

# WORK-ENERGY-POWER

Unit 10 & 11 Dr. John P. Cise , Professor of

Physics, Austin Community College, 1212 Rio Grande St. , Austin Tx. 78701 [jpcise@austincc.edu](mailto:jpcise@austincc.edu) & New York Times , March 27, 2016 by Michael Benanav



Mountains near the village of Potolo.

**INTRODUCTION:** POWER = work/time =  $W/t = F x/t = F v$   
 Animals: Horses, OX, mules ,donkeys, man all can do work and exert forces. The purpose of this application is to verify size of forces these animals can produce at normal speeds of doing work. POWER (ft. lb./s.) & normal speed (ft./s.) of doing work are listed in the table below. For a point of reference  $\sim 1.5$  ft./s. is  $\sim 1$  mph. Thus, in the table below most of listed animals are working at  $\sim 2$  mph.

**QUESTION:** For the five animals listed below knowing Power & velocity verify the forces they can exert?

## In the Mountains of Bolivia, Encounters With Magic

The scenery would have been enough to draw me to the cordillera, with its upthrust layers of multicolored sedimentary rock set around a crater that's encircled by rugged river canyons. But I was equally intrigued by the indigenous Jalq'a people who live there and who are known for intricate weavings that represent a fantastical underworld filled with spirits and mythical animals. In the same way that a place like Varanasi exudes a distinctly Hindu aura, and Cairo is palpably Islamic, I wondered how it would feel to be in a place where the culture is strongly associated with strange, subterranean dreamscapes.

### Slide Show



### TWO OX POWER ABOVE IN ANDES MOUNTAINS

Sustainable power of individual animals in good condition <sup>2</sup> (from Wikipedia)

Animal	Force Exerted (lbs.)	Velocity (ft/sec)	Power (ft-lbs/sec)	Standard Horsepower	Force Exerted (N.)	Velocity (m/s)	Power (W)
draft horse	120	3.6	432	0.864	535	1.1	587
ox	120	2.4	288	0.576	535	0.7	391
mule	60	3.6	216	0.432	267	1.1	293
donkey	30	3.6	108	0.216	134	1.1	147
man	18	2.5	45	0.090	80	0.8	61

Though I've trekked alone in remote regions around the world, I decided to go into the cordillera with a guide. If I hoped to talk to local people, I would need help from someone fluent in [Quechua](#), the area's native language. Additionally, I had heard that some Jalq'a were extremely reluctant to be photographed (I met one French couple who had stones thrown at them when they aimed their cameras at people), and I figured I would have a better chance of shooting pictures without upsetting anyone if I was accompanied by a guide who had local connections. It also sounded as if walking the entire route with a backpack would be a daunting prospect for a 9-year-old, so I wanted vehicle support. When I asked around about trekking companies in Sucre, travelers and locals alike pointed me in the same direction: [Condor Trekkers](#).

**HINTS:** POWER = WORK/TIME =  $W / t = F x/t = F v$  , Thus  $P = F v$

**ANSWERS:**  $F_{HORSE} = 120$  LB.,  $F_{OX} = 120$  LB. ,  $F_{MULE} = 60$  LB.,  $F_{DONKEY} = 30$  LB.,  $F_{MAN} = 18$  LB.

**EDITERS COMMENTS:** The two ox in the above picture thus produce a net force plowing of 240 lb.