Subtest 8: Mechanical Comprehension

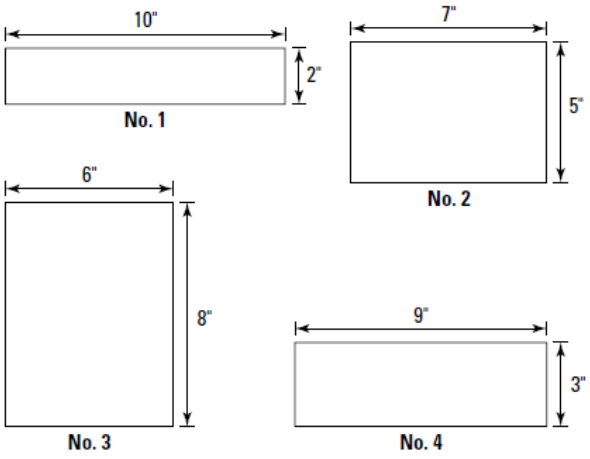
Time: 19 minutes for 25 questions

Directions: This test is about mechanical principles. Many of the questions use drawings to illustrate specific principles. Choose the correct answer and mark the corresponding space on the answer sheet.

1. An induction clutch works by
   (A) magnetism.
   (B) pneumatics.
   (C) hydraulics.
   (D) friction.

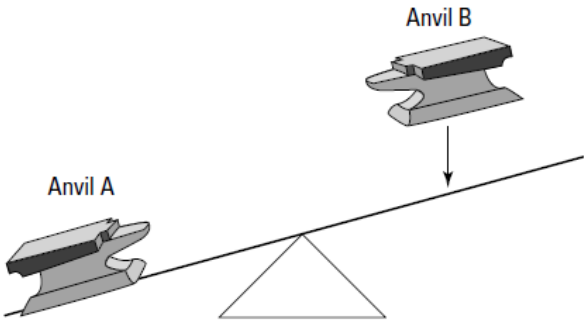
2. If a first-class lever with a resistance arm measuring 2 feet and an effort arm measuring 8 feet are being used, what's the mechanical advantage?
   (A) 2
   (B) 4
   (C) 6
   (D) 1

3. The bottoms of four boxes are shown below. The boxes all have the same volume. If postal regulations state that the sides of a box must meet a minimum height, which box is most likely to be too short to go through the mail?



   (A) No. 4
   (B) No. 2
   (C) No. 1
   (D) No. 3

4. Looking at the figure below, when Anvil B lands on the seesaw, Anvil A will



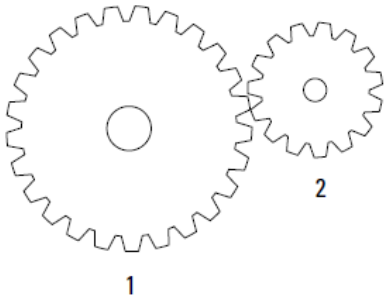
   (A) remain stationary.
   (B) hit the ground hard.
   (C) rise in the air quickly.
   (D) enter the stratosphere.

5. Air pressure at sea level is about 15 psi. What's the amount of force exerted on the top of your head, given a surface area of 24 square inches?
   (A) 360 pounds
   (B) 625 pounds
   (C) $\frac{5}{8}$ pound
   (D) 180 pounds

6. The force produced when a boxer's hand hits a heavy bag and "bounces" off it is called
   (A) response time.
   (B) bounce.
   (C) recoil.
   (D) gravity.

Technical Comprehension

7. In the figure below, if Gear 1 has 25 teeth and Gear 2 has 15 teeth, how many revolutions does Gear 2 make for every 10 revolutions Gear 1 makes?



(A) about $16\frac{2}{3}$

(B) 12

(C) about $\frac{1}{3}$ more

(D) about 20

8. A cubic foot of water weighs about 62.5 pounds. If an aquarium is 18 feet long, 10 feet deep, and 12 feet wide, what's the approximate pressure in pounds per square inch (psi) on the bottom of the tank?

(A) 2 psi

(B) 4 psi

(C) 5 psi

(D) 7 psi

9. Springs used in machines are usually made of

(A) plastic.

(B) bronze.

(C) nylon fiber.

(D) steel.

10. A clutch is a type of

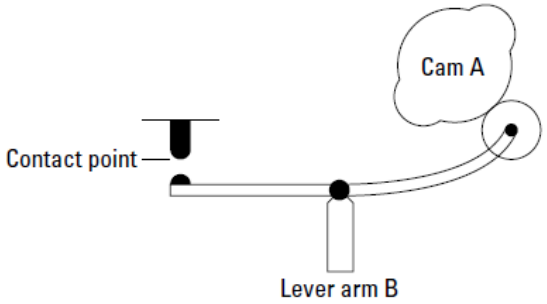
(A) universal joint.

(B) coupling.

(C) gear differential.

(D) cam follower.

11. When Cam A completes one revolution, the lever will touch the contact point



(A) once.

(B) never.

(C) four times.

(D) twice.

12. A single block-and-fall is called a

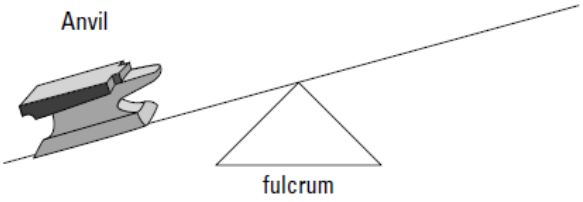
(A) fixed pulley.

(B) gun tackle.

(C) runner.

(D) sheave.

13. In the figure below, if the fulcrum supporting the lever is moved closer to the anvil, the anvil will be



(A) easier to lift and will move higher.

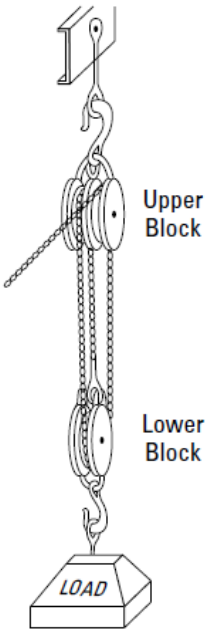
(B) harder to lift but will move higher.

(C) easier to lift but will not move as high.

(D) harder to lift and will not move as high.

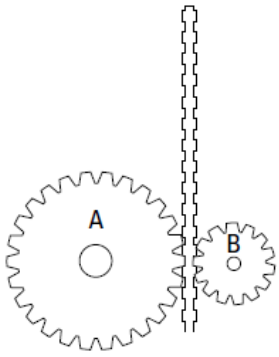
Technical Comprehension

14. The mechanical advantage of the block-and-tackle arrangement shown below is



(A) 2
(B) 4
(C) 6
(D) 1

15. In the figure below, if the cogs move up the track at the same rate of speed, Cog A will

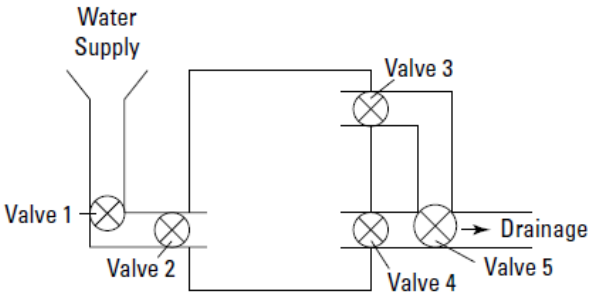


(A) reach the top at the same time as Cog B.
(B) reach the top after Cog B.
(C) reach the top before Cog B.
(D) have greater difficulty staying on track.

16. If a house key, a wooden spoon, a plastic hanger, and a wool jacket are all the same temperature. On a cool day, which one feels the coldest?

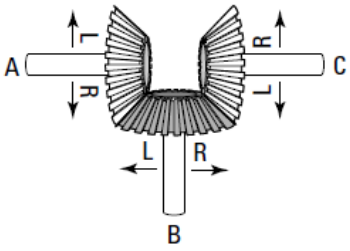
(A) key
(B) spoon
(C) hanger
(D) jacket

17. In the figure below, assume the valves are all closed. To fill the tank but prevent it from filling entirely, which valves should be open?



(A) 1 and 2 only
(B) 1, 2, and 3 only
(C) 1, 2, and 4 only
(D) 1, 2, 3, and 5 only

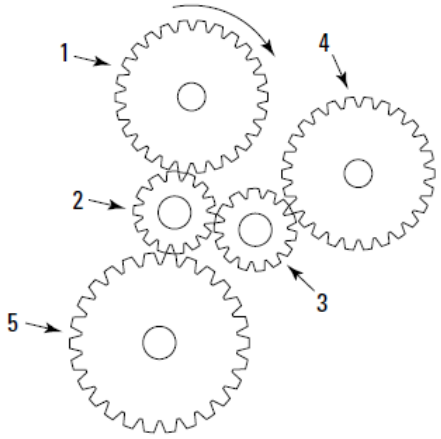
18. If Gear A is turned to the left,



(A) Gear B turns to the right and Gear C turns to the left.
(B) Gear B turns to the left and Gear C turns to the left.
(C) Gear B turns to the right and Gear C turns to the right.
(D) Gear B turns to the left and Gear C turns to the right.

Technical Comprehension

19. If Gear 1 moves in a clockwise direction, which other gears also turn clockwise?



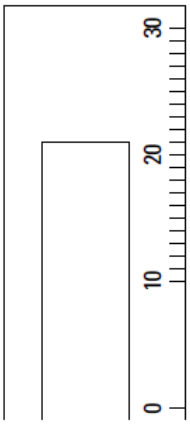
(A) 3 and 5

(B) 3, 4, and 5

(C) 2 and 5

(D) 3 and 4

20. The pressure gauge in the figure below shows a reading of



(A) 15.0

(B) 19.5

(C) 21.0

(D) 23.0

21. A way to determine the amount of power being used is to

(A) multiply the amount of work done by the time it takes.

(B) multiply the distance covered by the time it takes to move a load.

(C) divide the amount of work done by 550 pounds per second.

(D) divide the amount of work done by the amount of time it takes.

22. A wood tool, a silver tool, and a steel tool are placed in boiling water for cleaning. Which tool will get the hot the fastest?

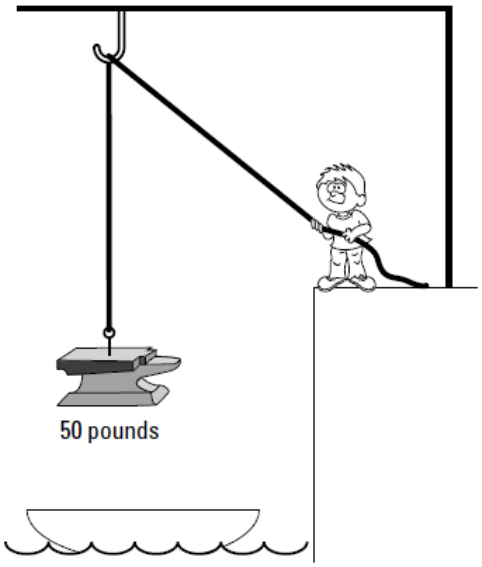
(A) steel

(B) wood

(C) silver

(D) All three are equally hot.

23. A runner is being used in the figure shown. How much effort is the boy who's lifting the 50-pound anvil using? Disregard friction, wind resistance, and the weight of the pulley and the rope.



(A) 50-pound effort

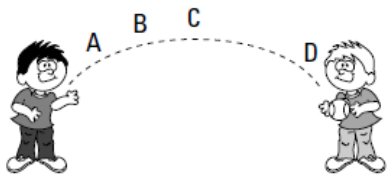
(B) 100-pound effort

(C) 25-pound effort

(D) 10-pound effort

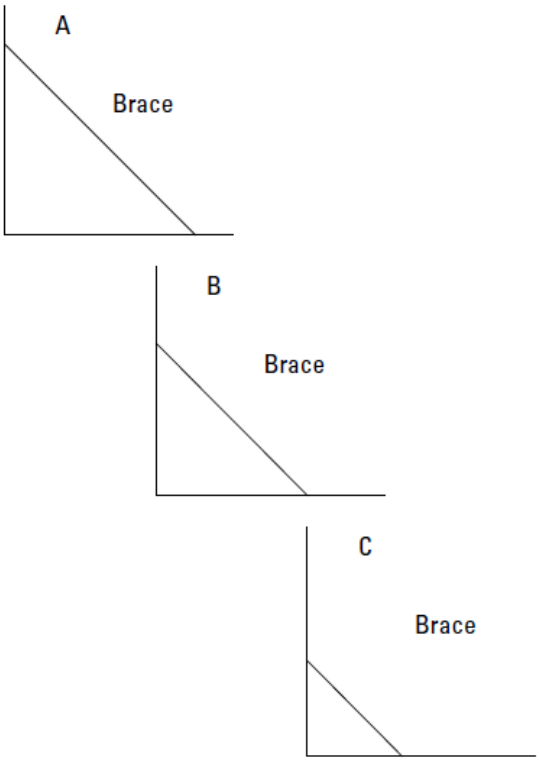
Technical Comprehension

24. In the figure below, at what point was the ball traveling most slowly?



(A) A
(B) B
(C) C
(D) D

25. In the figure below, which angle is braced most solidly?



(A) A
(B) B
(C) C
(D) All are braced equally solidly.

Answers

Subtest 8: Mechanical Comprehension Answers

The Mechanical Comprehension subtest is important only if you want to pursue a military career that requires a good score on this subtest (check Appendix A to see whether the jobs you're interested in require a score in this subtest). Otherwise, spend your time studying more important areas of the ASVAB. If you're considering a military job that requires a high mechanical aptitude and you missed more than four or five questions on this subtest, give Chapter 12 another once over.

Technical Comprehension

1. **A.** An induction clutch is a magnetic clutch. When a conductor (wire) is wrapped around a core and electricity is passed through the wire, it sets up a magnetic field. The same wire also acts as an inductor, which produces inductance, during AC current flow. It's similar to resistance in a resistor in that it "resists" current flow, but the value of inductance is based on the value of the inductor (written as *L*) and the frequency of the AC current. Therefore, an induction clutch uses magnetism to operate.
2. **B.** You can calculate mechanical advantage as Length of Effort Arm ÷ Length of Resistance Arm. Simply plug in the numbers: $MA = 8 \div 2 = 4$.
3. **D.** The box with the largest area on the bottom will have the shortest sides. If Length × Width × Height = Volume and all the boxes have equal volume, then the sides must be shortest on the box with the largest area on the bottom. Calculate the area of each box bottom:

   No. 1 = 20 square inches

   No. 2 = 35 square inches

   No. 3 = 48 square inches

   No. 4 = 27 square inches

   No. 3, which has the largest area, will have the shortest sides.
4. **C.** Anvil B's landing on the seesaw will propel Anvil A into the air.
5. **A.** Pressure equals force divided by area in square inches ($P = F \div A$). You can also state this formula as $F = A \times P$. Substitute the known quantities: $F = 15 \times 24 = 360$ pounds.
6. **C.** *Recoil* occurs when an object producing a force is kicked back.
7. **A.** To determine the answer, multiply the number of teeth Gear 1 has *(D)* and the number of revolutions it makes *(R)*. Divide that number by the number of teeth Gear 2 has *(d)* to determine the number of revolutions Gear 2 makes *(r)*. Because the gears are proportional, this formula shows you the ratio of teeth to revolutions.

$$r = \frac{DR}{d}$$
$$r = \frac{25 \times 10}{15}$$
$$r = \frac{250}{15} = \frac{50}{3} = 16\frac{2}{3}$$

8. **B.** You can determine the pressure of all that water by multiplying the volume of the aquarium by the weight of the water. Volume = *lwh*. The bottom of the tank is 18 feet long by 12 feet wide by 10 feet high for a total volume of 2,160 cubic feet: $18 \times 12 \times 10 = 2{,}160$ ft.^{3} A cubic foot of water weighs approximately 62.5 pounds, so multiply the volume of water by 62.5: $2{,}160 \times 62.5 = 135{,}000$.

   That gives an approximate pressure on the bottom of the tank of about 135,000 pounds over the entire surface area. The surface area of the bottom of the tank is length × width. Convert feet to inches and then find the area: A = (18 ft. × 12 in./ft.) × (12 ft. × 12 in./ft.) = 216 in. × 144 in. = 31,104 in.^{2}.

   Dividing the pressure of 135,000 by the number of square inches of surface area gives an approximate psi of 4.
9. **D.** Machine springs are usually made of steel, although sometimes they're made of brass or other metal alloys.
10. **B.** Clutches connect and disconnect parts, so they're a type of coupling.

Technical Comprehension

11. **D.** When the high point of the cam connects with the lever arm, the lever arm will touch the contact point. Two high points on the cam mean the lever arm will touch the contact point twice with each revolution of the cam.
12. **C.** A *single block-and-fall* is a way to get mechanical advantage by threading a rope through a pulley or stationary point, the load being attached to the end of the rope, and you pulling on the other end of the rope, hoisting the load. The device is also called a *runner.*
13. **C.** If the fulcrum is moved closer to the anvil, the length of the effort arm of the lever will be increased, making the anvil easier to raise, but the height to which the anvil can be raised will be reduced.
14. **A.** Because this block-and-tackle arrangement merely changes the direction of the pull, it has a mechanical advantage of only 2.
15. **C.** The larger cog (Cog A) covers a greater linear distance in a given period of time, so Cog A reaches the top first.
16. **A.** The key will feel coldest because metal is a better conductor than the other materials.
17. **D.** All but Valve 4 should be open. Opening Valves 1 and 2 allows water to enter the tank. Opening Valves 3 and 5 prevents water from filling the tank entirely. Opening Valve 4 allows water to leave the tank.
18. **A.** Gears with their teeth together in mesh turn in opposite directions. Gear A turns Gear B in the opposite direction (right), and Gear B turns Gear C in the opposite direction (left).
19. **A.** Gears with their teeth together in mesh turn in opposite directions. Gear 1 turns clockwise. Gear 2, in mesh with Gear 1, turns counterclockwise. Gear 3, in mesh with Gear 2, turns clockwise. Gear 4, in mesh with Gear 3, turns counterclockwise. Gear 5, in mesh with Gear 2, turns clockwise.
20. **C.** The gauge shows a reading of 21.
21. **D.** The formula for determining power is Power = Work ÷ Time.
22. **C.** Silver is the best conductor, so it will become hotter faster than the other objects because heat transfers faster into materials with greater conductivity than with those with lower conductivity.
23. **A.** Stationary pulleys give no mechanical advantage, so effort equals the weight of the crate, or 50 pounds.
24. **C.** At the height of the arc, the ball has no upward momentum, so it goes the slowest at that point.
25. **A.** The brace on Angle A covers more area of the angle, so it's more solidly braced.