wins the race?
- (iv) In how many different ways can the first three positions in the race be filled?

QUESTION 25. (Continued)

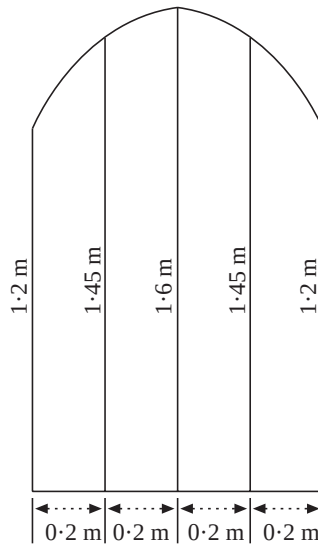
- (c) At Oscar's Casino a game called 'Doubles' is played. To play 'Doubles', the player pays \$6 and rolls two ordinary dice. If the result of the roll is a 'double', the player receives the amount shown.

PLAY DOUBLES! ONLY \$6 PER GAME!	
RESULT OF ROLL OF DICE	WIN!
Double 1 	\$10
Double 2 	\$20
Double 3 	\$30
Double 4 	\$40
Double 5 	\$50
Double 6 	\$60

- (i) What is the probability of rolling a Double 1?
- (ii) Calculate the expected return from this game.
- (iii) Is 'Doubles' a fair game? Explain your answer.

QUESTION 26. Land and Time Measurement. Use a SEPARATE Writing Booklet.

- (a) The window of a chapel is drawn below.



Use Simpson's rule to find the approximate area of this window.

$$\left[\text{Area} \approx \frac{h}{3} (d_F + d_L + 4d_M) \right]$$

- (b) Beijing (China) is located at $40^\circ\text{N } 116^\circ\text{E}$. Perth (Australia) is located at $32^\circ\text{S } 116^\circ\text{E}$.
- What is the difference in latitude between these two cities?
 - Find the distance between these two cities. Give your answer to the nearest kilometre.
(1° subtends 60 nautical miles; 1 nautical mile = 1.852 km)
 - A plane left Beijing for Perth at 10:30 pm on Monday (Beijing time). The flying time from Beijing to Perth is eleven hours.

When the plane landed in Perth, what was the local time and what day was it?
 - What is the difference between Greenwich Mean Time and Beijing time? (Ignore time zones.)

Question 26 continues on page 19

QUESTION 26. (Continued)

- (c) A group of students surveyed the school playground.

The notebook entries shown below are the result of their traverse survey.

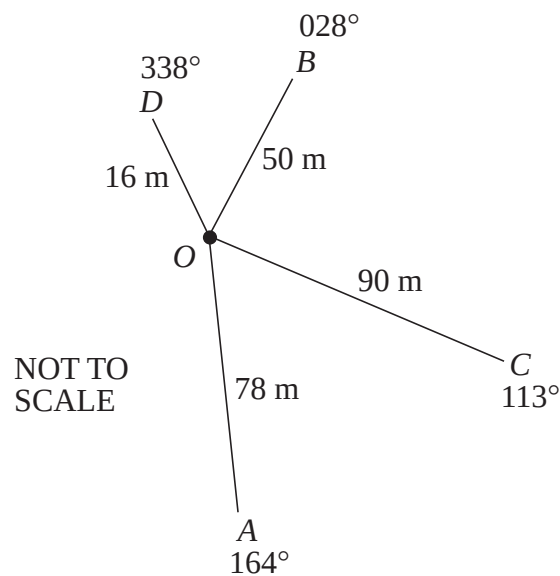
		B			
		120			
D	40	90			
		40	60	C	
		0			
		A			

(Measurements are in metres.)

- (i) Use these notebook entries to draw a neat sketch of the playground. Mark the interval and offset measurements on your diagram.
- (ii) Use Pythagoras' theorem to find the distance BC .

The following day, the students carry out a radial survey of the same playground.

The notebook entries shown below are the result of their radial survey.



- (iii) Find the size of $\angle BOC$.
- (iv) Use the cosine rule in $\triangle BOC$ to find the distance BC to the nearest metre.

$$(\text{Cosine rule: } c^2 = a^2 + b^2 - 2ab \cos C)$$

- (v) Explain why the distances calculated in parts (ii) and (iv) are slightly different.

QUESTION 27. Personal Finance. Use a SEPARATE Writing Booklet.

- (a) Jayden has a credit card which has an interest rate of 18.25% per annum.
- Convert the interest rate to a daily percentage rate.
 - Jayden has an outstanding balance of \$975 for a period of twenty-four days. How much interest will she be charged?
- (b) Below is Trudy's timesheet for one week's work at Tim's Hardware.

<i>Day</i>	<i>Start</i>	<i>Finish</i>	<i>Meal break</i>
Monday	8:30 am	5:30 pm	1 hour
Tuesday	8:30 am	2:00 pm	30 minutes
Wednesday	8:30 am	5:30 pm	1 hour
Thursday	8:30 am	9:00 pm	2 hours
Friday	1:00 pm	5:00 pm	—
Saturday	8:00 am	4:00 pm	1 hour
Sunday	10:00 am	4:00 pm	1 hour

<i>Conditions of employment at Tim's Hardware</i>	
Normal pay rate: \$9.80 per hour	
Staff are not paid for meal breaks.	
Monday–Friday	Normal pay rate for first eight hours worked; time-and-a-half thereafter
Saturday	Time-and-a half
Sunday	Double time

- For how many hours did Trudy work at the normal pay rate during this week?
- How much did Trudy earn at the normal rate of pay during this week?
- How much did Trudy earn from working at penalty rates (that is, time-and-a-half and double time) during this week?
- What percentage of her pay for this week did Trudy earn by working at penalty rates?

QUESTION 27. (Continued)

(c) The table shows monthly payments for each \$1000 borrowed.

INTEREST RATE (% p.a.)	PERIOD OF LOAN				
	<i>5 years</i>	<i>10 years</i>	<i>15 years</i>	<i>20 years</i>	<i>25 years</i>
5	\$18·87	\$10·61	\$7·91	\$6·60	\$5·85
6	\$19·33	\$11·10	\$8·44	\$7·10	\$6·44
7	\$19·80	\$11·61	\$9·00	\$7·75	\$7·07
8	\$20·28	\$12·13	\$9·56	\$8·36	\$7·72
9	\$20·76	\$12·67	\$10·14	\$9·00	\$8·39
10	\$21·25	\$13·22	\$10·75	\$9·65	\$9·10
11	\$21·74	\$13·78	\$11·37	\$10·32	\$9·80
12	\$22·24	\$14·35	\$12·00	\$11·01	\$10·53
13	\$22·75	\$14·93	\$12·65	\$11·72	\$11·28
14	\$23·27	\$15·53	\$13·32	\$12·44	\$12·04
15	\$23·79	\$16·13	\$14·00	\$13·17	\$12·81

Christopher borrows \$150 000 to buy a house at 8% p.a. over twenty-five years.

- (i) Use the information in the table to calculate Christopher's monthly payment on this loan.
- (ii) How much does Christopher pay in total to repay this loan?
- (iii) How much extra per month would Christopher pay if he were to repay the same loan over twenty years?

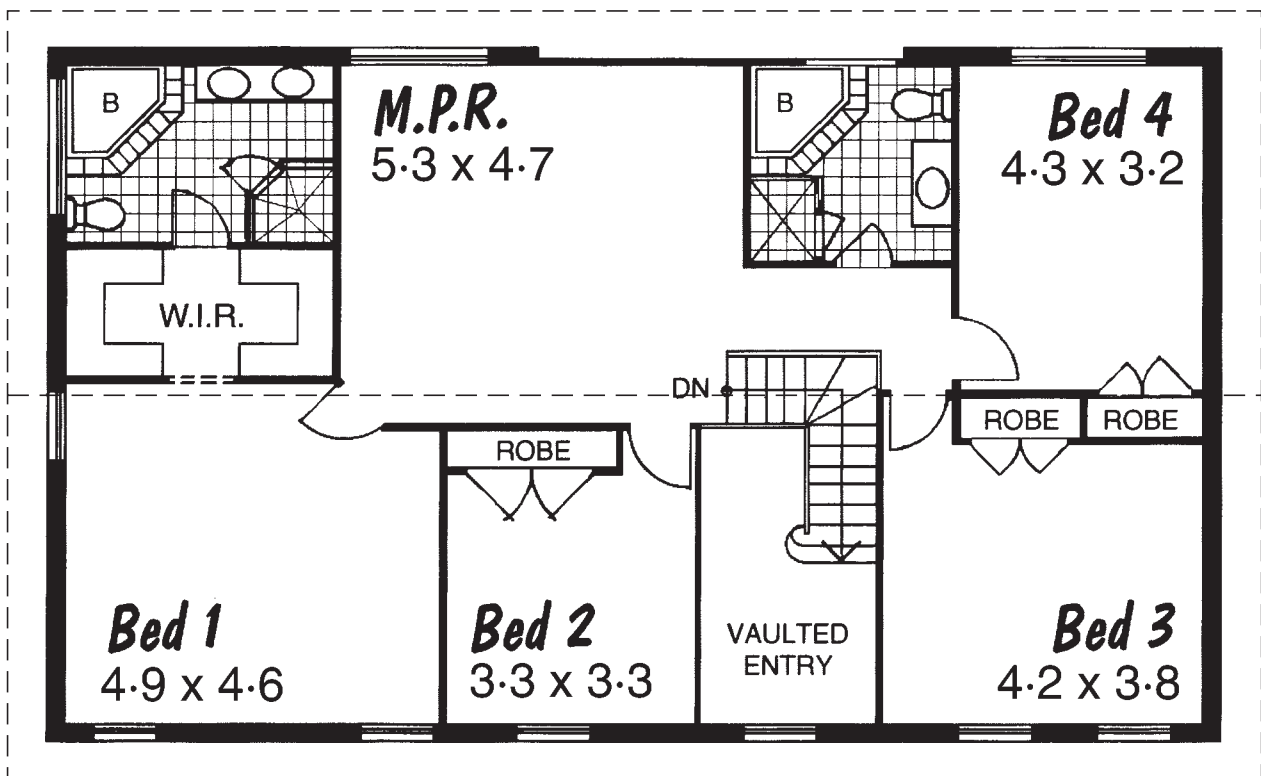
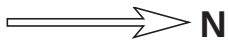
Yang Yang wants to buy a house for \$150 000. She has saved some money for a deposit and will borrow the rest at 8% p.a. She will repay the loan over fifteen years, paying \$1195 monthly.

- (iv) How much will she borrow?
- (v) How much has she saved for a deposit?

QUESTION 28. Mathematics in Construction. Use a SEPARATE Writing Booklet.

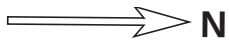
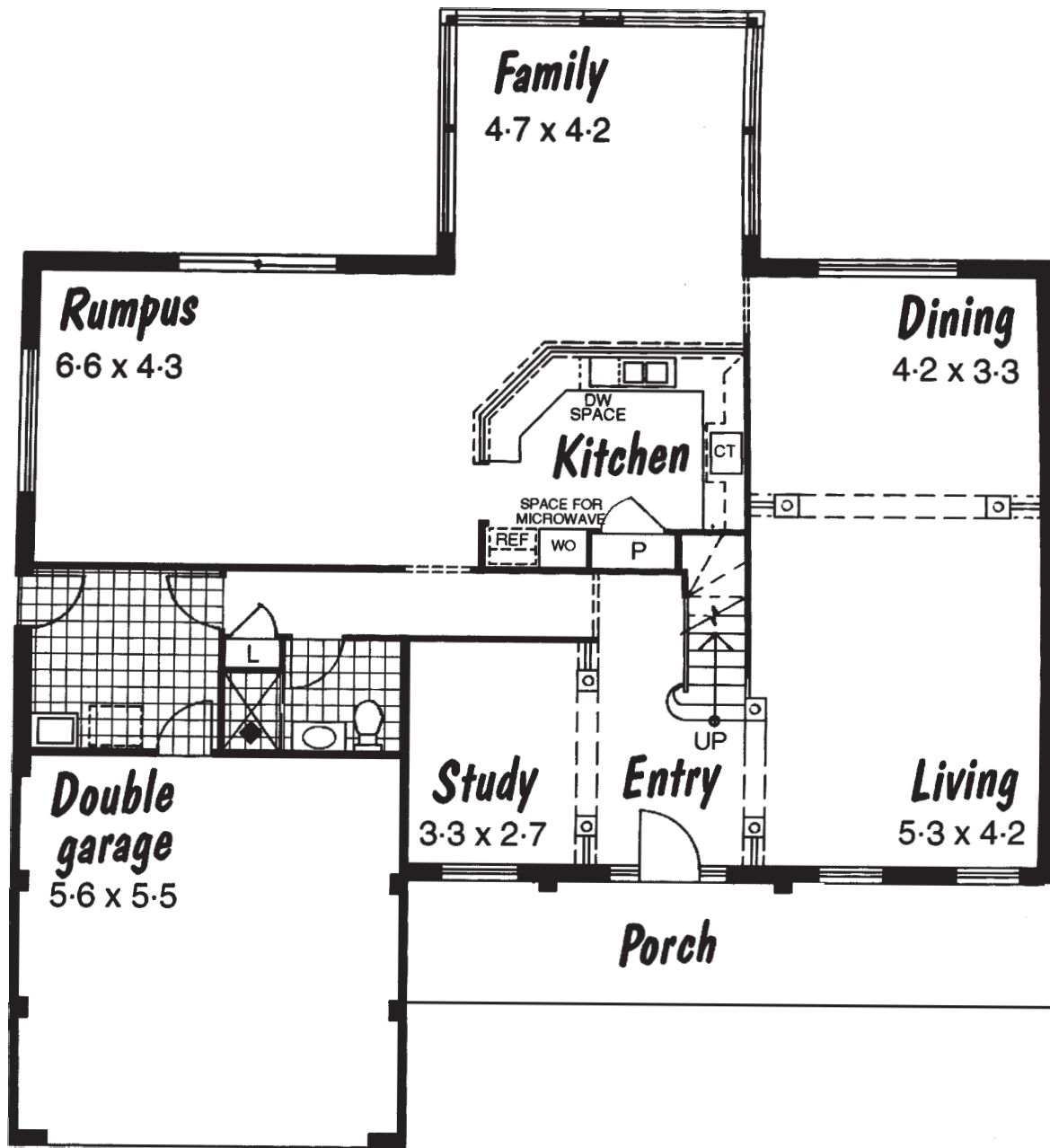
The floor plans shown on this page and the following page represent the first floor and ground floor of a two-storey home.

- What is the shape of the roof to be used on the first floor?
- What scale is used in these floor plans?
- What is the area (in m^2) of the porch?
- The dining room and living room are to be carpeted. The carpet is 4.2 m wide and is sold for \$120 per metre. How much will it cost to carpet these rooms, including a charge of \$100 for labour?
- How many steps are in the staircase connecting the ground floor to the first floor?
- If the distance between the ground floor and the first floor is 3.5 m, how high is each step? (Give your answer in centimetres to one decimal place.)
- Sketch the south elevation of the first floor.
- The height of the ridge of the roof above the eaves is 2.2 m. By measuring and calculating, find the pitch of the roof.



FIRST FLOOR

QUESTION 28. (Continued)

**GROUND FLOOR****EAST ELEVATION***Lifestyle Series, Huxley Planning & Design Pty Ltd***End of paper**

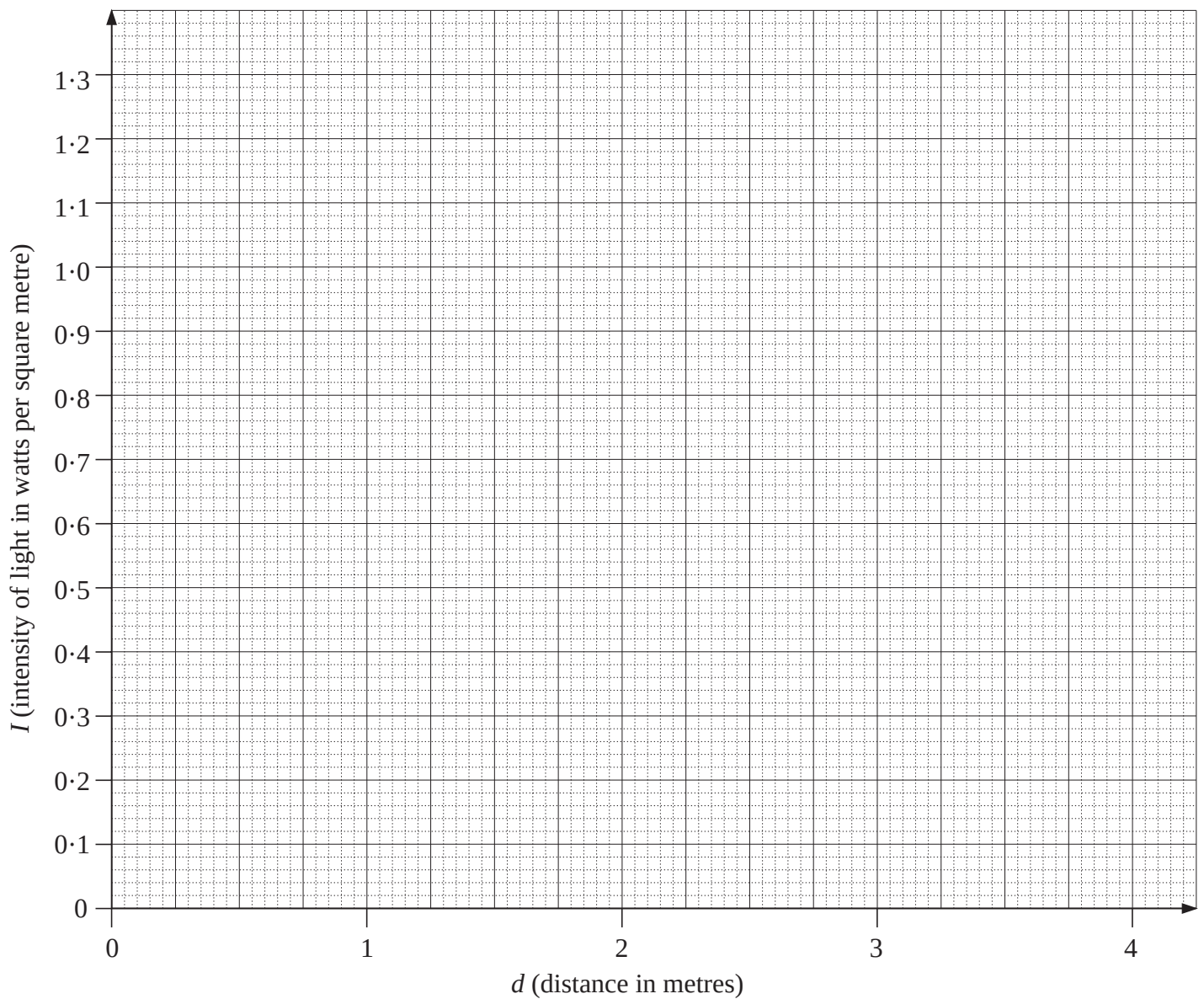
BLANK PAGE

MARKER'S USE ONLY**STUDENT NUMBER**

**1998
HIGHER SCHOOL CERTIFICATE EXAMINATION
MATHEMATICS IN SOCIETY
2 UNIT**

CENTRE NUMBER

This page is to be detached, completed and attached to your Writing Booklet for Question 23.

QUESTION 23

BLANK PAGE