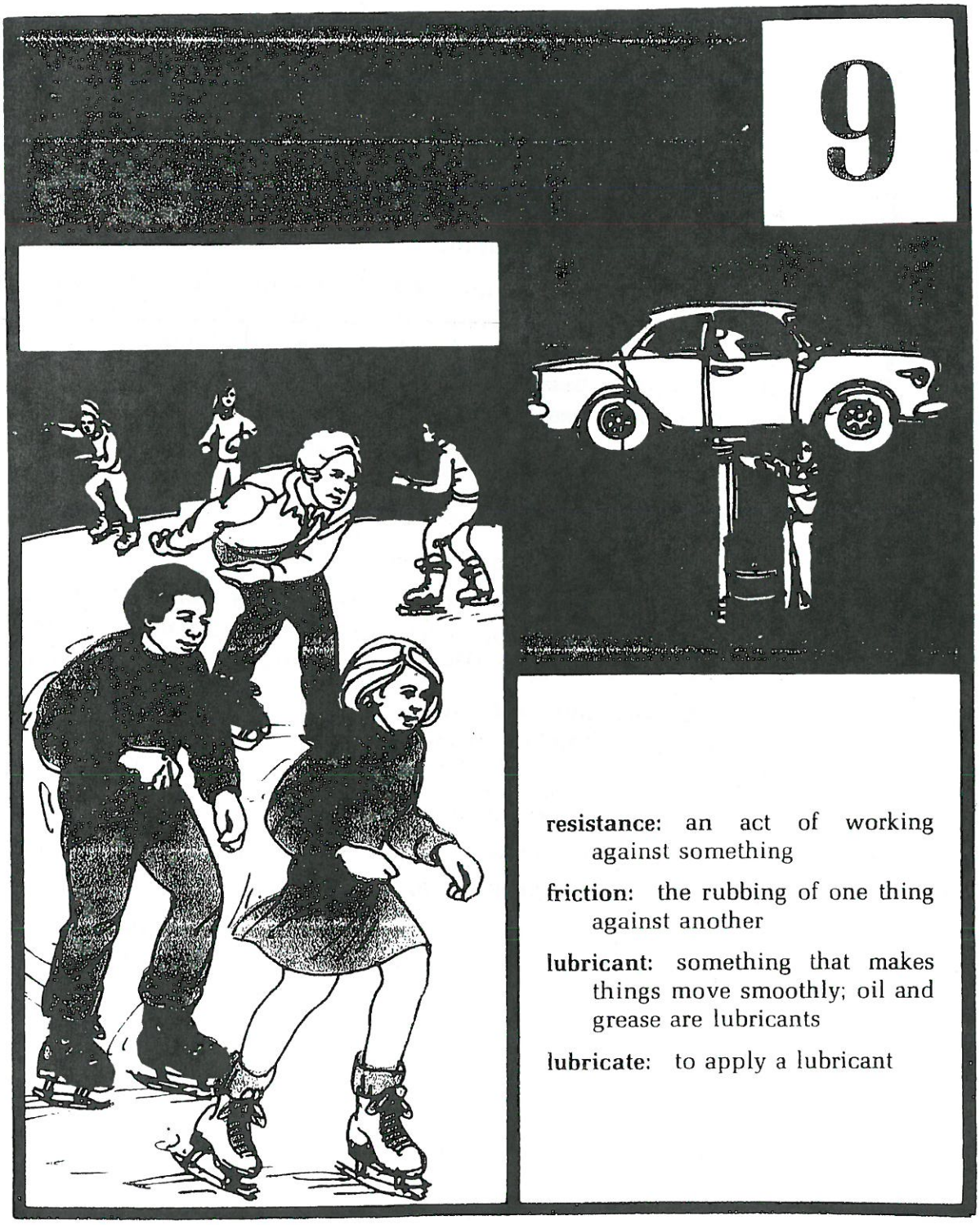
HOW CAN YOU MOVE SOMETHING WITH LESS FORCE?

9



resistance: an act of working against something

friction: the rubbing of one thing against another

lubricant: something that makes things move smoothly; oil and grease are lubricants

lubricate: to apply a lubricant

AIM 9 | How can you move something with less force?

It is easy to slide on ice. Ice is smooth.

It is harder to slide on a sidewalk. A sidewalk is rough.

Everyone knows that it is easier to slide on a smooth surface than on a rough surface. But did you ever ask why?

Here is an explanation:

All surfaces have bumps and scratches. Even "smooth" surfaces have them. Smooth surfaces just have much smaller bumps and scratches than rough surfaces do. Sometimes they are so tiny you need a microscope to see them. Do you need a microscope to see a sidewalk's bumps and scratches?

When one surface moves on another surface, the bumps and scratches rub together. The rubbing is called *friction* [FRIK shun]. Friction makes movement more difficult.

Friction *resists* movement.

There is always some friction when surfaces move against one another. But the amount of friction can be greater or lesser. The rougher the surface, the greater the friction.

Friction not only builds resistance. Friction also builds heat. And heat can cause damage. That is why we try to reduce friction.

There are two main ways to reduce friction:

1. *Rolling things instead of sliding them.* Rolling friction is less than sliding friction.

2. *Lubricating* [LOO bruh kayt ing] *the surfaces of things.* Oil and grease are the most used lubricants [LOO bruh kants].

SURFACES AND FRICTION

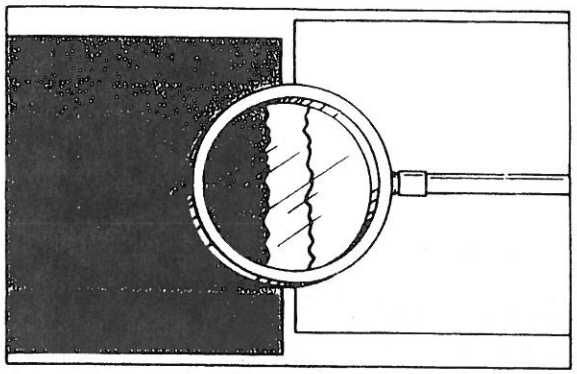


Figure A

Bumps and scratches on surfaces rub against each other and cause friction. All surfaces have bumps and scratches.

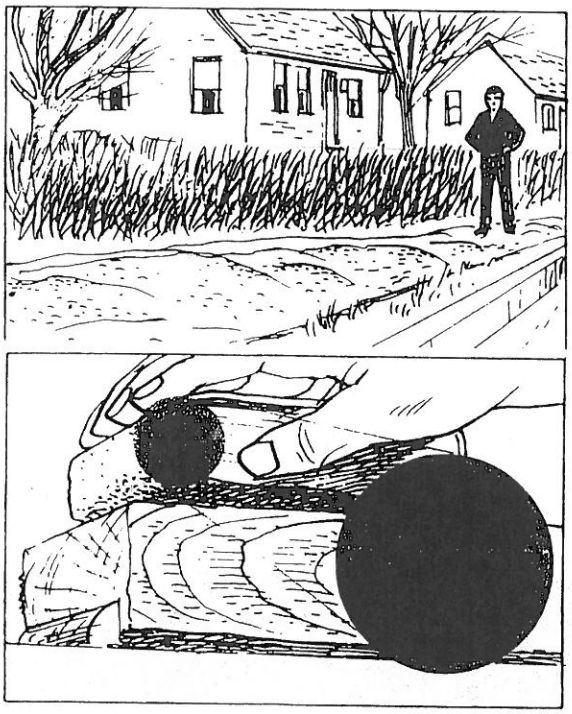


Figure B

Some surfaces have large bumps and scratches. You can see them easily.

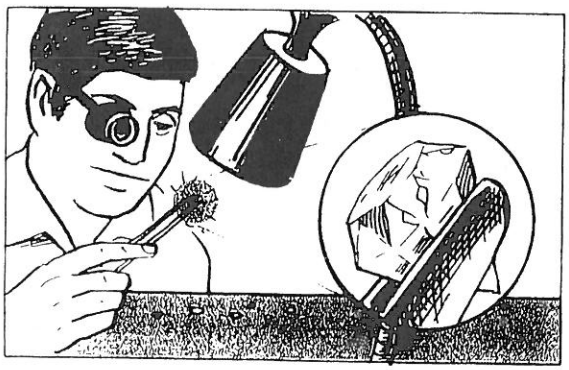


Figure C

Some surfaces—like glass, polished wood, and metal—have tiny bumps and scratches. You cannot see them easily.

UNDERSTANDING FRICTION, RESISTANCE, AND WORK

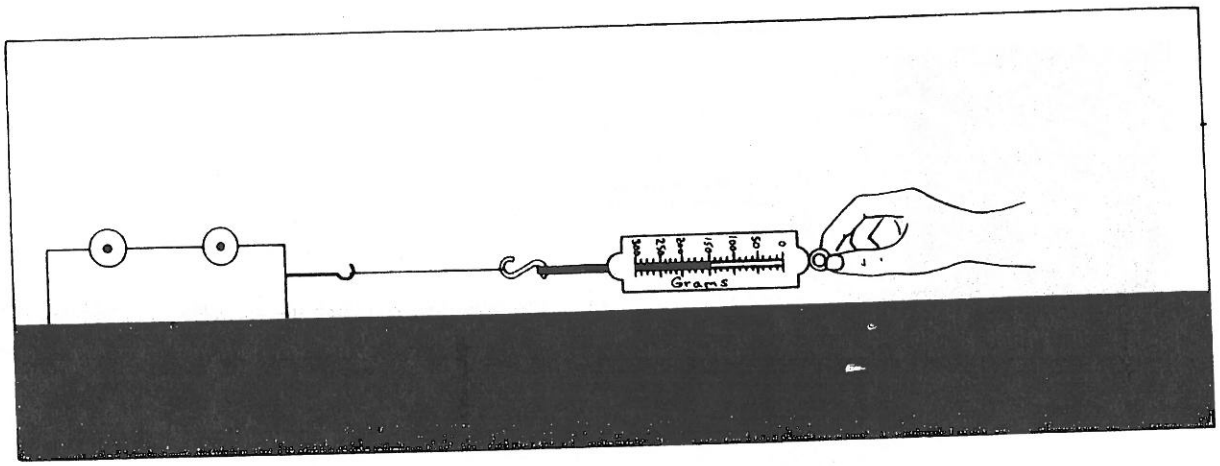


Figure D

1. How much force is pulling the laboratory carriage in Figure D? _____

2. Are the wheels in use? _____

3. This shows _____ (sliding, rolling) friction.

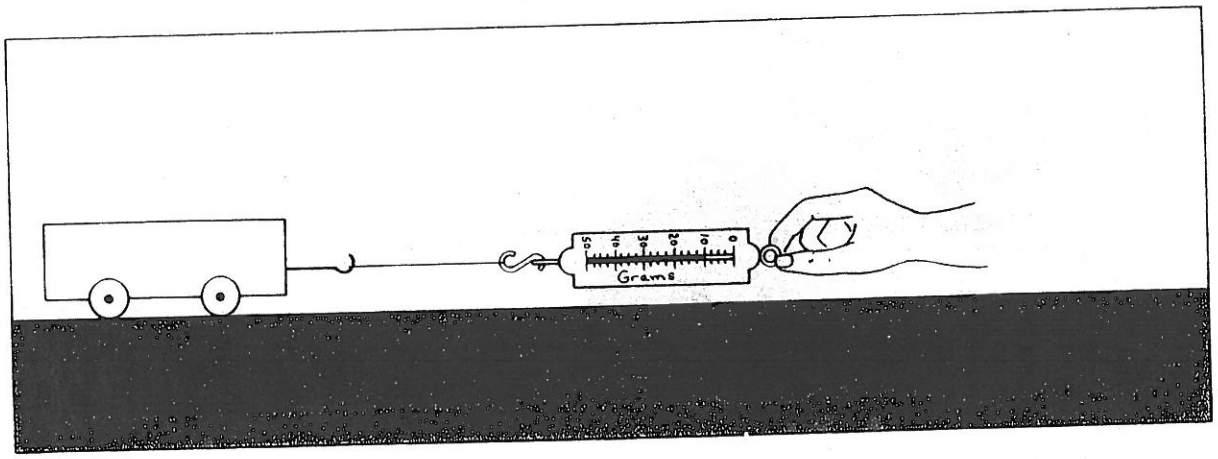


Figure E

4. a) Now, how much force is being used in Figure E? _____

   b) This is _____ (more, less) force than was needed in Figure D.

   c) Why is less force needed in Figure E? _____

5. This is an example of _____ (sliding, rolling) friction.

6. Rolling friction is _____ than sliding friction.
greater, less

7. Sliding friction is _____ than rolling friction.
greater, less

8. With sliding, there is _____ resistance than with rolling.
more, less

9. With rolling, there is _____ resistance than with sliding.
more, less

10. With sliding, you do _____ work.
more, less

11. With rolling, you do _____ work.
more, less

12. With sliding, you do more work because you use _____ force.
more, less

13. With rolling, you do less work because you use _____ force.
more, less

14. Which builds more heat, sliding or rolling? _____

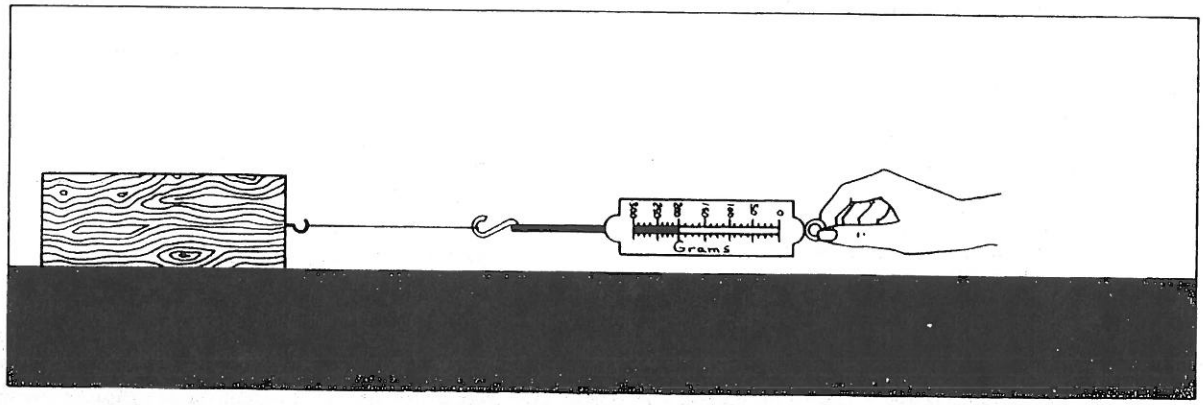


Figure F

15. How much force is pulling the piece of wood in Figure F? _____

16. Is the surface lubricated? _____

17. Now, how much force is needed to pull the wood in Figure G? (Turn the page.)

_____

18. This is _____ force than was needed in Figure F.
more, less

19. Why is less force needed? _____

_____

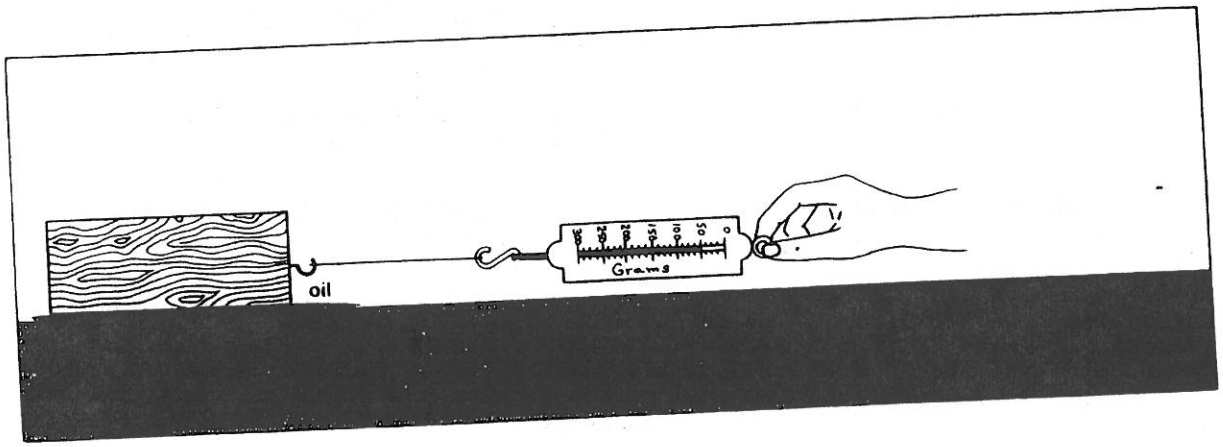


Figure G

20. Lubrication makes a surface _____ (rougher, smoother).

21. Lubrication _____ (increases, decreases) resistance.

22. Lubrication _____ (increases, decreases) friction.

23. With lubrication you need _____ (more, less) force to move an object.

24. With lubrication, you do _____ (more, less) work.

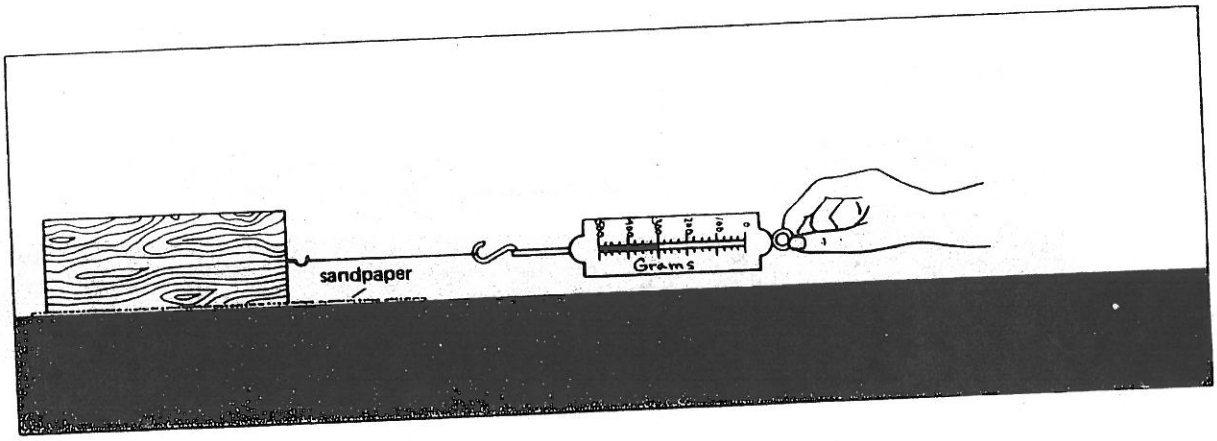


Figure H

25. How much force is needed to pull the wood in Figure H? _____

26. This is _____ (more, less) force than was needed in Figure F.

27. Why is more force needed? _____

28. Sandpaper is a _____ (rough, smooth) surface.

29. Sandpaper _____ friction.
increases, decreases

30. On sandpaper, you need _____ force to move an object.
more, less

31. On sandpaper, you do _____ work.
more, less

32. Which figure shows heat building up? _____
F only, G only, H only, all three

33. Which figure shows the most heat building up? _____
F, G, H

FRICTION IS NOT ALL BAD

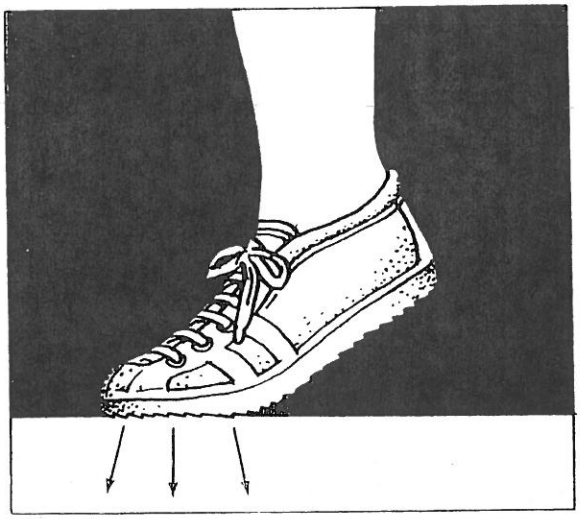


Figure I

We could not walk without friction.

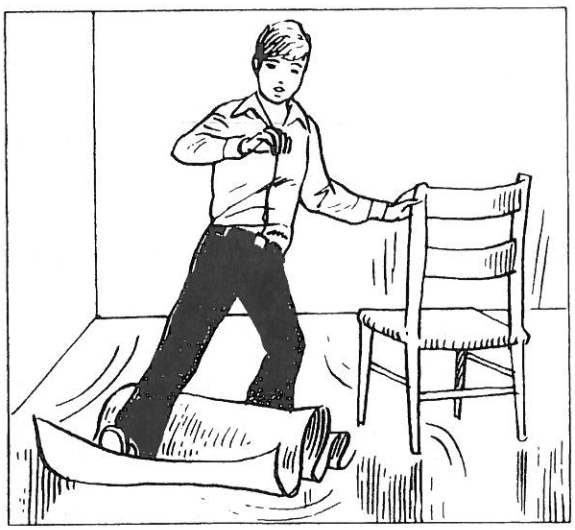


Figure J

Without friction things would always be moving around.

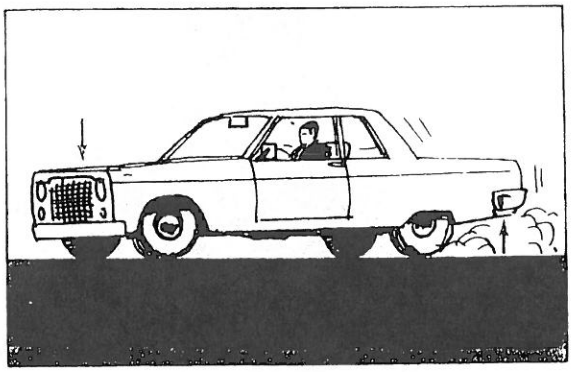


Figure K

Car brakes would not work without friction. Why do cars slide on ice and snow?

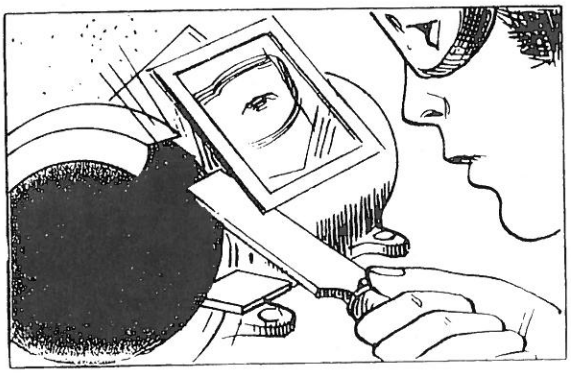


Figure L

Sandpaper and grindstones depend upon friction.

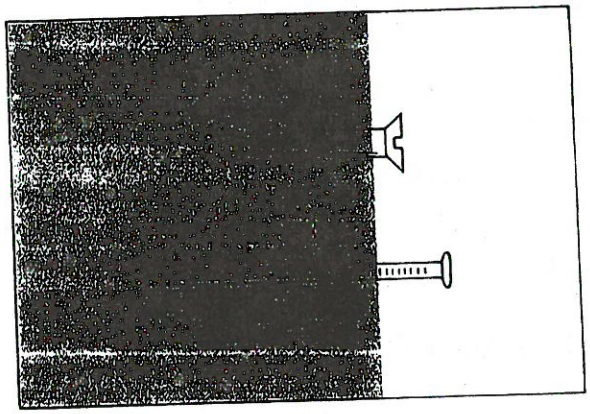


Figure M

The force of friction keeps nails and screws in wood.

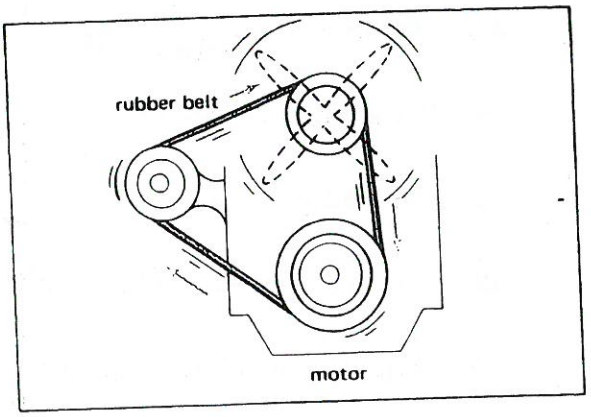


Figure N

The force of friction also keeps motor belts from slipping.

TRUE OR FALSE Write T on the line next to the number if the sentence is true. Write F if the sentence is false.

1. ____ Friction always builds heat.
2. ____ Smooth surfaces build more heat than rough surfaces do.
3. ____ Oil and grease reduce friction.
4. ____ Sand is a lubricant.
5. ____ More friction means more work. (Remember: $W = F \times D$)

REACHING OUT

Many things work better when they are lubricated.

Name five. _____

_____

_____

_____

_____

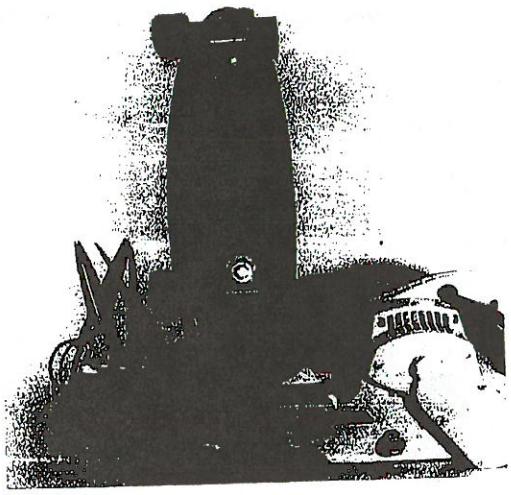


Figure O