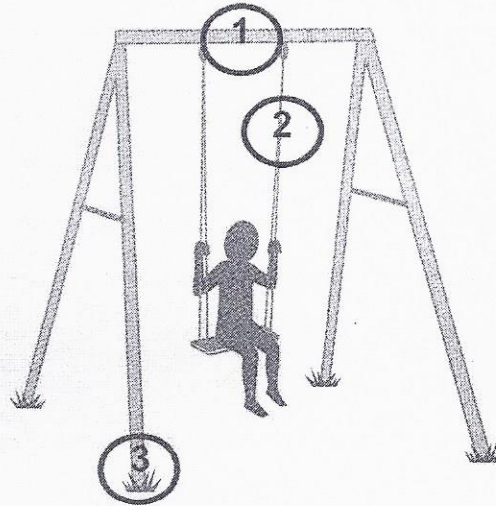


Links, Guides, Systems and Material Review

A- Multiple Choice

1. The diagram below shows a child sitting on a swing without swinging. Circles numbered 1, 2 and 3 indicate places on the swing set that are subjected to a constraint in this case.



Which answer correctly identifies the constraints that the swing set is subjected to in this case?

	1	2	3
A)	Compression	Deflection	Torsion
B)	Compression	Torsion	Deflection
C)	Deflection	Tension	Compression
D)	Deflection	Compression	Tension

2. Different methods of protecting certain materials are listed below.

Protection methods

1	Zinc coating
2	Oil treatment
3	High temperature treatment
4	Soaking in an acidic solution

Which are the two appropriate methods for protecting a piece of iron from oxidation (rust)?

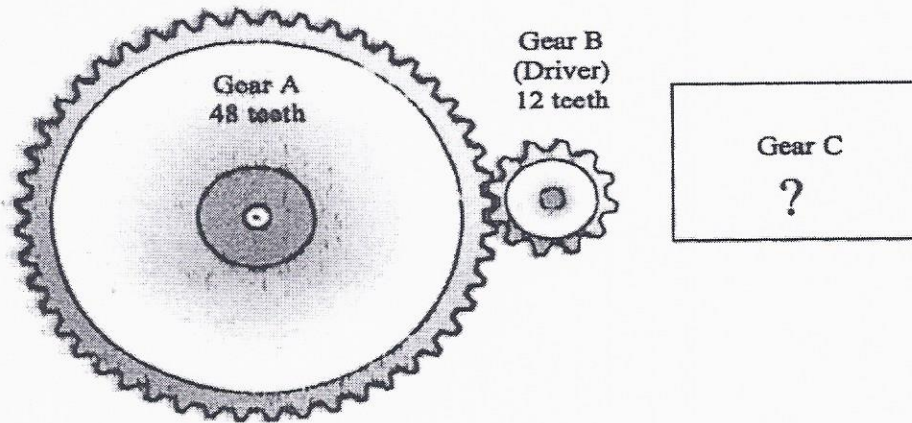
A) 1 and 2

B) 1 and 4

C) 2 and 3

D) 3 and 4

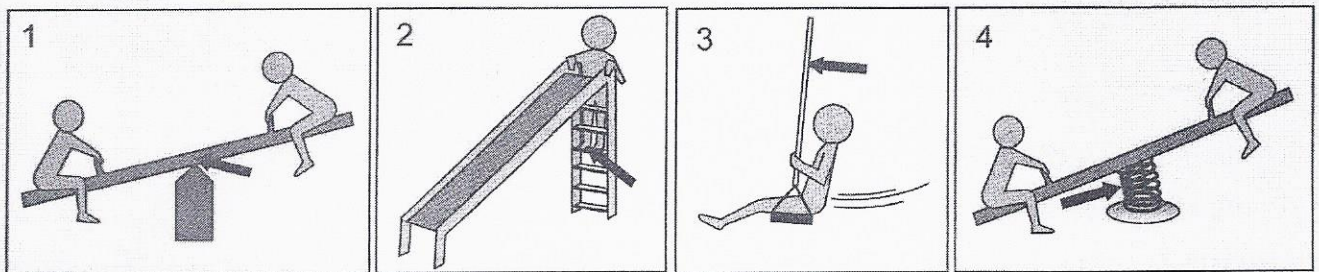
3. During a violent storm, the windows of the “Three Little Pigs” boutique were broken by flying debris, nearly injuring its customers. As a result, the owners want to replace the glass in their windows with a transparent material that is more resistant. What mechanical properties must the transparent material have?
- A) Elasticity and hardness
 B) Elasticity and malleability
 C) Resilience and hardness
 D) Resilience and malleability
4. A washing machine contains many parts that may break down over time. From the choices below, explain which would be the best system to attach the back cover of the machine to the body of the washing machine to permit access for repairs.
- A) rivet
 B) glue (adhesive)
 C) screw
 D) nail
5. The diagram below shows a motion transmission system consisting of three gears. Gear B is the driver.



Which of the following indicates the speed ratio between gears A and B and the number of teeth gear C should have so that speed ratio between gears B and C is $1/3$?

- A) The speed ratio between gears A and B is 0.25, and gear C should have 4 teeth
 B) The speed ratio between gears A and B is 0.25, and gear C should have 36 teeth
 C) The speed ratio between gears A and B is 4, and gear C should have 4 teeth
 D) The speed ratio between gears A and B is 4, and gear C should have 36 teeth

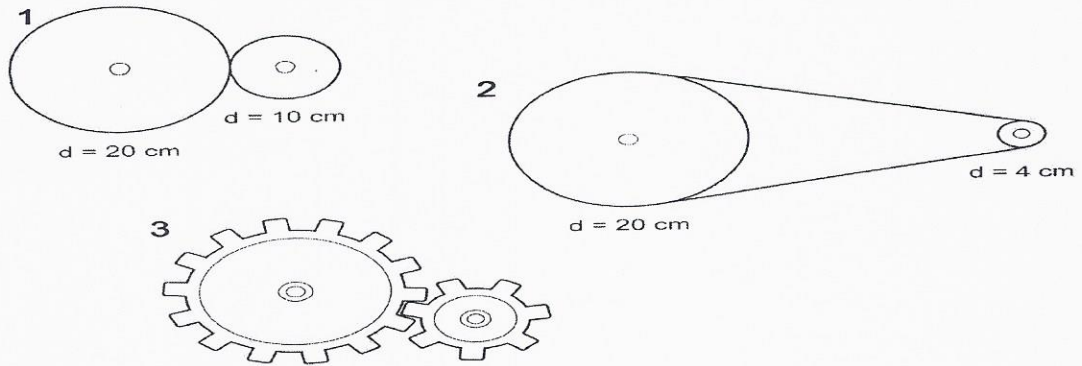
6. The following diagrams show different playground activities, for each item of playground, the arrow indicates where something is subjected to a constraint.



Which diagram shows tension being exerted?

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

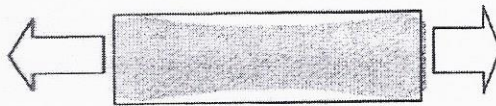
7. Look at the three motion transmission systems below.



In which of these three systems does the biggest speed change occur?

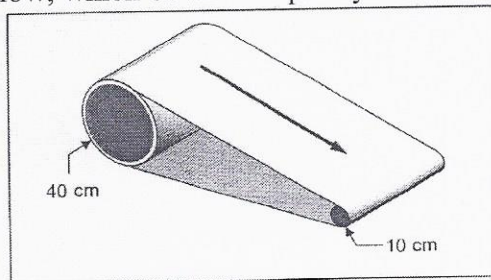
- A) System 1 because the diameter difference between the driver and the driven is greater than system 2 and 3.
- B) System 2 because the diameter difference between the driver and the driven is greater than system 1 and 3.
- C) System 3 because the diameter difference between the driver and the driven is lesser than system 1 and 2.
- D) System 1 and 3 because the diameter difference between the driver and the driven is lesser than system 2.

8. What mechanical constraint is illustrated below?



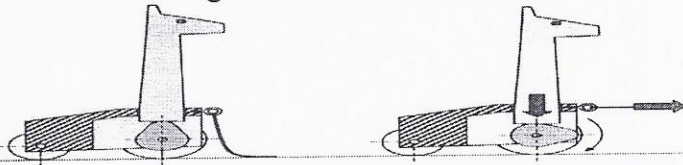
- A) Compression
- B) Deflection
- C) Torsion
- D) Tension

9. A sorting line for recyclable materials works with a pulley and belt system. The driver pulley is 40 cm in diameter and the driven pulley is 10 cm in diameter. Using the picture below, which of the two pulleys turns faster and in what direction?



- A) The driven pulley turns faster than the driver pulley and in the opposite direction.
- B) The driven pulley turns faster than the driver pulley and in the same direction.
- C) The driver pulley turns faster than the driven pulley and in the same direction.
- D) The driver pulley turns faster than the driven pulley and in the opposite direction.

10. Your little brother likes to play with his wooden giraffe because when he moves it forward or backward, its head moves up and down. However, he does not understand why he cannot move the giraffe by pushing down on its head. Below are diagrams of the wooden giraffe.



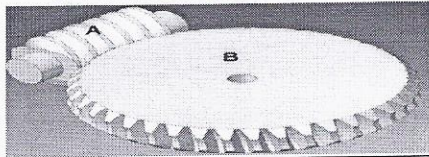
The following statements are related to the mechanism that controls the giraffe's neck.

- 1-The mechanism that controls the giraffe's neck transforms rotational motion into translational motion.
- 2-The mechanism that controls the giraffe's neck transforms translational motion into rotational motion.
- 3-The mechanism that controls the giraffe's neck is a non-reversible motion transformation system.
- 4-The mechanism that controls the giraffe's neck is a reversible motion transformation system.

Which statements are TRUE?

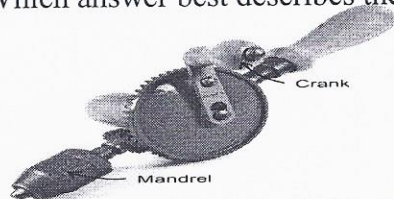
- A) 1 and 3 B) 1 and 4 C) 2 and 3 D) 2 and 4

11. Choose the answer which best explains the picture below.



	Type of system	Reversible	Which is the driver
<input type="radio"/> A	Transmission	Yes	A or B
<input checked="" type="radio"/> B	Transmission	No	Only A
<input type="radio"/> C	Transformation	No	Only A
<input type="radio"/> D	Transformation	Yes	A or B

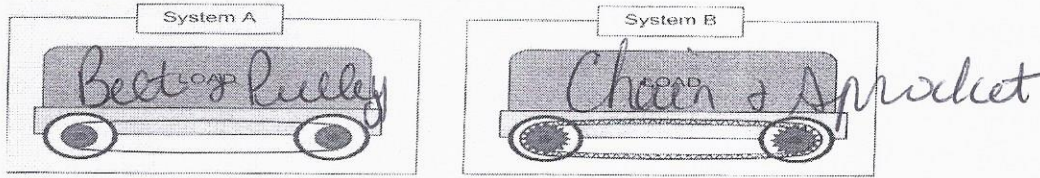
12. Below, is a picture of a manual hand drill. When you rotate the crank, the mandrel will also rotate. Which answer best describes the drill?



- A) The crank is the driver and the mandrel is the driven and it represents a motion transformation system.
- B) The crank is the driven and the mandrel is the driver and it represents a motion transformation system.
- C) The crank is the driver and the mandrel is the driven and it represents a motion transmission system.
- D) The crank is the driven and the mandrel is the driver and it represents a motion transmission system.

B- Short Answer

13. In a competition, two teams must manufacture a vehicle that can carry a load over a certain distance. The team whose vehicle moves the largest load the fastest over a distance of 5 m will win the competition.






- a) Indicate the name for each system.
 b) Will system A or system B be more effective for winning the competition? Justify your answer.

B- less chance of slippage

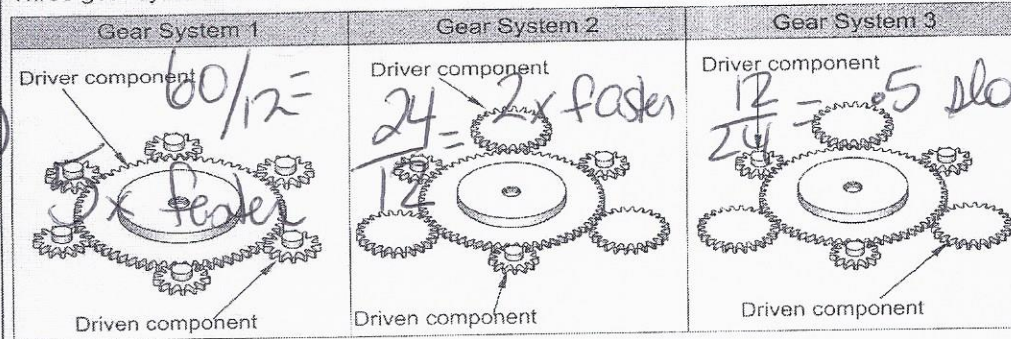
- c) Indicate the disadvantage of the system you have chosen.

heavier

14. The three gears shown below can be used in a gear system.

Gear A (Small)	Gear B (Medium-Sized)	Gear C (Large)
12 teeth 	24 teeth 	60 teeth 

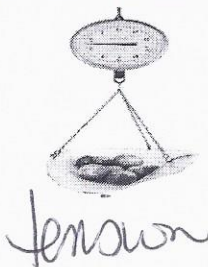
Three gear systems are shown below.



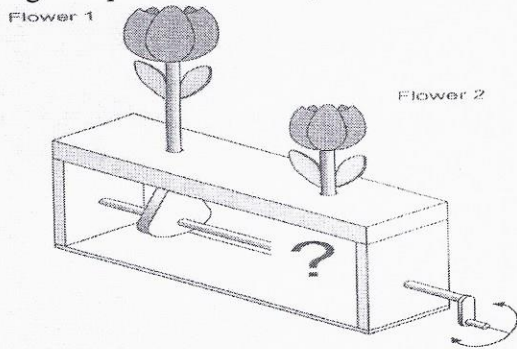
- a) Determine the speed ratios in each of the gear systems.
 b) Which of these gear systems provides the greatest increase in speed?

*System 1
5x faster*

15. The pictures below show two possible ways fruits can be weighed. What is the constraint seen which allows the fruit to be weighed?

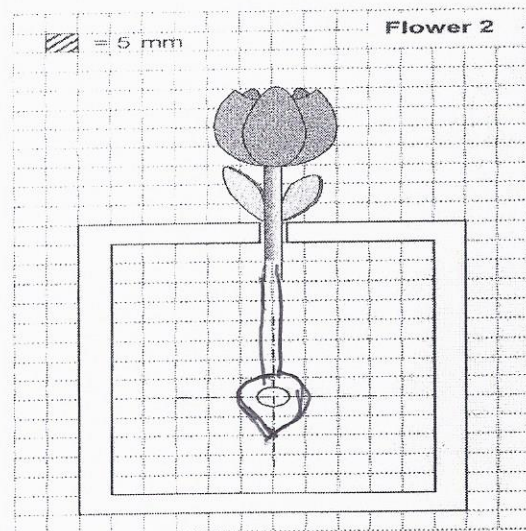
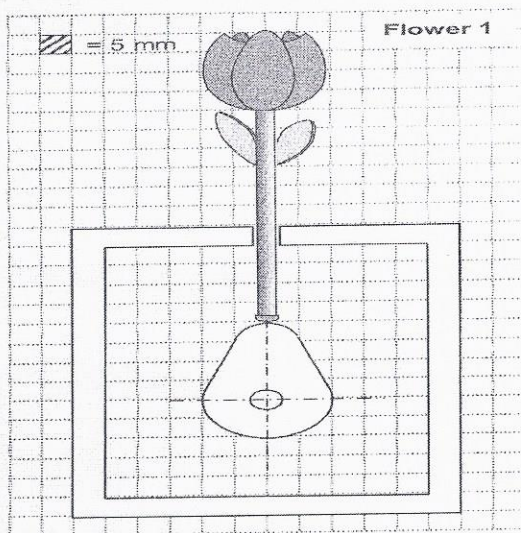


16. In the toy illustrates below, when you turn the crank in either direction, one of the flowers goes up and the other goes down.

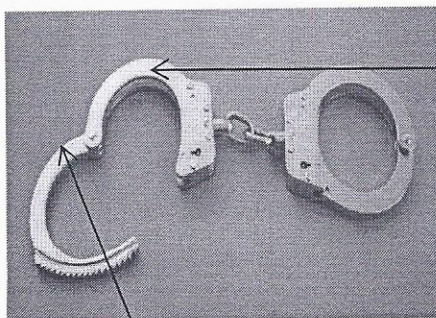


Complete the diagram below of the mechanical system for flower 2, taking into account all the specifications.

- The same mechanical system is used for both flowers.
- The length of the stem must be the same for both flowers.
- At first, when flower 1 is at its highest position, flower 2 is at its lowest position.
- The range of motion of flower 2 is half the range of motion of flower 1.
(Flower 2 goes up half as much and goes down half as much as flower 1.)



17. Give the links for Part A and Part B which is attached with a rivet.

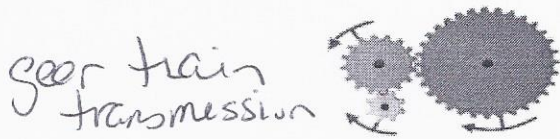
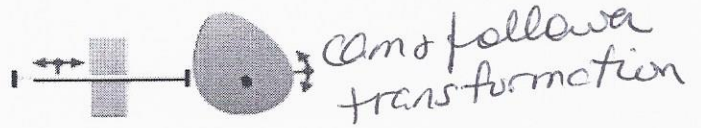
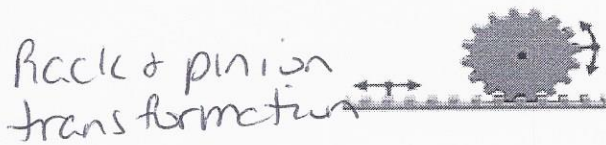
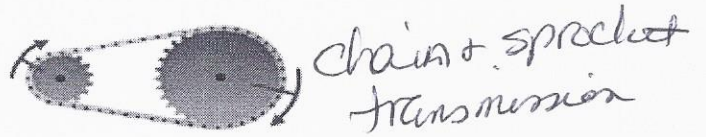
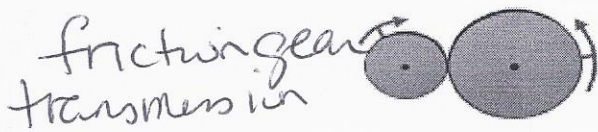


Part A

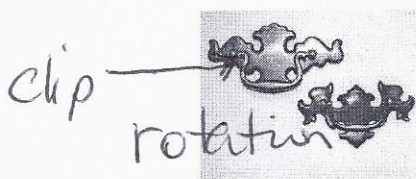
Part B

Nk, indruct, rigid, partial

18. Name each system below and state whether they perform a transmission system or transformation system.



19. Identify the type of guide in the pictures provided and determine the movement it controls.



20. An electric motor spins a 16-tooth gear in a clockwise fashion at the rate of 12 rotations per second.

12 rotations / s



You are working on a project and need to reduce the overall speed to 8 rotations per second clockwise. Four different gears are available: A, B, C, and D.

Gear A 8-tooth gear	Gear B 16-tooth gear	Gear C 24-tooth gear	Gear D 32-tooth gear

Describe how you would add gears to the motor gear in order to create an overall clockwise motion of 8 rotations per second.

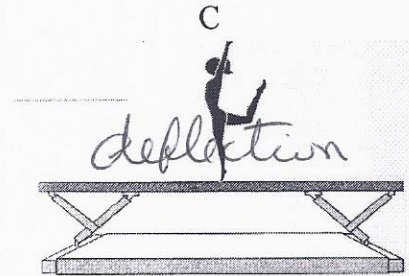
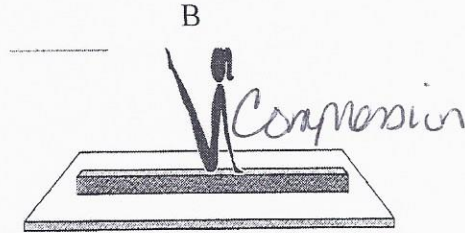
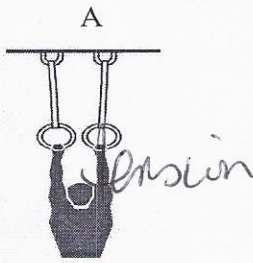
Indicate the order in which the gears must be added, the direction of motion of each gear (clockwise or counter-clockwise) and the number of teeth on each gear.

Justify your answer with calculations.

$$\frac{2}{3} = \frac{16}{x} = 24 \text{ teeth}$$

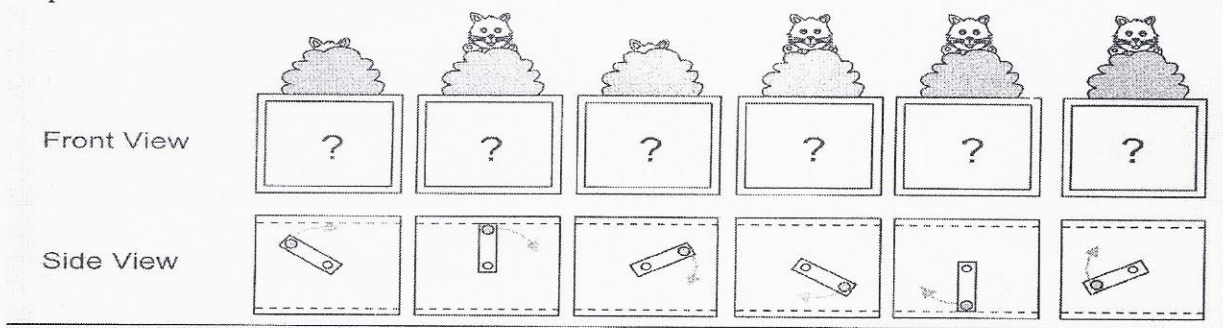


21. Gymnastics equipment is subjected to many constraints. Name each constraint for the following pictures.



22. A toy is represented in the diagram below. This toy is a box containing a cam that can move a cat in and out of the box through the rotation of a crank.

Sequence for one rotation of the crank

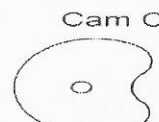
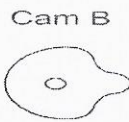


The designers want the toy to work as follows:

- The cat must move in and out of the box twice with each rotation of the crank and remain out longer the second time.
- The cat's head must come out as far out of the box as possible.

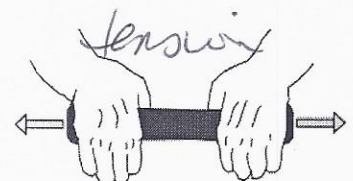
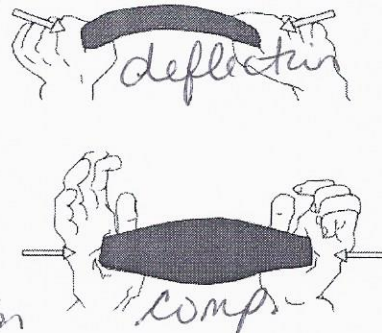
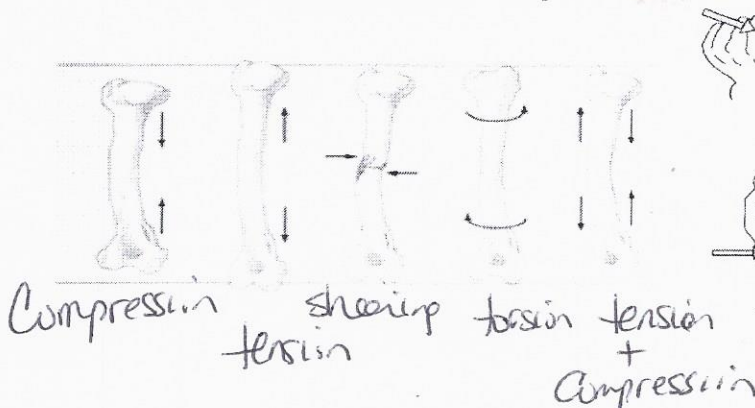
Which one of the cams below will make the toy move according to the designer's specifications?

Justify your answer.



- needs 2 close set cavities to enter the box 2x rapidly
- need cam w/ the largest diameter to come out furthest

23. Give the constraint for each picture below.



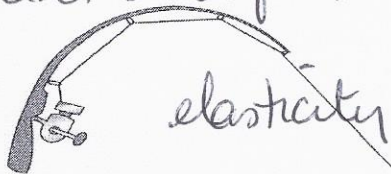
24. Using the

24. Using the words from the following vocabulary list, name the **constraint** to which the object is subjected **and the mechanical property** the material must have in each of the two situations illustrated below.

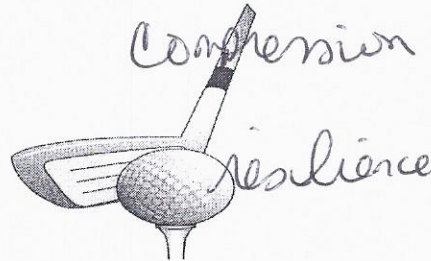
Vocabulary: compression – deflection – ductility – elasticity – hardness – malleability – resilience – shearing – tension – torsion

Situation 1: fishing rod

Constraint: deflection
MP: elasticity

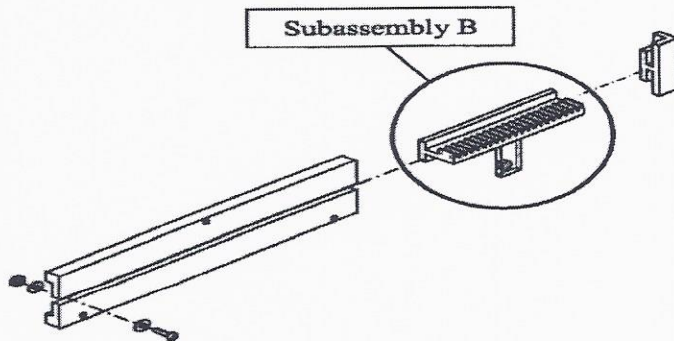


Situation 2: a golf ball when it is hit



Use the appendix on the last page to answer questions 25-29

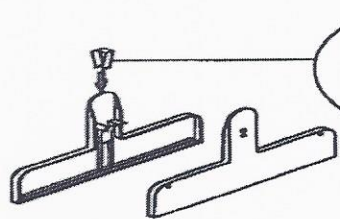
25. To move appropriately, subassembly B represented below needs a guiding control. Which part acts as the guiding control for this subassembly and what type of guiding is involved?



- translation
- runner

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

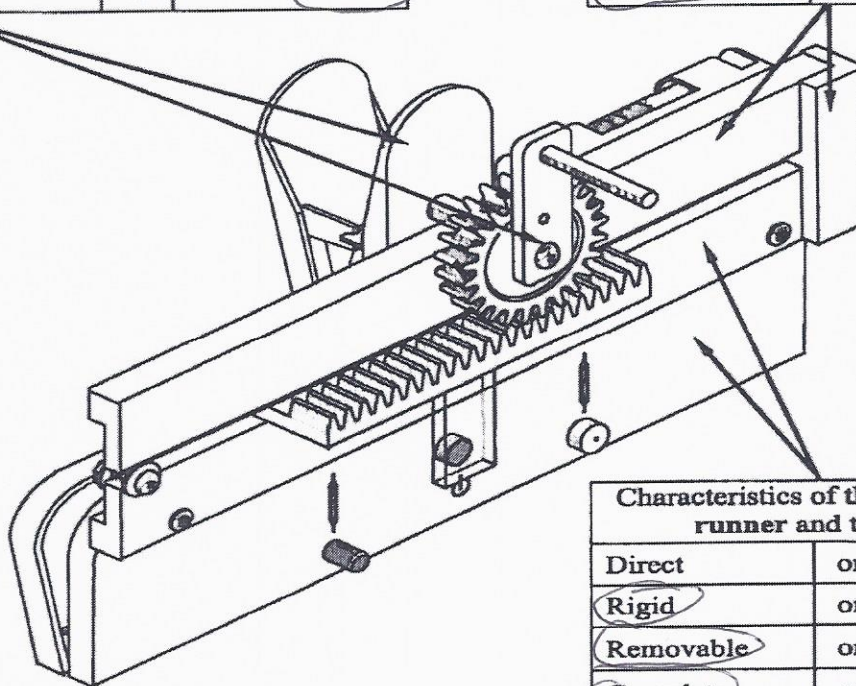


elasticity
Ends the clip must return to its original shape for the memo holder to close properly.

27. Circle the links for each part.

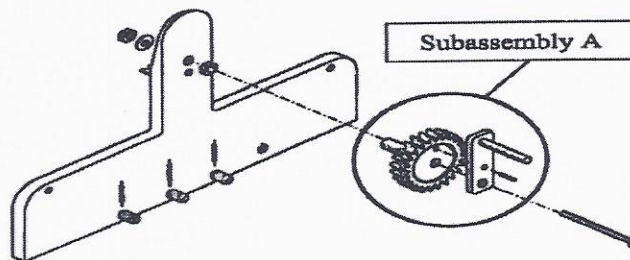
Characteristics of the link between the front jaw and the crank		
Direct	or	Indirect
Rigid	or	Elastic
Removable	or	Non-removable
Complete	or	Partial

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



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

28. To move appropriately, subassembly A shown below needs a guiding control
- Which part acts as the guiding control for this subassembly?
 - What type of guiding is involved?



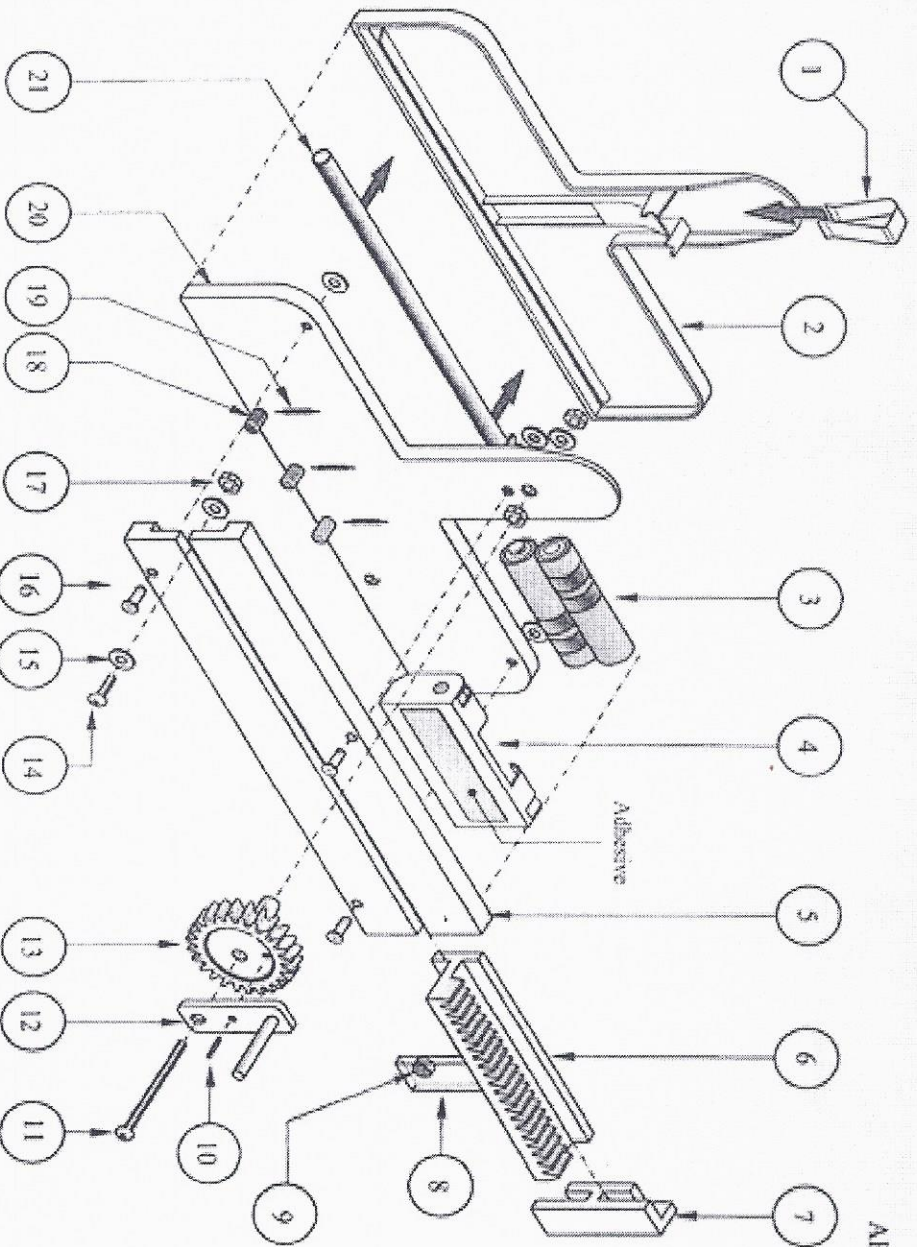
Belt rotation

29. When the memo holder is opened, to what mechanical constraint are its jaws subjected? What mechanical property must the jaws have so that they can be subjected to this constraint?



*Compression
Stiffness*

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	Barton 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