



# **ARMED FORCES OF PAKISTAN**

**TOPIC Mat(mechanical aptitude test) solved EXAMPLES**

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### Mechanical Reasoning Tests > Levers

A lever consists of a bar which pivots at a fixed point known as the fulcrum. In the example shown the fulcrum is at the center of the lever. This lever provides no mechanical advantage and the force needed to lift the weight is equal to the weight itself.



However, if you want to lift a weight that is heavier than the force applied you can move the fulcrum closer to the weight to be lifted. This affects the force required in the following way:

$$w \times d1 = f \times d2$$

Where:  
w = weight  
d1 = distance from fulcrum to weight  
f = force needed  
d2 = distance from fulcrum to point where force is applied

In this example the fulcrum has been moved towards the weight so that the weight is 1 meter from the fulcrum. This means that the force can now be applied 2 meters from the fulcrum.

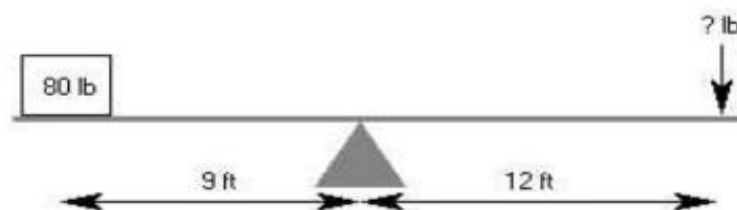


If you needed to calculate the force needed to lift the weight then you can rearrange the formula.

$w \times d1 = f \times d2$  can be rearranged to  $f = (w \times d1)/d2$   
 $f = (10 \times 1)/2$  (10/2 is the same as 5/1, the force required is 5 Kg)

#### Example Questions

1. How much force is required to lift the weight?



Answer

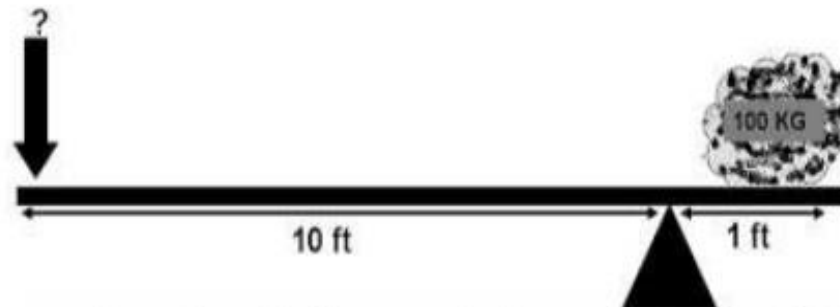
1. C - 60lbs is needed to lift the weight. It can be calculated like this:

$$f = (w \times d1)/d2$$

$$f = (80 \times 9)/12$$

$$f = (720)/12$$

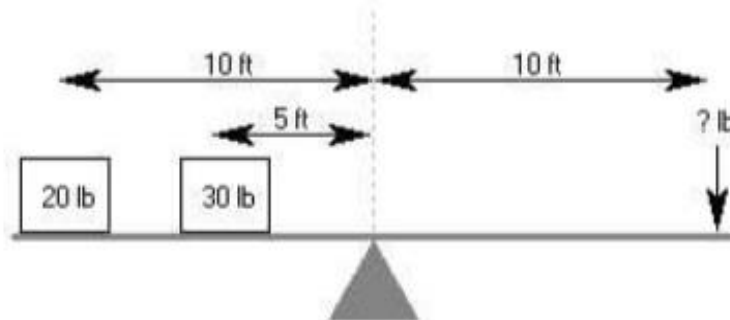
$$f = 60 \text{ lbs}$$



In practice, levers are used to reduce the force needed to move an object, in other words to make the task easier. However, in mechanical aptitude questions it is possible that you will see questions where the fulcrum has been placed closer to the force than the weight. This will mean that a force greater than the weight will be required to lift it.

You may see more complex questions involving levers, where there is more than one weight for example. In this case you need to work out the force required to lift each weight independently and then add them together to get the total force required.

2. How much force is required to lift the weights?



A) 25lbs

B) 35lbs

C) 40lbs

D) 45lbs

Answer

2. B - 35lbs is needed to lift the weight. It can be calculated like this:

$$f = (w1 \times d1) + (w1a \times d1a)/d2$$

$$f = (20 \times 10) + (30 \times 5)/10$$

$$f = (200 + 150)/10$$

$$f = 35 \text{ lbs}$$

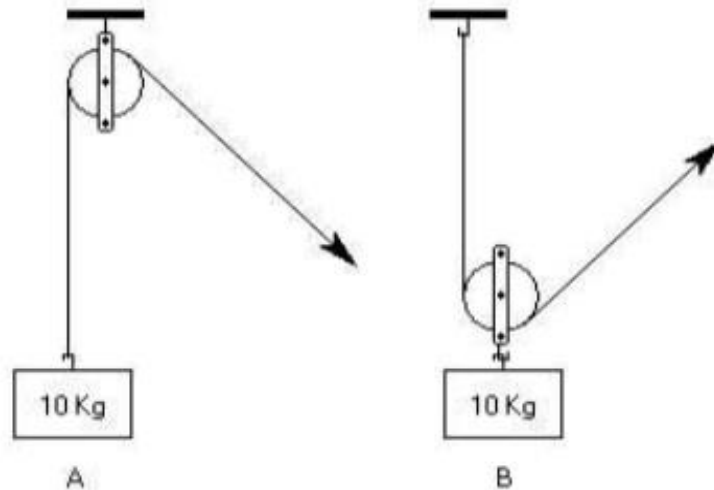
**Mechanical Reasoning Tests > Pulleys**

The pulleys used in this type of question are made up a grooved wheel and a block which holds it. A rope runs in the groove around the wheel and one end will usually be attached to either: a

weight, a fixed object like the ceiling or to another pulley. For the purposes of these questions you can ignore the effect of friction.

#### Single Pulley

3. Which weight requires the least force to move?



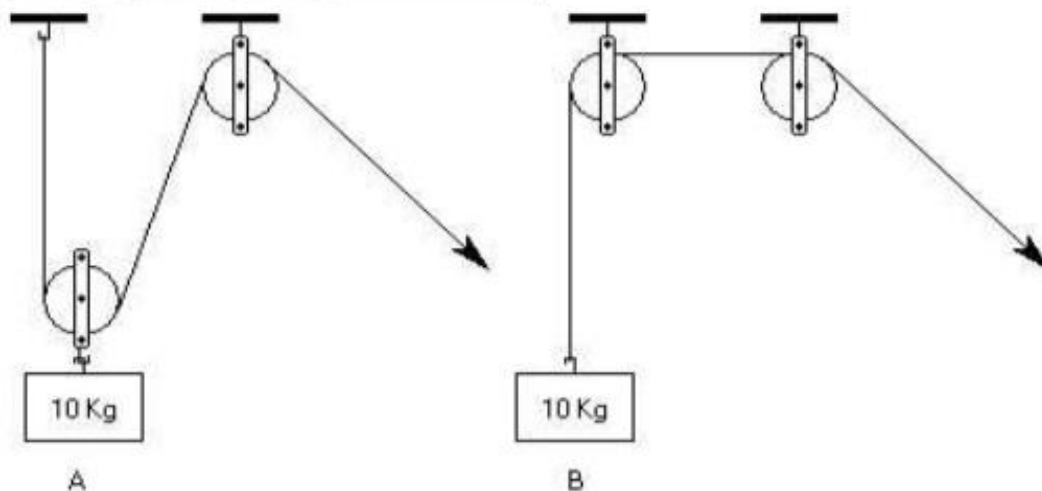
#### Answer

3. B – Weight B requires a force equal to 5 Kg whereas A requires a force equal to 10 Kg. Single pulley questions are relatively straightforward. If the pulley is fixed, then the force required is equal to the weight. If the pulley moves with the weight then the force is equal to half of the weight. Another way of thinking about this is to divide the weight by the number of sections of rope supporting it to obtain the force needed to lift it. In A there is only one section of rope supporting the weight, so  $10/1 = 10$  Kg required to lift the weight. In B there are two sections of rope supporting the weight, so  $10/2 = 5$  Kg required to lift it.

#### Double Pulleys

There are two possible ways that two pulleys can be used. Either one pulley can be attached to the weight or neither of them can be.

4. Which weight requires the least force to move?



A) A

B) B

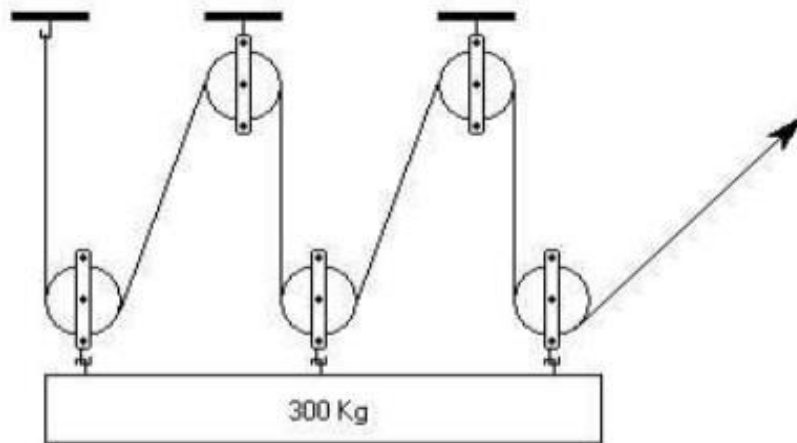
C) Both require the same force

Answer

4. A – Weight A requires a force equal to 5 Kg whereas weight B requires a force equal to 10 Kg. Remember to divide the weight by the number of sections of rope supporting it to get the force needed to lift the weight.

Using More Than Two Pulleys

5. How much force is required to move the weight?



A) 100kg

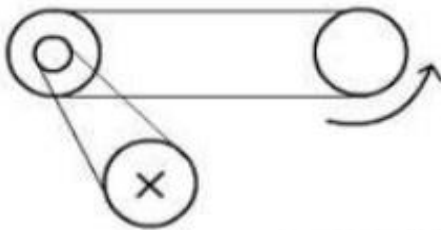
B) 150kg

C) 50kg

D) 60kg

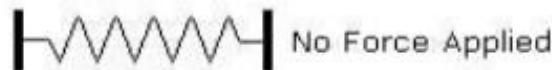
Answer

5. C – The weight is 300 Kg and there are 6 sections of rope supporting it. Divide 300 by 6 to get 50 Kg. In all cases, just divide the weight by the number of sections of rope supporting it to get the force needed to lift the weight.



**Mechanical Reasoning Tests > Springs**

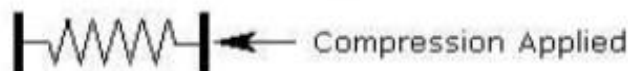
A spring is piece of wire or metal that can be extended or compressed by an external force but which then returns to its original length when that force is no longer applied.



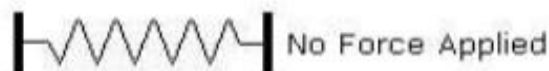
No Force Applied



Tension Applied



Compression Applied



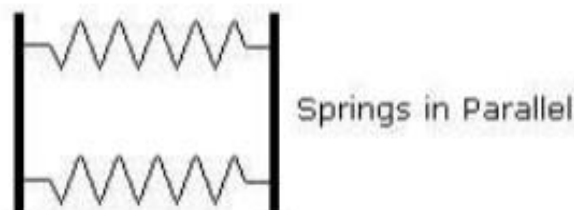
No Force Applied

Spring Under Tension & Compression

There are many different types of spring including, spiral coil, leaf springs and torsion springs. Springs are used in many applications including clocks, vehicle suspensions etc. In the type of questions that you will be asked in mechanical aptitude tests, you can assume that springs behave in a linear way. That is, doubling the force applied will stretch or compress the spring twice as much.

### Springs in Series & Parallel

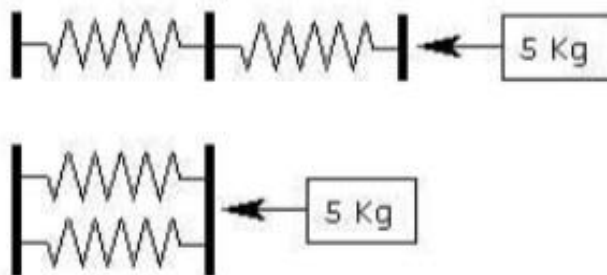
If more than one spring is used then they can be arranged in one of two ways, either in series or in parallel.



When springs are arranged in series, each spring is subjected to the force applied. When the springs are arranged in parallel the force is divided equally between the springs.

### Example Spring Question

1. A force of 5 Kg compresses the springs in series 10cm. What will be the total distance that the springs in parallel are compressed?



A) 10cms

B) 2.5cms

C) 5cms

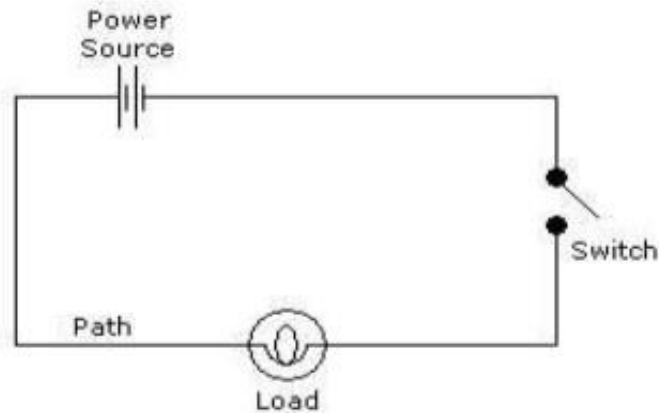
D) 7.5 cms

### Answer to Question

1. C – The total force will be divided equally between the 2 springs in parallel. Since the force is divided in half, the distance moved will also be halved. The springs in series were compressed 10 cms, so the springs in parallel will be compressed 5 cms.

### **Mechanical Reasoning Tests > Electricity**

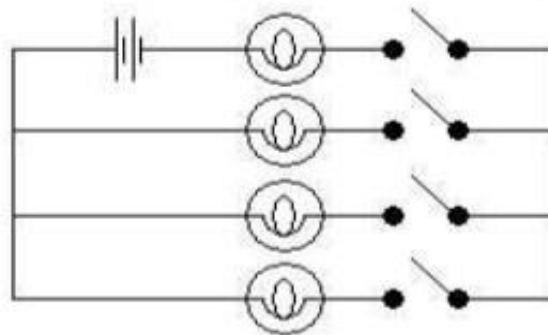
Questions on electricity usually take the form of simple circuit diagrams.



These diagrams are usually restricted to showing the power source, switches, loads (typically bulbs), and the path of the wiring. To answer these questions you need a basic understanding of how electricity flows around a circuit.

Example Question

1. How many switches need to be closed to light up one bulb?



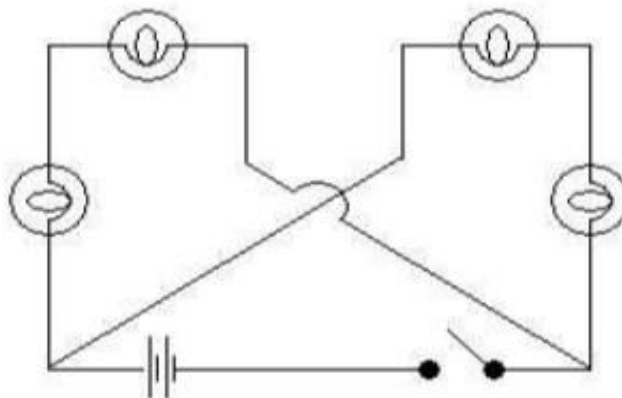
A) 1

B) 2

C) 3

D) 4

2. How many bulbs will light up when the switch is closed?



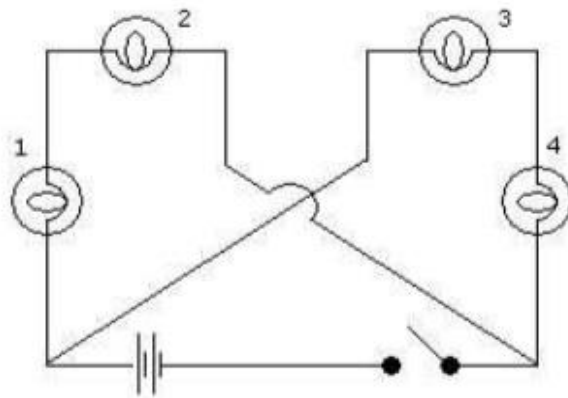
A) 1

B) 2

C) 3

D) 4

3. If bulb 1 is removed, how many bulbs will light up when the switch is closed?



A) 1

B) 2

C) 3

D) 0

Answer to Question

1. B – Two switches need to be closed to complete a circuit.

2. D – All 4 bulbs will light up.

3. B – Only bulbs 2 and 4 will light up.

### **Mechanical Reasoning Tests > Tools**

These questions are again straightforward and if you have spent significant time fixing or making things, they won't present any problems. However, mechanical goods of all types are relatively cheaper, less prone to breakdown and often less repairable than they were 20 years ago.

This means that many people under 30 years of age don't have much practical experience of fixing things or of watching someone else do so. If you feel that this applies to you, then you will need to make some effort to improve your knowledge of everyday tools. You can do this by getting hold of a catalog for a tool hire company and simply reading through it – boring but effective.

Example Questions



1) Which hammer is the most suitable tool for general carpentry?

A

B

C

D

E

None

1

2

3

4

2) Which hammer is the most suitable tool for general metalwork?



A	B	C	D	E
None	1	2	3	4

3) Which is the most suitable tool for breaking up concrete?

A	B	C	D	E
None	1	2	3	4

4) Which is the most suitable tool for assembling a friction fit wooden frame?

A	B	C	D	E
None	1	2	3	4



5) Which tool or combination of tools would be most useful for general woodworking?

A	B	C	D	E
4 & 2	3, 5 & 7	2, 4 & 6	4 & 7	3 & 6

6) Which tool or combination of tools would be most useful for repairing a broken radio?

A	B	C	D	E
1 & 8	3, 5 & 7	8	1 & 9	3 & 6

7) Which tool or combination of tools would be most useful for working with sheet glass?

A	B	C	D	E
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4 & 2                  6                  9                  4                  3 & 6

8) Which tool or combination of tools would be most useful for auto body repair work?

A                  B                  C                  D                  E

1 & 8                  3, 5 & 7                  8                  1 & 9                  3 & 6

Answers to Questions

- 1) B - Claw hammer.
- 2) E - Ball-peen hammer.
- 3) C - Sledge hammer.
- 4) A - Rubber mallet.
- 5) B - Plane, chisels and tenon saw.
- 6) D - Soldering iron and electrical test meter.
- 7) B - Glass cutter.
- 8) C - Mig welder

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