

# NLSI Peace Evangelical Secondary School

## Secondary 4

### Language across the Curriculum (LaC)

#### Book 2



Name: \_\_\_\_\_

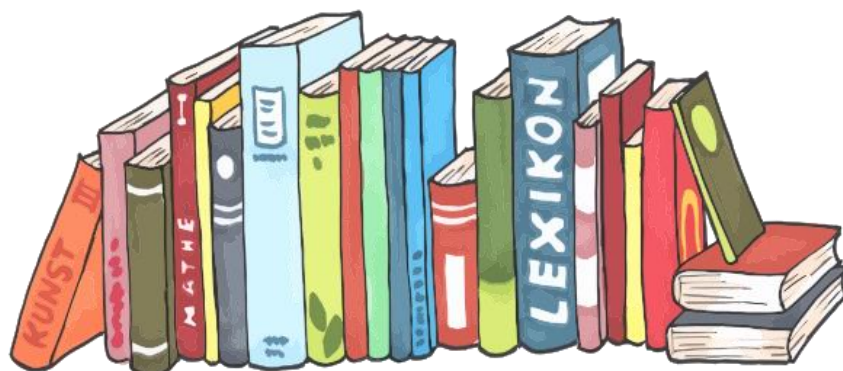
Class (No.): \_\_\_\_\_ (    )

**NLSI Peace Evangelical Secondary School**  
**S4 LaC (2022-23)**

<b>1<sup>st</sup> Term (Maths, P.E., X1)</b>		
<b>Period</b>	<b>Subject</b>	<b>Topic</b>
Cycle 1	Introduction	--
Cycle 2	Maths	Rounding
Cycle 3	History (X1)	Governing policies in early 20th Century Hong Kong
Cycle 4	BAFS (X1)	Business Environment
Cycle 5	--	--
1st UT (40mins)		
Cycle 6	P.E.	Tennis
Cycle 7	Biology (X1)	Nutrition
Cycle 8	Physics (X1)	Wave properties
Cycle 9	ICT (X1)	Printer
1st Exam(45mins)		
<b>2<sup>nd</sup> Term (Music, CSD, X2)</b>		
Cycle 13	Music	Function of Music in Society
Cycle 14	VA(X2)	7 elements of Art
Cycle 15	THS(X2)	Classification of Tourists
Cycle 16	Econ (X2)	Ownership of firms
2nd UT (40mins)		
Cycle 17	CSD	Achievements of the country in different areas in recent years
Cycle 18	Chinese History(X2)	Qin Dynasty
Cycle 19	Geography(X2)	Location of manufacturing industry in HK
Cycle 20	Chemistry(X2)	Rocks & Minerals
	ICT (X2) -Part B only	Peripheral Devices
2nd Exam (45mins)		

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## Cycle 6 - PE

### Tennis

# How To Play Tennis for Beginners (Rules for Singles & Doubles)

*'Introduction To Tennis For Beginners'*

By **Dannie** - January 24, 2021



New to the sport and interested in learning how to play tennis? Energized to embrace this challenging sport? Great. What is your motive? Is it the social aspect of the sport? Not a concern.

The warmth of the culture in the tennis world is abundant, so locating tennis players to compete against at all levels is virtually guaranteed.

The social aspect of the game is awesome, but you will find that most athletes that play tennis are goal-oriented individuals who are driven to compete. Whatever your **motive** is, it is my pleasure to be a part of your journey in learning how to play tennis.

The key to success in learning how to play tennis starts with you.

The initial goal is to advance to a level where you can comfortably **maneuver** around the tennis court with ease and maintain confidence in your game.

Take “baby steps” at first, but always strive for excellence as you progress in learning how to play tennis. Just like a baby though, you have got to creep before you crawl, crawl before you walk, and walk before you run.

On another note, learning how to play tennis is all about attitude and commitment.

“Your Attitude, Not Your **Aptitude**, Will Determine Your **Altitude**.”

Trigger this powerful quote and be patient as you initiate this quest to learn how to play tennis. Maintain a positive attitude, stay focused and most importantly practice...practice...practice.

Did I mention that you must PRACTICE? Hint...Hint...Hint!

Motivated, geared up and ready to learn how to play tennis? There are a number of skills and techniques to learn along the way. Before you lace up your tennis shoes, grab your tennis racquet and head to the tennis court, it is important that you review and understand the basics of how to play tennis.



Simply put, a tennis match is a competition played between two, three (Canadian Doubles, Australian Doubles, etc.) or four players.

Singles, Doubles, and Mixed Doubles are the three most common types match competitions played in tennis.

Singles is a match between two players. As a competitor, you are considered your own team.

Doubles is a match between four players. Two players are on each team. You and your teammate are depending on each other to play together as a team.

Most tennis **tournament** matches are gender, competitive level, and age specific. Depending on the competitive level and age of the tennis player(s), matches consist of men vs. men, women vs. women, boys vs. boys and girls vs. girls.

Mixed-Doubles tournaments are the exception. A Mixed-Doubles match is similar to a doubles match with the difference being the gender make-up of the teams. Each team consists of the pairing of a man and a woman on each team.

First things first. It is important to note as you are learning how to play tennis and before you start any tennis activity for that matter, please take the time to stretch out and warm up thoroughly.

This will prevent possible injuries and also give you time to scout out your competitor's strengths and weaknesses.

Time to play tennis. To initiate a match, tennis players decide amongst themselves who or which team will **serve** first and who will be on what side of the court to start a match.



There are several ways to decide this, but most competitors either flip a coin (heads or tails) or spin a racquet (letter or symbol on the bottom of the racquet is up or down).



Generally, the player(s) who wins the toss decides either who serves first or what side to start on. The player(s) who lost the toss decides the other option.

A tennis serve initiates game play. The moment the tennis ball is served, the battle to win that point begins. Tennis players return the tennis ball back and forth until the point is played out.

The goal is to win the point by strategic game planning and game play.

Points are won when your opponent...

- is unable to return the ball before it bounces twice.
- strikes the tennis ball into the net.
- returns the ball and it lands out-of-bounds.
- double faults when serving.

When your opponent successfully executes a return to your side of the court, it is your task to return the ball by performing...

- a forehand or a backhand ground stroke. A ground stroke is when a tennis player returns the tennis ball after it has bounced once within boundary lines.
- a volley. A volley is when a tennis player connects with the tennis ball in midair before it bounces.

Points are lost when you ...

- are unable to return the ball before it bounces twice.
- strike the tennis ball into the net.
- return the ball and it lands out-of-bounds.
- double fault when serving.

Basically, the main purpose of the game of tennis is to keep tennis ball play. When learning how to play tennis, the most common action that derails most beginners is the fixation of striking the ball with power instead of returning the ball with precision and control.

To start off on the right track, practice controlling the ball first and as you progress you will be able to add speed as well as power to your game.

The tennis player who is serving the ball is known as the server. This player serves the entire game by starting on the right side of the court at the baseline and strikes the ball diagonally to the left side of the court from the server's point-of-view.

The goal is to serve the ball into what is known as the service area on the receiver's side of the court. Throughout the game, the server rotates serves from the right side and to the left side of the baseline on the court. The receiver maneuvers accordingly from right to left to return the serve.

Tennis games can last from a few minutes to several minutes depending on how competitive the players are and how many points are played. It takes a **minimum** of four points to play out a game. In order to win a game, you must win by at least two points.

A set is a series of games played by tennis competitors. In order to win a set, one of the competitors must win a minimum of six games with at least a two game advantage.

A tennis player winning six games could have played up to ten games to win that set. In this case the possible results for the winner could be 6-0, 6-1, 6-2, 6-3, or 6-4.

Remember in order for a competitor to win a set, at least a two game advantage is required. Therefore, 6-5 will not close out a set. Game play must continue resulting in a final score of 7-5, 8-6, 9-7, etc.



## Key Learning Points

- 1 Singles, Doubles and Mixed Doubles
- 2 How points are won
- 3 How points are lost
- 4 Set and games

## TASK

### Part A Language

#### 1. Glossary (10 items, 10 marks)

Please fill in the meanings and Parts of Speech. Then, read the phrases in the last column aloud.

No.	Vocabulary	Meanings	Parts of Speech	Collocations/Phrases
1.1	motive (p.2)		<b>n.</b>	Whatever your <b>motive</b> is, it is my pleasure to....
1.2	Maneuver (p.2)			You can comfortably <b>maneuver</b> around the tennis court with ease...
1.3	Aptitude (p.2)		<b>n.</b>	Your attitude, Not your <b>aptitude</b> ...
1.4	Altitude (p.2)		<b>n.</b>	Will determine your <b>Altitude</b>
1.5	Tournament (p.3)			Most tennis <b>tournament</b> matches are gender...specific.
1.6	serve (p.3)			Tennis players decide amongst themselves who or which team will <b>serve</b> first.
1.7	Opponent (p.4)			When your <b>opponent</b> successfully executes a return to your side...
1.8	Stroke (p.4)		<b>n.</b>	A ground <b>stroke</b> is when a tennis player returns the ball after it...
1.9	bounces (p.4)			A tennis player connects with the tennis ball in midair before it <b>bounces</b> .
1.10	Minimum (p.5)			It takes a <b>minimum</b> of four points to play out a game.

**2. Matching (5 items, 5 marks)**

Please match the concepts below with the descriptive sentences.

Out-of-bounds	Singles	Doubles
A volley	Ground stroke	Mixed doubles

- 2.1 A match between four players. Two players are on each team. \_\_\_\_\_
- 2.2 A match between two players. You are considered as a competitor of your own team.  
\_\_\_\_\_
- 2.3 A match between four players, with the difference being the gender make-up of the teams.  
\_\_\_\_\_
- 2.4 A tennis player connects with the tennis ball in midair before it bounces. \_\_\_\_\_
- 2.5 A tennis player returns the ball after it has bounced one within boundary lines. \_\_\_\_\_

**3. True (T), False (F) and Not Given (NG) (5 items, 5 marks)**

- 3.1 \_\_\_\_ 'Baby steps' means you have got to creep before you crawl, walk after you crawl and run after walk.
- 3.2 \_\_\_\_ When you learn tennis, your attitude will determine your aptitude.
- 3.3 \_\_\_\_ Most tennis athletes have a motive to compete.
- 3.4 \_\_\_\_ The most common action that most beginners need to practice is returning the ball with precision and control.
- 3.5 \_\_\_\_ The game can end with a final score of 6-4.

**4. Fill in the blank (10 items, 10 marks)**

Before you head to the tennis (4.1)\_\_\_\_\_, you need to (4.2)\_\_\_\_\_ up your tennis shoes and grab your tennis (4.3)\_\_\_\_\_.

You win points when your opponent cannot return the ball before it (4.4)\_\_\_\_\_ twice or it (4.5)\_\_\_\_\_ out-of-bounds. In addition, the opponent has double faults when (4.6)\_\_\_\_\_.

The server starts on the right side of the court at the baseline and (4.7)\_\_\_\_\_ the ball (4.8)\_\_\_\_\_ to the left side of the court from his/her point-of-view.

It takes at least four points to play (4.9)\_\_\_\_\_ a game. In order to win a set, the winner must win a (4.10)\_\_\_\_\_ of 6 games with at least a two game advantage.

**Part A: Score : \_\_\_\_\_/30**

## Part B Knowledge & Skills

1. Name 3 types of the most common competitions played in tennis and explain each type of the competition. (9 marks)

Singles, Doubles and Mixed Doubles. (3 marks)

Singles is a match between 2 players. (2 marks)

Doubles is a match between 4 players. Two players are on each team. (2 marks)

Mixed-Doubles tournaments are the exception. A Mixed-Doubles match is similar to a doubles match with the difference being the gender make-up of the teams. (2 marks)

2. Mention 3 conditions that you will lose the points during a competition. (9 marks)

- are unable to return the ball before it bounces twice.
  - strike the tennis ball into the net.
  - return the ball and it lands out-of-bounds.
  - double fault when serving.
- (Any 3 of the above, @3 marks)

3A. What is the main purpose of playing a tennis game? (3 marks) What is the most common difficulty for the beginners? (3 marks)

The main purpose of the game of tennis is to keep tennis ball play. (3 marks)

The most common difficulty for the beginners is the fixation of striking the ball with power instead of returning the ball with precision and control. (3 marks)

3B. Explain how to win a set of a tennis competition. (6 marks)

In order to win a set, one of the competitors must win a minimum of six games with at least a two game advantage, (3 marks)

A tennis player winning six games could have played up to ten games to win that set. In this case the possible results for the winner could be 6-0, 6-1, 6-2, 6-3, or 6-4. (3 marks)

**Part B: Score : \_\_\_\_\_/30**

END

# Cycle 7 – Biology: Nutrition

## C. Health problems caused by an improper diet



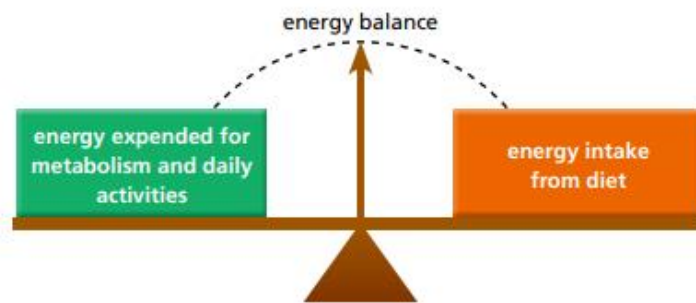
### Surf the net

Try the Food Nutrient Calculator in the following website to help you estimate how much nutrients and energy you have obtained in each meal:

e-aristo.hk/r/  
biocstn0603.e



A balanced diet **supplies** enough nutrients to maintain good health and enough energy to support daily activities. When energy intake is equal to energy output, the body weight will remain more or less the same.



**Figure 6.20** To maintain a stable body weight, the daily energy intake and energy output should be balanced.

An improper diet can lead to **malnutrition** which causes many health problems. Malnutrition refers to both **undernutrition** and **overnutrition**.

### 1. Undernutrition



**Figure 6.21** A child with kwashiorkor characterized by a swollen belly

If our energy intake from food is **less** than energy output, the body will **break down energy reserves** to release energy to support normal body activities. **Glycogen stored in the liver and skeletal muscles** will be used up first. Then, the **fat under the skin and around internal organs** is metabolized, causing weight loss.

If starvation continues, the body will start to use **proteins** (particularly those in muscles) as a source of energy. This causes serious health problems.

A severe **deficiency** of protein in the diet causes **kwashiorkor**. Children with kwashiorkor suffer from stunted growth, anaemia, hair loss, and have a swollen belly because tissue fluid **accumulates** in the abdomen.

 STSE connections
**Over-dieting and anorexia nervosa**

Undernutrition is often caused by poverty. However among wealthy people, over-dieting in pursuit of 'slimming' is also a common cause of undernutrition and may cause eating disorders such as anorexia nervosa.

Patients with anorexia nervosa see themselves as much fatter than they actually are. They eat very little because of an intense fear of gaining weight. If not treated properly, anorexia may cause serious health problems such as osteoporosis, kidney damage and heart disease, and the consequence may be **fatal**. However, patients can recover if they are given early treatment and counselling.



**i** A patient suffering from anorexia

 Surf the net

Learn more about other eating disorders at:

[e-aristo.hk/r/biocstn0604.e](http://e-aristo.hk/r/biocstn0604.e)

**2. Overnutrition**

If we eat too much or lack sufficient physical activity, our energy intake from food will be **greater** than our energy output. The **excess** energy will be **stored as fat** in our body, causing weight gain. A person becomes **overweight** when his body weight exceeds a normal range. A person is considered to be **obese** when he is seriously overweight.



**Figure 6.22** An obese person with excess fat stored around the waist

**Obesity** can lead to many health problems such as high blood pressure, heart disease, diabetes, gallstones and serious damage to joints.

To find out whether a person is overweight or obese, a simple measurement is to calculate his body mass index (BMI):

$$\text{BMI} = \frac{\text{weight (kg)}}{\text{height}^2(\text{m}^2)}$$

The table below lists the BMI definition for Asian adults:

BMI	Definition
< 18.5	Underweight
18.5 – 22.9	Normal weight
23.0 – 24.9	Overweight
≥ 25	Obese

**Table 6.3** BMI definition for Asian adults

obesity 肥胖症

diabetes 糖尿病  
gallstone 膽石  
body mass index 身高體重指數



 Extras: Health Issue
**Central obesity**

The health risk associated with obesity is determined not only by the amount of **excessive** fat stored in the body but also where the fat is **deposited**. Scientists classify body shape into two types: apple shape and pear shape. An apple-shaped body has more fat deposited around the waist (i.e. central obesity), while a pear-shaped body has more fat deposited around the hips and thighs.

Doctors have observed, for decades, that people with central obesity had a higher risk of premature cardiovascular disease, diabetes and death than people with a trimmer waist or a pear-shaped body. Two common ways to measure central obesity are **waist circumference** and waist-to-hip ratio.



**i** An apple-shaped body (left) and a pear-shaped body (right)

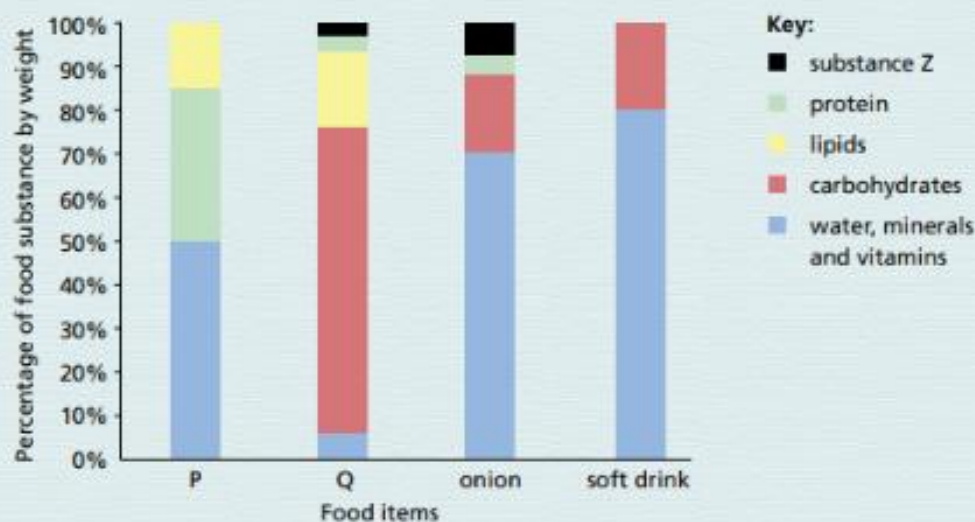
Measurement	Definition of central obesity
Waist circumference	Women: $\geq 80$ cm Men: $\geq 90$ cm
Waist-to-hip ratio = $\frac{\text{waist circumference}}{\text{hip circumference}}$	Women: $\geq 0.85$ Men: $\geq 0.9$

(Data source: World Health Organization)

Central obesity is a growing concern among children in Hong Kong. Collect information about the situation and suggest measures that can be taken by the Government, schools and parents to help improve the problem.

**Worked example 6.1**

Sam is a primary six student. He has lunch in school every day. His typical lunch choice is a box of fried rice with pork chop and onion and two cans of soft drink. The bar chart below shows the nutritional composition of his lunch.



cont'd



- (a) Which bar, P or Q, represents pork chop? Explain your answer. (2 marks)
- (b) (i) What is food substance Z? (1 mark)
- (ii) Explain the importance of this food substance to health. (2 marks)
- (c) Sam is overweight. Explain how the above lunch choice contributes to his weight problem. (3 marks)

**Solutions**

- (a) Bar P represents pork chop. .... (1)  
 Pork contains protein, lipids and water but do not contain carbohydrates. .... (1)
- (b) (i) Dietary fibre..... (1)
- (ii) Dietary fibre stimulates peristalsis of the digestive tract, ..... (1)  
 thus helping faeces pass out of the body more easily / preventing constipation. .... (1)
- (c) Sam's lunch choice contains a large proportion of energy-rich substances such as carbohydrates and lipids. .... (1)
- When Sam's energy intake is greater than his energy output, .. (1)
- the excess energy will be stored as body fat. .... (1)
- This causes weight gain.

**Reminder**

To explain weight gain or weight loss, remember to state clearly the effect of energy input and output.

**Key point**

1. A **balanced diet** contains all of the food substances in the **right amounts** and **proportions**. It provides us with enough energy and nutrients for body functions and daily activities.
2. The **food pyramid** shows the types and relative amounts of foods needed for a balanced diet.
3. Dietary requirements depend on a number of factors such as **age, gender, daily activities** and **body status**.
4. An improper diet can result in **malnutrition** which causes many health problems:
  - **Undernutrition** may lead to **weight loss** and deficiency diseases such as **kwashiorkor**.
  - **Overnutrition** may lead to weight gain, causing **overweight** and **obesity**

**Checkpoint**

1. Which of the following factors need to be considered when planning a balanced diet for a person?
  - (1) age of the person
  - (2) daily activities of the person
  - (3) climate where the person lives

A. (1) only                      B. (1) and (2) only

C. (2) and (3) only          D. (1), (2) and (3)
2. Which of the following correctly lists the diet that is linked with constipation and obesity?
 

	<b>Constipation</b>	<b>Obesity</b>
A.	high-salt diet	high-energy diet
B.	low-fibre diet	high-salt diet
C.	high-energy diet	high-fibre diet
D.	low-fibre diet	high-energy diet

## Key Learning Points

- 1 Undernutrition
- 2 Norexia nervosa
- 3 Overnutrition
- 4 Central Obesity

## TASK

### Part A Language

#### 1. Glossary (10 items, 10 marks)

No.	Vocabulary	Meanings	Parts of Speech	Collocations/Phrases
1.1	Supplies (p.26)		<b>v.</b>	A balanced diet supplies enough nutrients
1.2	Malnutrition (p.26)		<b>n.</b>	Malnutrition refers to undernutrition and overnutrition.
1.3	Reserves (p.26)		<b>n.</b>	The body will break down energy reserves to...
1.4	Deficiency (p.26)		<b>n.</b>	A deficiency of protein ...
1.5	Accumulates (p.26)		<b>v.</b>	Tissue fluid accumulates in the abdomen.
1.6	Fatal (p.27)		<b>adj.</b>	The consequence may be fatal.
1.7	Excess (p.27), excessive (p.28)		<b>adj.</b>	The excess/excessive energy Excessive fat
1.8	Deposited (p.28)		<b>v.</b>	
1.9	Waist circumference (p.28)		<b>n.</b>	Measure waist circumference
1.10	Constipation (p.29)		<b>n.</b>	Constipation is caused by low-fibre diet

**2. Matching (5 items, 5marks)**

Please match the concepts below with the descriptive sentences.

Overnutrition	Undernutrition	Starvation
Overweight	Central Obesity	Balanced diet

- 2.1 Energy output and energy intake remain more or less the same. \_\_\_\_\_
- 2.2 Energy output is greater than energy intake. \_\_\_\_\_
- 2.3 Energy output is less than our energy intake. \_\_\_\_\_
- 2.4 Our bodies start to use proteins in muscles as energy. \_\_\_\_\_
- 2.5 People have high body mass index. \_\_\_\_\_

**3. True or False (5 items, 5 marks)**

- 3.1 People who suffer from anorexia nervosa always see themselves being too slim.
- 3.2 If patients with anorexia nervosa are treated properly, they can solve the problem of eating disorder.
- 3.3 A person is considered to be obese when his BMI is below 25.
- 3.4 People with central obesity are more likely to suffer from cardiovascular disease when they are still young.
- 3.5 Central obesity happens when excessive fat is deposited around the hips and thighs.

3.1	3.2	3.3	3.4	3.5	3.6

**4. Fill in the blank (5 items, 10 marks)**

Please fill in the blank with **correct form of the word**.

It is important for us to have a (4.1) b diet which contains right amount and proportion of food (4.2) s. It gives us enough nutrition and energy to support our body activities. A (4.3) d of any nutrients like proteins may (4.4) l to health problems. On the other hand, if people have (4.5) e weight gain, they have a higher risk of serious health problems.

**Part A: Score :** \_\_\_\_\_/30

## Part B Knowledge & Skills

1. Potatoes are a staple food and a major source of carbohydrates for humans. The Great Irish Famine occurred between 1845 and 1849 when potato crops failed for several consecutive years. Many people starved because their diets mainly consisted of potatoes.
  - (a) Describe the cause of undernutrition. (1 mark)
  - (b) Describe the order in which the human body would break down its energy reserves in response to undernutrition. (3 marks)
  - (c) Suggest why Irish farmers might have been more affected by the famine compared to their housewives in terms of diet. (2 marks)
  
2. Obesity is a common nutritional disorder in wealthy countries. Eating too much will increase our weight to an unhealthy level.
  - (a) Two people of the same age and sex have been eating the same diet for a year. One becomes overweight but the other is still slim. Explain for such a difference. (3 marks)
  - (b) An obese person tried to get slim by eating only protein foods but he did not succeed.
    - (i) Suggest a possible reason to explain why he did not succeed. (2 marks)
    - (ii) A diet consisting of only protein foods is not good for health. Why? (1 mark)
    - (iii) Suggest a healthy way to get slim. (1 mark)
  - (c) Which snack contains less energy, deep-fried potato chips or baked potato chips? Explain. (2 marks)
  
3. Don and Ken are two teenage brothers who live on a farm and have the same diet of potatoes and dairy products. Don sits all day to study while Ken helps with the physical tasks at the farm. Table 1 gives the height and weight of the two brothers. Table 2 provides information on calculating and defining Body Mass Index figures.

**Table 1**

	<b>Don</b>	<b>Ken</b>
Height (m)	1.65	1.82
Weight (kg)	67	62

**Table 2**

<b>Body mass index (BMI) formula</b>  $\text{BMI} = \frac{\text{Weight (kg)}}{[\text{Height (m)}]^2}$	<b>BMI range</b>	
	Underweight	< 18.5
	Ideal	18.5 – 22.9
	Overweight	23.0 – 24.9
	Obese	> 24.9

- (a) (i) Using Table 1 and Table 2 above, calculate the BMI of Don and Ken.  
(Give your answer correct to one decimal place.) (2 marks)
- (ii) Based on your answers to (a)(i), define the weight of Don and Ken based on their BMI. (2 marks)
- (b) Ken encourages Don to help out with the farm work as a way to lose weight. Explain how increasing Don's level of physical activity can potentially result in weight loss. (5 marks)

**Part B: Score :** \_\_\_\_\_/24

END



### Suggested Answer

1. (a) Undernutrition occurs when energy intake is less than energy output. (1M)
    - (b) First, glycogen in the liver and skeletal muscles will be used up. (1M)  
Next, fat under the skin and around internal organs will be utilized. (1M)  
Finally, the protein in muscles will be used to obtain energy. (1M)
    - (c) Farmers performed heavier physical activities relative to their housewives. (1M)  
Thus, the farmers required more energy from their diet. (1M)
  
  2. (a) Whether we gain weight depends on the relative amount of energy intake and our energy needs. (1M)  
The two people may have different energy needs (1M)  
due to their different body status and different levels of activity. (1M)
    - (b) (i) Proteins also supply energy to the body. (1M)  
The person might eat a large amount of food. The excess energy provided by proteins was stored as fats in the body. (1M)
    - (ii) The body may not get enough minerals and nutrients (e.g. dietary fibres/ vitamins) that are absent / present in only small amounts in the protein foods. (1M)
    - (iii) Doing physical exercise (or other reasonable answers) (1M)
  - (c) Baked potato chips (1M)  
Less oil is used for baking than for deep-frying. (1M)
- 
3. (a) (i) BMI of Don:  $(67 / 1.65^2) = 24.6$  (1M)  
BMI of Ken:  $(62 / 1.82^2) = 18.7$  (1M)
    - (ii) Don is overweight. (1M)  
Ken has an ideal weight. (1M)
  - (b) Increasing Don's level of physical activity increases his energy output. (1M)  
If his energy intake from food is less than energy output, (1M)  
his body will break down energy reserves to support body activities. (1M)  
Glycogen stored in the livers and skeletal muscles will be used up first. (1M)  
Fat under skin and around internal organs is metabolized, causing weight loss. (1M)



# Cycle 8 – Physics: Wave properties

## Waves

The wave properties of water waves are established since these can readily be observed in a ripple tank. Later, diffraction and interference are used as criteria for determining if something is a wave.

### 17.3

Video 17.3 shows the reflection of water waves by straight and curved barriers in a ripple tank.



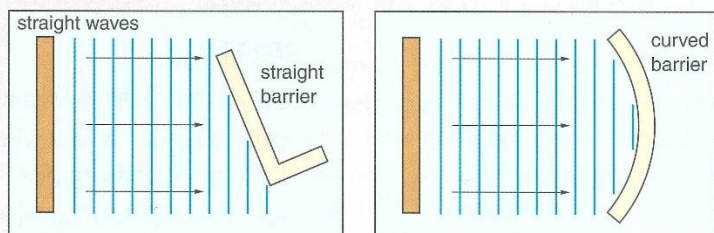
17.3

## Wave properties

Water waves show reflection, refraction, diffraction and interference. Other waves also display these four properties.

### Experiment 17D Reflection of water waves

Set up a ripple tank. Send continuous straight waves towards a straight and a curved barrier in turn. In each case, observe how the waves are reflected.



## Reflection

When straight (plane) waves hit a straight barrier, they bounce off according to the laws of reflection (Fig 17.3a). The angle of incidence is equal to the angle of reflection.

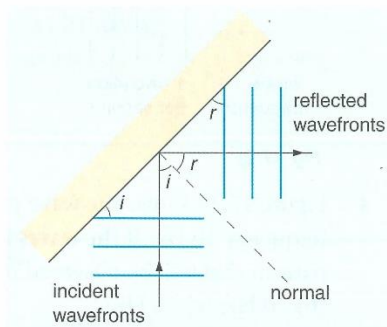


Fig 17.3a Water waves obey the laws of reflection.

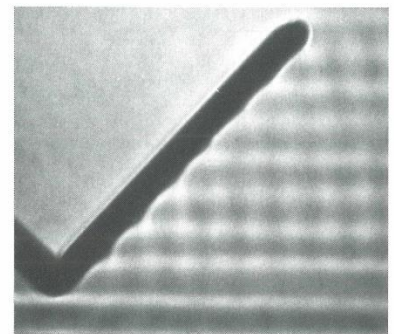


Figure 17.3b shows how straight waves and circular waves are reflected by a concave barrier.

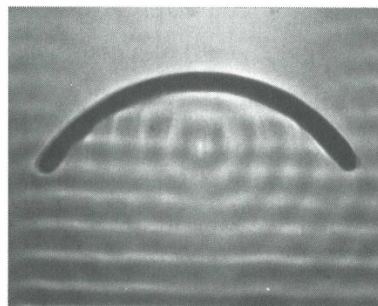
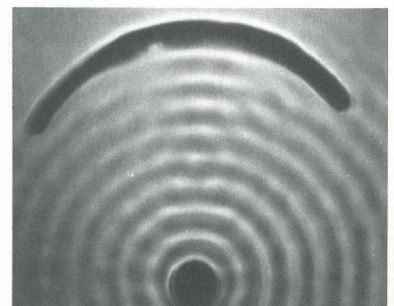


Fig 17.3b Plane and circular waves reflected by a concave barrier.



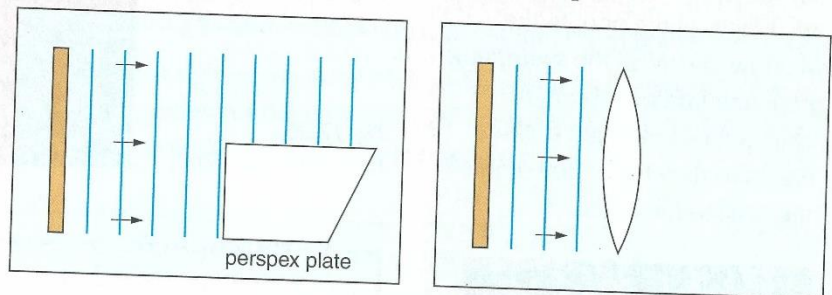
Video 17.4 shows the refraction of water waves when they travel from deep to shallow region in a ripple tank.

17.4

### Experiment 17E Refraction of water waves

Set up a ripple tank.

- 1 Put a sheet of perspex in the ripple tank. The water above the perspex is shallower than elsewhere. Send straight waves to pass over the sheet of perspex. Observe the wave pattern. To see the wave pattern more clearly, use a hand strobe to freeze the waves.
- 2 Put a lens-shaped perspex sheet in the ripple tank. Send straight waves towards the 'lens'. Observe the wave pattern.



### Refraction

When straight waves enter a shallower region in the ripple tank, the wavelength is reduced (Fig 17.3c). Since the frequency of the waves stays the same, the wave speed is also reduced in the shallow region.

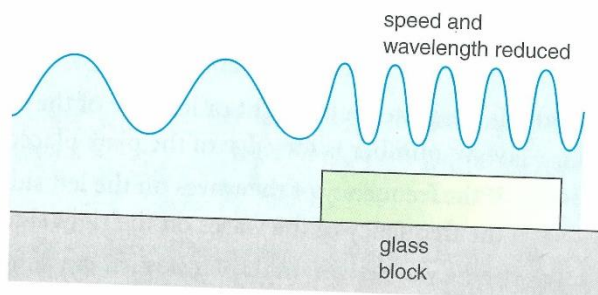
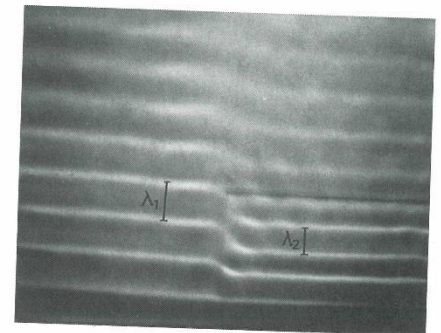


Fig 17.3c Water waves travel more slowly in shallow water.



When the straight waves enter the shallow water at an angle to the boundary, both its wave speed and wavelength are reduced. In addition, the waves change direction, i.e., they are refracted (Fig 17.3d) and they bend towards the normal in shallow water.

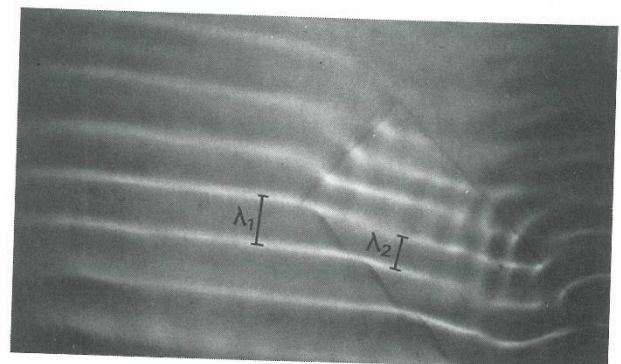
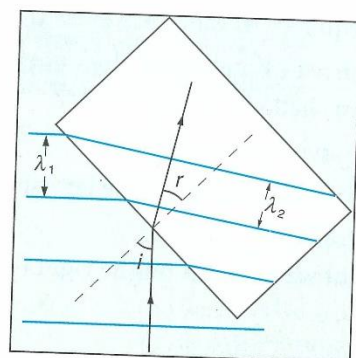


Fig 17.3d Refraction of water waves.

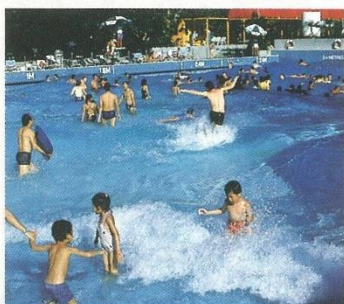




## Everyday physics

### Making waves in a swimming pool

The Wave Pool at Ocean Park has a wave machine that makes waves at the deep end of the pool. These waves travel along the length of the pool to the shallow end. Visit the swimming pool and find out about the change in wavelength of the waves as they travel from end of the pool to the other.



The Wave Pool at Ocean Park.

On the other hand, if waves move from shallow to deep water, the waves **bend** away from the normal.

**Refraction** of waves is similar to the refraction of the light. It takes place whenever there is a change in wave speed as waves cross a boundary between two media.

Figure 17.3e shows how a piece of lens-shaped perspex converges plane waves to its focus.

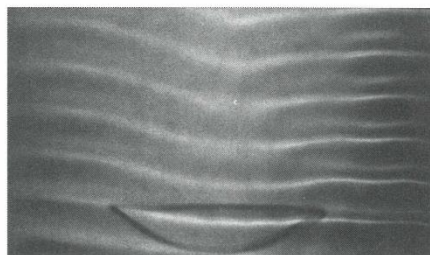
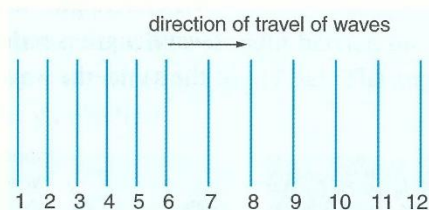


Fig 17.3e  
Refraction by a 'lens'.

### Example 4

The figure shows a set of straight water waves in a ripple tank. A glass plate is placed in the tank to make the water above it shallower. The waves are parallel to the edge of the plate.



- Is the plate on the right or left side of the diagram? At which wave number is the edge of the plate placed?
- If the frequency of the waves on the left side is 0.5 Hz, what is the frequency of the waves on the right side?
- If the wavelength on the left side is 2 cm and that on the right side is 3 cm, find the speed of the ripples on both sides of the tank.

### Solution

- The glass plate is placed on the left side with its edge on wave number 6 where there is a change in the wavelength.
- The frequency of water waves on the right side is also 0.5 Hz. Frequency of water waves does not change across the boundary between shallow and deep water.
- Apply wave equation,  $v = f\lambda$ .  
 Speed of water waves on the left (shallow) side =  $0.5 \text{ Hz} \times 2 \text{ cm}$   
 $= 1.0 \text{ cm s}^{-1}$   
 Speed of water waves on the right (deep) side =  $0.5 \text{ Hz} \times 3 \text{ cm}$   
 $= 1.5 \text{ cm s}^{-1}$



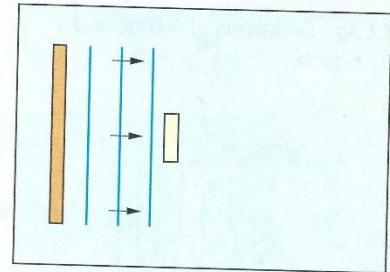
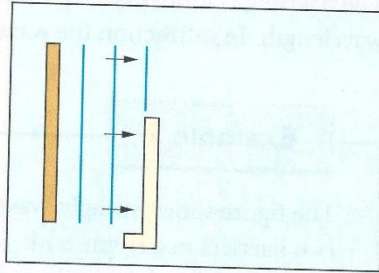
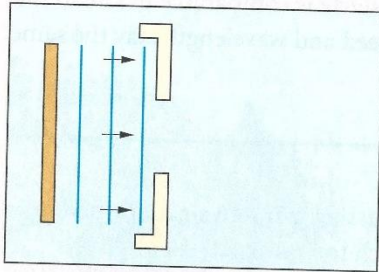
17.5

Video 17.5 shows the diffraction of water waves through a gap and around a barrier.

### Experiment 17F Diffraction of water waves

Set up a ripple tank.

- 1 Send straight waves to pass through a **gap** between two barriers. Observe the pattern beyond the gap. Change the width of the gap to find out how this affects the wave pattern. Also change the wavelength of the waves.
- 2 Use only one barrier as an **obstacle** to block the waves. Observe the wave pattern beyond the obstacle. Change the wavelength of the waves to find out how this affects the wave pattern.
- 3 Send straight waves towards a small obstacle. Observe the wave pattern beyond the obstacle. Change the wavelength of the waves to find out how this affects the wave pattern.



Point out to students that to produce observable diffraction, the width of the gap and the size of the obstacle should be of the order of magnitude of several wavelengths.

### Diffraction

When straight waves pass through a gap between obstacles, they spread out (Fig 17.3f). If the gap is very small (say about one wavelength wide), the waves are so spread out that they become circular.

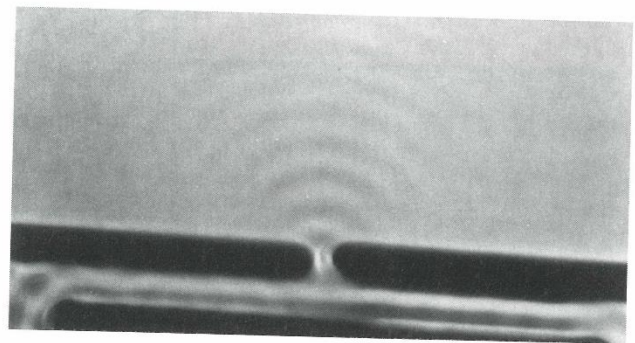
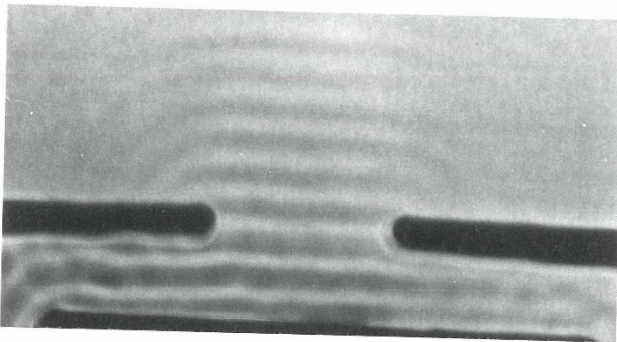
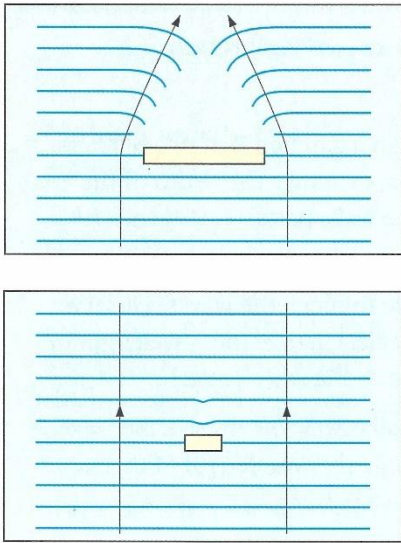


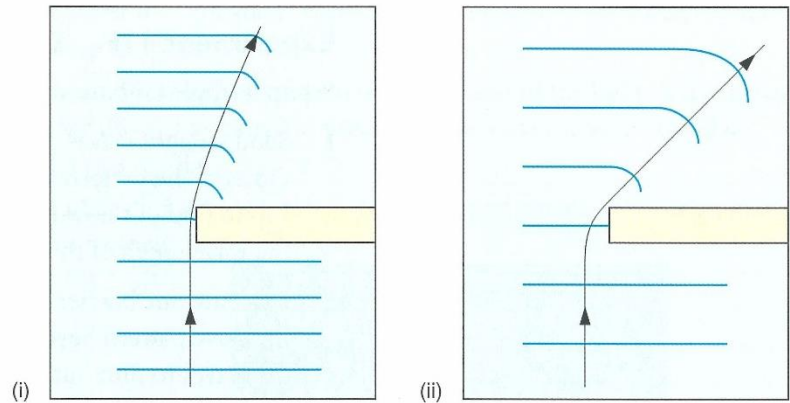
Fig 17.3f Diffraction at a wide and a narrow gap.

When straight waves pass the edge of an obstacle, they bend around the edge into the 'shadow'. There is more bending if the wavelength is increased. If the size of the obstacle is small compared with the wavelength, the waves pass around the obstacle and close up on the other side. Figures 17.3g and 17.3h on the next page show some examples.





**Fig 17.3g** Diffraction at a large and a small obstacle.

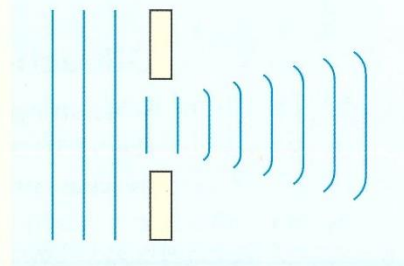


**Fig 17.3h** Diffraction at an edge.

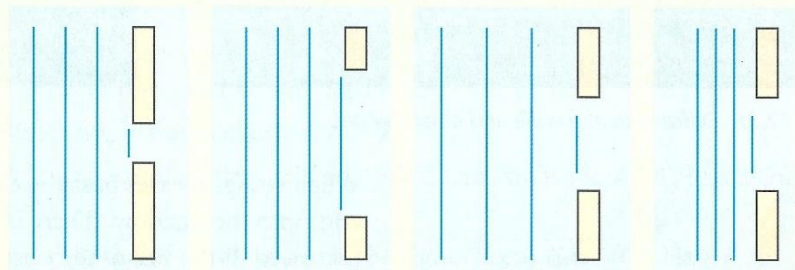
The bending of waves around obstacles is called **diffraction** (繞射). The bending is more marked if the obstacle is **comparable** in size to the wavelength. In diffraction the wave speed and wavelength stay the same.

**Example 5**

The figure shows straight waves passing through a gap formed by two barriers in a ripple tank. Sketch the wave pattern observed when the following changes are made:



- (a) the width of the gap is reduced,
- (b) the width of the gap is increased,
- (c) the wavelength of the waves is increased,
- (d) the wavelength of the waves is decreased,



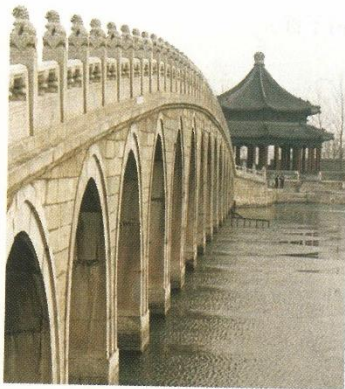
(a) (b) (c) (d)



## Everyday physics

### Diffraction of water through an arch bridge

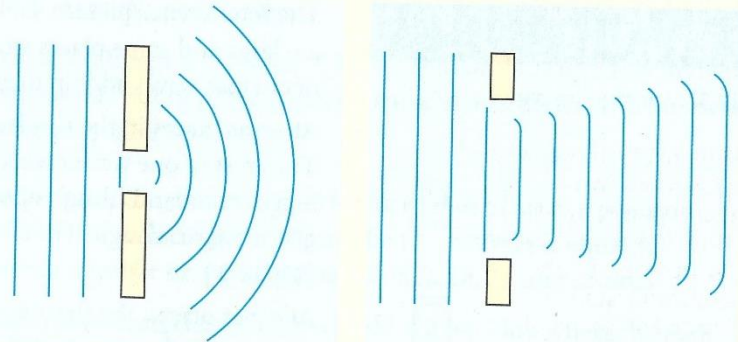
Water wave patterns can often be observed in everyday life. The figure shows the diffraction pattern of water waves through the Marble Bridge (玉帶橋) in the Summer Palace (頤和園) in Beijing. The arch bridge has many gaps each producing a diffraction pattern.



Diffraction pattern under the Marble Bridge in the Summer Palace, Beijing.

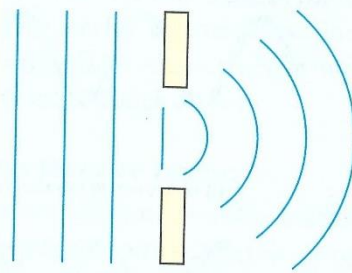
### Solution

(The amount of diffraction depends on the width of the gap as compared with the wavelength of the waves. The narrower the gap, the more spread out are the waves.)



(a)

(b)



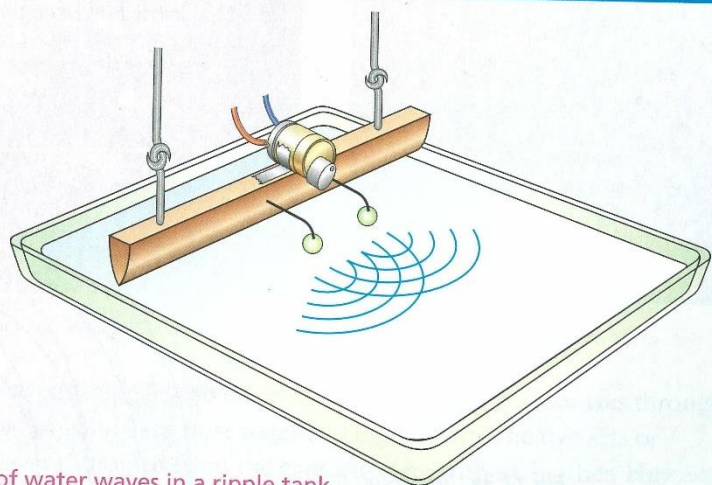
(c)

(d)

### Experiment 17G Interference of water waves

Set up the ripple tank.

- 1 Attach two dippers to the vibrating bar to produce two sets of circular waves that overlap. Observe the wave pattern produced.
- 2 Change the wavelength of the waves and observe the effect on the pattern. Also change the separation of the dipper.



17.6 Video 17.6 shows the interference of water waves in a ripple tank.



## Key Learning Points

1. Reflection
2. Refraction
3. Diffraction
4. Interference of Water Waves

## TASK

### Part A Language

#### 1. Glossary (10 items, 10 marks)

Please fill in the meanings and Parts of Speech. Then, read the phrases in the last column aloud.

No.	Vocabulary	Meanings	Parts of Speech	Collocations/Phrases
1.1	ripple (p.21)		<b>n.</b>	Put a sheet of perspex in the <b>ripple</b> tank.
1.2	curved (p.21)		<b>adj.</b>	Send continuous straight waves towards a <b>curved</b> barrier.
1.3	concave (p.21)		<b>adj.</b>	A <b>concave</b> barrier.
1.4	Shallow, shallower (p.22)			The water above the perspex is <b>shallower</b> than elsewhere.
1.5	frequency (p.22)			The <b>frequency</b> of the waves stays the same, the wave speed...
1.6	boundary (p.22)			When the straight waves enter the shallow water at an angle to the <b>boundary</b> , both its wave speed...
1.7	bend (p.23)			If waves move from shallow to deep water, the waves <b>bend</b> away from the normal.
1.8	gap (p.24)			Send straight waves to pass through a gap between two barriers.
1.9	obstacle (p.24)			Use only one barrier as an <b>obstacle</b> to block the waves.
1.10	comparable (p.25)			The bending is more marked if the obstacle is <b>comparable</b> in size to the wavelength.

**2. Matching (4 items, 8 marks)**

Please match the concepts below with the descriptive sentences.

Refraction	Diffraction	Reflection	Interference
------------	-------------	------------	--------------

- 2.1 The gap gets narrower, the waves spread out more. \_\_\_\_\_
- 2.2 The straight waves enter the shallow water, the waves change direction. \_\_\_\_\_
- 2.3 When straight waves hit a concave obstacle, they become circular waves. \_\_\_\_\_
- 2.4 Some objects/actions make sets of circular waves that overlap. \_\_\_\_\_

**3. Fill in the blank. (8 items, 8 marks)**

When straight waves hit a straight barrier, they (3.1)\_\_\_\_\_ off. The angle of incidence is (3.2)\_\_\_\_\_ to the angle of reflection.

The water above the Perspex is (3.3)\_\_\_\_\_ than other area. The wavelength and wave speed are (3.4)\_\_\_\_\_ when straight waves pass the perspex. Moreover, the waves change (3.5)\_\_\_\_\_ which is known as refraction.

When straight waves pass through a gap between obstacles, they (3.6)\_\_\_\_\_ out and become (3.7)\_\_\_\_\_ if the gap is narrow.

If the size of the obstacle is smaller than the wavelength, the waves (3.8)\_\_\_\_\_ up on the other side after passing around the obstacle.

**4. Short Questions (2 items, 4 marks)**

4.1 Please give an example of diffraction in daily life.

\_\_\_\_\_

4.2 How is diffraction shown in this example?

\_\_\_\_\_

**Part A: Score : \_\_\_\_\_/30**

## Part B Knowledge & Skills

Q.1 State the laws of reflection. (2 marks)

**Answer:**

The angle of incidence is equal to the angle of reflection. (1M)

The incident ray, the reflected ray and the normal all lie in the same plane. (1M)

Q.2 State when the refraction of water waves occurs and how the direction of water wave changes. (3 marks)

**Answer:**

The refraction of water waves takes place whenever there is a change in wave speed as water waves cross a boundary between two media. (1M)

The direction of the incident water wave will bend away from the normal if the water wave travels from a shallow region into a deeper region. (2M)

Q.3 Diffraction occurs when straight waves passing through a gap formed by two barriers in a ripple tank. Describe how the amount of diffraction is affected by the width of the gap. (2 marks)

**Answer:**

The amount of diffraction depends on the width of the gap as compared with the wavelength of the waves. (1M)

The narrower the gap, the more spread out are the waves. (1M)

Q.4 Explain why the diffraction of sound is more easily observed than the diffraction of light in daily life. (4 marks)

**Answer:**

The wavelength of sound (in the order of 0.1 m) is much longer than the wavelength of light (in the order of  $10^{-7}$  m). (1M)

The wavelength of sound is comparable in size with the gap or obstacles in daily life such as windows and doors. (1M)

Therefore, the amount of diffraction of sound is very significant and easily observed. (1M)

Q.5 Read the following passage about tsunamis and answer the questions that follow.

### Tsunami

When earthquakes occur under the sea, the water above is vertically displaced and waves are formed as water attempts to regain equilibrium. When large areas of sea floor rise or sink, a tsunami can be produced. Other than earthquakes, landslides and undersea volcanic eruptions can also cause tsunamis.

Tsunamis are different from wind-generated waves. Wind-generated waves we usually see at beaches may have a wavelength of 150 m and a period of about 10 s. A tsunami, however, can have a wavelength exceeding 100 km and a period of a few hours.

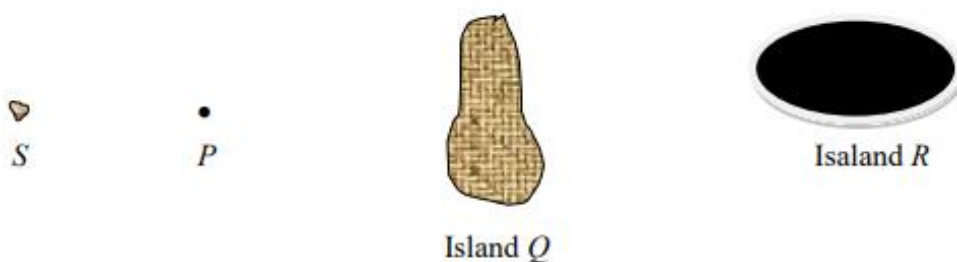
Tsunamis can travel great distances with limited energy losses. As tsunamis leave the deep water of the open sea and approach the coast, their wave speed decreases but their height grows. Tsunamis may reach a height onshore above sea level of 20 m or more and cause serious destruction.

(a) Name two natural phenomena that can cause tsunamis. (2 marks)

**Answer:**

Undersea earthquakes/landslides/undersea volcanic eruptions (any two) (2M)

(b) As shown in the map in the figure below, an undersea earthquake occurs at *S* and produces tsunamis. Both islands *Q* and *R* are struck by the tsunamis.



(i) Although island R is sheltered from S by island Q, why is it still struck by the tsunamis? (1 mark)

**Answer:**

The tsunamis undergo diffraction and get around island Q. (1M)

- (ii) When the undersea earthquake occurs, a ship is at point P which is in the open sea deep water area as shown in the figure above. On receiving the tsunami warning, the captain of the ship decides to stay at P rather than going back to island Q. Referring to the given passage, comment on whether the captain's decision is correct or not. (2 marks)

**Answer:**

The height of the tsunami grows as it travels near to the coast. (1M) Therefore, the captain's decision is correct. (1M)

**Part B: Score : \_\_\_\_\_/30**

END

## C Printer

Printers are devices that produce hard copies, which are usually electronic documents in paper form. There are different types of printers.

Here are the common attributes of printer specifications.

Attribute	Description
Printing size	A printer usually can produce printouts in A4 size or letter size.
Dot density	It means how many dots there will be in a given area of a printout. It is measured in dots per inch (dpi). The higher the dot density, the better the quality of the resulting printout. It is sometimes referred to as "resolution" in specifications.
Monochrome printing or colour printing	Some printers can only print one colour while others can print numerous colours by mixing different colours.
Printing speed	The number of printouts a printer can produce in a given duration. It is usually measured in pages per minute (ppm).
Memory	A printer needs to store images temporarily in case of data transfer and thus it has a built-in RAM. It is measured in the unit of data, such as MB.
Interface	Printers can be connected to computers through USB port or network. It is important to state which types of network standards, such as 802.11n and 802.11ac, are supported.

Table 1.9 Printer specifications

## Thermal printer

Thermal printers produce printouts by heating thermal paper. Thermal paper is made with heat-sensitive materials which change colour when heated.



Fig. 1.46 Thermal printer (left) and thermal paper (right)

Thermal printers are commonly seen on cashier's desks for receipt printing due to their high printing speed and quiet printing. However, text and images printed by thermal printers fade over time.

Therefore, thermal printers are not suitable for printing documents for long-term storage.



## Inkjet printer

Inkjet printers produce printouts by spraying ink droplets drawn from their ink cartridges.



Fig. 1.47 Inkjet printer (left) and ink cartridge (right)

They are widely used domestically and commercially due to their affordable purchase price and high printing quality. However, they suffer from relatively slow printing speed, high printing cost per page and their printouts may become blurry when getting wet.

## Laser printer

Here is the printing process of a laser printer:

1. Laser beams are shot to alter the charge of a photosensitive drum.
2. Toner is attracted to the drum due to the charge.
3. When the drum rolls, the toner is heated and stuck onto the paper, recreating the desired text or image.



Fig. 1.48 Laser printer (left) and toner cartridge (right)

A laser printer is often used in business offices. It has a high printing speed and low printing cost per page. Moreover, its printouts are not susceptible to water.

However, it is less used domestically since it is expensive.

Here is a table comparing the above three types of printers.

Attribute	Thermal printer	Inkjet printer	Laser printer
Expendables	Thermal paper	Ink cartridges, usually regular paper	Toner cartridges, usually regular paper
Purchase price	Low ↓	High ↑	Very high ↑↑
Printing cost per page	Low ↓	High ↑	Low ↓
Printing speed	Fast ↑	Slow ↓	Fast ↑
Dot density	Low ↓	Very high ↑↑	High ↑
Support colour printing?	Usually supports monochrome printing only ✗	Usually supports colour printing ✓	Usually supports colour printing ✓
Remarks	<ul style="list-style-type: none"> <li>• Durable due to having fewer moving parts than other printers</li> <li>• Quiet printing</li> <li>• Small in size and light in weight</li> <li>• Printed text and images on thermal paper are susceptible to heat and chemicals and fades over time</li> </ul>	<ul style="list-style-type: none"> <li>• May have cartridge clogging and misalignment over time</li> <li>• Printed text or images may blur when the paper gets wet</li> </ul>	<ul style="list-style-type: none"> <li>• Usually has a higher power consumption than inkjet printer</li> </ul>

**Table 1.10** Comparison between printers

#### HISTORICAL NOTE

##### Dot matrix printer

Dot matrix printers produce printouts by pressing pins on an ink-soaked ribbon against the paper. They have very low dot density and thus low image quality. Due to the pressure applied during printing, text or images can be printed on multiple multipart forms (also known as carbonless copy paper, 過底紙) simultaneously.



**Fig. 1.49** Dot matrix printer (left) and multipart forms (right)

Nowadays, dot matrix printers are rarely seen. However, they are not completely replaced due to their capability of producing multiple copies at the same time.

## Plotter

Plotters are expensive printers that are specialised in creating high quality vector drawings precisely by moving their pens continuously instead of printing dots by dots like some other printers. They may use ink or toner to draw.



Fig. 1.50 Plotter

## 3D printer

3D printers are used to produce physical objects based on digital three-dimensional models. There are many types of 3D printers, which has different principles and produce objects using different materials.



Fig. 1.51 3D printer printing a mask

3D printers are used for medicine, architecture, art, etc. Compared with moulding, 3D printing is usually faster and has less waste of materials.

For medicine, 3D printers can produce customised dentures and limb prostheses for patients. For architecture and art, 3D printers allow a faster preview of 3D designs and prototypes.

## Key Learning Points

- 1 Types of Printers
- 2 Attributes

### TASK

#### Part A Language

##### 1. Glossary (30 items, 30 marks)

Please fill in the meanings and Parts of Speech. Then, read the phrases in the last column aloud.

No.	Vocabulary	Meaning	Parts of Speech	Collocations/Phrases
1.1	devices (p.1)			The president's car is equipped with a homing <b>device</b> as a security measure.
1.2	electronic documents (p.1)			If you are making redactions from <b>electronic documents</b> , you need to be aware that technological advances may allow redactions to be reversed.
1.3	attribute (p.1)			Organizational ability is an essential <b>attribute</b> for a good manager.
1.4	printouts (p.1)			There were pages of computer <b>printout</b> all over the desk.
1.5	dot density (p.1)			You can generate maps that show data variances through shading, <b>dot density</b> , or graduated symbols
1.6	resolution (p.1)			He replied that the U.N. had passed two major <b>resolutions</b> calling for a complete withdrawal.
1.7	numerous (p.1)			We have discussed these plans on <b>numerous</b> occasions.
1.8	duration (p.1)			He planned a stay of two years' <b>duration</b> .
1.9	measured in pages per			Sweets are often <b>measured in</b>



	minute (p.1)			<p>tablespoons.</p> <p>We have recently installed a scanner capable of scanning at <b>65 pages per minute</b>.</p>
1.10	store images temporarily (p.1)			<p>It could <b>store</b> an <b>image</b> for milliseconds to minutes and even hours.</p> <p>Checkpoints between the two zones were <b>temporarily</b> closed.</p>
1.11	data transfer (p.1)			<p>That means that as long as the energy demand of the peripheral isn't too high, it will recharge while connected for <b>data transfer</b>.</p>
1.12	thermal (p.1)			<p>A <b>thermal</b> printer uses heat elements to produce images on heat - sensitive paper</p>
1.13	heat-sensitive materials (p.1)			<p><b>Heat-sensitive material</b> should be thoroughly disinfected and removed from the lab.</p>
1.14	cashier (p.1)			<p>There is no bar code for the <b>cashier</b> to scan.</p>
1.15	receipt (p.1)			<p>Make sure you are given a <b>receipt</b> for everything you buy.</p>
1.16	fade (p.1)			<p>The sun had <b>faded</b> the blue walls.</p>
1.17	storage (p.1)			<p>We've had to build some cupboards to give us more <b>storage</b> space.</p>
1.18	spraying ink droplets (p.2)			<p>Weeding is done by hand rather than by <b>spraying</b> herbicides.</p>
1.19	domestically and commercially (p.2)			<p>The movie made \$76 million <b>domestically</b> but only \$1.3 million abroad.</p>

				The drug won't be <b>commercially</b> available until it has been thoroughly tested.
1.20	affordable purchase price (p.2)			The simplification of clothing itself made clothing more <b>affordable</b> .  Property websites began advertising many unfinished flats below the original <b>purchase price</b> in an attempt to lure buyers.
1.21	blurry (p.2)			She noticed that her vision was <b>blurry</b> .
1.22	alter (p.2)			Prices did not <b>alter</b> significantly during 2019.
1.23	susceptible (p.2)			She isn't very <b>susceptible</b> to flattery.
1.24	specialized (p.4)			Psychiatric patients get <b>specialized</b> support from knowledgeable staff.
1.25	precisely (p.4)			The meeting began at <b>precisely</b> 4.00 p.m.
1.26	physical objects (p.4)			All <b>physical objects</b> occupy space.
1.27	three dimensional models (p.4)			Kids use rolls of papers to create two dimensional and <b>three dimensional</b> designs.
1.28	architecture (p.4)			The town's modern <b>architecture</b> is very well integrated with the old.
1.29	customized (p.4)			Each move is completely <b>customized</b> to catered to the customers needs.
1.30	patients (p.4)			The <b>patient</b> had surgery on his heart.

2. Fill in each blank with an appropriate word. Write ONE word on each blank. (20 items, 20 marks)

**Thermal Printer**

(2.1) \_\_\_\_\_ is required as the colour of materials in the paper can be changed by the (2.2) \_\_\_\_\_

Thermal printers are used in printing (2.3) \_\_\_\_\_ which you can get after making your payment at the (2.4) \_\_\_\_\_.

However, if you want to keep the receipts, you need to make a copy as the texts will (2.5) \_\_\_\_\_ after a while.

**Inkjet printer**

It is good for (2.6) \_\_\_\_\_ and (2.7) \_\_\_\_\_ uses because it is more (2.8) \_\_\_\_\_

However, there are 3 disadvantages when compared with other printers:(ONE word only)

- (2.9) \_\_\_\_\_ speed
- (2.10) \_\_\_\_\_ printing cost
- (2.11) \_\_\_\_\_ Images when getting wet

**Laser printer**

The charge of a photosensitive drum is (2.12) \_\_\_\_\_ when laser beams are shot.

The drum (2.13) \_\_\_\_\_ toner because of the charge.

The rolling drum (2.14) \_\_\_\_\_ the texts and images desired.

However, its printouts are not (2.15) \_\_\_\_\_ to moisture.

**Plotter**

(2.16) \_\_\_\_\_ in high quality printing and drawing, this kind of printers is supposed to be more expensive.

**3D printer**

To create (2.17) \_\_\_\_\_, we use 3D printers.

They are commonly used in (2.18) \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_.

It is beneficial for (2.19) \_\_\_\_\_ who want to (2.20) \_\_\_\_\_ their own dentures and limb prostheses.

**3. Matching:** Please match the attributes with the 7 descriptions by writing the letter from a to g. Each type can be matched more than once. **(10 items, 10 marks)**

a. Printing Size	b. Dot density	c. Monochrome printing	d. Colour printing
e. Printing speed	f. Memory	g. Interface	

Characteristics	Type a - g
1. Only black-and-white colour can be printed.	
2. Printouts can be produced on different papers e.g A3, B3 etc.	
3. The lower of which, the poorer the quality.	
4. It determines the amount of data to be stored.	
5. Multiple colours can be printed.	
6. It shows how long it takes to print out a certain number of printouts.	
7. It states where the printers are connected to.	
8. It affects the resolution of the printouts.	
9. It keeps data in the devices.	
10. It shows how close the dots are on printouts.	

**4. True (T) or False (F) and Not Given (NG) (10 items, 10 marks)**

Statements	T/F/NG
1. All printers can support colour printing.	
2. Only one kind of paper can be used in thermal printers.	
3. The images will never change in all printers.	
4. The printing cost of Inkjet printer is the most economical.	
5. It takes more time to print in laser printers than thermal printer.	



6. The lifespan of laser printers is long.	
7. Thermal printers are more portable.	
8. Laser printers are the costliest.	
9. You cannot keep printouts of thermal printers for a long period of time.	
10. The resolution is the best in inkjet printers.	

**Part A: Score :** \_\_\_\_\_ **/70**

## Part B Knowledge & Skills

1. (a) State **two** major factors in evaluating the performance of a printer. How are they measured?

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(4 marks)

- (b) State **two** kinds of printers.

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(2 marks)

- (c) State two kinds of products that 3D printers can be produced in medicine.

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(2 marks)

- (d) State the advantage of using 3D printers in architecture and art.

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(2 marks)

2. (a) Briefly explain how each of the following types of printers print documents.

- (i) Inkjet printer

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(2 marks)

- (ii) Laser printer

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(2 marks)

- (b) Write down **three** reasons why point-of-sale systems commonly use thermal printers.

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(3 marks)

(c) Write down a suitable type of printers for each of the following objects.

(i) A receipt from a supermarket

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(1 mark)

(ii) A poster

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(1 mark)

(iii) A multi-part form

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(1 mark)

3. The following table shows the comparison between printers A and B.

Specification	Printer A	Printer B
Printing speed (black)	9 ppm	19 ppm
Printing speed (colour)	6.5 ppm	10 ppm
Duty cycle (monthly)	3,000 pages	5,000 pages
Printing quality (black)	600 dpi	600 dpi
Printing quality (colour)	1,200 dpi	1,200 dpi
Duplex printing	Manual	Auto

(a) What is meant by ppm?

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(1 mark)

(b) For printers A and B, one is an inkjet printer while the other is a laser printer. Which one is an inkjet printer? Explain briefly.

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(2 marks)

(c) Which of the above printers can handle a greater workload? Explain briefly.

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(2 marks)

(d) (i) What is meant by duplex printing?

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(1 mark)

(ii) Describe the difference between manual and auto duplex printing.

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(2 marks)

(e) Why does a printer take more time to print a colour printout when compared with a monochrome one?

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(2 marks)

**Part B: Score :** \_\_\_\_\_/30

END

## Suggested Answer

1.
  - a) Dot density (1)  
It is measured in dots per inch (dpi). (1)  
Printing speed (1)  
It is measured in pages per minute (ppm). (1)
  - (b) Thermal printer / inkjet printer / laser printer / plotter / dot matrix printer /3D printer (any 2, @1)
  - (c) customized dentures, limb prostheses for patients (2)
  - (d) 3D printers allow a faster preview of 3D designs and prototypes. (2)
  
2.
  - (a)
    - (i) An inkjet printer uses a black cartridge and one or more colour cartridges, and spray tiny ink drops onto the paper. (2)
    - (ii) A laser printer uses a laser beam to produce an electrostatic film on a drum according to the dot pattern of the output image. The toner sticks to the charged area when the drum rotates against the toner cartridge, and is then transferred and fused on the paper as the drum presses against it. (2)
  - (c) The printing speed of thermal printers is high, e.g. it can print 20 lines in one second. (1)  
The printing cost is low. (1)  
It is quieter than other printers when printing. (1)  
(or any reasonable answer)
  - (c)
    - (i) A thermal printer (1)
    - (ii) A plotter (1)
    - (iii) A dot-matrix printer (1)
  
3.
  - (a) Page per minute (1)
  - (b) Printer A (1)  
The printing speed of printer A is lower. (1)
  - (c) Printer B (1)  
The duty cycle of printer B is higher. (1)
  - (d)
    - (i) The printer can print on both sides of a sheet of paper. (1)
    - (ii) Paper needs to be flipped for duplex printing. Auto means the flipping is done by the printers automatically (1)  
while manual means the users need to do the flipping by themselves. (1)
  - (e) A black-and-white printout is processed (printed) once only (1)  
while a colour printout needs to be processed at least twice. (1)