$E = \frac{MA}{SR} \times 100\%$

$MA = \frac{F_L}{F_E}$ $\left(\frac{F_{out}}{F_{in}}\right)$

$SR = \frac{d_{in}}{d_{out}}$

Grade 8 Science
Mechanical Systems Quiz
Name Key
Date _____

1. Label the following objects with their fulcrum, effort, and load, and then indicate whether it's a first, second, or third class lever. (6 marks)

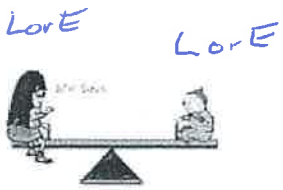
a)

3rd

b)

2nd

c)



1.5+

2. You use 40 N of force to move a box 150 cm. How much work did you do? (2 marks)

W = ? J
F = 40 N
d = 150 cm = 1.5 m

$W = F \times d$
$W = 40\,N \times 1.5\,m$
$W = 60\,J$

The work done to move the box was 60 J.

3. It takes 400 N of force exerted on the handle of a jack in order to lift the car. It takes 15 500 N of force from the jack to lift the car. What is the mechanical advantage? Is it a **speed** advantage or a **force** advantage? (3 marks)

$F_{in} = 400\,N$
$F_{out} = 15\,500\,N$
$MA = ?$

$MA = \frac{F_{in}}{F_{out}}$
$MA = \frac{400\,N}{15\,500\,N}$
$MA = 0.026$

The mechanical advantage of the jack is

4. Describe a situation in which a person exerts a force yet no work is done. (1 mark)

If the object does not move a distance ex. pushing against a wall, no work has been done.

x = variable (any number)

$W = F \times d$
$W = x\,N \times 0\,m$
$W = 0\,J$

5. Calculate the work done to pull a sled 15 m with a force of 300 N. (2 marks)

$W = ?\ J$
$d = 15\ m$
$F = 300\ N$

$W = F \times d$
$W = 300N \times 15\ m$
$\boxed{W = 4500\ J}$
It takes 4500J to pull the sled.

6. List 6 simple machines. (3 marks)

- lever
- inclined plane
- wheel + axle
- screw
- pulley
- wedge

7. If a lever has a mechanical advantage of 0.45, and you want to lift a load of 700 N, how much effort force would be required? (2 marks)

$F_E = ?$
$F_L = 700N$
$MA = 0.45$

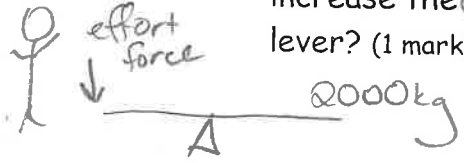
$F_E = \frac{F_L}{MA}$
$F_E = \frac{700N}{0.45}$
$F_E = 1555.\overline{5}\ N$
$\boxed{F_E = 1556N}$
The effort force required to lift the load would be 1556 N.

8. You are pushing a box up a ramp. You need to get the box 480cm of the ground. In order for you to be able to do this the ramp has to be at least 12M in length. What is the speed ration of the ramp? (2 mark)

m (meters)
d_{out} 480cm = 4.8 m
$d_{in} = 12m$
$SR = ?$

$SR = \frac{d_{in}}{d_{out}}$
$SR = \frac{12m}{4.8m}$
$\boxed{SR = 2.5}$
The speed ratio of the ramp is 2.5 (times quicker)
↳ this should be a mechanical advantage question though as ramps aren't really for increasing speed.

9. If using a 1st class lever to move an object with a mass of 2000 kg. What could you do to decrease the amount of effort force (or to increase the mechanical advantage) that needs to be applied to the lever? (1 mark)



Moving the fulcrum closer to the load will make it "easier" to lift. The mechanical advantage is higher and less effort force is required.

★ Archimedes said: give me a lever long enough and I will move the earth!

1 kg = 10 N

10. If moving the object with a mass of 2000 kg with a second class lever, what would the mechanical advantage be if the effort force needed was 6N? (1 mark)

$F_L = 2000\,kg = 20\,000\,N$

$MA = ?\,N$

$F_E = 6\,N$

$MA = \frac{F_L}{F_E}$

$MA = \frac{20\,000\,N}{6\,N}$

MA = 3333.3

MA = 3333

The mechanical advantage of the lever is 3333 (extremely high. Strange that 6N would be able to lift 2000 kg)

11. If you are using a lever to lift a car and there is a speed ratio of 2.5 and the car is raised 50 cm, how far does the effort arm of the lever move? (2 marks)

$SR = 2.5$

$d_{out} = 50\,cm = 0.5\,m$

$d_{in} = ?\,m$

$d_{in} = SR \times d_{out}$

$d_{in} = 2.5 \times 0.5\,m$

$d_{in} = 1.25\,m$

The effort arm moves 1.25 m.

12. What is the mechanical advantage if 675 N of force is required to lift a load of 5000 N? (2 marks)

$MA = ?$

$F_L = 5000\,N$

$F_E = 675\,N$

$MA = \frac{F_L}{F_E}$

$MA = \frac{5000\,N}{675\,N}$

MA = 7.4

The mechanical advantage required is 7.4.

strange numbers

1 kg = 10 N

★ 13. You are using a pulley to lift an airplane engine weighing 3800kg's 4.3m's off the ground. You need to pull the rope a distance of 12600cm's with a force of 146N's to reach the desired height. What is the efficiency of the machine? Show all your work! (4 marks)

100cm = 1m

$MA = ?$

$F_L = 3800\,kg = 38000\,N$

$F_E = 146\,N$

$MA = \frac{F_L}{F_E}$

$MA = \frac{38\,000\,N}{146\,N}$

MA = 260

$SR = \frac{d_{in}}{d_{out}}$

$SR = ?$

$d_{in} = 126\,m$

$d_{out} = 4.3\,m$

$SR = \frac{126\,m}{4.3\,m}$

SR = 29

$E = \frac{MA}{SR} \times 100\%$

$E = \frac{260}{29} \times 100$

$E = 896\%$ (approx)

14. Car breaks use a simple hydraulic system to create friction and slow a vehicle's wheels down. When you push on the break with your foot you are applying a force of 64N. The area of the break pedal piston is $4cm^2$. The output piston which pushes the break pads against the tires has a surface area of $72cm^2$. What is the force that is applied to the break pads by the hydraulic system? What is the mechanical advantage given by a hydraulic breaking system? (10 marks)

** Use this to help you P= F/A = Fin/Ain = Fout/Aout = P **