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Work, High School Students and Horses

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Work, High School Students, and Horses

or

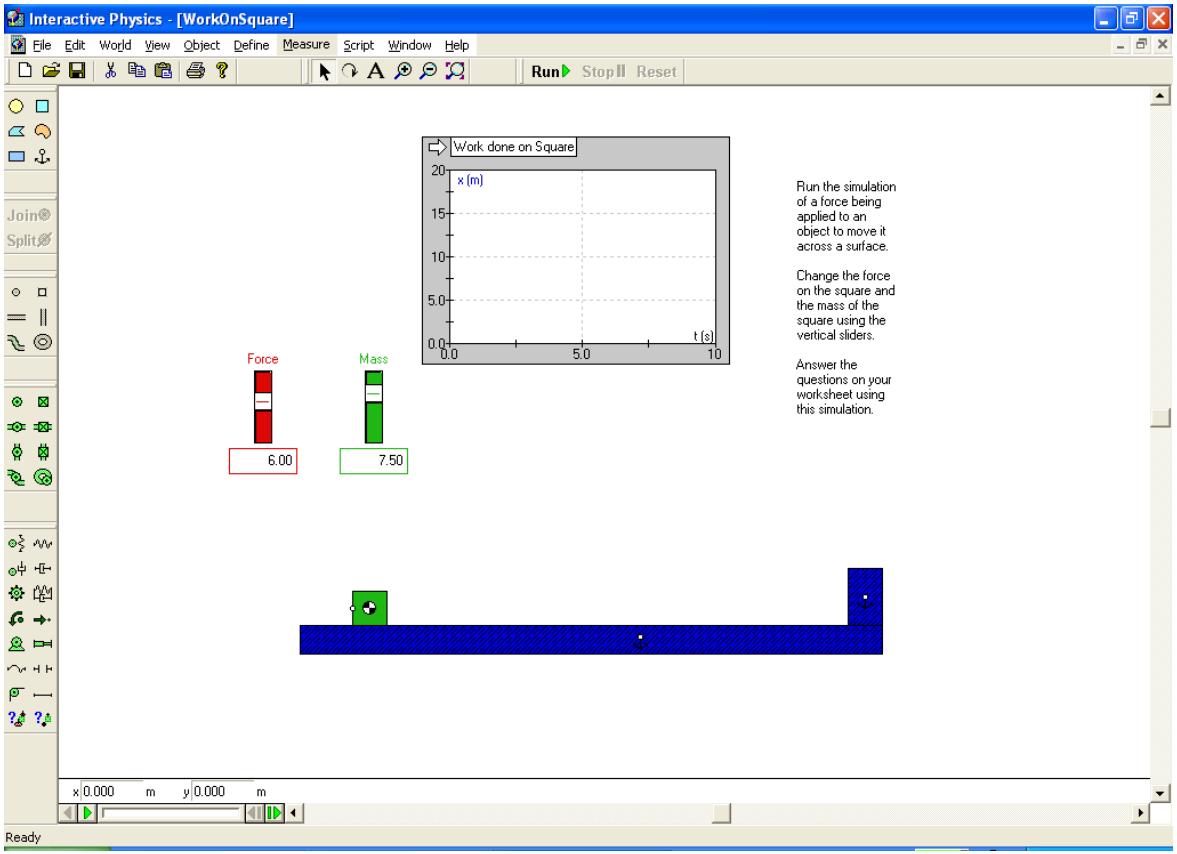
How to use Interactive Physics to measure the horsepower of an electric motor

What is a “horsepower”?

What is Work?

- Khalil works at Wal-Mart unloading trailers and stocking the backroom and shopping floor.
- He gets paid for moving items, sometimes large items, from one place to another.
- The more items he moves, or the further he moves items, the more work he does.

Interactive Physics Simulation of Work



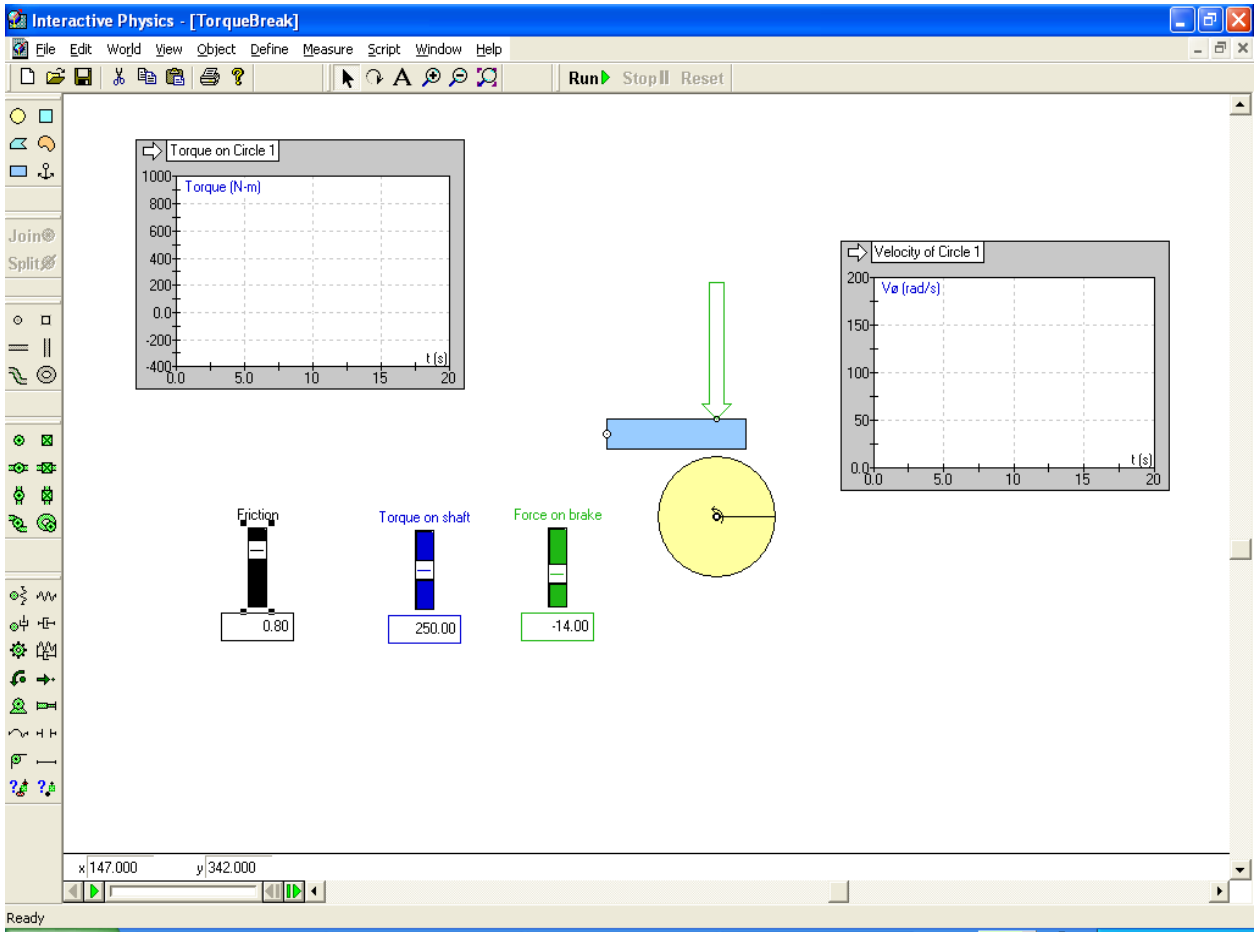
Learn about Work

- Students apply force to a mass to produce work.
- Adjust the mass, kinetic friction and the force to see the effects on the work done.
- “Play with the simulation”
- One student maximized friction and force, and minimized mass. The cube started rotating and bounced off the track. Teachable moment about what happened.

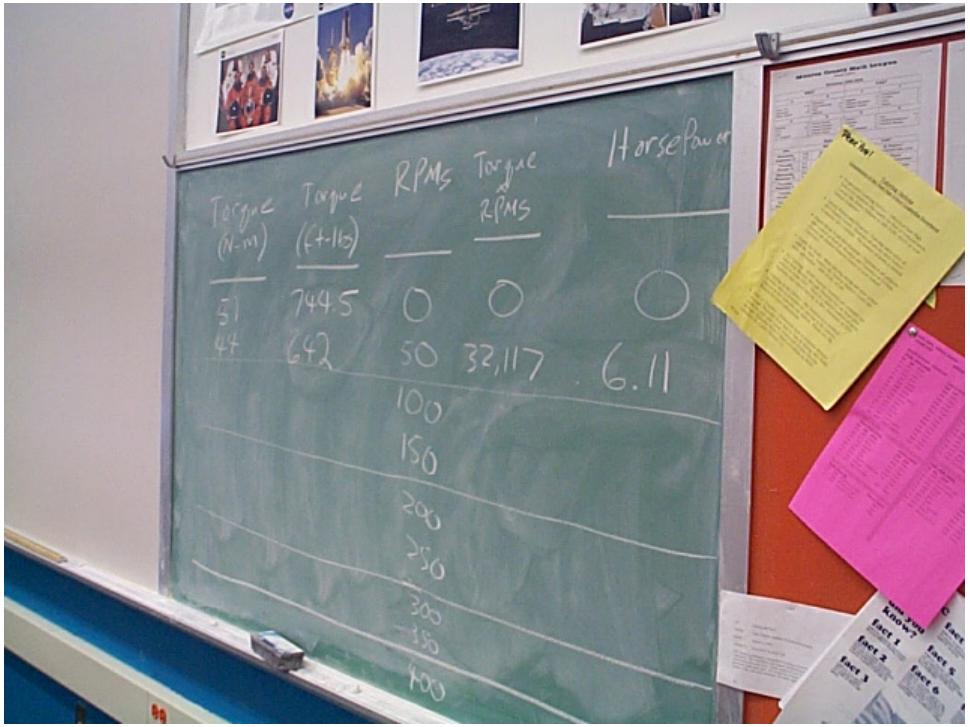
Torque and friction

- Torque is a force in a rotating direction.
- I brought in a torque wrench to show how torque could be measured.
- We spoke about an electric pencil sharpener. The rotating force produces work, resulting in a sharpened pencil.
- Too little load, fast spinning motor, no work.
- Too much load, stopped sharpener motor, no work.
- Measure rotational force in foot-pounds or Newton-meters

Interactive Physics Simulation of Torque Break



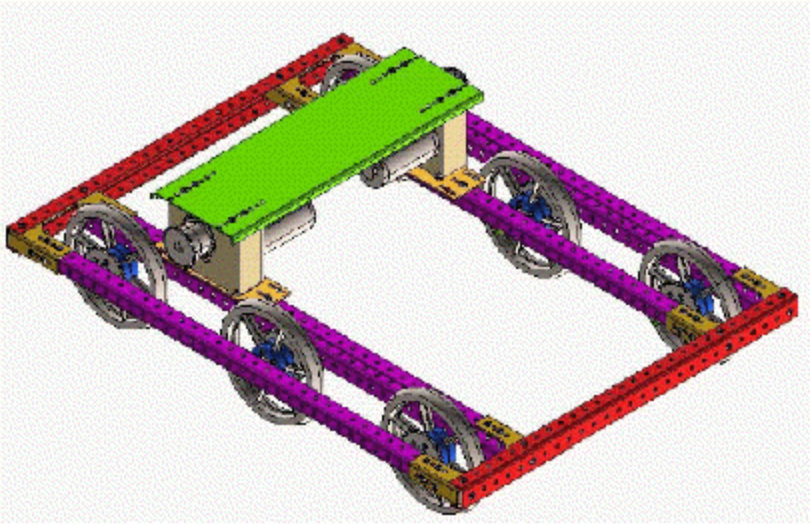
Calculation of Horsepower



A Horsepower measures the speed of work done.

- 1 horsepower = 33,000 foot-lbs. per minute
- Our chart shows RPMs vs Torque (Newton-meter)
- Convert N-m to ft.-lbs. by multiplying 0.738
- H.P. = Torque x RPM / 5252
- What is the horsepower of one of the tranmissions on our competitive robot?

Our robot transmission config.



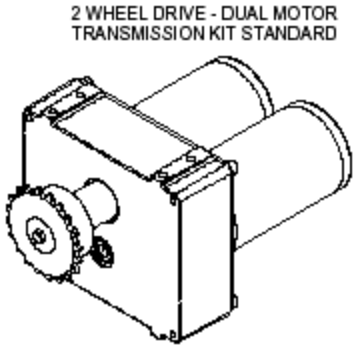
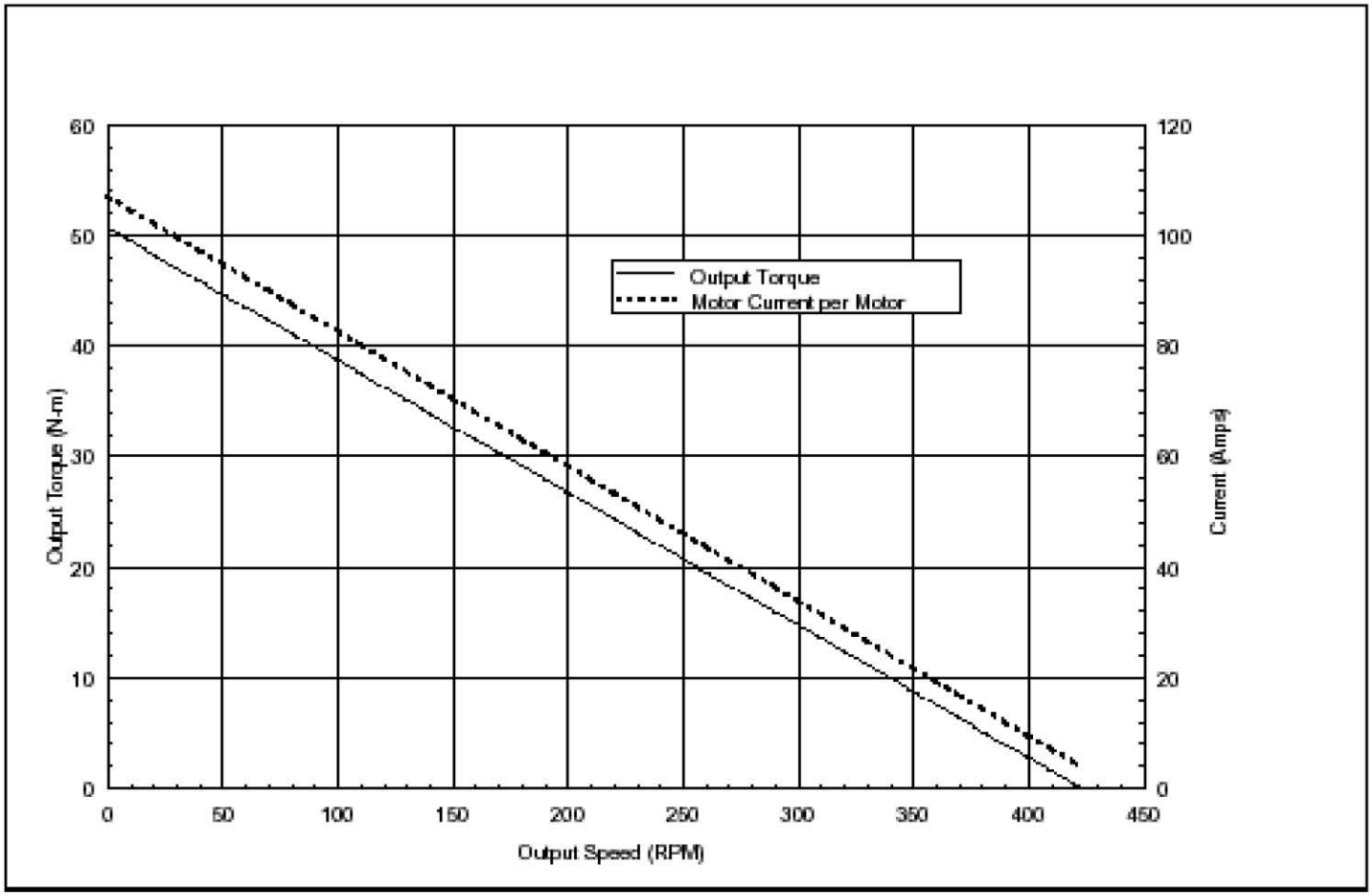


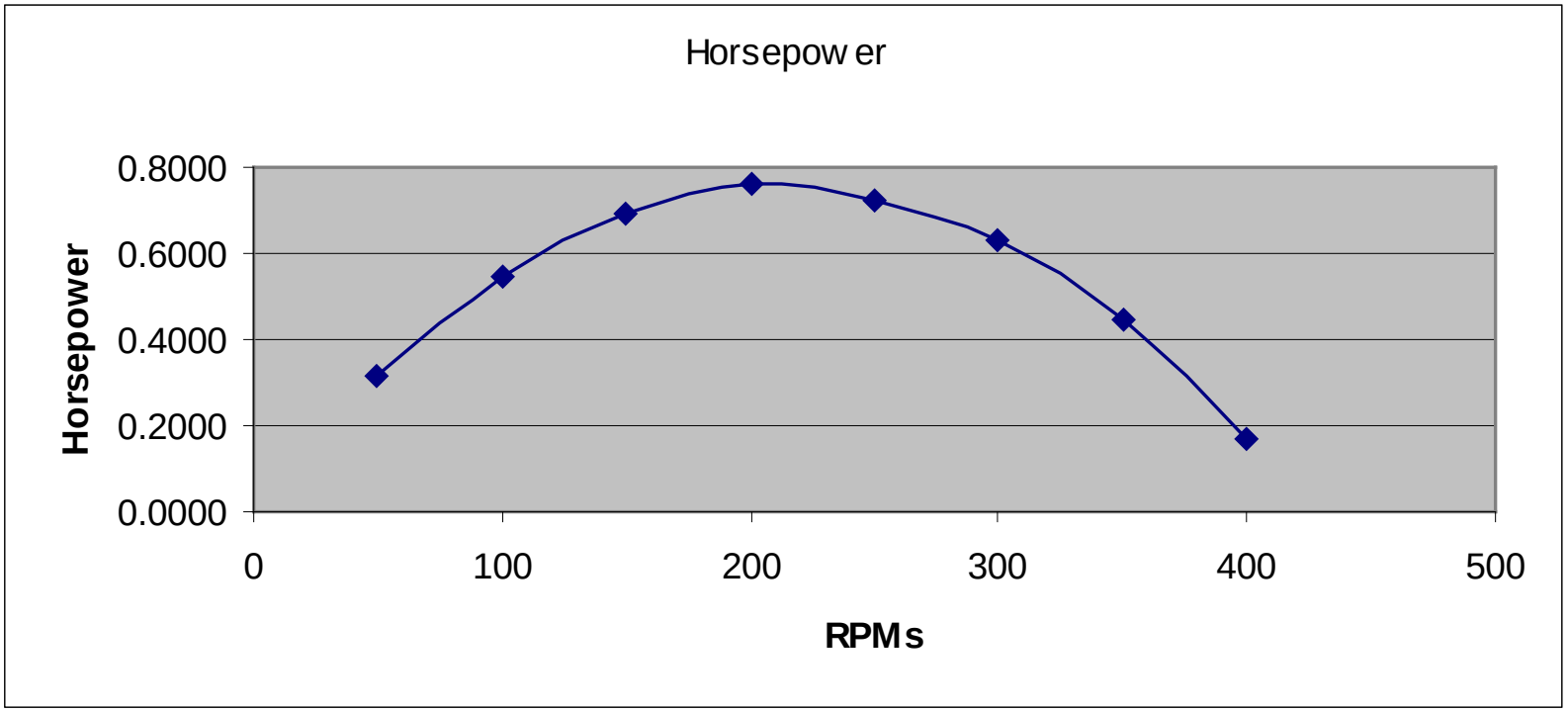
Figure 6–2. 2005 Dual Motor Transmission Kit Performance Curve



Calculation of Power Curve

Torque (N-m)	Torque (ft.-lbs.)	RPMs	Horsepower
45	33.21	50	0.3162
39	28.782	100	0.5480
33	24.354	150	0.6956
27	19.926	200	0.7588
20.5	15.129	250	0.7202
15	11.07	300	0.6323
9	6.642	350	0.4426
3	2.214	400	0.1686

Graph of Power Curve



What is horsepower?

- Horsepower is different based on the speeds of a motor.
- Horsepower tells you how much work can be done in a certain time.
- The maximum horsepower for an electric motor seems to be in the middle RPMs.
- Analogy with electric pencil sharpener, what speed accomplishes the most work?
- Application with robot, program RPM limiters to maximize power output.

References

- Auto Math Handbook, HPBooks 1991 by John Lawlor
- HowStuffWorks website,

  http://auto.howstuffworks.com/