PART A

MULTIPLE-CHOICE QUESTIONS

INSTRUCTIONS

ANSWER QUESTIONS 1 TO 15 IN YOUR *ANSWER BOOKLET* BY FILLING IN THE CORRECT SPACE.

1. With which living organism is primary productivity associated?

   A) A bee B) A tree C) A cow D) An earthworm

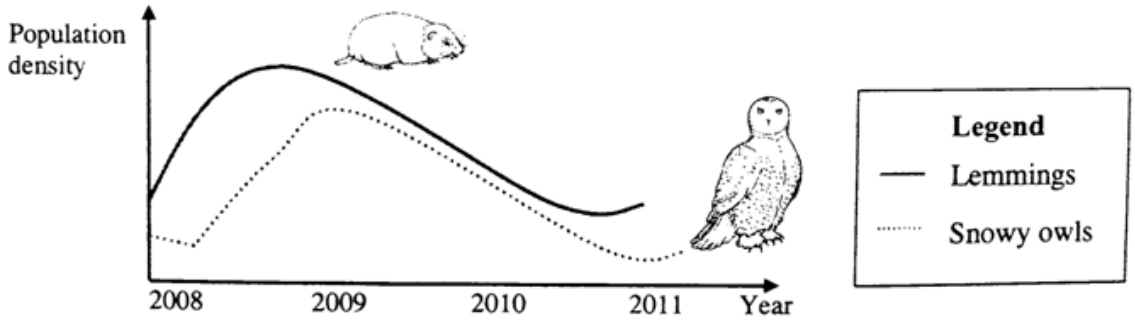
2. A warm air mass meets a cold air mass.

   What kind of weather occurs when these two air masses meet?

   A) Light showers B) A hurricane C) A sunny day D) A heavy thunderstorm

3. The snowy owl feeds mostly on lemmings. Its biological cycle is therefore closely linked to the size of the lemming population.

   Graph I – Change in the Density of the Lemming and Snowy Owl Populations



   Referring to the above graph, place the following four situations in the correct order to indicate what should happen starting in 2011 once the snowy owl population has reached its lowest point.

   1. The density of the snowy owl population will be reduced.
   2. The density of the snowy owl population will rise.
   3. The density of the lemming population will be reduced.
   4. The density of the lemming population will rise.

   A) 2-3-1-4 B) 2-4-1-3 C) 4-1-3-2 D) 4-2-3-1

4. The melting of glaciers and pack ice has environmental consequences. Which of the following statements is true?

   A) The melting of glaciers reduces the concentration of sea salts, which increases the density of sea water.

   B) The melting of pack ice influences thermohaline circulation.

   C) The melting of glaciers and pack ice has no impact on the quantity of available drinking water.

   D) The melting of pack ice is the main cause of rising sea levels.

5. Scientific studies show that the number of aquatic species declines when a lake becomes more acidic. The pH of the water in four lakes was measured to determine whether aquatic species are threatened. The table below lists the pH values obtained.

Table I – pH of the lakes examined

Lake	pH
1	4.2
2	6.5
3	7.0
4	7.8

Which of these lakes poses the greatest threat to aquatic species?

A) Lake 1 B) Lake 2 C) Lake 3 D) Lake 4

6. Listed below are the characteristics of an element from the periodic table.

   - It is a nonmetal.
   - Its outermost energy level has seven electrons.
   - It is used to purify and disinfect water.

To which group in the periodic table does this element belong?

A) Alkali metals B) Alkaline earth metals C) Halogens D) Inert gases

7. Which of the following is the Lewis structure for magnesium?

A) Mg :

B) • Mg

C) • Mg •

D) : Mg :

8. City regulations state that municipal swimming pools must be closed when the concentration of free available residual chlorine in the water is less than 0.3 ppm or greater than 5 ppm.

The table below lists the concentrations of free available residual chlorine in water samples taken from four swimming pools.

Table I – Concentration of Free Available Residual Chlorine in the Water From Four Swimming Pools

Swimming pool	Concentration of free available residual chlorine
1	0.00002% (m/V)
2	0.0004% (m/V)
3	0.0004 g/L
4	0.0058 g/L

Which of these pools has water that complies with these regulations?

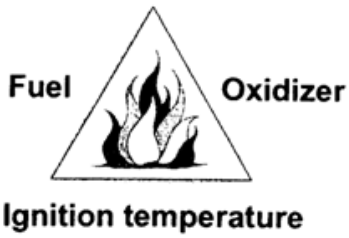
A) Pools 1 and 3

B) Pools 1 and 4

C) Pools 2 and 3

D) Pools 2 and 4

9. A fire is extinguished by removing at least one of the three conditions required for combustion to occur. These conditions are indicated in the fire triangle below.



The following table describes three functions of a CO_2 extinguisher.

Table I – Functions of a CO_2 Extinguisher

1	The main function of the carbon dioxide (CO_2) is to smother the fire by reducing the amount of oxygen gas (O_2) that feeds it.
2	In the very early stages of a fire, the CO_2 has a cooling effect, since it comes out of the extinguisher at a temperature of –78 °C.
3	The gas comes out of the extinguisher as a powerful spray that puts out small paper fires by scattering the pieces of material involved.

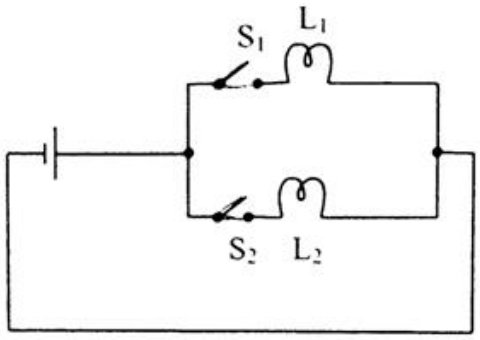
Which of the following shows the correct match between the numbered functions of the CO_2 extinguisher and the conditions required for combustion to occur?

A)	1- fuel	2- ignition temperature	3- oxidizer
B)	1- oxidizer	2- ignition temperature	3- fuel
C)	1- ignition temperature	2- oxidizer	3- fuel
D)	1- fuel	2- oxidizer	3- ignition temperature

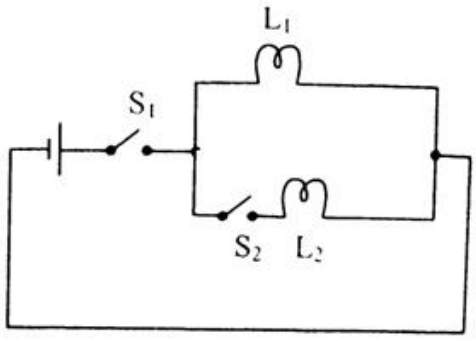
10. Which one of the diagrams below represents a circuit in which the following two situations are possible?

- When switch S_1 is on and switch S_2 is off, only light L_1 will be on.
- When switch S_1 is off and switch S_2 is on, neither light will be on.

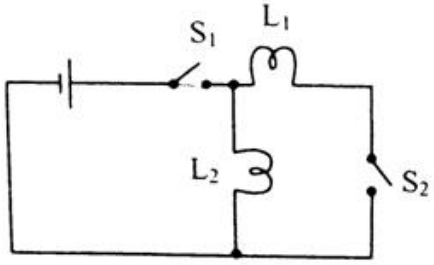
A)



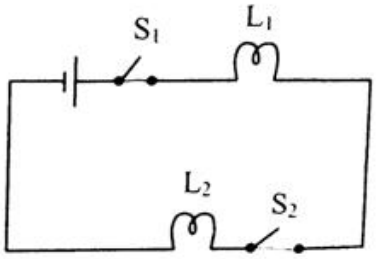
B)



C)



D)



11. An electrical appliance has a defective resistor with a resistance of 5 Ω. You are asked to replace this resistor.

The following table provides information about four resistors you have been given.

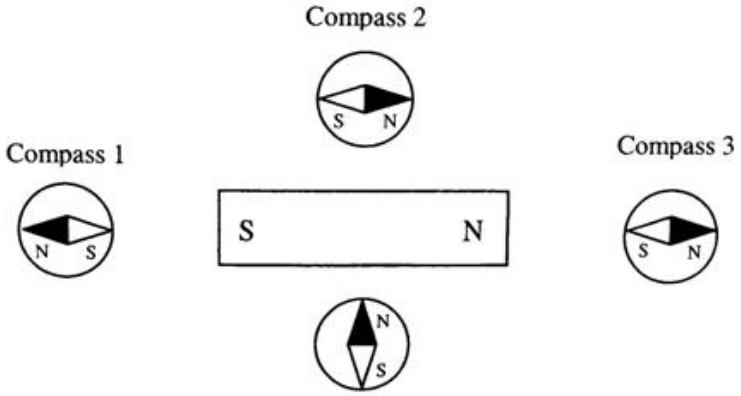
Table I – Potential Difference Across the Terminals of the Four Resistors and the Current Flowing Through Them

Resistor	Potential Difference (V)	Current (A)
1	2	0.4
2	6	0.5
3	15	2.5
4	20	2.0

Which one of these resistors should you use to replace the defective resistor?

A) Resistor 1 B) Resistor 2 C) Resistor 3 D) Resistor 4

12. The following diagram shows a bar magnet and four compasses.



Which compass shows the needle pointing in the correct direction?

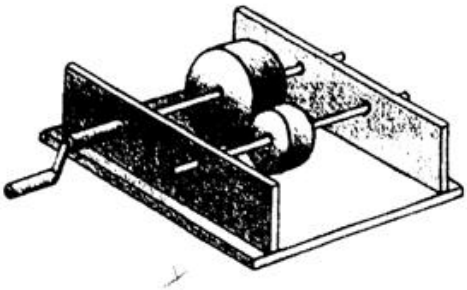
A) Compass 1

B) Compass 2

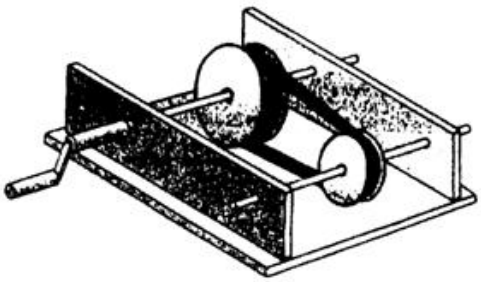
C) Compass 3

D) Compass 4

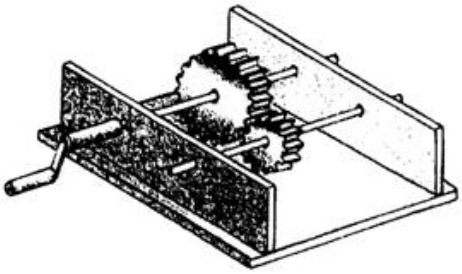
13. The following are diagrams of different mechanisms.



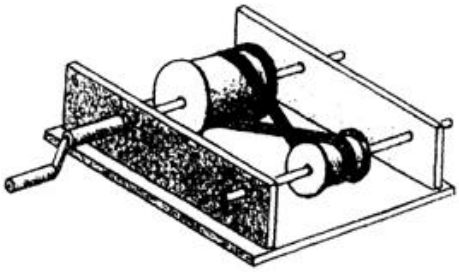
Mechanism 1



Mechanism 2



Mechanism 3



Mechanism 4

Which of these mechanisms makes the driven component rotate in the same direction as the driver component?

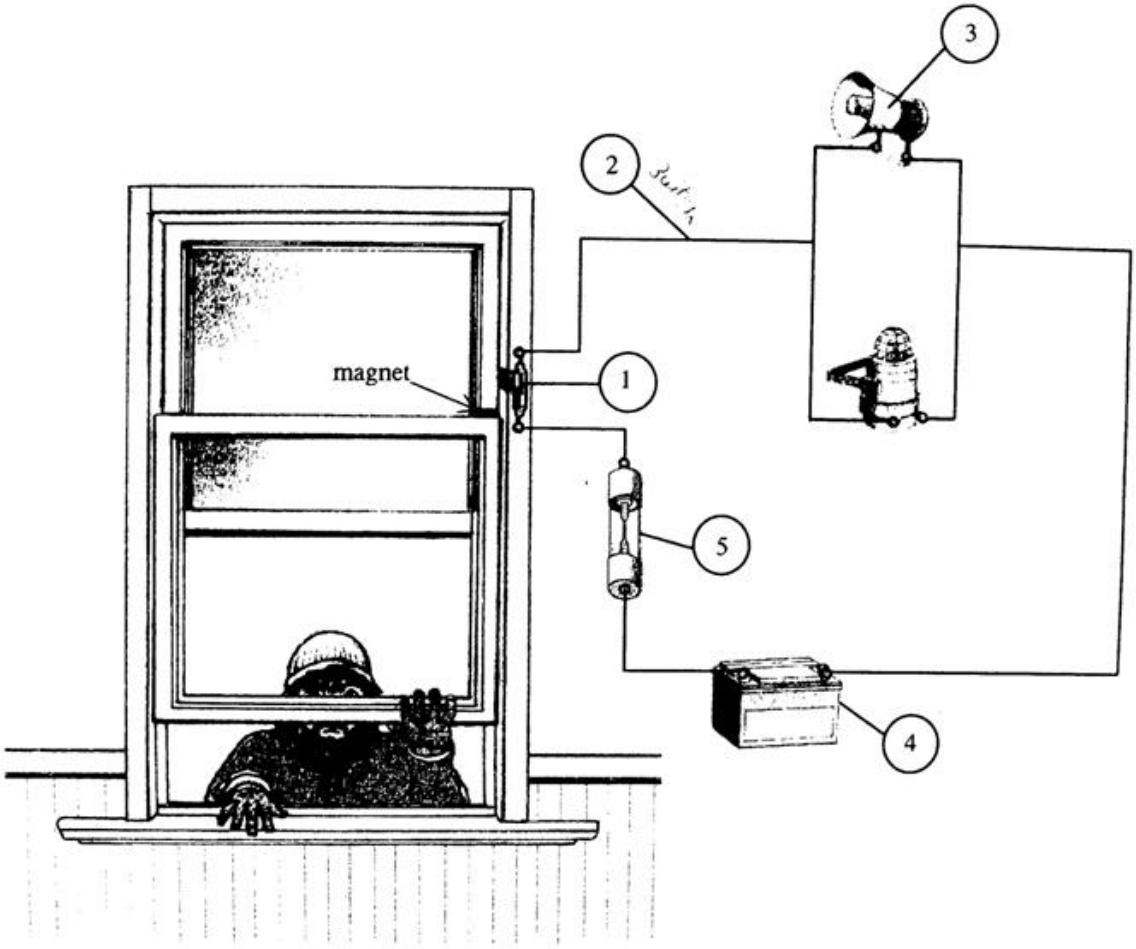
A) Mechanism 1

B) Mechanism 2

C) Mechanism 3

D) Mechanism 4

14. The electrical circuit of a magnetic alarm system is illustrated in the diagram below.



What is the electrical function of component 3 in this electrical circuit?

A) Power supply

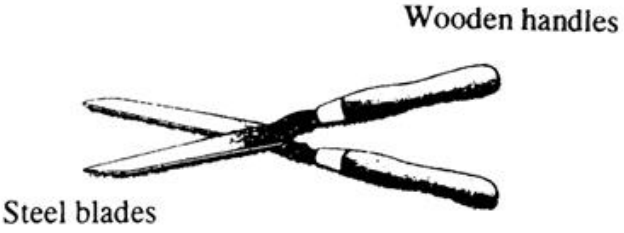
B) Control

C) Conduction

D) Transformation

15. A pruning shear manufacturer recommends greasing the shear handles and blades before storing this tool for the winter in an outdoor shed.

These pruning shears are shown in the diagram below.



The table below lists some possible reasons why greasing is necessary.

1- To protect the wood from fungus and microorganisms
2- To keep the wood from breaking in the winter
3- To keep the steel blades from rusting in the winter
4- To ensure that the steel blades will be sharper in the spring

Which of these reasons are true?

A) 1 and 3

B) 1 and 4

C) 2 and 3

D) 2 and 4

PART B

CONSTRUCTED-RESPONSE QUESTIONS

INSTRUCTIONS

ANSWER QUESTIONS 16 TO 21 IN YOUR *ANSWER BOOKLET*, SHOWING ALL YOUR WORK.

16. A variety of human activities involve the combustion of fossil fuels (coal, natural gas and other hydrocarbon derivatives).

    For example, when methane (CH_4) burns, it reacts with oxygen gas (O_2) to produce carbon dioxide (CO_2) and water (H_2O).

    The unbalanced equation for this reaction is given below.

    $$CH_4 + O_2 \rightarrow CO_2 + H_2O$$

    Write the balanced equation for this reaction, and represent it using the particle model.

17. Write the symbol for the alkali metal in Period 2, and represent this element using the Rutherford-Bohr model.

18. Electric cars are increasingly popular in cities. Automobile manufacturers are working to improve their performance and make them more affordable.

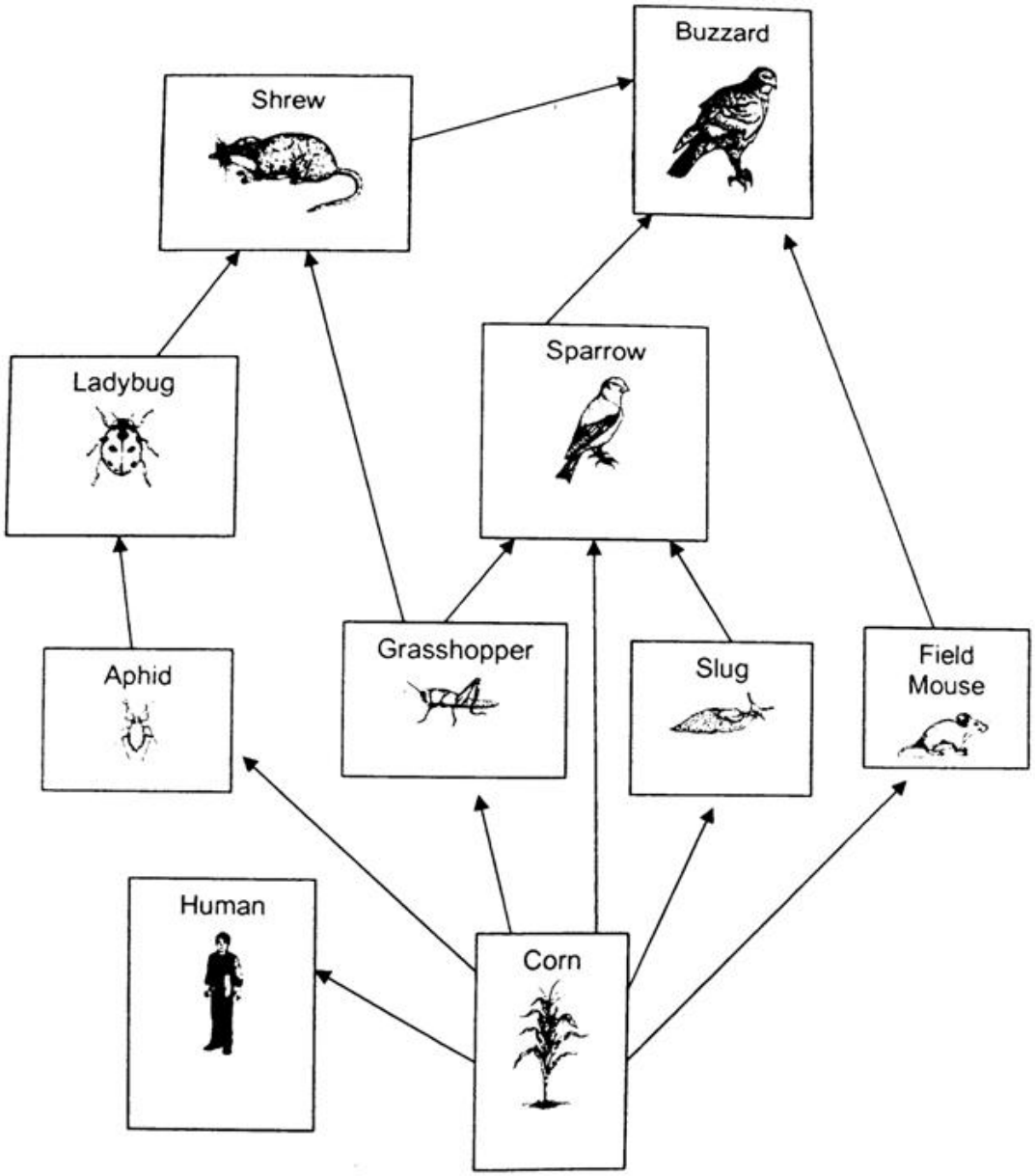
    Can using these cars have an impact on the greenhouse effect? Explain your answer.

19. It can be dangerous to go swimming in the ocean during a thunderstorm.

    a) Complete the diagram in your *Answer Booklet* by illustrating the property of ocean water that makes it dangerous to go swimming during a thunderstorm.

    b) Explain your diagram using the appropriate terms.

20. The following diagram shows the food web of a corn field.



Which would have the greater impact on the food web of the corn field: the extinction of ladybugs or the extinction of slugs? Explain your answer by comparing the impact of the extinction of each of these two animals.

21. **By buying electrical appliances and products that use less energy, it is possible to lead a more ecological lifestyle.**

Electrical appliances and products that meet certain standards qualify for the ECO-STAR label.

The following table indicates one of the standards that a television set must meet to qualify for the ECO-STAR label.

Table I – Maximum Power According to Screen Size

Screen Size (inches)	Maximum Power (W)
20	37
32	78
42	115

The following table lists three different models of television sets along with the energy they consume over different periods.

Table II – Energy Consumed by Different Models of Television Sets According to the Amount of Time They Are Used per Day

Model of Television Set	Screen Size (inches)	Energy Consumed When in Use (W•h)	Amount of Time Used per Day (h)
X	20	157	5.0
Y	32	255	3.0
Z	42	392	3.5

Which model or models qualify for the ECO-STAR label? Justify your answer by showing all your work.

PART C

TECHNOLOGICAL ANALYSIS QUESTIONS

INSTRUCTIONS

ANSWER QUESTIONS 22 TO 25 IN YOUR *ANSWER BOOKLET*, SHOWING ALL YOUR WORK.

Students in your school have designed a memo holder equipped with three different coloured indicator lights.

Overall Function

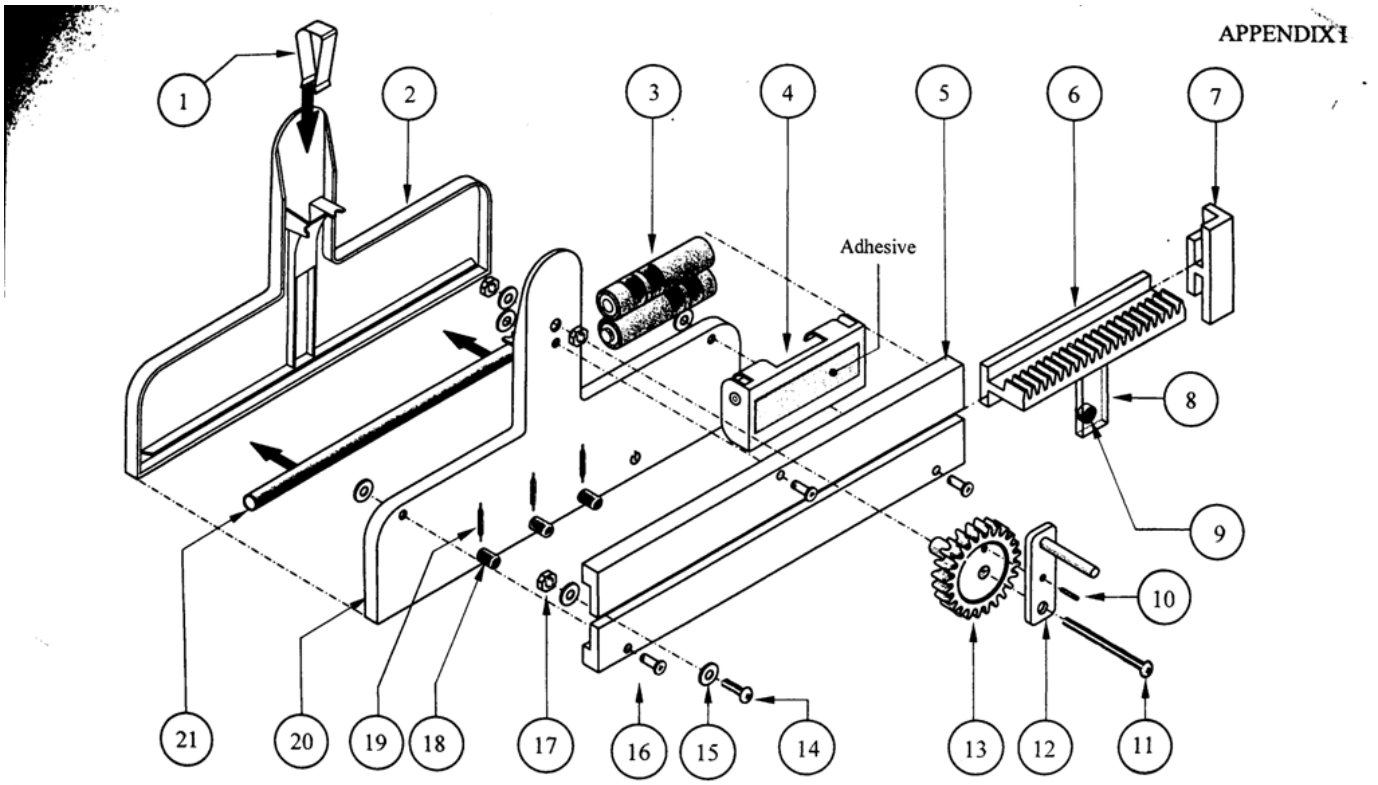
To indicate the importance of a message, using different coloured indicator lights.

You must analyze this memo holder by considering:

- its mechanical parts
- its electrical parts

The information in the animated DVD presentation as well as Appendixes I and II on pages 15 and 16 will help you answer questions 22 to 25.

APPENDIX I



ITEM	QUANTITY	NAME	ITEM	QUANTITY	NAME	ITEM	QUANTITY	NAME
1	1	Clip	8	1	Magnet holder	15	6	Washers
2	1	Rear jaw	9	1	Magnet	16	3	Button rivets
3	2	Batteries	10	1	Locking pin	17	3	Nuts
4	1	Battery holder	11	1	Bolt	18	3	Indicator lights
5	1	Runner	12	1	Crank	19	3	Magnetic switches
6	1	Rack	13	1	Pinion	20	1	Front jaw
7	1	Metal end fitting	14	1	Stop screw	21	1	Rubber strip

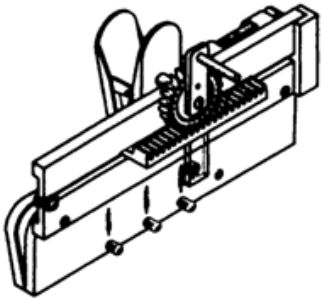
Memo Holder: Parts Named and Separated From One Another

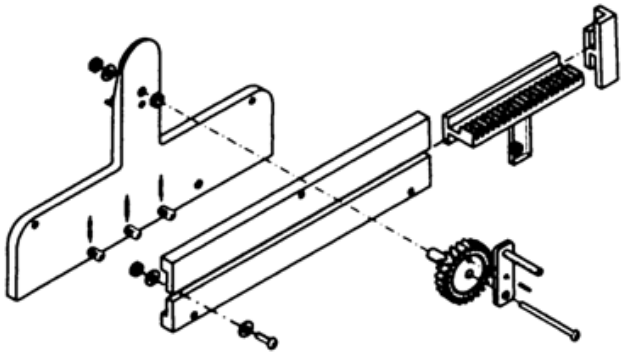
PART C

TECHNOLOGICAL ANALYSIS QUESTIONS

Note: You must use Appendixes I and II on pages 15 and 16 of the *Student Booklet* to answer the questions in Part C.

22. Using scientific and technological vocabulary, explain the electrical and mechanical operation of the memo holder by describing what all the listed components do.





Crank: _____

_____

Rack **and** pinion: _____

_____

Runner: _____

_____

Magnet **and** magnetic switch: _____

_____

Indicator lights: _____

_____

Metal end fitting and stop screw: _____

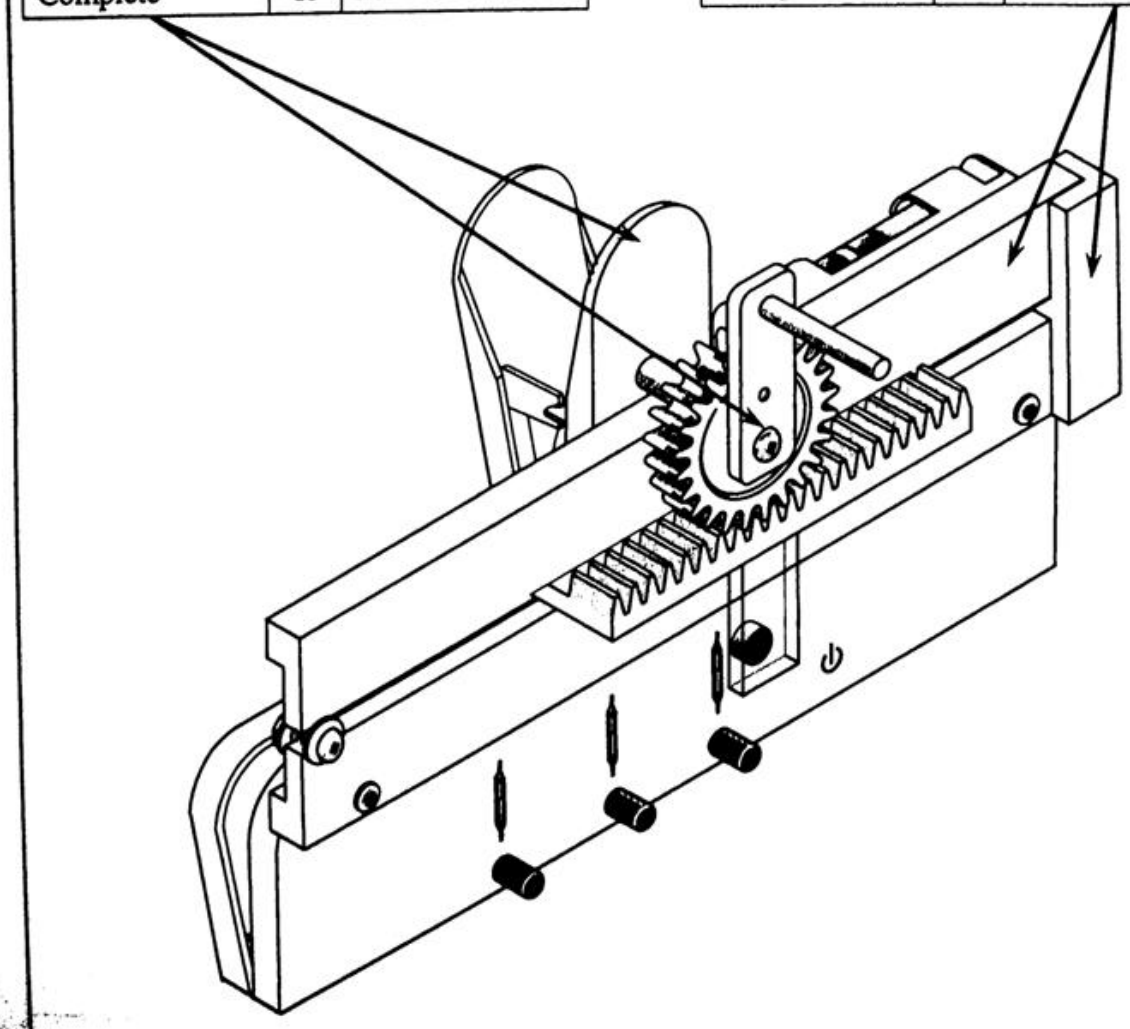
_____

Two links are identified in the diagram below.

Circle the four characteristics that describe each link.

Characteristics of the link between the **front jaw** and the **crank**		
Direct	or	Indirect
Rigid	or	Elastic
Removable	or	Non-removable
Complete	or	Partial

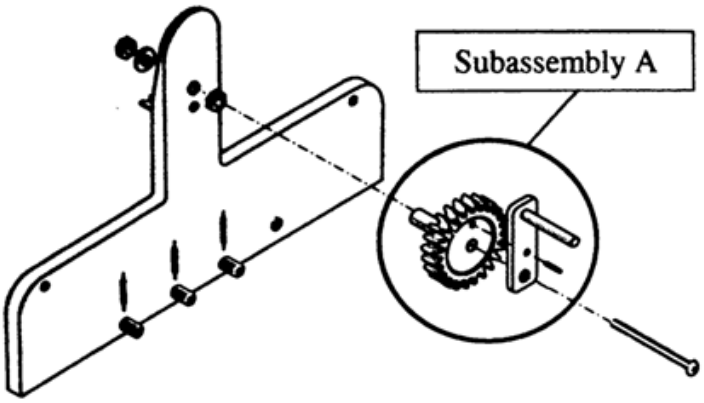
Characteristics of the link between the **metal end fitting** and the **runner**		
Direct	or	Indirect
Rigid	or	Elastic
Removable	or	Non-removable
Complete	or	Partial



4 3 2 1 0

a) To move appropriately, subassembly A represented below needs a guiding control.

Which part acts as the guiding control for this subassembly and what type of guiding is involved?

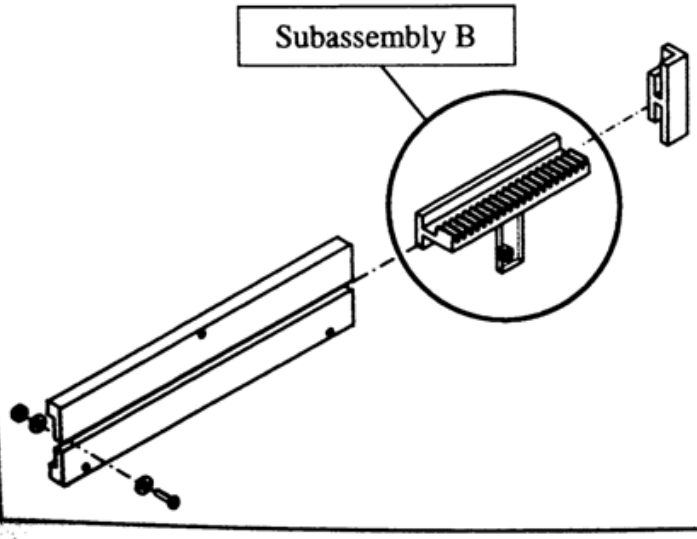


Part acting as the guiding control: _____

Type of guiding involved: _____

24. b) To move appropriately, subassembly B represented below needs a guiding control.

Which part acts as the guiding control for this subassembly and what type of guiding is involved?

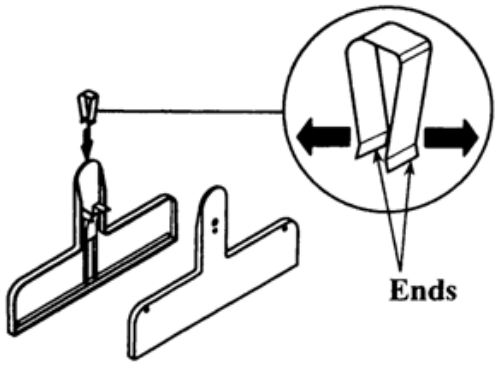


Part acting as the guiding control: _____

Type of guiding involved: _____

4 3 2 1 0

25. a) To what constraint are the two ends of the clip subjected when the memo holder is opened?



Constraint: _____

25. b) The following are mechanical properties of materials.

– Hardness – Elasticity – Malleability – Stiffness – Resilience

What mechanical property must the clip have so that it can be subjected to this constraint when the memo holder is used? Explain why.

Mechanical property: _____

Because: _____

_____

_____

_____

4	3	2	1	0