

Goal • Assess your understanding of mechanical advantage and efficiency.

What to Do

Carefully read the instructions before answering each set of questions.

Multiple Choice

Circle the best answer.

1. In which of the following examples is work being done?

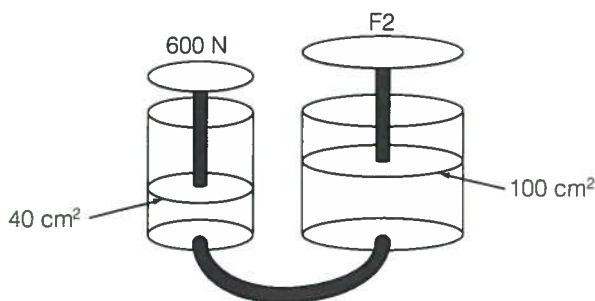
- (a) A weight lifter is holding a set of barbells high overhead.
- (b) A tow truck is pulling a car out of a ditch using a winch.
- (c) A student is pushing against a locked door with all her strength.
- (d) Two students sit perfectly balanced on a seesaw.

2. Shears are made of

- (a) two Class 1 levers
- (b) two Class 2 levers
- (c) one Class 1 and one Class 2 lever
- (d) one Class 1 and one Class 3 lever

3. In the diagram below, the plunger on the left is pushed down with a force of 600 N.

With how much force will the plunger on the right push up?



- (a) 1500 N
- (b) 240 N
- (c) 6000 N
- (d) 150 N

UNIT 4
ASSESSMENT**Unit 4 Test** (continued)**BLM 4-30**

4. What is the mechanical advantage (MA) produced by the hydraulic lift illustrated in question 3?
- (a) 6.0
 - (b) 0.4
 - (c) 2.5
 - (d) 15.0
5. Suppose that the syringe on the right in question 3 is changed to a syringe with a plunger area of 5 cm^2 . How much force will it exert upward when the left syringe is depressed?
- (a) 12 000 N
 - (b) 75.0 N
 - (c) 4800 N
 - (d) 30 N
6. What would happen if a hydraulic system had a leak and lost some of its fluid?
- (a) The pressure would remain the same, but less force would be transferred.
 - (b) The pressure would be reduced, and less force would be transferred.
 - (c) The pressure would increase, and more force would be transferred.
 - (d) There would be little or no effort.
7. What happens when a gas is compressed within a closed container?
- (a) The particles get closer together, and their temperature decreases.
 - (b) The particles get closer together, and their temperature increases.
 - (c) The particles get farther apart, and their temperature increases.
 - (d) The particles get farther apart, and their temperature decreases.
8. What is the main difference between steam engines and internal combustion engines?
- (a) Steam engines do not use the combustion of fuel.
 - (b) Pistons are found only in internal combustion engines.
 - (c) In steam engines, combustion occurs externally.
 - (d) Internal combustion engines are larger.

UNIT 4
ASSESSMENT**Unit 4 Test** (continued)**BLM 4-30**

9. How does a steam engine differ from a steam turbine?
- (a) A steam engine does not have pistons, but a steam turbine does.
 - (b) A turbine does not have pistons, but an engine does.
 - (c) They burn different types of fuel.
 - (d) Steam only pushes moving parts in the turbine.
10. The Canadian Standards Association is testing air bags. Scientists are studying how the speed of air bag inflation affects the amount of force that is transferred to the passenger. For each trial in one experiment, the same model of test car travelled at exactly the same speed and ran into the same barrier. The speed of air bag deployment varied with each trial.
- In this experiment, the independent (manipulated) variable was
- (a) the speed of the car
 - (b) the speed of air bag deployment
 - (c) the amount of force transferred to the passenger
 - (d) the number of trials in the experiment
11. Which of the variables was controlled during the experiment in question 10?
- (a) the speed of the car
 - (b) the speed of air bag deployment
 - (c) the amount of force transferred to the passenger
 - (d) the number of trials in the experiment
12. Air bags, seats, and seat belts are designed and positioned within a car to give the occupants a comfortable ride. The science that designs machines to fit people is called
- (a) biology
 - (b) economics
 - (c) ergonomics
 - (d) chiropractics
13. Air bags are usually filled with air instead of fluids, such as water. Which of the following is *not* a reason for using air in air bags?
- (a) Air is easily compressed.
 - (b) Air can be quickly injected into an air bag.
 - (c) Compressed air is lightweight and easily stored.
 - (d) An airbag does not change shape easily.

True or False

In the space provided, indicate whether each statement is true (T) or false (F). If you think that a statement is false, rewrite it to make it true.

T 14. The part of a lever on which the lever arm pivots is called the fulcrum.

F 15. A winch is designed to move loads more ~~quickly~~.

easily (less work).

T 16. The follower gear always turns in the direction opposite to that of the gear driving it.

F 17. When a chain connects two sprockets, they turn in ~~opposite~~ directions.

the same.

18. Put a D beside the descriptions that are true of a diesel engine. Put a G beside the descriptions that are true of a gasoline engine.

G (a) ignites fuel with a spark

D (b) mixes fuel and oxygen inside the cylinder

D (c) causes fuel to self-ignite when compressed

G (d) mixes fuel and oxygen outside the cylinder

D (e) produces more power

D (f) burns fuel more efficiently

G (g) produces less power

G (h) burns fuels less efficiently

Short Answers

Answer the following questions briefly in the space provided.

19. Suggest two ways that you could alter a Class 1 lever in order to decrease the effort force that needs to be applied.

The fulcrum could be moved closer to the load or the length of the lever arm could be increased.

20. Imagine that you are throwing a football. Where is the fulcrum, the load, and the effort force?

The fulcrum is your elbow or shoulder.
 The effort is applied at the hand or forearm.
 The load is the ball.

21. What is the purpose of a fixed pulley?

A fixed pulley changes the direction that the effort force is applied in.

22. Describe three ways that the flow rate of a fluid through a pipeline could be increased.

The diameter of the pipe could be increased.
 The pipeline could be straightened.
 The pipeline could be cleaned of debris and kept smooth.

23. Name two ways that a person's blood pressure could

(a) decrease

Person's heart may pump with less force.
 Person's blood could be getting thinner.

(b) increase

Person's heart is pumping with greater force.
 Blood vessels may be blocked or constricted.

24. Why can air not be used inside the brake system of an automobile?

Air is compressible so it could not push with enough force unless it is compressed first. It would take a longer time for the brakes to engage.

UNIT 4
ASSESSMENT
Unit 4 Test (continued)

BLM 4-30

25. Some city buses have bumpers filled with water. This gives a bus extra protection if it is involved in a head-on collision. What happens to the bumper if a bus is involved in such a collision?

Water doesn't compress so it does not soften the impact, unless water slowly escapes through valves.

26. List three ways that an engine can lose energy to the environment.

Heat from friction between moving parts.
 Hot exhaust lost through the exhaust pipe.
 Heat transferred to engine coolants.

27. Which class of lever are you using if you use a hammer to pull a nail out of a board?

Class 1

28. When you throw a football, what type of lever are you using?

Class 3

29. Movers often use a ramp (an inclined plane) to move large objects into their trucks more easily. Suppose that movers have to exert a force of 1000 N to push a large box 4 m up a ramp. How much force would it take to lift the box 1 m straight up into the truck without using the ramp? Show your calculations.

$$\begin{aligned}
 W &= F \times d \\
 &= (1000 \text{ N})(4 \text{ m}) \\
 &= 4000 \text{ J} \\
 &/ \\
 &\text{Pushing}
 \end{aligned}$$

$$\begin{aligned}
 F &= \frac{W}{d} \\
 &= \frac{4000 \text{ J}}{1 \text{ m}} \\
 &= 4000 \text{ N} \\
 &/ \\
 &\text{lifting.}
 \end{aligned}$$