CHAPTER 13

Simple Probability

A pink team and a blue team are playing against each other in a netball game. Based on the records, the pink team scored 12 goals out of 18 attempts. The blue team scored 18 goals out of 30 attempts. What is the ratio of the goals to the attempts for the pink team and blue team? In your opinion, which team will win the game?

WHAT WILL YOU LEARN?

WORD LINK

- Probability
- Sample space
- Event
- Complement of an event
- Theoretical probability
- Experimental probability
- Tree diagram

- *Kebarangkalian*
- *Ruang sampel*
- *Peristiwa*
- *Peristiwa pelengkap*
- *Kebarangkalian teori*
- *Kebarangkalian eksperimen*
- *Gambar rajah pokok*

WALKING THROUGH TIME

Richard Carl Jeffrey was an innovative philosopher in the 20th century. He was also one of the members in the department of philosophy at Princeton University between 1974 to 1999. He contributed much in the field of logic and statistics. The book 'The Logic of Decision' written by him, discusses a new theory about making decisions in a state of uncertainty and the belief in possibilities. His writings are widely used in the field of logic including 'Formal Logic: Its Space and Limits' and 'Computability and Logic'. He also wrote the book 'Probability and the Art of Judgement' and 'Subjective Probability: The Real Thing'.

For more information:

http://rimbunanilmu.my/mat_t2e/ms277

WHY STUDY THIS CHAPTER?

- Economists use the knowledge of probability in predicting the increase or decrease in stock value depending on the current economic situation and political stability of a country.
- Meteorologist use the science of probability in predicting weather and wind change for the days ahead.
- Businessmen also use knowledge of probability to review their business profit statistics and to forecast the future profits and earnings.

CREATIVE ACTIVITY

Aim: Identifying probability

Materials: Weather forecast results, blue and red marbles

Steps:

1. Consider the following situations:
   (a) Rain is expected the next day.
   (b) Choose a female student from the Girl Guides for a netball game.
   (c) The possibility of a black marble is taken from a box containing 3 blue marbles and 7 red marbles.
2. Discuss the possibility of each of the above situations and appropriate value to represent each possibility.

The situations above indicate that the events may occur, will occur and may not occur. The possibility of an event occurring is determined by the value between 0 to 1 and is known as probability.

> Probability is the measurement of possible occurrence of an event expressed either in the form of fractions or percentages.

13.1 Experimental Probability

In the Creative Activity, you are introduced to the probability concept. Now let's look at the relationship between frequency and the number of trials.

13.1.1 Experimental probability

LEARNING STANDARD

Perform simple probability experiments, and hence state the ratio $\frac{\text{frequency of an event}}{\text{number of trials}}$ as the experimental probability of an event.

COGNITIVE STIMULATION Group

Aim: Introducing simple probability

Materials: A coin

Steps:

1. Flip the coin 25 times.
2. Note down whether it is head or tail.
3. Then, repeat step one 50 times.
4. Next, repeat step one 100 times.
5. Write the result obtained in the table.

	Number of flips			Ratio $\frac{\text{frequency of appearance}}{\text{number of flips}}$		
The frequency of appearance	25	50	100	25	50	100
head						
tail						

Discussion:

The relationship between the ratio obtained and the experimental probability.

Experimental probability is the probability that is obtained from an experiment. Ratio 'frequency of appearance towards number of flips' that is obtained from flipping the coin is the experimental probability for an event.

In general,

$$\text{The experimental probability of an event} = \frac{\text{Frequency of an event}}{\text{Number of trials}}$$

13.1.2 Experimental probability of an event

LEARNING STANDARD

Make conclusions about the experimental probability of an event when the number of trials are large enough.

COGNITIVE STIMULATION Group

Aim: Making a conclusion on experimental probability

Materials: Dynamic geometry software

Steps:

1. Open the file MS279.
2. Click the *New experiment* button.
3. Click the *Start* button. Study the parallel marker and the reading on the graph.
4. Repeat steps 2 and 3 for 4 times.

Discussion:

(i) Differences in the graph that is formed in all five experiments.
(ii) The conclusion that can be obtained regarding experimental probability when the number of trials is higher.

QR CODE

Scan the QR Code or visit http://rimbunanilmu.my/mat_t2e/ms279 to view flipping coins experiment.

The file shows possible outcomes of obtaining head from flipping a coin. As much as 1 200 trials of flipping the coin has been done. From the graph that is shown, the experimental probability of obtained heads from 1 200 trials moves towards one value, that is 0.5.

It is observed that all the five graphs show the same shape. The conclusion that can be made is, experimental probability moves towards a certain value if the experiment is repeated with a higher number of trials.

SELF PRACTICE 13.1

1. Perform an experiment by throwing a fair dice. Write the ratio of the number of obtaining even numbers in 16 trials.

13.2 The Probability Theory Involving Equally Likely Outcomes

13.2.1 Sample space for an experiment

Before starting a football game, the referee usually flips the coin to decide the team that will start the game. Why does the referee use a coin and not dice or other objects? What is the sample space of the possible outcomes of flipping a coin?

LEARNING STANDARD

Determine the sample space and events of an experiment.

COGNITIVE STIMULATION Individual

Aim: Writing the possible end result for the fair dice throw

Materials: Fair dice

Steps:

1. Throw a dice and record the number that appears on the fair dice.
2. Complete the table below:

Number on the fair dice						

3. Repeat step 1 a few times until you are sure that all the numbers on the fair dice have been obtained. (The number on the fair dice that has been obtained does not need to be recorded again).
4. List all numbers that appear using notation set { }.
5. State the relationship of the list in step 4 as sample space.

Discussion:

The possible outcomes of a fair dice throw.

THINK SMART

A coin has only two faces, that is the head and tail. What is the sample space for one flip of the coin?

FLASHBACK

Notation set { }

Set A = {odd number less than 10}

A = {1, 3, 5, 7, 9}

When a fair dice is thrown, the number that is shown is either 1, 2, 3, 4, 5, 6. Although the number shown is repeated, it is still in the range of 1 to 6. The outcome list for the thrown fair dice consists of numbers 1,2,3,4,5,6. The sample space for the thrown fair dice is $S = \{1,2,3,4,5,6\}$.

DO YOU KNOW ?

1. Experiment is a procedure to observe possible outcome.
2. The outcome is the possible result of an experiment.
3. Sample space is all the possible outcomes of an experiment.

COGNITIVE STIMULATION Group

Aim: Using a tree diagram to denote outcomes.

Materials: Two empty boxes labelled *A* and *B*, 4 pieces of card labelled 2, 3, 5 and 7

Steps:

1. Form a group of 5.
2. Place the card labelled 2 into box *A*.
3. Place the card labelled 3, 5, 7 into box *B*.
4. One student takes one card from box *A* and one card from box *B*.
5. Write the pair of numbers in the table below.

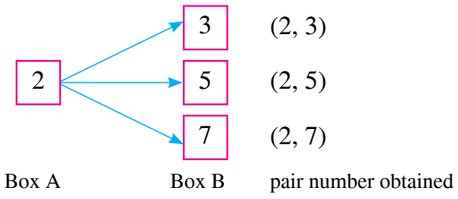
	Member 1	Member 2	Member 3	Member 4	Member 5
Box A					
Box B					

6. Place both the cards into the original boxes.
7. Repeat steps 4 to 6 until all the members have a pair of numbers. Write the results in the table.
8. List the outcomes using in the notation set, { }.

Discussion:

The similarities and differences of the paired number that is obtained by each member.

A tree diagram can help you determine probability.



When you pick a card randomly, you might get pairs like the ones shown in the tree diagram above. The possible outcomes of the activity is known as sample space, $S = \{(2,3), (2,5), (2,7)\}$.

TIPS

A tree diagram can be used to show the flow of a process. It is used to organise and calculate the probability of an event happening.

Sample space is a set of all possible outcomes of an experiment.

Event of an experiment

COGNITIVE STIMULATION Group

Aim: Identifying event

Materials: Two red balls, two yellow balls and a box

Steps:

1. Form groups of 4.
2. Mark every ball with the symbols M_1 and M_2 for the red balls. K_1 and K_2 for the yellow balls.
3. Place all the balls into the box.
4. One member takes two balls from the box, one by one.
5. Write the label of the ball that is taken in the table below.
6. Place both the balls back into the box.
7. Repeat steps 4 to 6 for each member. Complete the table below.

	Member 1	Member 2	Member 3	Member 4
First ball				
Second ball				
Outcome				

Discussion:

The possible outcomes list that fulfils the following conditions.

(i) Two balls are of the same colour.

(ii) At least one ball is red.

The discussion in the activity above requires you to list the possible outcomes that fulfils two conditions. The first condition is that both the balls are of the same colour. The second condition is at least one of the balls is red. The outcomes list that fulfils the conditions is known as event.

Event is a set of possible outcomes that fulfils certain conditions for a sample space and is a subset for the sample space.

FLASHBACK

Set $A = \{1, 3, 5, 7, 9\}$

Set $B = \{2, 4, 6, 8\}$

Number of elements:

Set A, $n(A) = 5$

Set B, $n(B) = 4$

EXAMPLE 1

One letter is randomly chosen from the word SEMPURNA. List the possible outcomes and write the sample space for the experiment. State the number of elements in the sample space.

Solution:

The word SEMPURNA is made up of eight different letters. The possible outcomes are S, E, M, P, U, R, N, A. Sample space, $S = \{S, E, M, P, U, R, N, A\}$. The number of elements in the sample space, $n(S) = 8$.

EXAMPLE 2

A number is chosen randomly from the prime numbers between 20 to 40. List the possible outcomes and write the elements in the sample space for this experiment. State the number of elements in the sample space.

Solution:

Prime numbers are between 20 to 40 are 23, 29, 31, 37.

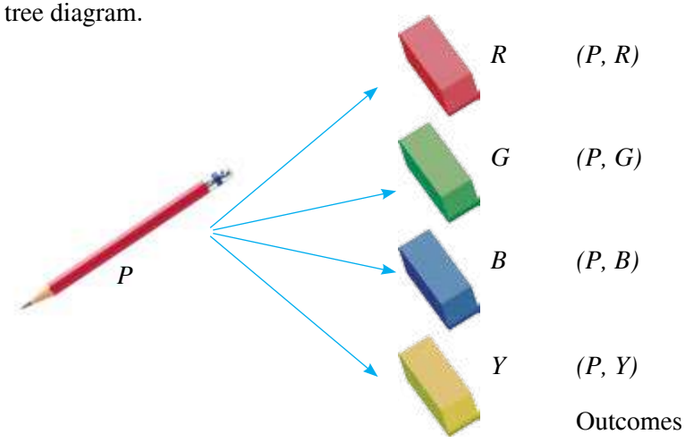
Sample space, $S = \{23, 29, 31, 37\}$. Number of elements in sample space, $n(S) = 4$.

EXAMPLE 3

A school cooperative sells brand P pencil. The erasers that are sold are red, green, blue and yellow. Palin wants to buy a pencil and one eraser. With the help of the tree diagram, list the possible outcomes and write the elements in the sample space of the items bought by Palin. State the number of pairs.

Solution:

Step 1: Draw the tree diagram.



Step 2: List of elements in the sample space, $S = \{(P,R), (P,G), (P,B), (P,Y)\}$.

Therefore, number of elements in sample space, $n(S) = 4$

EXAMPLE 4

One card has been chosen from the box containing cards with numbers 1 to 9. Determine whether the event below may occur.

(i) Number bigger than 5. (ii) Two digits number.

(iii) Factor of 15.

Solution:

Sample space , $S = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$

(i) May occur (ii) May not occur

(iii) May occur

EXAMPLE 5

In a telematch, the contestants must take one card that has the letters K, A, S, U, T from a jar. List the elements in the sample space for the event, if

(a) consonant are chosen (b) vowel are chosen

Solution:

Sample space, $S = \{K, A, S, U, T\}$

(a) Consonants = $\{K, S, T\}$ (b) Vowels = $\{A, U\}$

EXAMPLE 6

Jar A has a card labelled I. Jar B has four cards labelled I, K, A and N. One card from Jar A and one card from Jar B are picked.

(a) List the the elements in the sample space

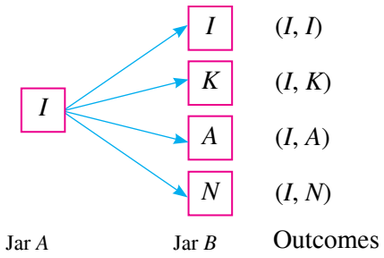
(b) List the elements in the sample space if

(i) the letters are the same.

(ii) at least one consonant is picked.

Solution:

Step 1: Draw the tree diagram



Step 2: Write the answers.

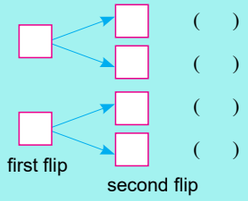
(a) $S = \{(I, I), (I, K), (I, A), (I, N)\}$

(b) (i) Event $X = \{(I, I)\}$ (ii) Event $Y = \{(I, K), (I, N)\}$

THINK SMART

A coin is flipped two times consecutively. The tree diagram below shows the possible end result.

1. State the sample space for both flips.
2. What is the probability of obtaining heads in both flips?



13.2.2 Probability of an event

LEARNING STANDARD

Construct probability models for an event,and hence make connection between theoretical probability and experimental probability.

Throwing a fair dice has six possible outcomes.They are numbers 1, 2, 3, 4, 5 and 6. Assuming that each number has an equal chance of appearing in a throw. What is the

(i) chances of getting number 4.

(ii) chances of getting an odd number.

The possible outcomes from a throw of a fair dice:

(i) The number 4 occurs only once. The probability of getting 4 is $\frac{1}{6}$.

(ii) Odd numbers occur three times, that is 2, 3, and 5. The probability of getting an odd number is $\frac{3}{6} = \frac{1}{2}$.

From the two situations above, the number of possible outcomes from a throw of a fair dice is represented by $n(S)$ and number of an events is represented by $n(A)$. The probability of the event, A is $P(A)$.

Then, Probability of an event A is represented by $P(A) = \frac{n(A)}{n(S)}$

The table on the right shows the total sum when two fair dice are thrown.

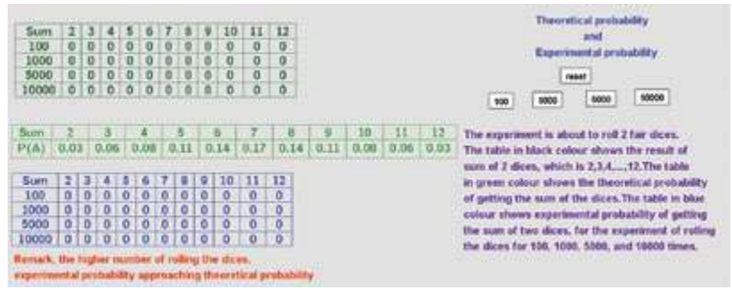
From the table, when two fair dice are thrown, the sum of 5 appears 4 times. The probability of getting a sum of 5 is $\frac{4}{36} = \frac{1}{9}$.

This probability is called **theoretical probability**.

In the experiment of throwing two fair dice thirty-six times, the sum of 2 fair dice with the value 5 appears 12 times. The probability of obtaining sum of 5 is $\frac{12}{36} = \frac{1}{3}$. This probability is called **experimental probability**.

		Dice 1					
	+	1	2	3	4	5	6
Dice 2	1	2	3	4	5	6	7
	2	3	4	5	6	7	8
	3	4	5	6	7	8	9
	4	5	6	7	8	9	10
	5	6	7	8	9	10	11
	6	7	8	9	10	11	12

If the number of trials of throwing two fair dice is large enough, the probability of the experimental probability, $\left(\frac{1}{3}\right)$ converges to the theoretical probability, $\left(\frac{1}{9}\right)$ as in the diagram below.



QR CODE

Scan the QR Code or visit http://rimbunanilmu.my/mat_t2e/ms285 to read about theory vs experiment.

13.2.3 Determining probability

LEARNING STANDARD

Determining the probability of an event.

Probability of an event A is determined by using,

$$P(A) = \frac{n(A)}{n(S)}$$

EXAMPLE 7

An apple is picked from a box that contains 25 green apples and 35 red apples. Calculate the probability of getting a green apple.

Solution:

Number of green apples = 25

Number of red apples = 60

Assume A is an event of getting a green apple.

The probability of getting a green apple.

$$P(\text{green apple}) = \frac{\text{NUMBER OF GREEN APPLES}}{\text{TOTAL NUMBER OF APPLES}}$$

$$P(A) = \frac{n(A)}{n(S)}$$

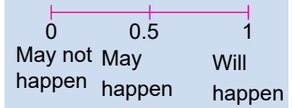
$$= \frac{25}{60}$$

$$= \frac{5}{12}$$

TIPS

Probability can be written in the form of fraction or decimal number.

TIPS



EXAMPLE 8

Pramjit gets RM5 pocket money every Tuesday, Wednesday and Thursday. Calculate the probability of him getting the amount of RM5 in four weeks?

Solution:

Assume A is an event of obtaining pocket money.

Total of Tuesday, Wednesday, and Thursday in 4 weeks, $n(A) = 12$

Total days in 4 weeks, $n(S) = 28$ days

Probability of getting RM5 pocket money in 4 weeks, $P(A) = \frac{n(A)}{n(S)}$

$$= \frac{12}{28}$$

$$= \frac{3}{7}$$

SELF PRACTICE 13.2

1. A bicycle shop has a stock of 35 bicycles. If the shop sold 15 bicycles in January, calculate the probability of selling a bicycle in that month.

2. The Meteorological Department predicted that rain will fall in the eastern states every three days in the months of November and December. Calculate the probability of rain falling in the months of November and December.

3. A supermarket held a lucky draw for a week in conjunction with its 10th anniversary. The supermarket has set a condition that every purchase of RM50 is eligible to submit one entry. The supermarket recorded the distribution of gift coupons on the average of 30 pieces a day for a week. Danial, a food stall owner, spends RM450 throughout the draw period. Calculate the probability of Danial will win the lucky draw.

13.3 Complement of An Event Probability

13.3.1 Describing complement of an event

LEARNING STANDARD

Describe the complement of an event in words and by using set notations.

COGNITIVE STIMULATION Individual

Aim: Identifying complement of an event.

Materials: Nine cards numbered in multiples of three, magnetic board, and magnet bar

Steps:

1. Arrange the first nine numbers of multiples of three on the magnetic board

3	6	9	12	15	18	21	24	27

2. List the element A. A is an event when an even number is picked .

$A = \{ \square, \square, \square, \square \}$

3. List the element A'. $A'$is an event of when not an even number is picked

$A' = \{ \square, \square, \square, \square, \square \}$

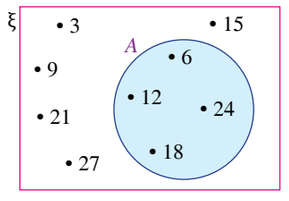
4. (i) Calculate the probability of picking an even number. $P(A)$.
   (ii) Calculate the probability of picking not an even number.$P(A')$.

Discussion:

(i) Relate $P(A)$ and $P(A')$.

(ii) Relationship between sample space, S and universal set ξ.

From the activity above, the universal set, ξ is the first nine numbers of multiples of three. A is a subset of a universal set. A' is the complement set of A. The relationship between set A and the universal set is shown in the Venn diagram on the right. The complement of an event A in a sample space S, consists of all outcomes that is not the outcome of A.



In the sample space probability, S is a universal set. If set A represents event A, then set A' is complement of an event for event A.

Probability of picking an even number, $P(A) = \frac{4}{9}$.

Probability of picking not an even number, $P(A') = \frac{5}{9}$.

$$P(A) + P(A') = \frac{4}{9} + \frac{5}{9}$$
$$= \frac{9}{9}$$
$$= 1$$

Then $P(A) + P(A') = 1$.

Thus $P(A') = 1 - P(A)$, where $0 \leqslant P(A) \leqslant 1$.

TIPS

If $P(A) = 0$, event A will not take place

If $P(A) = 1$, event A is will to take place

EXAMPLE 9

An employee at a florist shop arranges 15 bouquets according to the number of flowers, arranged in odd numbers 1 to 30 in ascending order. A is the event of selling a flower bouquet that has a perfect square number of flowers. Determine the complement of an event, A' in

(i) words

(ii) set notations

Solution:

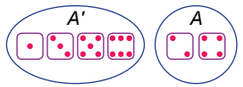
Sample space, $S = \{1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29\}$

Event $A = \{9, 25\}$

(i) A' = event of a number which is not a perfect square.

(ii) $A' = \{1, 3, 5, 7, 11, 13, 15, 17, 19, 21, 23, 27, 29\}$

DO YOU KNOW?

1. For the event of getting a head when flipping a coin, the complement event is getting a tail.
2. For the event of selecting a day in a week, if {Monday, Thursday} is selected, the complement is {Sunday, Tuesday, Wednesday, Friday and Saturday}.
3. 

4. Set $A = \{2, 4\}$
   Set $A' = \{1, 3, 5, 6\}$
   $P(A) = \frac{2}{6} = \frac{1}{3}$
   $P(A') = \frac{4}{6} = \frac{2}{3}$

13.3.2 Probability of the complement of an event

LEARNING STANDARD

Determine the probability of the complement of an event.

EXAMPLE 10

One number was chosen randomly from a set of integers from 1 to 20. A is an event of choosing prime numbers. Determine the complement of probability A.

Solution:

Sample space, $S = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20\}$

Event $A = \{2, 3, 5, 7, 11, 13, 17, 19\}$

Probability of an event A, $P(A) = \frac{n(A)}{n(S)}$

$$= \frac{8}{20}$$
$$= \frac{2}{5}$$

ATTENTION

$P(A) + P(A') = 1$

$P(A) = 1 - P(A')$

$P(A') = 1 - P(A)$

Method 1:

Complement probability, $P(A')$

$P(A') = 1 - P(A)$

$= 1 - \frac{8}{20}$

$= \frac{12}{20}$

Then, $P(A') = \frac{12}{20}$

$= \frac{3}{5}$

Method 2:

Event $A' = \{1, 4, 6, 8, 9, 10, 12, 14, 15, 16, 18, 20\}$

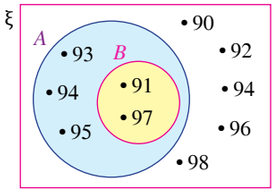
$P(A') = \frac{n(A')}{n(S)}$

$= \frac{12}{20}$

$= \frac{3}{5}$

EXAMPLE 11

The Venn diagram on the right shows the elements in a universal set. Calculate the probability $P(A')$.



Solution:

Number of elements in the complement set, $n(A') = 5$

Number of elements in the universal set is 10

The probability, $P(A') = \frac{n(A')}{n(S)}$

$= \frac{5}{10}$

$= \frac{1}{2}$

SELF PRACTICE 13.3

1. A container has 5 red bean buns, 8 *sambal* buns and 4 chocolate buns. One bun is taken randomly from the container. If A is an event getting a chocolate bun, determine the complement of the event A in

   (a) words (b) set notations

2. A container contains a number of red and blue pens. The probability of choosing one blue pen from the container is $\frac{3}{5}$. Calculate the probability of choosing one red pen from the same container.

3. A souvenir shop sells 25 cups, 30 picture frames and 15 other souvenirs within two weeks. Z is the event of selling a cup. Calculate the probability of selling other souvenirs.

4. Ali has RM73. A shop selling shoes gives Ali a choice by offering three pairs of shoes priced below RM50 a pair, four pairs of shoes priced between RM50 to RM70 a pair and five pairs of shoes priced at RM70 a pair. If B is an event where Ali buys a pair of shoes, express the complement of an event B' in

   (a) words (b) set notations

5. A sum of 10% of oranges from three boxes of oranges is found to be rotten. C is a non-rotten orange event. If an orange box contains 30 oranges, calculate the probability of taking one non-rotten orange at random.

13.4 Simple Probability

13.4.1 Solving problems

LEARNING STANDARD

Solve problems involving the probability of an event.

EXAMPLE 12

A shirt manufacturer manages to produce 80 pieces of shirts in one month. He sells 15 pieces of shirts in one week. If the profit from selling 15 pieces of shirts is RM135, calculate:

(a) the probability of the shirts sold in one month

(b) the profit obtained in two months

(c) the probability of the shirts not sold in one month.

Solution:

Understand the problem

(a) The probability of shirts sold.

(b) Profit earned within two months.

(c) The probability of shirts not sold in one month.

Planning a strategy

Sample space, S = Number of shirts produced,

$n(S) = 80$

Event A = The number of shirts in a month

$n(A) = 60$

Implementing the strategy

(a) $P(A) = \dfrac{n(A)}{n(S)}$

$= \dfrac{60}{80}$

$= \dfrac{3}{4}$

(b) Number of shirts sold in two months $= \dfrac{3}{4} \times 80 \times 2$

$= 120$ pieces

Total profit $= \dfrac{120}{15} \times \text{RM}135$

$= \text{RM}1\,080$

(c) $P(A') = 1 - P(A)$

$= 1 - \dfrac{3}{4}$

$= \dfrac{1}{4}$

The number of shirts not sold $= \dfrac{1}{4} \times 80$

$= 20$ pieces

Conclusion

(a) The probability of shirts sold within a month is $\frac{3}{4}$.

(b) Total profit is RM1 080.

(c) The number of shirts not sold in a month is 20 pieces.

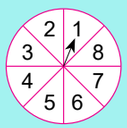
THINK SMART

The table below shows the usage of laptops and tablets according to gender at a college.

Gender	Laptop	Tablet	Total
Male	19	71	90
Female	84	4	88
Total	103	75	178

- What is the probability that a student chosen is a laptop user?
- What is the probability that a female student who uses a tablet is chosen?

THINK SMART



The picture above shows a number wheel. The needle in the number wheel is spun and stops randomly. Calculate the probability the needle stopping at

(i) an even number

(ii) an odd number

(iii) a prime number

SELF PRACTICE 13.4

1. In a crossword competition, a contestant sends 15 entry forms. The probability that the contestant wins is $\frac{3}{25}$. Determine the total number of entry forms submitted in the competition?

2. A set of letters that forms the word MENJUSTIFIKASI is inserted into a box. One letter is taken from the set randomly. Calculate
   (a) the probability of getting a vowel.
   (b) the probability of the complement of choosing a vowel.

3. A container contains 35 red marbles and a few blue marbles. A marble is randomly taken from the container. The probability of taking the red marble is $\frac{7}{15}$. Calculate
   (a) the probability of choosing a blue marble
   (b) the number of blue marbles
   (c) the probability of choosing blue marbles if 8 red marbles are added.

GENERATING EXCELLENCE

1. A box contains cards with the letters that form the word PEMBELAJARAN. One card is taken from the box randomly.
   (a) List the sample space for the experiment.
   (b) List all the vowels
   (c) Calculate the probability of taking a consonant.

2. A basket contains 6 mini blue cones, 10 mini yellow cones and a few mini green cones. One cone is taken randomly from the basket. The probability of getting a mini blue cone is $\frac{1}{4}$. Calculate
   (a) the total number of mini cones in the basket.
   (b) the probability of choosing a mini yellow cone.

3. The probability of Aiman shooting an arrow accurately is 85%. In one minute, Aiman is able to take 3 shots. Calculate the number of non-accurate shots that is taken by Aiman in one hour.

4. A box contains 3 balls that are marked with three vowels *a*, *e*, *i*. One ball is taken randomly from the box and the vowel obtained is written down. The ball is placed back into the box and the second ball is taken randomly from the box. With the help of a tree diagram,
   (a) list the sample space for the experiment.
   (b) list all element of the complement of the event of obtaining different vowels.
   (c) calculate the probability of the complement of an event for experiment (b).

5. Box *A* has a piece of card with the first multiple of 2 and box *B* has three pieces of cards with the first three terms of the multiple of 3. A card is drawn randomly from box *A* and box *B*. With the aid of a tree diagram, list the sample space for this experiment and calculate the probability that a person gets
   (a) at least one number of multiple of two.
   (b) at least one number of multiple of three.
   (c) an odd number.

6. Hazrin's hobby is collecting stamps. He has a collection of 75 pieces of stamps from Indonesia, Singapore, Thailand, the Philippines and Malaysia. A stamp is selected at random. The probability of getting a stamp from Thailand and the Philippines is $\frac{3}{5}$. If the number of stamps from Singapore and Indonesia equals the number of stamps from Malaysia, calculate the probability of selecting stamps from Malaysia.

CHAPTER SUMMARY

SIMPLE PROBABILITY

Sample space
The sample space is the set of all the possible outcomes of an experiment and is represented with the letter *S*.

Event
An event is a result of an experiment

$$P(A) = \frac{\text{The number of ways event } A \text{ may occur}}{\text{Total number of possible outcomes}}$$

The probability for the complement of an event, $P(A')$

$$P(A) + P(A') = 1$$

$$P(A') = 1 - P(A)$$

$$0 \leqslant P(A) \leqslant 1$$

SELF REFLECTION

At the end of this chapter, I will be able to:

1. Perform simple probability experiments, and thus determine the ratio $\frac{\text{frequency of an event}}{\text{number of trials}}$ as the experimental probability of an event.	
2. Make conclusions about the experimental probability of an event when the number of trials is large.	
3. Determine the sample space and events of an experiment.	
4. Construct probability model for an event, and thus make a connection between theoretical probability and experimental probability.	
5. Determine the probability of an event.	
6. Describe the complement of an event in words and by using set notations.	
7. Determine the probability of a complement of an event.	
8. Solve problems involving the probability of an event.	

MINI PROJECT

Divide your class into five groups. Each group will create five types of games and set up five probability questions for each game.

Group 1 : Model of 2 pieces of fair dice.
Group 2 : Model of 2 pieces of coins of different values.
Group 3 : Rotation Board.
Group 4 : A black box containing numbered cards.
Group 5 : Snake and ladder board game.

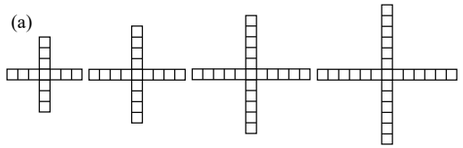
Place the games at the corner of your class.

Answers

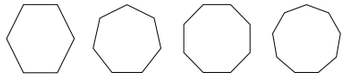
CHAPTER 1 PATTERN AND SEQUENCES

SELF PRACTICE 1.1

1. (a)



(b)



2. (a) Pattern: add 7 to the previous number.
(b) Pattern: subtract 3 from the previous number.
(c) Pattern: add 4 to the previous number.
(d) Pattern: divide the previous number by 2.
(e) Pattern: subtract $\frac{1}{4}$ from the previous number.
(f) Pattern: multiply the previous number by –3.

3. (i) 37, 55, 73, 91, 109... Pattern: add 18
+18
(ii) 28, 46, 64, 82, 100... Pattern: add 18
+18

4. 1, [1], 2, [3], [5], [8], [13]

5. [2] [6] [6] [2]

SELF PRACTICE 1.2

1. (a) Pattern
(b) Pattern
(c) Not a pattern
(d) Not a pattern
(e) Not a pattern
(f) Not a pattern

2. (a) 34, 28, [22], 16, [10], [4], ...
(b) [128], [64], 32, 16, [8], 4, ...
(c) 0.07, [0.28], 1.12, [4.48], 17.92, ...
(d) $1\frac{1}{10}$, 1, [$\frac{9}{10}$], [$\frac{4}{5}$], [$\frac{7}{10}$], ...
(e) 0.2, 2.4, 28.8, [345.6], [4147.2], ...
(f) [−400], −80, −16, [−3.2], [−0.64], ...
(g) [$\frac{3}{4}$], [$\frac{2}{3}$], [$\frac{7}{12}$], [$\frac{1}{2}$], [$\frac{5}{12}$], ...
(h) −8.1, [−6.1], −4.1, −2.1, [−0.1], ...

3. (a) 42, [49], [56], [63], [70], [77], ...
(b) 96, [48], [24], [12], [6], [3], ...

SELF PRACTICE 1.3

1. (a) Multiply the previous number by 3.
(b) Divide the previous number by 2.

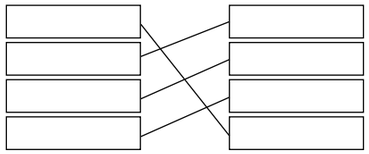
2. (a) 2^n $n = 1, 2, 3, ...$
(b) $5 + 3n$ $n = 0, 1, 2, 3, ...$
(c) $3 + 3n$ $n = 0, 1, 2, 3, ...$
(d) $3 - 2n$ $n = 0, 1, 2, 3, ...$

3. (a) $T_7 = 45$, $T_{11} = 77$ (b) $T_7 = 13$, $T_{11} = 19$ (c) $T_7 = -7.3$, $T_{11} = -9.7$

4. (a) 30 minutes (b) 10:00 a.m. (c) 3:00 p.m.

GENERATING EXCELLENCE

1.



2. (a) add 6
(b) subtract 4
(c) multiply 3
(d) divide 6

3. (a) **Number**
+2

Words
Add 2 to the previous number.

Algebraic Expression
$2x$ $x = 1, 2, 3, 4, ...$

(b) **Number**
÷2

Words
Divide the previous number by 2.

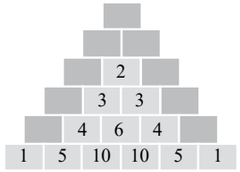
Algebraic Expression
$\frac{100}{2^n}$ $n = 0, 1, 2, 3, ...$

4. (a) 1, 3, 5, [7], 9, [11], ...
(b) [−80], [−40], −20, −10, −5
(c) 268, [235], [202], 169, 136, [103], ...
(d) $\frac{1}{2}$, [$\frac{5}{12}$], $\frac{1}{3}$, [$\frac{1}{4}$], $\frac{1}{6}$

5. (a) $x = 2$
(b) (i) The pattern is −7
(ii) Subtract 7 from the previous number.
(iii) $9 - 7n$, $n = 0, 1, 2, 3, ...$

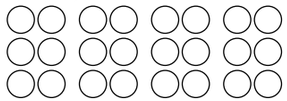
6. 0, 1, 1, [2], [3], [5], ...

7.



8. (a) $x = 3$
(b) −61

9. (a) Add 6
(b) 6, 12, 18, ...
(c)



(d) 36 buttons

10. 841.86 m²

11.

Ubat	1	2	3
Fever	8:30 a.m.	4:30 p.m.	12:30 a.m.
Antibiotics	8:30 a.m.	8:30 p.m.	
Flu	8:30 a.m.		

CHAPTER 2 FACTORISATION AND ALGEBRAIC FRACTIONS

SELF PRACTICE 2.1

1. (a) $(a + 2)(a + 1)$ (b) $(4x - 3)(4x - 3)$

2. (a) $3x + 6$ (b) $32x - 12$
(c) $2a + 10$ (d) $6p^2 - 8p$
(e) $-\frac{rs}{4} + r$ (f) $-2pr + 4pq$
(g) $15bc - 18$ (h) $14ef + 21e$
(i) $16g + 8g^2h$

3. (a) $a^2 + 3a + 2$ (b) $x^2 - x - 20$
(c) $10 + 3m - m^2$ (d) $12p^2 - 11p + 2$
(e) $12r^2 - 11r + 2$ (f) $8r^2 - 3s^2 - 2rs$
(g) $6d^2 - \frac{5}{2}db + \frac{1}{4}b^2$ (h) $r^2 - 6rs + 9s^2$
(i) $16e^2 - 24e + 9$

4. (a) $17b - 4a + 3$ (b) $-4m - 17mn$
(c) $-5h^2 + 4hj + j^2$ (d) $3x^2 - y^2 + 4xy$

5. (a) $4p^2 - 12p + 9$ (b) $\frac{3}{2}y^2 - \frac{5}{2}y + 1$
(c) $10x^2 - 11x - 6$ (d) $5w^2 + w$

6. $p^2 - 2p + 2$

7. $(5x^2 - 17x + 6)$ m²

8. $\sqrt{33y^2 - 34y + 8}$

SELF PRACTICE 2.2

1. (a) 1, 2, 4, $4y$ (b) 1, b
(c) 1, w (d) 1, 5, m
(e) 1, c (f) 1, 2, b

2. (a) $5(e + 2)$ (b) $2a(b - 4a)$
(c) $3ab(c + 2a)$ (d) $4x(1 - 3x)$
(e) $f(e + f + g)$ (f) $2x(x - 2y + 3w)$

3. (a) $(b - 9)(b + 9)$ (b) $(a + b)(a - b)$
(c) $(x + 1)(x - 1)$ (d) $(4y - 7)(4y + 7)$
(e) $(m + 7)(m - 1)$ (f) $(2x + 1)(2x - 5)$

4. (a) $(x + 2)(x + 7)$ (b) $(x - 2)(x + 9)$
(c) $(x - 8)(x + 3)$ (d) $(m - 2)(m + 13)$
(e) $(y - 5)(y + 3)$ (f) $(k - 4)^2$
(g) $(m - 6)(2m + 1)$ (h) $(3f - 2)^2$
(i) $(2m - 4)(m + 4)$ (j) $(2x - 7)(x + 1)$
(k) $(6y - 5)(2y + 3)$ (l) $(5p - 4)(p + 2)$
(m) $(5m - 4)(-m - 2)$ (n) $(-p + 2)(3p - 2)$
(o) $(-2x + 3)(3x + 5)$

5. (a) $(p - r)(q - w)$ (b) $(x + y)(x + 6)$
(c) $(3a + c)(b - 3d)$ (d) $(h + j)(a - b)$
(e) $(m - n)(j + y)$ (f) $(3x + 4p)(3y - z)$

6. (a) $2y^2 + 3y - 8$ (b) 1 section

SELF PRACTICE 2.3

1. (a) $(2b - 5)(2b + 1)$ (b) $(m - 1)(m + 7)$
(c) $(p - 12)(p + 2)$ (d) $7x^2 - 7x - 3$
(e) $4c^2 - 2c + 9$

2. (a) $\frac{6y}{5}$ (b) $\frac{2m + 7n}{m - 2n}$ (c) $\frac{r + s}{2r + 3s}$

3. (a) $\frac{5p - 2}{p^2}$ (b) $\frac{2s}{9}$ (c) $\frac{12 - 3z}{4(x + y)}$

4. (a) $\frac{9u + 20v}{12}$ (b) $\frac{5t - 12s}{30st}$ (c) $\frac{6s + 4r - 8}{3rs - 6s}$

5. (a) $\frac{4m + 3n}{36}$ (b) $\frac{6m + n^2}{6m^2n}$ (c) $\frac{20 + 3d}{5d^2g}$

6. (a) $\frac{x - 1}{y}$ (b) $\frac{2a + 5}{4}$ (c) $\frac{1}{m - n}$
(d) $\frac{1}{2k + 1}$ (e) $\frac{c - 3}{2}$

7. (a) $\frac{6}{(a-3)(3+a)}$ (b) $\frac{hy}{(k-2)(h+3)}$

   (c) $\frac{6m^2n}{(m-n)(n-2m)}$ (d) $\frac{2rs-8r}{rs+5s-2r-10}$

8. (a) $\frac{2}{m(x-a)}$ (b) $\frac{5r}{s(1-2r)}$

   (c) $\frac{x+3}{5x}$ (d) $\frac{-2f(e+2f)}{3e(e-3f)}$

9. (a) $\frac{5a(a+b)}{3b(2a+3)}$ (b) $\frac{3}{2a}$

   (c) $\frac{y}{3x^2}$ (d) $\frac{1}{eg}$

10. (a) $\frac{xy(x+1)}{(x+y)^2}$ (b) $\frac{2q(p+1)}{2p-1}$

    (c) $\frac{pr}{(r-1)(q+r)}$ (d) $\frac{t(2t+1)}{(2t-1)(s-u)}$

GENERATING EXCELLENCE

1. (a) $3a+6b$ (b) $n^2-3n-10$
   (c) $a^2+4ab+4b^2$ (d) $16x^2-8xy+y^2$
   (e) $6v^2+\frac{v}{3w}-\frac{2}{9w^2}$ (f) $13h^2-10hk+k^2$

2. (a) $6m(2-3m)$ (b) $(y+9)(y-9)$
   (c) $4ab(1-2a)$ (d) $(x-4y)(x+4y)$
   (e) $(s-4)(s-2)$ (f) $(x+1)(x+3)$
   (g) $(x-3)(x+5)$ (h) $(x+2)(x+4)$
   (i) $(2c-b)(3d-e)$

3. (a) $\frac{3a-2b+2}{4v}$ (b) $\frac{12ec-25abd}{20abc}$

   (c) $\frac{20-3f}{5f^2g}$ (d) $\frac{pn+2p+nm}{m^2p}$

   (e) $\frac{15x^2+2y^2-2y}{24xyz}$ (f) $\frac{9rsz+4-2r}{36yz}$

4. $(k+4)$ cm

5. $4x^2+4x-6$

6. (i) 25 pieces (ii) 21 units

7. (i) $2x^2+14x-10$
   (ii) RM$(16x^3+112x^2-80x)$

8. (i) $\frac{7+4x}{2}$ (ii) 2 hour

9. $\frac{3x^2+8x+4}{18}$ cm^2

10. (i) xy (ii) $(xy-2x)$m (iii) $18xy$

CHAPTER 3 ALGEBRAIC FORMULAE

SELF PRACTICE 3.1

1. (a) $m=z+qp$ (b) $u=v-2$

   (c) $x=\frac{7w}{3y}$ (d) $b=\frac{4}{3a}-5$

   (e) $u=\frac{3}{5q+5}$ (f) $v=\frac{5}{2w+4}$

   (g) $b=\frac{(2a-5)^2}{3}$ (h) $w=6t$

   (i) $m=-\frac{\sqrt{4p-8}}{3}$ (j) $r=\frac{4s-7}{3}$

2. $z=29.75x+40.5y$

3. (a) (i) $c=16$ (b) (i) $p=2$
   (ii) $d=\frac{1}{2}$ (ii) $q=2$

   (c) (i) $m=-6$ (d) (i) $n=\sqrt{13}$

   (ii) $n=3$ (ii) $m=\frac{1}{16}$

   (e) (i) $u=6$ (f) (i) $p=0$

   (ii) $r=\frac{3}{2}$ (ii) $q=\frac{9}{2}$

   (iii) $s=4$ (iii) $r=-4$

   (g) (i) $a=\frac{1}{3}$ (h) (i) $s=12$

   (ii) $b=2$ (ii) $t=\sqrt{50}$

   (iii) $c=6$ (iii) $u=\sqrt{\frac{7}{4}}$

4. (a) $z=5.9x+3.6y$ (b) $b=\frac{24p-7}{q}$

   (c) $P=0.85(35\,m+76n)$ (d) $x=$ RM$0.1st$

GENERATING EXCELLENCE

1. (a) $A=x^2$ (b) $p=5+3h$

   (c) $a=\frac{v_2-v_1}{t}$

2. (a) $q=\frac{m-p}{-3}$ (b) $w=p-x$

   (c) $g=\frac{2e-3h}{4}$ (d) $q=m-8p$

   (e) $v=\sqrt{\frac{w}{3}}$ (f) $n=\sqrt{\frac{8m}{3}}$

   (g) $v=36w^2-1$ (h) $k=\frac{16}{f^2}+7$

3. (a) (i) $w=-2$ (b) (i) $b=\frac{2}{9}$

   (ii) $x=-\frac{15}{19}$ (ii) $c=8$

   (iii) $y=29$ (iii) $d=3$

   (c) (i) $p=-\frac{1}{6}$ (d) (i) $s=-\frac{1}{5}$

   (ii) $q=-\frac{1}{19}$ (ii) $t=-46$

   (iii) $r=1\frac{1}{6}$ (iii) $u=-\frac{2}{11}$

4. $z=65xy$

5. $t=13\frac{1}{3}s$ minutes

6. $x=4$
   $y=7$

CHAPTER 4 POLYGONS

SELF PRACTICE 4.1

1. (a) Irregular polygon (b) Irregular polygon
   (c) Regular polygon (d) Regular polygon
   (e) Irregular polygon (f) Regular polygon
   (g) Regular polygon (h) Regular polygon
   (i) Regular polygon

2. (a) One axis of simmetry (b) 2 axis of simmetry
   (c) No axis of simmetry (d) No axis of simmetry

3.

Name of polygon	Number of sides	Number of vertices	Number axis of symmetry
Hexagon	6	6	6
Heptagon	7	7	7
Octagon	8	8	8
Nonagon	9	9	9

4. Students answer

5. Students answer

SELF PRACTICE 4.2

1.

Number of triangles in a polygon	Sum of interior angle
3	540°
4	720°
5	900°
6	1 080°
7	1 260°

2. (a) Interior angle: a, g, e, c
   Exterior angle: b, d, f, h

   (b) Interior angle: a, b, c, d, e
   Exterior angle: f, g, h, i, j

3. (a) $x=150°$ (b) $x=100°$
   (c) $x=22°$ (d) $x=54°$

4. (a) $p=80°$ (b) $p=68°$
   $q=55°$ $q=100°$
   $r=125°$ $r=88°$

5. (a) $a+b+c=300°$ (b) $a+b+c=170°$
   (c) $a+b+c=265°$ (d) $a+b+c=254°$

6. (a) 7 sides (b) 8 sides (c) 9 sides

7. (a) Decagon (b) $y=144°$

8. $x=117°$

GENERATING EXCELLENCE

1. (a) Students answer (b) Students answer

2. (a) $p=40°$ (b) $p=45°$ (c) $p=75°$
   $q=135°$ $q=95°$ $q=140°$
   $r=95°$ $r=50°$ $r=105°$

3. (a) $x=50°$ (b) $x=42.5°$ (c) $x=80°$

4. (a) $\frac{360°}{45°}=8$ sides (b) $\frac{360°}{36°}=10$ sides

   (c) $\frac{360°}{40°}=9$ sides (d) $\frac{360°}{30°}=12$ sides

5. (a) $x+y=215°$ (b) $x+y=180°$
   (c) $a+b+c+d=425°$

6. Students answer

7. 17 sides

8. $p+q=276°$

9. $\angle CBM=58°$

10. (a) $h=20°$
    (b) Interior angle $=140°$
    Exterior angle $=40°$
    (c) Number of sides, $n=\frac{360°}{40°}=9$, nonagon

11. $x=54°$

12. Cannot, because the sum of interior angles is $(n-2)\times 180°$ when $n=3, 4, \ldots$

13. 12 sides

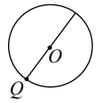
14. $x=72°$

15. $x=12°$

CHAPTER 5 CIRCLES

SELF PRACTICE 5.1

1. (i) centre of circle
   (ii) diameter
   (iii) minor sector
   (iv) radius
   (v) minor arc
   (vi) chord
   (vii) minor segment
2. Student answer
3. (a) 

   (b) 

4. Student answer
5. Student answer

SELF PRACTICE 5.2

1. $KL = 24$ cm
2. $KOM = 45$ cm

SELF PRACTICE 5.3

1. (a) 44.00 cm (b) 352.00 cm
   (c) 28.91 cm (d) 308.00 mm
2. (a) 7.80 cm (b) 3.90 cm
3. (a) 1 386.00 m^2 (b) 9 856.00 mm^2
   (c) 154.00 cm^2 (d) 6.16 cm^2
4. (a) 3.50 cm (b) 22.00 cm
5. 18.87 cm^2
6. 102.75 cm^2
7. (a) 14.00 cm (b) 7.04 cm
   (c) 14.70 cm (d) 31.51 cm
8. (a) 10.8° (b) 7.2° (c) 25°
9. 70 cm
10. $25\pi - 49$

GENERATING EXCELLENCE

1. (a) 3 cm (b) 3 cm (c) 4 cm
2. 51.71 m^2
3. 66 cm^2
4. 122.9 cm^2
5. 550 cm^2
6. 2 827.8 cm^2

CHAPTER 6 THREE-DIMENSIONAL GEOMETRY SHAPES

SELF PRACTICE 6.1

1. (a) (i) One circular base.
   (ii) One curved surface that meets at the vertex of the cone.
   (b) (i) 6 square surfaces.
   (ii) sides and edges.
   (c) (i) One vertex.
   (ii) sides and edges.
   (d) (i) Two circular bases that are congruent and parallel.
   (ii) A curved side surface that lists two sites.
2. (a) cone (b) pyramid (c) sphere

SELF PRACTICE 6.2

1. (a) 
   (b) 
   (c) 
   (d) 
2. (a) Hexagonal prism (b) Pyramid
   (c) Triangular prism (d) Triangular prism

SELF PRACTICE 6.3

1. (a) 282.86 cm^2 (b) 754.29 cm^2
   (c) 84 cm^2
2. (a) 1 257.14 cm^2 (b) 66 980.57 mm^2
   (c) 15 150 cm^2
3. (a) 455.71 m^2 (b) 361.43 cm^2
   (c) 1 428.57 cm^2

SELF PRACTICE 6.4

1. (a) 576.19 cm^3 (b) 618.67 cm^3 (c) 142.48 cm^3
2. (a) 157.14 cm^3 (b) 183.43 cm^3 (c) 146.79 cm^3
3. 2 192.67 cm^3
4. 2 block of pyramid

GENERATING EXCELLENCE

1. (a) Cube (b) Triangular prism
   (c) Hexagonal prism
2. 8 cm
3. (a) 60 mm (b) 8.5 cm (c) $h = 9$ cm
4. (a) 4 790.76 cm^3 (b) 13 967 marble

5. 30 tube
6. 81 pieces of sweet
7. 770 cm^2
8. 45 cm

CHAPTER 7 COORDINATES

SELF PRACTICE 7.1

1. (a) 4 units (b) 5 units
   (c) 8 units (d) 14 units
2. (a) 4.47 cm (b) 1341.64 cm
   (c) 12.37 units (d) 11.4 units
3. (a) 4 units (b) 18 units
   (c) 7 units (d) 1 units
4. (a) $a = 3, b = 3$ (b) $a = 1, b = 4$
   (c) $a = -2, b = 2$ (d) $a = -4, b = 1$
5. (a) 5.66 units (b) 5.83 units
   (c) 7.07 units (d) 12.53 units
6. 5.39 units
7. 7 units
8. 5.83 units
9. $a = 2, b = 7$
10. (a) (4, 1) (b) (2, −1)
    (c) (5, 2) (d) (0, 0)
11. 15.91 units
12. 15.71 units

SELF PRACTICE 7.2

1. (a) B (b) B
2. (a) (4 , 8) (b) (4 , 2) (c) (2 , 5)
3. (a) (3 , 6) (b) (6 , 4)
   (c) (4 , 0) (d) (−2, 3)
4. (a) (−1, 4) (b) (3, −2)
   (c) (4, 1) (d) (3, 0)
5. $P(-4, 6)$
   $R(-4, -4)$
6. (a) $a = 4$, $b = 3$ (b) 8 units (c) (3 , 4)
7. (a) $m = 4$, $n = 6$ (b) (−2 , 6) (c) (2 , −6)
8. $A(3,-1)$
9. $s = 8$, $u = 3$
10. (a) $a = 1$ (b) $B(7, 1)$

SELF PRACTICE 7.3

1. (a) (−2, 1) (b) (0 , 5)
   (c) (1, 3) (d) 4.47 units
2. (a) 14.4 units (b) (−2, −2) (c) (−2, 4)
3. (a) (4, 3) (b) (4 , −3) (c) 6 units
4. (a) $K(-4,1)$ (b) (0, 1)
   $L(4, 1)$
5. (2, 3), 3.6 units

GENERATING EXCELLENCE

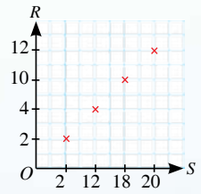
1. (a) K (b) A
   (c) H (d) D
2. (−4 , 5)
3. $P'(6, 2)$
   $Q'(3, -4)$
   $R'(-3 , 0)$
   Distance P' Q' = 6.7 units
   Distance R' Q' = 7.2 units
4. 20 $units^2$
5. 10 $units^2$
6. 8 $units^2$

CHAPTER 8 GRAPHS OF FUNCTIONS

SELF PRACTICE 8.1

1. (a) (9, 18) (b) Many to many
2. $b = 7$
3. (a) Function (b) Function
   (c) Not a function
4. (a) Function (b) Not a function
5. (a) {(10,2), (12, 4), (18, 10), (20, 12)}
   (b)

S	10	12	18	20
R	2	4	10	12

   (c) 

   (d) $R = S - 8$

6. $a = 9$ $b = 15$

7. (a) domain $\{-5, 2, 4\}$, range $\{0, 8, 15, 16\}$ (b) domain $\{-4, 0, 1, 4\}$, range $\{-5, -3, 1, 2, 4\}$

SELF PRACTICE 8.2

1. (a)

x	0	1	2	3	4
y	2	5	8	11	14

(b)

x	0	1	2	3	4
y	0	2	8	18	32

(c)

x	−2	−1	0	1	2	3
y	−6	1	2	3	10	29

2. (a)

x	−3	−2	−1	0	1	2	3
y	−8	−6	−4	−2	0	2	4

(b)

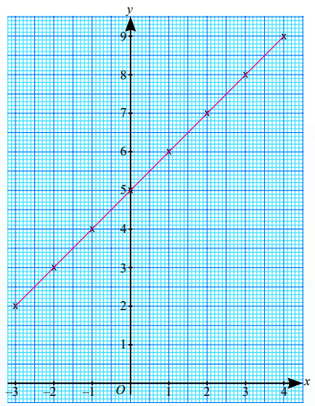
x	−1	0	1	2	3
y	−4	−5	−2	5	16

(c)

x	−2	−1	0	1	2	3	4
y	−30	−9	−6	−3	18	75	186

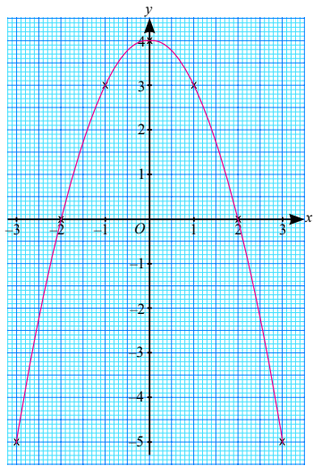
3. (a)

x	−3	−2	−1	0	1	2	3	4
y	2	3	4	5	6	7	8	9



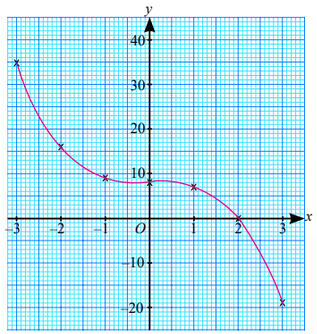
(b)

x	−3	−2	−1	0	1	2	3
y	−5	0	3	4	3	0	−5



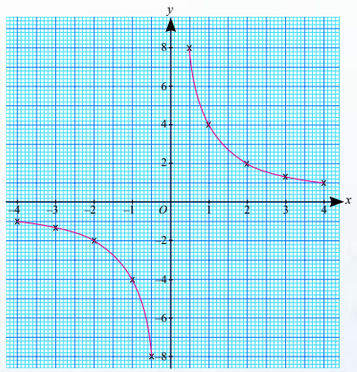
(c)

x	−3	−2	−1	0	1	2	3
y	35	16	9	8	7	0	−19



(d)

x	−4	−3	−2	−1	−0.5	0.5	1	2	3	4
y	−1	−1.33	−2	−4	−8	8	4	2	1.33	1

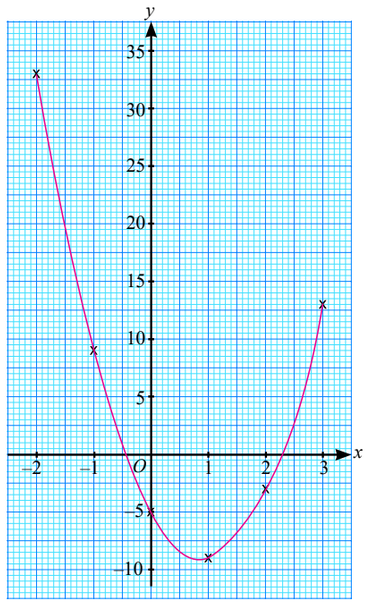


4. (a) (i) 30 km (ii) 42 km
(b) RM82.80

5. (a)

x	−2	−1	0	1	2	3
y	33	9	−5	−9	−3	13

(b)(c)



(d) 2.3, −0.4

GENERATING EXCELLENCE

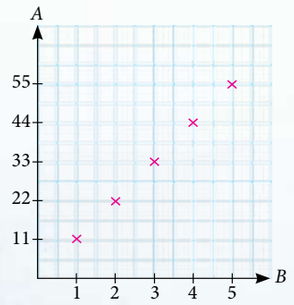
1. (a) Yes (b) No pair

2. (a) Ordered pairs:
$\{(1, 11), (2, 22), (3, 33), (4, 44), (5, 55)\}$

Table:

B	1	2	3	4	5
A	11	22	33	44	55

Graph:



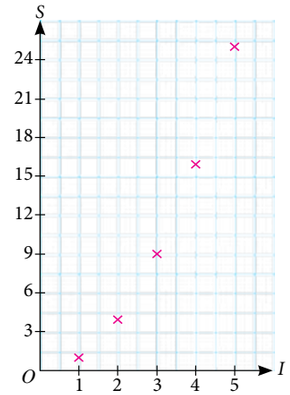
Equation: $f(x) = 11x$

(b) Ordered pairs:
$\{(1, 1), (2, 4), (3, 9), (4, 16), (5, 25)\}$

Table:

I	1	2	3	4	5
S	1	4	9	16	25

Graph:



Equation: $f(x) = x^2$

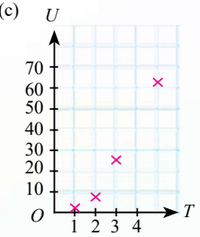
3. (a) (i) L (ii) r
(b) $L = 4\pi r^2$

4. (a) $\{(1, 1), (2, 8), (3, 27), (4, 64)\}$

(b)

T	1	2	3	4
U	1	8	27	64

(c)



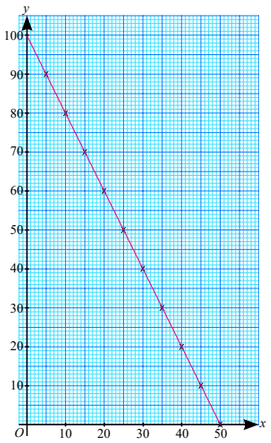
(d) $y = x^3$ or $f(x) = x^3$

5. (a) (i) RM96 (ii) RM90 (iii) RM80

(b)

x	5	10	15	20	25	30	35	40	45	50
y	90	80	70	60	50	40	30	20	10	0

(c)

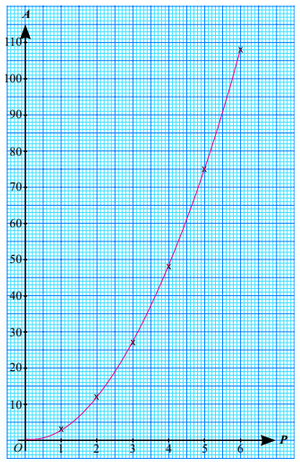


(d) (i) Day to -50 (ii) Day to -28

6. (a)

p	0	1	2	3	4	5	6
A	0	3	12	27	48	75	108

(b)



(c) (i) 80 m^2 (ii) 75 m^2

7. (a)

Number of T-shirts	10	30	50	70
Cost (RM)	100	200	300	400

(b) RM 50
(c) RM 390
(d) 72 pieces

8. (a) 15 m
(b) 1.5 second and 6.5 second
(c) 8 second
(d) 16 m
(e) Ascending and descending

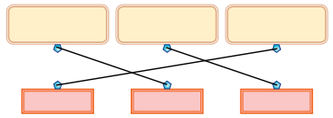
9. (a) RM8
(b) Company A because it only charges RM4 per hour used whereas company B charges RM5 per hour used.
(c) Company B with RM7, Zarul could use the bicycle for 3 hours whereas company A allows use for 2 hours 30 minutes only.
(d) the first 2 hours.
(e) RM10

10. (a) (i) RM 3 (ii) RM2.80
(b) Berjaya Company because it charges RM40 whereas Maju company charges RM5.
(c) Umai has to choose Berjaya Company because he can speed longer than with Maju Company.

CHAPTER 9 SPEED AND ACCELERATION

SELF PRACTICE 9.1

1.



2. (a) 120 km (b) 1543.5 km
(c) 16.5 m (d) 666.67 km

3. 8.29 m/s

4. hour 1154

5. (a) 833.33 m/min (b) 2.88 km/h
(c) 1.83 km/minute

6. 114.29 km/h

7. 93.24 km/h

SELF PRACTICE 9.2

1.

Situation	Acceleration	True / False
(a)		True
(b)		False
(c)		True
(d)		False

2. (a) 100 km/h (b) –360 km/h

3. 0.5 ms^{-2}

4. 8.75 cms^{-2}

GENERATING EXCELLENCE

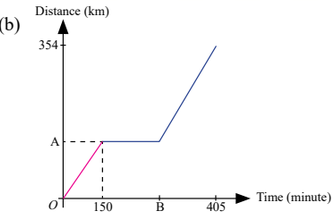
1. Constant Speed: lift,clock, fan
Irregular Speed: wave, wind, mini bus

2. (a) 180 km/h^2 (b) –200 km/h^2
(c) 120 km/h^2

3. (a) 30 minute (b) 7:10 morning

4. (a) A = 185 km, B = 185 min

(b)



(c) 52.44 km/j

5. (a) 0.38 m/min^2 (b) 5.2 min
(c) 1 m/min (d) 180 second

6. x = 315 km

CHAPTER 10 GRADIENT OF A STRAIGHT LINE

SELF PRACTICE 10.1

1. (a) Vertical distance = 4 m
Horizontal distance = 6 m
(b) Vertical distance = 12 m
Horizontal distance = 3 m
(c) Vertical distance = 16 m
Horizontal distance = 2 m

2. (a) AB
Vertical = 3 unit
Horizontal = 3 unit
(b) CD
Vertical = 8 unit
Horizontal = 1 unit
(c) PQ
Vertical = 6 unit
Horizontal = 4 unit

3. Vertical = 36 cm
Horizontal = 36 cm

4. (a) Vertical = 6 units
Horizontal = 5 units
(b) Vertical = 4 units
Horizontal = 5 units
(c) Vertical = 4 units
Horizontal = 2 units
(d) Vertical = 4 units
Horizontal = 4 units
(e) Vertical = 6 units
Horizontal = 1 units
(f) Vertical = 9 units
Horizontal = 3 units

5. (a) y – intercept = 4
x – intercept = 8
(b) y – intercept = −7
x – intercept = 3
(c) y – intercept = 3
x – intercept = −5
(d) y – intercept = –2
x – intercept = −1

6. (a) AB (b) EF

7. (a) Negative (b) Positive
(c) Negative (d) Positive

8. (a) 2 (b) 4 (c) $\frac{2}{7}$

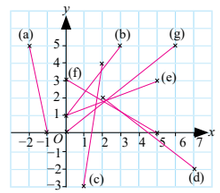
9. (a) 2 (b) $\frac{1}{2}$
(c) $-\frac{5}{6}$ (d) $-\frac{4}{7}$

10. (a) 3 (b) 9
(c) $\frac{5}{3}$ (d) $-\frac{3}{4}$

11. (a) $-\frac{1}{4}$ (b) $-\frac{10}{9}$
(c) $\frac{8}{3}$ (d) −1

GENERATING EXCELLENCE

1.



(a) Negative (b) Positive
(c) Positive (d) Negative
(e) Positive (f) Negative
(g) Positive

2. $\frac{11}{7}$

3. (c) has the highest gradient

4. (a) −8 (c) −12
(e) 2 (f) −5

5. −3

6. $Q(-3, 4)$

7. x – intercept = 9

8. $\frac{4}{3}$

9. (−6, 0)

10. (a) 0.67 (b) 9.01 m

11. (a) 20 ms^{-1} (b) v = 42 m/s

12. Gradient = $\frac{3}{2}$
Surface area = 14.42 m^2

CHAPTER 11 ISOMETRIC TRANSFORMATIONS

SELF PRACTICE 11.1

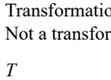
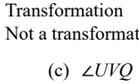
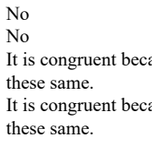
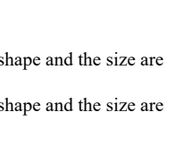
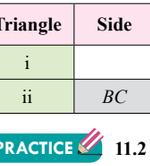
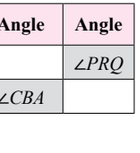
1. (a) Transformation (b) Transformation
   (c) Not a transformation (d) Not a transformation
2. (a) T (b) QR (c) $\angle UVQ$
3. (a) No
   (b) No
   (c) It is congruent because the shape and the size are these same.
   (d) It is congruent because the shape and the size are these same.
4.

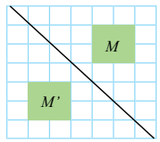
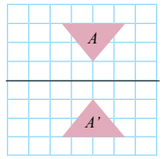
Triangle	Side	Line	Angle	Angle
i		RQ		$\angle PRQ$
ii	BC		$\angle CBA$	

SELF PRACTICE 11.2

1. (a) Translation (b) No
   (c) Translation (d) No
2. (a) $(7, -1)$ (b) $(9, 3)$
   (c) $(2, -4)$ (d) $(3, -8)$
3. (a) $(-2, -8)$ (b) $(2, -9)$
   (c) $(7, -4)$ (d) $(-8, -6)$
4. (a) $\begin{pmatrix} 2 \\ 4 \end{pmatrix}$ (b) $\begin{pmatrix} -6 \\ -8 \end{pmatrix}$
   (c) $\begin{pmatrix} 4 \\ -4 \end{pmatrix}$ (d) $\begin{pmatrix} -3 \\ -7 \end{pmatrix}$
5. (a) $(5, -8)$ (b) $(2, 7)$
   (c) $(3, 3)$ (d) $(-5, -17)$
6. (a) $(1, -7)$ (b) $(7, -8)$

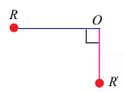
SELF PRACTICE 11.3

1. (b)  (c) 
2. (a)  (b) 
3. (a)  (b) 

4. $P(-1, 7)$ $Q(-4, -2)$
   $R(5, -3)$ $S(8, 7)$
5. (a)  (b) 
6. (a) Reflection on line $y = 6$
   (b) Reflection on line $x = -2$
   (c) Reflection on line $y = 3$
   (d) Reflection on line $y = 1$
7. (a) Reflection on the y −axis
   (b) Reflection on the x −axis
   (c) Reflection on the y −axis
   (d) Reflection on line $x = 3$
8. (a) $(-3, 7)$ (b) $(7, 4)$

SELF PRACTICE 11.4

1. (a) 90° clockwise rotation, centre P.
   (b) 90° anticlockwise rotation, centre P.
   (c) 90° anticlockwise rotation, centre P.
   (d) 90° clockwise rotation, centre P.
2. (a) 90° clockwise rotation, at point P.
   (b) 180° clockwise rotation / anticlockwise rotation at point P.
   (c) 180° clockwise rotation / anticlockwise rotation at point T.
   (d) 90° rotation, clockwise rotation at the origin.
3. 90° anticlockwise rotation at the origin O.



Rotation 180° at centre O.

4. Coordinate:
   $P(-4, 0)$ $R(-1, -2)$
   $Q(0, 2)$ $S(-1, 6)$

SELF PRACTICE 11.5

1. (a) Isometric transformation
   (b) Not an isometric transformation
   (c) Isometric transformation
   (d) Isometric transformation
2. (a) Isometric transformation
   (b) Isometric transformation
   (c) Isometric transformation
3. A: Translation
   B: Rotation
   C: Reflection
4. K, L and M
5. $x = 100°$

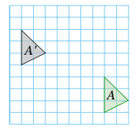
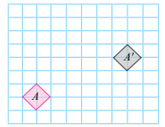
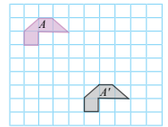
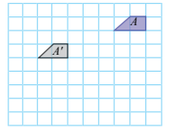
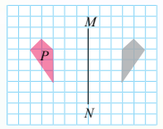
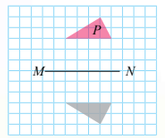
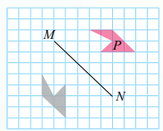
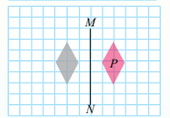
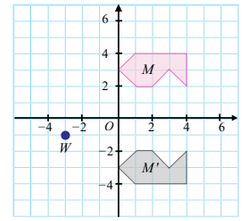
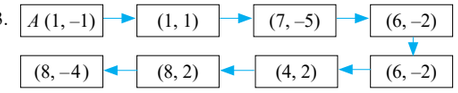
SELF PRACTICE 11.6

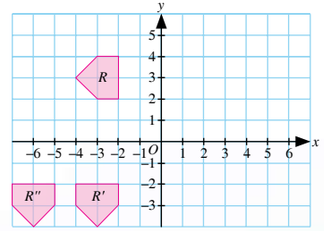
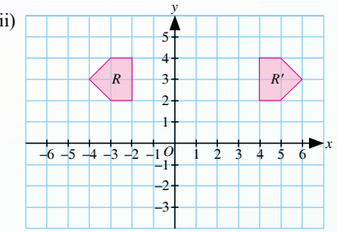
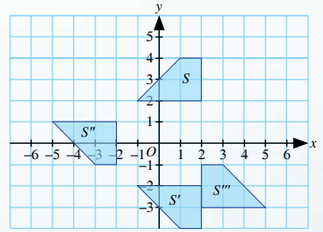
1. (a) ✓ (b) × (c) × (d) ×
2. (a) No order (b) 2nd order
   (c) 4th order (d) 1st order
3.

Clockwise	Anticlockwise
(i) order 2	order 4
(ii) order 2	order 4
(iii) order 5	order 1

4. (2,8)

GENERATING EXCELLENCE

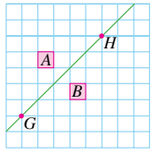
1. (a) F (b) U
2. (a) translation because there is a change in position
   (b) not a translation
   (c) translation because there is a change in position
3. (a)  (b) 
   (c)  (d) 
4. (a) $(-2, 0)$ (b) $(1, -3)$
   (c) $(-7, 2)$ (d) $(-5, 2)$
   (e) $(-4, -2)$ (f) $(2, -5)$
5. (a)  (b) 
   (c)  (d) 
6. Coordinate:
   $C'(5, 2)$
   $D'(7, -2)$
   $E(2, -4)$
   $F(3, 1)$
7. Coordinate:
   $K'(3, -1)$
   $L'(1, 3)$
   $M(0, 3)$
   $N(3, -4)$
8. (a) ✓ (b) ✓ (c) × (d) ✓
9. (i) 
   (ii) $W' = (-3, 1)$
10. (a) 90° clockwise rotation, centre $(-1, 1)$.
    (b) 180° anticlockwise rotation, centre $(0, 2)$.
    (c) 180° clockwise rotation, centre $(1, 0)$.
    (d) 90° clockwise rotation, centre $(1, -1)$.
11. (i) OBC (ii) OCD (iii) ODA
12. (a) $P \rightarrow Q$ Reflection on the line $x = 4$
    $Q \rightarrow R$ Translation $\begin{pmatrix} 0 \\ -4 \end{pmatrix}$
    $R \rightarrow S$ 90° clockwise rotation, centre (5, 1)
    (b) (0,4)
13. 

14. (a) (i) 
    (ii) 
    (b) 

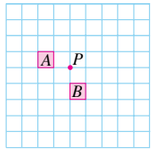
R is a pentagon and S is a square

15. (i) Translation $\begin{pmatrix} -2 \\ 2 \end{pmatrix}$

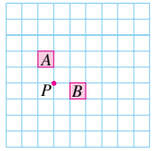
(ii) Reflection on the line GH as shown in the diagram below



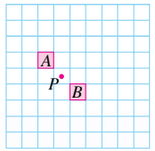
(iii) 90° clockwise rotation, centre *P* as shown in the diagram below



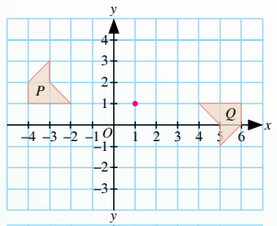
(iv) 90° anticlockwise rotation, centre *P* as shown in the diagram below.



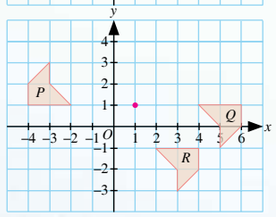
(v) 180° clockwise/ anticlockwise rotation, centre *P* as shown in the diagram below



16. (a)



(b)



(c) 180° rotation, centre origin

17. Zainun will go through a clockwise symmetrical order 3 or a symmetrical order 1 anticlockwise, Fauziah will go through a symmetrical order 1 clockwise or a symmetrical order 3 anticlockwise.

CHAPTER 12 MEASURES OF CENTRAL TENDENCIES

SELF PRACTICE 12.1

1. (a) 1 (b) RM7 and RM8
(c) 60
2. L size
3. (a) 0.5 (b) 32 and 37
(c) RM2 (d) Yellow
4. (a) 7 (b) 42.5 (c) 10
5. 30
6. (a) 5 (b) L
7. (a) 7 (b) 3.06
8. (a) 2 (b) 8
9. 1 day
10. (a)

Age (Year)	Tally	Frequency
6 - 10	/	1
11 - 15	/	1
16 - 20	//// /	6
21 - 25	~~////~~	4
26 - 30	////	4
31 - 35	////	4

(b)

Number of ping pong balls	Tally	Frequency
10 - 19	/	1
20 - 29	//	2
30 - 39	~~////~~ /	6
40 - 49	~~////~~ ///	8
50 - 59	//	2
60 - 69	/	1

11. (a) mean = 11.3
median = 8.5
mode = 2
(b) median is used because there is an extreme value 40.
12. (a) mean = 7.2
median = 7
mode = 6
(b) mean is used because there are no extreme values.
13. (a) mean is used because there are no extreme values in the data.
(b) median is used because it is numeric data and there are extreme values in the data.
14. (a) Mean or median (b) Mode
(c) Mean

GENERATING EXCELLENCE

1. 4
2. (a) 70 (b) 12
3. (a) 83 marks (b) 8 packets
4. 20
5. (a) mean = 6.3
median = 6
mode = 6
(b) (i) 8.3, 8, 8 (ii) 12.7, 12, 12
(iii) 4.3, 4, 4 (iv) 3.2, 3, 3
6. 16
7. (a) (i) 284 (ii) 90
(b) 66
8. (a) (i) 32.27 (b) 60%
(ii) 32
(iii) 32
9. (a) (i) 32.17 (b) $\frac{3}{5}$
(ii) 32
(iii) 32
10. (a) $x + 2 + y + 6 + 14 = 40$
$x + y + 22 = 40$
$x + y = 40 - 22$
$x + y = 18$
(b) 6.4
(c) (i) 7 (ii) 10
11. Gold - Yip
Silver - Ravi
Bronze - Malek
12. (a) mean because the mean mark is 85. He has obtained an A in History.
(b) 74 because out of that 5 tests Joshua obtained 74 marks twice.

CHAPTER 13 SIMPLE PROBABILITY

SELF PRACTICE 13.1

1. Students answer

SELF PRACTICE 13.2

1. $\frac{3}{7}$
2. $\frac{1}{3}$
3. $\frac{3}{70}$

SELF PRACTICE 13.3

1. (a) A' = event of not setting a chocolate cake
(b) $A' = \{K_1, K_2, K_3, K_4, K_5, S_1, S_2, S_3, S_4, S_5, S_6, S_7, S_8\}$
2. $\frac{2}{5}$
3. $\frac{9}{14}$
4. (a) B' = event of Ali not buying a shoe
(b) $B' = \{\ \}$
5. $\frac{9}{10}$

SELF PRACTICE 13.4

1. 125 forms
2. (a) $\frac{3}{7}$ (b) $\frac{4}{7}$
3. (a) $\frac{8}{15}$ (b) 40 seeds (c) $\frac{40}{83}$

GENERATING EXCELLENCE

1. (a) $S = \{P, E, M, B, E, L, A, J, A, R, A, N\}$
(b) $\{E_1, E_2, A_1, A_2, A_3\}$
(c) $\frac{7}{12}$
2. (a) 24 cone (b) $\frac{7}{12}$
3. 27 aim
4. (a) $S = \{(a, a), (a, e), (a, i), (e, a), (e, e), (e, i), (i, a), (i, e), (i, i)\}$
(b) $S = \{(a, a), (e, e), (i, i)\}$
(c) $\frac{2}{3}$
5. (a) 1 (b) 1 (c) $\frac{2}{3}$
6. $\frac{1}{5}$

Glossary

Acceleration (*Pecutan*) Increase in speed with time.

Algebraic expression (*Sebutan Algebra*) A mathematical expression that consists of variables, numbers and operations.

Algebraic expression (*Ungkapan Algebra*) The combination of constant and variables, connected by signs and fundamental operations.

Algebraic formula (*Rumus algebra*) A mathematical rule or relationship that uses numbers, letters and algebraic expression in the form of an equation.

Algebraic fraction (*Pecahan Algebra*) Fraction with algebraic expression in the numerator and denominator.

Anticlockwise (*Lawan arah jam*) In the opposite direction to the movement of the hands of a clock.

Average speed (*Laju purata*) Total distance divided by total time taken.

Axis of symmetry (*Paksi simetri*) The line that divides an object, shape or diagram into two congruent forms.

Centre (*Pusat*) Midpoint in a space.

Centre of rotation (*Pusat putaran*) In a rotation, the point that does not move, the rest of the plane rotates around this point.

Chord (*Perentas*) A line segment that connects two points on a circumference.

Circle (*Bulatan*) A two dimensional shape on a plane that is always the same distance from the centre.

Circumference *(Lilitan*) Perimeter of a circle.

Clockwise (*Ikut arah jam*) Motion that proceeds in the same direction as a clock's hand.

Coefficient (*Pekali*) A multiplicative factor of a term, polynomial or expression.

Common factor (*Faktor sepunya*) A factor that divides two or more number exactly.

Complementary angle (*Sudut pelengkap*) Either of the two angles whose sum is 90°.

Congruency (*Kekongruenan*) The same shape and size.

Coordinate (*Koordinat*) A pair of numbers used to indicate position relative to *x*-axis and *y*-axis.

Cross section (*Keratan rentas*) Intersection of a solid body in a three-dimensional space with a line or plane.

Deceleration (*Nyahpecutan*) Negative acceleration or reduction in speed.

Denominator (*Penyebut*) The number that appears on the bottom of a fraction.

Dependent variable (*Pemboleh ubah bersandar*) Variable that is the subject in a algebra formula.

Diameter (*Diameter*) A straight line going through the centre of circle or sphere that connects two points on the circumference.

Distance (*Jarak*) How far apart the length or width of two points.

Even numbers (*Nombor genap*) Integer divisible by two.

Event (*Peristiwa*) A set of outcomes of an experiment.

Expansion (*Kembangan tunggal*) When a linear algebraic expression is multiplied by an algebraic term or a number.

Expansion of two brackets (*Kembangan dua kurungan)* When two linear algebraic expression is multiplied.

Exterior angle (*Sudut peluaran*) Angle formed by one side of a polygon and a line extended from an adjacent side.

Extreme value (*Nilai ekstrem*) Refers to very extreme deviation of values in a sample.

Factor (*Faktor*) A number, term or algebraic expression that divides the number, term and algebraic expression given exactly.

Frequency table (*Jadual kekerapan*) Tabulated data.

Function (*Fungsi*) Relationship between two variables in a equation.

Geometrical characteristics (*Sifat geometri*) Relating to geometry or principles of geometry.

Gradient (*Kecerunan*) Ratio of the vertical distance to the horizontal distance.

Graph of function (*Graf fungsi*) A graph of a certain function.

Horizontal distance (*Jarak mengufuk*) The length parallel to the plane.

Hypotenuse (*Hipotenus*) The longest side of a right angled triangle, opposite the right angle.

Image (*Imej*) Reflection of an object.

Inclination (*Kecondongan*) Gradient or slope of a line.

Independent variable (*Pemboleh ubah tidak bersandar*) Variable that is not the subject in a algebra formula.

Intercept (*Pintasan*) The point where a line or curve crosses the *x*-axis or *y*-axis.

Interior angle (*Sudut pedalaman*) The angle inside a shape.

Isometry (*Isometri*) Transformation of an object into an image that is congruent.

Linear equation (*Persamaan linear*) An algebraic equation in which each term has an exponent of one.

Linear function (*Fungsi linear*) A function that has variables with exponents equal to one.

Mean (*Min*) In a data set, the sum of all the data points, divided by the number of data points.

Measure of central tendency (*Sukatan kecenderungan memusat*) A single value that describes a set of data such as mean, median and the mode.

Median (*Median*) Middle number in a set listed from the least to the greatest.

Midpoint (*Titik tengah*) A point on a line segment that divides it into two equal parts.

Mode (*Mod*) Most frequently occuring number(s) in a set.

Net (*Bentangan*) A net is a two-dimensional figure that can be folded into a three-dimensional object.

Non-linear function (*Fungsi bukan linear*) A function that has variables with exponents greater than one.

Non-uniform speed (*Laju tak seragam*) Different distance covered in equal intervals of time.

Number pattern (*Pola nombor*) A list of numbers that follow a certain sequence or pattern.

Numerator (*Pengangka*) The number that appears on the top of a fraction.

Object (*Objek*) Shape, diagram before transformation.

Odd numbers (*Nombor ganjil*) Integers not divisible by two.

Origin (*Asalan*) The point where the *x*-axis and *y*-axis intersect (0,0).

Perfect square (*Kuasa dua sempurna*) An integer that is the square of an integer. Example $1^2 = 1$, $2^2 = 4$, $3^3 = 9$. Thus, 1, 4 and 9 are perfect squares.

Plot (*Plot*) To mark the coordinates, to draw the graph.

Position (*Kedudukan*) Spatial location.

Probability of an event (*Kebarangkalian suatu peristiwa*) The ratio of the chance that an event will occur to total number of outcomes.

Radius (*Jejari*) The line segment from the centre to its perimeter of a circle or sphere.

Ratio (*Nisbah*) A comparison of two quantities that can also be in the form of fraction.

Reflection (*Pantulan*) Flip over a line.

Regular polygon (*Poligon sekata*) Polygon that is equilateral and equiangular.

Relation (*Hubungan*) Relationship between two or more variables.

Sample space (*Ruang sampel*) The set of all possible outcomes of an experiment.

Sector (*Sektor*) A sector is the part of a circle enclosed by two radii of a circle and their intercepted arc.

Segment (*Tembereng*) The part of a circle made by a line and a connecting arc.

Sequence (*Jujukan*) A list of numbers in a special order.

Side (*Sisi lurus*) A line segment to form a polygon.

Speed (*Laju*) Rate of change of distance with time.

Stationary (*Keadaan pegun*) Not moving.

Steepness (*Kecuraman*) Gradient or slope of a line.

Subject of a formula (*Perkara rumus*) The single variable to which every variable in the formula is equal.

Supplementary angle (*Sudut penggenap*) Two angles that add up to 180°.

Symmetry (*Simetri*) The correspondence in size, form and arrangement of parts on the opposite sides of a plane, line or point.

Three-dimensional shape (*Bentuk tiga dimensi*) Shape that has three dimensions such as length, width and height.

Transformation (*Transformasi*) The process of changing position, orientation or size of an object by translation, reflection, rotation and dilation.

Translation (*Translasi*) Every point of the object must be moved in the same direction and same distance.

Two-dimensional shape (*Bentuk dua dimensi*) Shape that has two dimensions such as length and width.

Uniform speed (*Laju seragam*) Same distance covered in equal intervals of time.

Value of table (*Jadual nilai*) A table of dependent and independent variables of a function.

Variable (*Pemboleh ubah*) Liable to change or take different values.

Vector (*Vektor*) A quantity having direction as well as magnitude.

Vertical distance (*Jarak mencancang*) The length of the height.

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