PISA Problem Solving Items

The *Problem Solving Items* document contains, in a ready-to-use format, 10 problem solving assessment units and 19 items associated with these units. These released items from the PISA 2003 assessment are distinct from the secure items which are kept confidential so that they may be used in subsequent cycles to monitor trends. This set of PISA *Problem Solving Items* is designed to be used in tandem with PISA *Problem Solving Items and Scoring Guides*, which contains both the items and the PISA scoring guides adapted for classroom use.

TABLE OF CONTENTS

MOVIE OUTING

This problem is about finding a suitable time and date to go to a movie.

Isaac, a 15-year-old, wants to organize a movie outing with two of his friends, who are of the same age, during the one-week school vacation. The vacation begins on Saturday March 24th and ends on Sunday April 1st.

Isaac asks his friends for suitable dates and times for the outing. The following information is what he received.

Fred: *"I have to stay home on Monday and Wednesday afternoons for music practice between 2:30 and 3:30"*

Stanley: *"I've to visit grandmother on Sundays, so it can't be Sundays. I have seen Pokamin and don't want to see it again."*

Isaac's parents insist that he only goes to movies suitable for his age and does not walk home. They will pick up the boys any time up to 10 p.m.

Isaac checks the movie times for the vacation week. This is the information that he finds.

TIVOLI MOVIE THEATER

Advance Booking Number: 919-545-6400
24 hour phone number: 919-545-6405
Bargain Day Tuesdays: All films $5

Films showing from Fri March 23rd for two weeks:

Children in the Net		**Pokamin**	
113 mins 2:00 p.m. (Mon-Fri only) 9:35 p.m. (Sat/Sun only)	Suitable only for persons of 12 years and over	105 mins 1:40 p.m. (Daily) 4:35 p.m. (Daily)	Parental Guidance. General viewing, but some scenes may be unsuitable for young children
Monsters from the Deep		**Enigma**	
164 mins 7:55 p.m. (Fri/Sat only)	Suitable only for persons of 18 years and over	144 mins 3:00 p.m. (Mon-Fri only) 6:00 p.m. (Sat/Sun only)	Suitable only for persons of 12 years and over
Carnivore		**King of the Wild**	
148 mins 6:30 p.m. (Daily)	Suitable only for persons of 18 years and over	117 mins 2:35 p.m. (Mon-Fri only) 6:50 p.m.(Sat/Sun only)	Suitable for persons of all ages

Question 1: MOVIE OUTING

X601Q01

Taking into account the information Isaac found on the movies, and the information he got from his friends, which of the six movies should Isaac and the boys consider watching?

Circle "Yes" or "No" for each movie.

Movie	**Should the three boys consider watching the movie?**
Children in the Net	Yes / No
Monsters from the Deep	Yes / No
Carnivore	Yes / No
Pokamin	Yes / No
Enigma	Yes / No
King of the Wild	Yes / No

Question 2: MOVIE OUTING

X601Q02

If the three boys decided on going to "Children in the Net," which of the following dates is suitable for them?

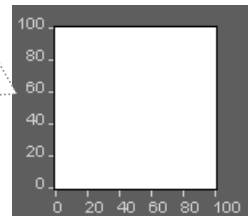
A Monday, March 26th
B Wednesday, March 28th
C Friday, March 30th
D Saturday, March 31st
E Sunday, April 1st

DESIGN BY NUMBERS©

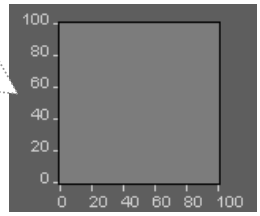
Design by Numbers is a design tool for generating graphics on computers. Pictures can be generated by giving a set of commands to the program.

Study carefully the following example commands and pictures before answering the questions.

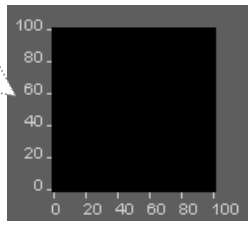
Paper 0



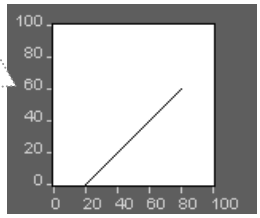
Paper 50



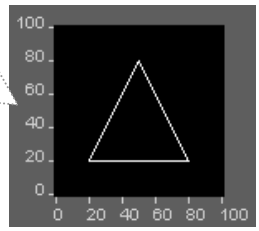
Paper 100



Paper 0
Pen 100
Line 20 0 80 60



Paper 100
Pen 0
Line 20 20 80 20
Line 80 20 50 80
Line 50 80 20 20

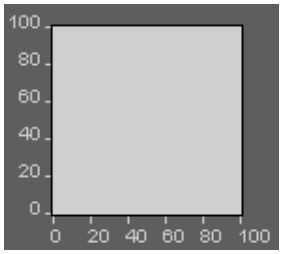


Question 1: DESIGN BY NUMBERS

X412Q01

Which of the following commands generated the graphic shown below?

A Paper 0
B Paper 20
C Paper 50
D Paper 75

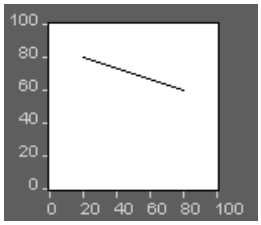


Question 2: DESIGN BY NUMBERS

X412Q02

Which of the following set of commands generated the graphic shown below?

A	Paper 100	Pen 0	Line 80 20 80 60
B	Paper 0	Pen 100	Line 80 20 60 80
C	Paper 100	Pen 0	Line 20 80 80 60
D	Paper 0	Pen 100	Line 20 80 80 60

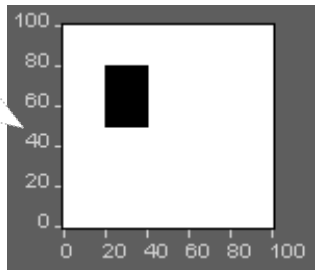


Question 3: DESIGN BY NUMBERS

X412Q03 - 0 1 2 9

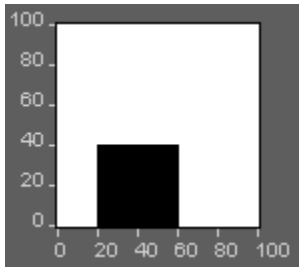
The following shows an example of the “Repate” command.

```
Paper 0
Pen 100
Repeat A 50 80
{
  Line 20  A  40  A
}
```



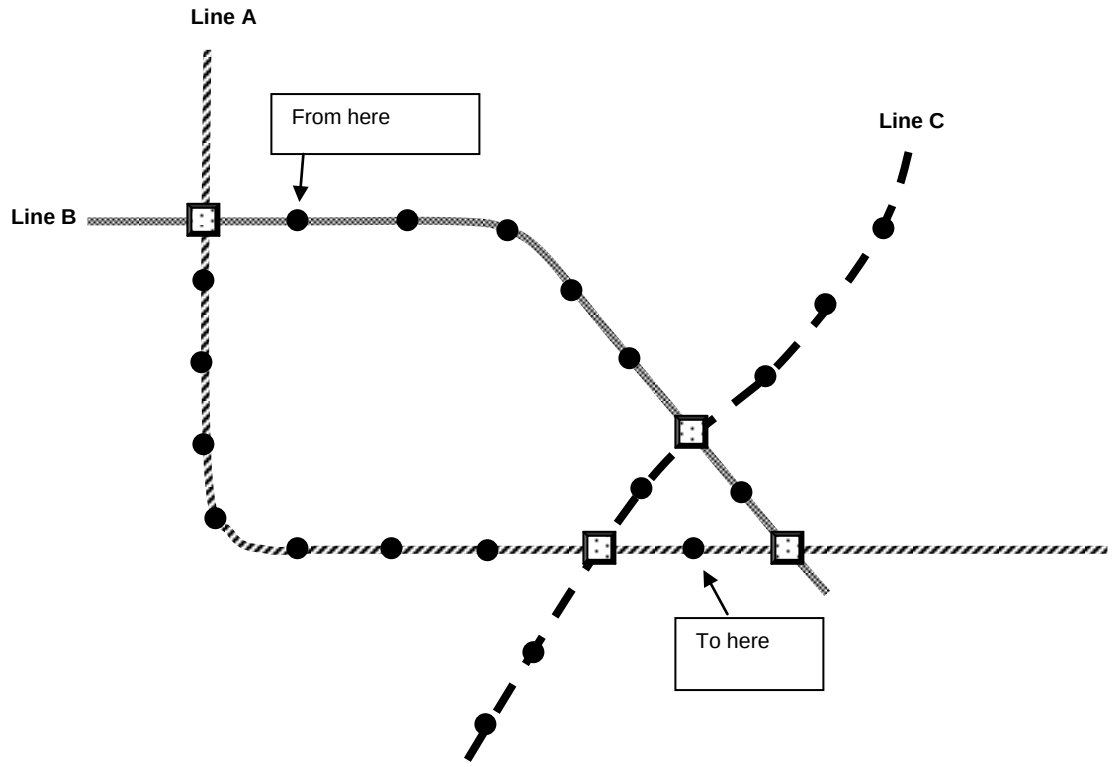
The command “Repeat A 50 80” tells the program to repeat the actions in brackets { }, for successive values of A from A=50 to A=80.

Write commands to generate the following graphic:



TRANSIT SYSTEM

The following diagram shows part of the transportation system of a city in Zedland, with three railway lines. It shows where you are now, and where you have to go.



The fare is based on the number of stations travelled (not counting the station where you start your journey). Each station travelled costs 1 zed.

The time taken to travel between two adjacent stations is about 2 minutes.

The time taken to change from one railway line to another at a junction is about 5 minutes.

Question 1: TRANSIT SYSTEM

X415Q01 - 01 02 11 12 13 21 22 99

The diagram indicates a station where you are currently at ("From here"), and the station where you want to go ("To here"). **Mark on the diagram** the best route in terms of cost and time, and indicate below the fare you have to pay, and the approximate time for the journey.

Fare: ..... zeds.

Approximate time for journey: ..... minutes.

COURSE DESIGN

A technical college offers the following 12 subjects for a 3-year course, where the length of each class is one year:

	Class Code	Class Name
1	M1	Mechanics Level 1
2	M2	Mechanics Level 2
3	E1	Electronics Level 1
4	E2	Electronics Level 2
5	B1	Business Studies Level 1
6	B2	Business Studies Level 2
7	B3	Business Studies Level 3
8	C1	Computer Systems Level 1
9	C2	Computer Systems Level 2
10	C3	Computer Systems Level 3
11	T1	Technology and Information Management Level 1
12	T2	Technology and Information Management Level 2

Question 1: COURSE DESIGN

X414Q01 - 0 1 2 9

Each student will take 4 classes per year, thus completing 12 subjects in 3 years.

A student can only take a class at a higher level if the student has completed the lower level(s) of the same class in a previous year. For example, you can only take Business Studies Level 3 after completing Business Studies Levels 1 and 2.

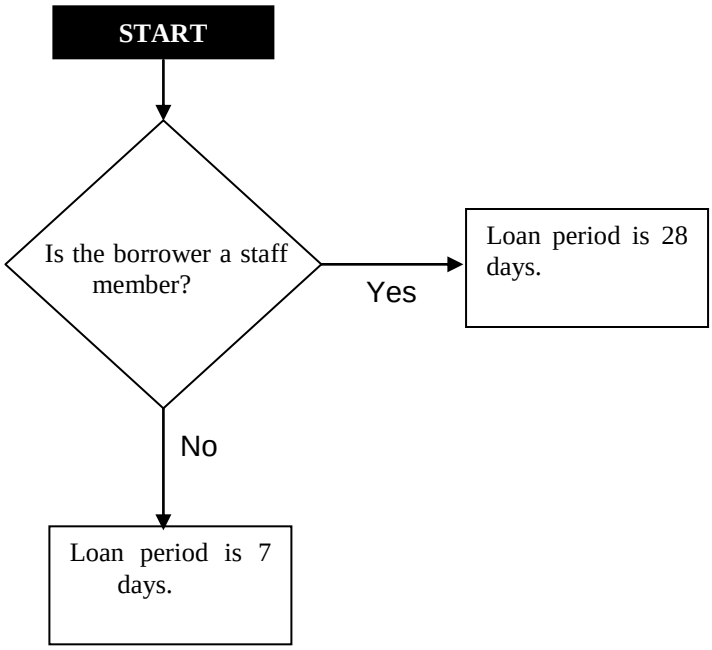
In addition, Electronics Level 1 can only be taken after completing Mechanics Level 1, and Electronics Level 2 can only be taken after completing Mechanics Level 2.

Decide which classes should be offered for which year, by completing the following table. Write the class codes in the table.

	Class 1	**Class 2**	**Class 3**	**Class 4**
Year 1				
Year 2				
Year 3				

LIBRARY SYSTEM

The **John Hobson High School** library has a simple system for lending books: for staff members the loan period is 28 days, and for students the loan period is 7 days. The following is a decision tree diagram showing this simple system:



The **Greenwood High School** library has a similar, but more complicated, lending system:

- All publications classified as "Reserved" have a loan period of 2 days.
- For books (not including magazines) that are **not** on the reserved list, the loan period is 28 days for staff, and 14 days for students.
- For magazines that are **not** on the reserved list, the loan period is 7 days for everyone.
- Persons with any overdue items are not allowed to borrow anything.

Question 1: LIBRARY SYSTEM

X402Q01

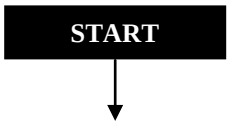
You are a student at **Greenwood High School**, and you do not have any overdue items from the library. You want to borrow a book that is **not** on the reserved list. How long can you borrow the book for?

Answer: ..... days.

Question 2: LIBRARY SYSTEM

X402Q02 - 01 02 11 12 21 22 23 31 99

Develop a decision tree diagram for the **Greenwood High School Library** system so that an automated checking system can be designed to deal with book and magazine loans at the library. Your checking system should be as efficient as possible (i.e. it should have the least number of checking steps). Note that each checking step should have only **two** outcomes and the outcomes should be labelled appropriately (e.g. “Yes” and “No”).



TRIP

This problem is about planning the best route for a trip.

Figures 1 and 2 show a map of the area and the distances between towns.

Figure 1: Map of roads between towns.

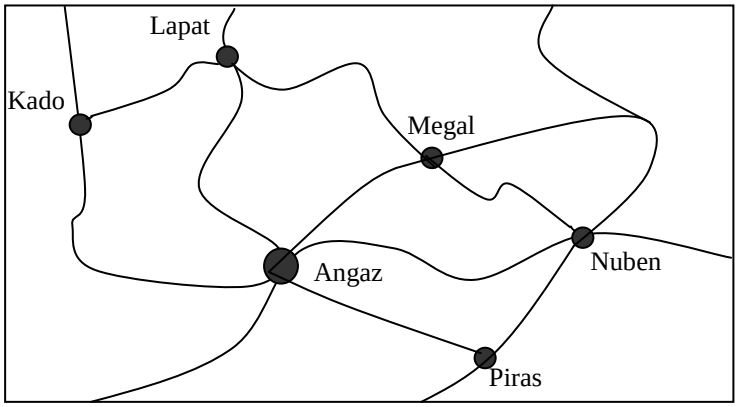


Figure 2: Shortest road distance of towns from each other in kilometres.

Angaz						
Kado	550					
Lapat	500	300				
Megal	300	850	550			
Nuben	500		1000	450		
Piras	300	850	800	600	250	

Question 1: TRIP

X602Q01 – 0 1 9

Calculate the shortest distance by road between Nuben and Kado.

Distance:..... kilometers.

Question 2: TRIP

X602Q02 - 0 1 2 9

Zoe lives in Angaz. She wants to visit Kado and Lapat. She can only travel **up to 300 kilometres** in any one day, but can break her journey by camping overnight anywhere between towns.

Zoe will stay for **two nights** in each town, so that she can spend one whole day sightseeing in each town.

Show Zoe's itinerary by completing the following table to indicate where she stays each night.

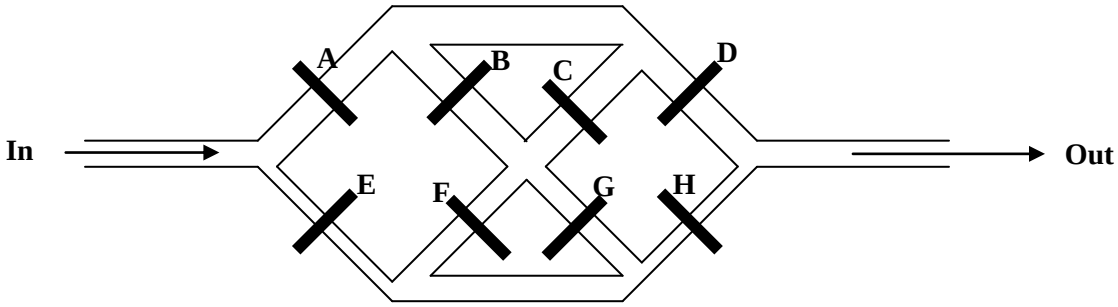
Day	Overnight Stay
1	Camp-site between Angaz and Kado.
2	
3	
4	
5	
6	
7	Angaz

IRRIGATION

Below is a diagram of a system of irrigation channels for watering sections of crops. The gates A to H can be opened and closed to let the water go where it is needed. When a gate is closed no water can pass through it.

This is a problem about finding a gate which is stuck closed, preventing water from flowing through the system of channels.

Figure 1: A system of irrigation channels



Michael notices that the water is not always going where it is supposed to.

He thinks that one of the gates is stuck closed, so that when it is switched to “open”, it does not open.

Question 1: IRRIGATION

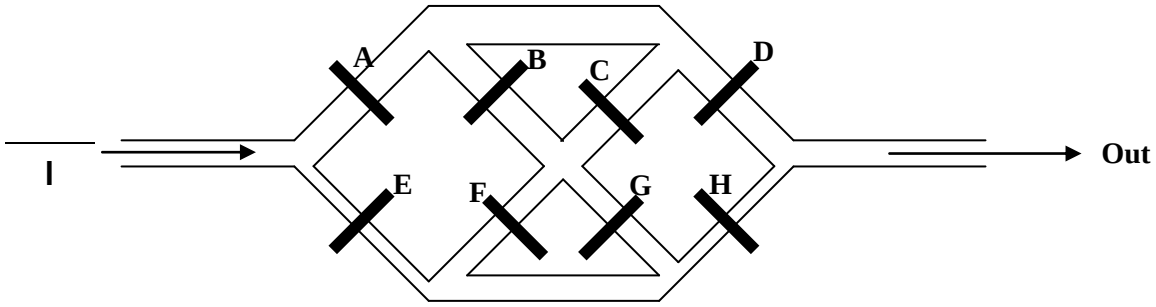
X603Q01 - 0 1 9

Michael uses the settings given in Table 1 to test the gates.

Table 1: Gate Settings

A	B	C	D	E	F	G	H
Open	Closed	Open	Open	Closed	Open	Closed	Open

With the gate settings as given in Table 1, **on the diagram below** draw all the possible paths for the flow of water. Assume that all gates are working according to the settings.



Question 2: IRRIGATION

X603Q02

Michael finds that, when the gates have the Table 1 settings, no water flows through, indicating that at least one of the gates set to “open” is stuck closed.

Decide for each problem case below whether the water will flow through all the way. Circle “Yes” or “No” in each case.

Problem Case	Will water flow through all the way?
Gate **A** is stuck closed. All other gates are working properly as set in Table 1.	Yes / No
Gate **D** is stuck closed. All other gates are working properly as set in Table 1.	Yes / No
Gate **F** is stuck closed. All other gates are working properly as set in Table 1.	Yes / No

Question 3: IRRIGATION

X603Q03 - 0 1 9

Michael wants to be able to test whether **gate D** is stuck closed.

In the following table, show settings for the gates to test whether **gate D** is stuck closed when it is set to “open”.

Settings for gates (each one “open” or “closed”)

A	B	C	D	E	F	G	H

ENERGY NEEDS

This problem is about selecting suitable food to meet the energy needs of a person in Zedland. The following table shows the recommended energy needs in kilojoules (kJ) for different people. [NOTE: A kilojoule is the metric unit for energy, similar to a Calorie.]

DAILY ENERGY NEEDS RECOMMENDED FOR ADULTS

		MEN	***WOMEN***
Age (years)	**Activity Level**	**Energy Needed (kJ)**	**Energy Needed (kJ)**
From 18 to 29	Light Moderate Heavy	10660 11080 14420	8360 8780 9820
From 30 to 59	Light Moderate Heavy	10450 12120 14210	8570 8990 9790
60 and above	Light Moderate Heavy	8780 10240 11910	7500 7940 8780

ACTIVITY LEVEL ACCORDING TO OCCUPATION

Light:	**Moderate:**	**Heavy:**
Indoor sales person	Teacher	Construction worker
Office worker	Outdoor salesperson	Laborer

Question 1: ENERGY NEEDS *X430Q01 - 019*

Mr. David Edison is a 45-year-old teacher. What is his recommended daily energy need in kJ?

Answer:..... kilojoules.

Jane Gibbs is a 19-year-old high jumper. One evening, some of Jane's friends invite her out for dinner at a restaurant. Here is the menu.

MENU		**Jane's estimate of energy per serving (kJ)**
Soups:	Tomato Soup	355
	Cream of Mushroom Soup	585
Main courses:	Mexican Chicken	960
	Caribbean Ginger Chicken	795
	Pork and Sage Kebabs	920
Salads:	Potato Salad	750
	Spinach, Apricot and Hazelnut Salad	335
	Couscous Salad	480
Desserts:	Apple and Raspberry Crumble	1380
	Ginger Cheesecake	1005
	Carrot Cake	565
Milk shakes:	Chocolate	1590
	Vanilla	1470

The restaurant also has a special fixed price menu.

Fixed Price Menu
50 zeds
Tomato Soup
Caribbean Ginger Chicken
Carrot Cake

Question 2: ENERGY NEEDS

X430Q02 - 0129

Jane keeps a record of what she eats each day. Before dinner on that day her total intake of energy had been 7520 kJ.

Jane does **not** want her total energy intake to go **below or above her recommended daily amount** by more than 500 kJ.

Decide whether the special "Fixed Price Menu" will allow Jane to stay within ±500 kJ of her recommended energy needs. Show your work.

CHILDREN'S CAMP

The Zedish Community Service is organizing a five-day Children's Camp. 46 children (26 girls and 20 boys) have signed up for the camp, and 8 adults (4 men and 4 women) have volunteered to attend and organize the camp.

Table 1: Adults

Mrs. Madison
Mrs. Carroll
Ms. Grace
Ms. Kelly
Mr. Stevens
Mr. Neill
Mr. Williams
Mr. Peters

Table 2: Dormitories

Name	Number of beds
Red	12
Blue	8
Green	8
Purple	8
Orange	8
Yellow	6
White	6

Dormitory rules:

1. Boys and girls must sleep in separate dormitories.
2. At least one adult must sleep in each dormitory.
3. The adult(s) in a dormitory must be of the same gender as the children.

Question 1: CHILDREN'S CAMP

X417Q01 - 0 1 2 9

Dormitory Allocation.
Fill the table to allocate the 46 children and 8 adults to dormitories, keeping to all the rules.

Name	Number of boys	Number of girls	Name(s) of adult(s)
Red			
Blue			
Green			
Purple			
Orange			
Yellow			
White			

FREEZER

Jane bought a new upright freezer. The manual gave the following instructions:

- Connect the appliance to the power and switch the appliance on.
    - You will hear the motor running now.
    - A red warning light (LED) on the display will light up.
- Turn the temperature control to the desired position. Position 2 is normal.

Position	Temperature
1	-15°C
2	-18°C
3	-21°C
4	-25°C
5	-32°C

    - The red warning light will stay on until the freezer temperature is low enough. This will take 1–3 hours, depending on the temperature you set.
- Load the freezer with food after four hours.

Jane followed these instructions, but she set the temperature control to position 4. After 4 hours, she loaded the freezer with food.

After 8 hours, the red warning light was still on, although the motor was running and it felt cold in the freezer.

Question 1: FREEZER

X423Q02

Jane wondered whether the warning light was functioning properly. Which of the following actions and observations would suggest that the light was working properly?

Circle “Yes” or “No” for each of the three cases.

Action and Observation	Does the observation suggest that the warning light was working properly?
She put the control to position 5 and the red light went off.	Yes / No
She put the control to position 1 and the red light went off.	Yes / No
She put the control to position 1 and the red light stayed on.	Yes / No

Question 2: FREEZER

X423Q01

Jane read the manual again to see if she had done something wrong. She found the following six warnings:

1. **Do not connect the appliance to an ungrounded power point.**
2. **Do not set the freezer temperatures lower than necessary (–18 ^{o}C is normal).**
3. **The ventilation grills should not be obstructed. This could decrease the freezing capability of the appliance.**
4. **Do not freeze lettuce, radishes, grapes, whole apples and pears, or fatty meat.**
5. **Do not salt or season fresh food before freezing.**
6. **Do not open the freezer door too often.**

Ignoring which of these six warnings could have caused the delay in the warning light going out?

Circle "Yes" or "No" for each of the six warnings.

Warning	Could ignoring the warning have caused a delay in the warning light going out?
Warning 1	Yes / No
Warning 2	Yes / No
Warning 3	Yes / No
Warning 4	Yes / No
Warning 5	Yes / No
Warning 6	Yes / No