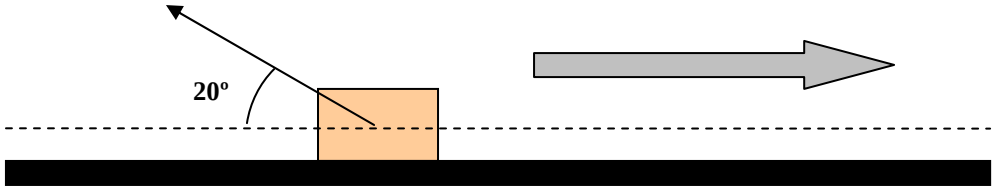
Work, power and energy

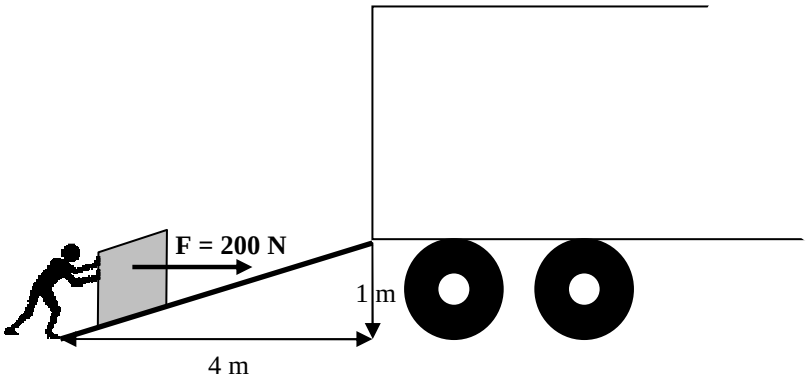
1. A car exerts a force of *10,000 N* while driving on a horizontal stretch of road. *How much work* is done when the car travels *50 m*? ***A: $5 \cdot 10^5$ J.***

2. A *12 kg* sled & rider is pulled by a 50 N for *200 m*. The force acts at a *60°* angle with the ground. How much *work* is done by the applied force? ***A: 5000 J.***

3. A *150 kg* object is stopped by a *force applied at a 30°* angle with the ground. The object is stopped in *20 m* with *500 J* of work. What is the *magnitude of the force*? ***A: 29 N.***



4. An *82 kg* trucker loads a crate as shown below. He pushes the *50 kg* box such that *his arms are parallel to the ground*. He pushes with a *200 N force*. How much *work is done* by the trucker on the box? ***A: 800 J.***



5. A car *1600 kg* is traveling down the road at *20 m/*s. If the car accelerates up to *30 m/s* over a distance of *200 m* then a) How much *work* is done by the car? b) How much *power* is exerted by the car, in *watts* and *horsepower*? ***A: a) $8 \cdot 10^5$ J. b) $2 \cdot 10^5$ w, 268 hp.***

6. After accelerating, the car mentioned in the previous problem now locks the brakes and skids to a stop in *300 m*. a) How much *work* is done by the brakes? b) How much *power* is exerted by the car's brakes? ***A: a) - $1.44 \cdot 10^6$ J. b) $1.44 \cdot 10^5$ w***

7. What *average power* must a crane deliver in order to raise a *150 kg girder* through *70 m* in *20 s* at a constant speed? ***A.: 5145 w.***

8. A *50 kg* box is dragged *30 m* on a horizontal floor, applying a *F = 100 N* exerted by a person. Such force acts doing a *60º* angle. The *coefficient of kinetic friction is 0.2*. Calculate: a) The *work* done for each one of these *forces F, the friction, the weight and the normal*. b) The *net work* done on the box. ***A: a) ..... b) 1760 J.***

9. What is the *kinetic energy* of a *25 g* dart that is thrown at *20 m/s*?. ***A: 5 J.***

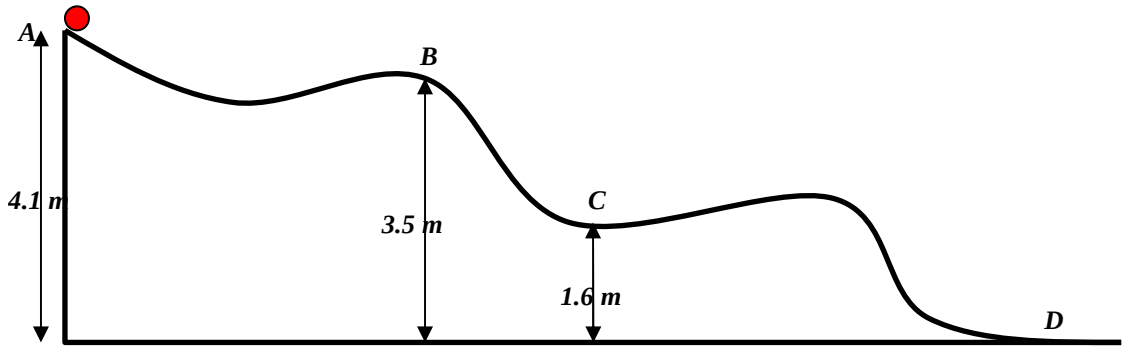
10. A *800 kg* elevator rises straight up *60 meters*. What is the *change in potential energy* of the elevator relative to the ground? ***A: $4.7 \cdot 10^5$ J.***

11. A projectile is shot upward from the earth with a speed of 30 m/s . How high is it when its speed is *15 m/s* ? Ignore air friction. ***A: 34.4 m.***

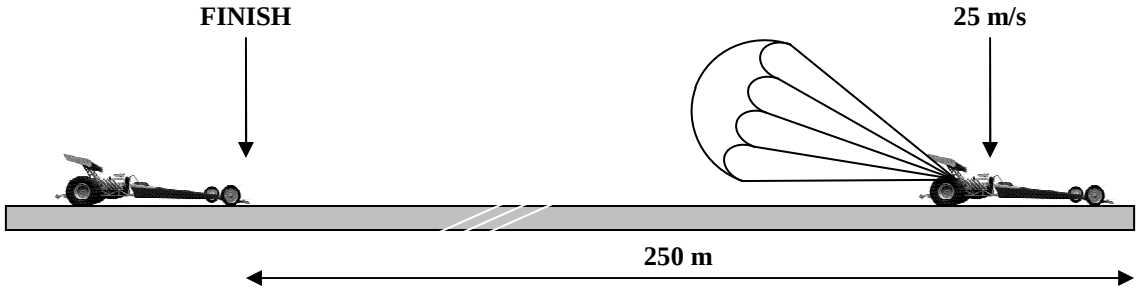
12. A *2 m* pendulum makes an angle of *30 degree* with the vertical. Calculate its *speed* at the *bottom* of its swing. ***A: 2.3 m/s.***

13. A *1400 kg* does *200,000 J* of work when it accelerates across *180 m*. The car starts from *25 m/s* before traveling the *180 m*. What is the *final velocity* of the car? ***A: 30.2 m/s.***

14 A particle of mass *m = 5 kg* is released from point *A* and slides on the frictionless track shown in figure. Determine: a) The *particle´s speed* at points *B, C* and *D*. b) The *net work* done by the *gravitational force* in moving the particle from *A* to *C*. c) How *high* is the particle when its speed is *4 m/s* ? ***A: a) 3.42 m/s, 7 m/s, 8.96 m/s. b) 122.5 J. c) 2.8 m/s.***



15. An *900 kg* dragster finishes the race with some u*nknown velocity*. A parachute is deployed after crossing the finish line and exerts a stopping force of *20,000 N* across a distance of *250 m* before the dragster slows down to *25 m/s*. What was the *speed* of the dragster when it passes the *finish line*. ***A: 111 m/s***



16. A bullet, *20 g*, is shot through a piece of wood. The bullet enter the wood at *600 m/s*. The wood is *7 cm* thick. The wood exerts *15,000 N* of force to slow the bullet down. *How fast is the bullet* traveling when it leaves the piece of wood on the *opposite side*? ***A: 505 m/s.***

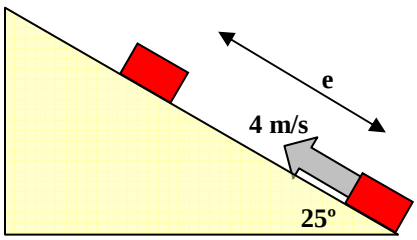
17. A musket ball, 0.22 kg, is shot with a speed of *300 m/s* into a metal can holding some clay. The musket ball penetrates *15 cm* into the clay before coming to a stop. a) What is the *kinetic energy* of the musket ball before it hits the clay if its mass is 0.22 kg? b) How much *work* does the clay do in stopping the musket ball? c) What *average force* does the clay exert in stopping the musket ball? d) Calculate the *speed of the musket* ball when it has penetrated the clay only *5 cm*. ***A: a) 9900 J. b) ..... c) 66000 N. d) 261 m/s***

18. A *20 kg* box is given an initial speed of *10 m/s* along a horizontal surface with a coefficient of kinetic friction of *0.2*. *How far* will the box slide before coming to rest? Do not use the kinematic equations of motion. ***A: 25.5 m***

19. A *1000 kg* car coasts from rest down a driveway that is *inclined 25º* to the horizontal and is *16 m* long. How fast is the car going at the end of the driveway if a *friction of 3000 N* opposes the motion? ***A: 3.35 m/s.***

20. Starting from rest, a *4.00 kg* block slides *3.50 m* down a rough *30.0º* incline. The coefficient of kinetic friction between the block and the incline is $\mu = 0.400$. Determine the *work* done by: a) The *force of gravity*. b) The *friction force* between block and incline. c) The *normal force*. d) Determine the *speed* of the block after sliding *3.50 m*. ***A: a) W_g= 68.6 J. b) W_f = - 47.4 J. c) ..... d) 3.2 m/s.***

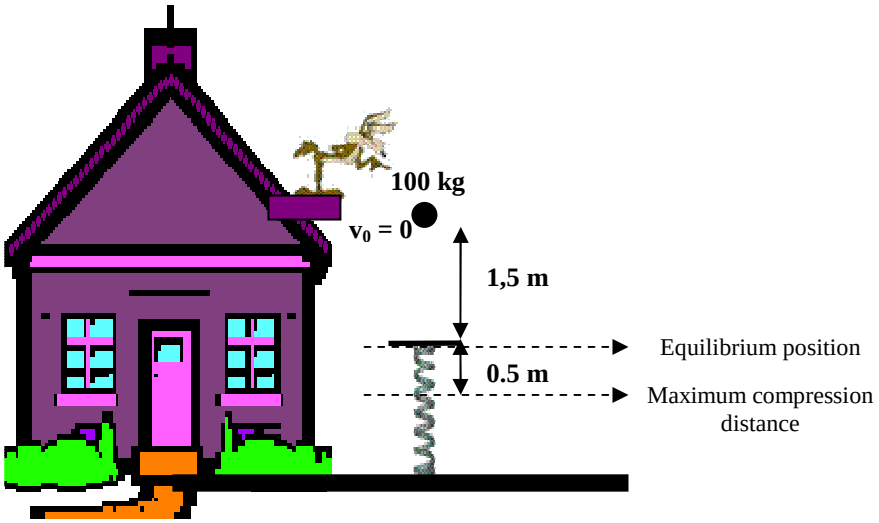
21. A *2 kg* block is shot up the incline in figure with an initial speed of *4 m/s*. How far up the incline will it go if the coefficient of friction between it an the incline is 0.1? ***A: 1.6 m.***



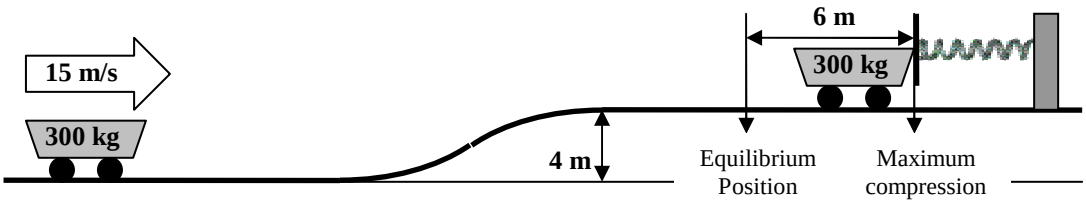
22. A teacher wants to determine the coefficient of friction between a block and a particular surface. She places a block of mass *3 kg* on an inclined plane. The plane makes an angle of *30º* with respect to the horizontal. The block starts from rest a distance of *12 m* up the incline. He lets the block go, and it slides down the plane and along a table top. The block comes to rest *8 m* from the start of the incline. The coefficient of kinetic friction is the same on the incline and the tabletop. What is the *coefficient of friction*? **A: *μ = 0.33.***

23. Consider the track shown. The *section AB* is one quadrant of a circle of radius *2.0 m* and is *frictionless*. *B to C is a horizontal span 3.0 m long with a coefficient of kinetic friction μk = 0.25*. The section *CD under the spring is frictionless*. A block of *mass 1.0 kg* is released from *rest at A*. After sliding on the track, it *compresses the spring by 0.20 m*. Determine: a) The velocity of the block at point B. b) The velocity of the block at C. c) The *stiffness constant k* for the spring. ***Answer: a) 6.3 m/s. b) 4.9 m/s. c) 610 N/m.***

24. Wyle E. Coyote is trying to catch that road runner- when will he learn? As part of this new ACME trap he throws a ball down on a spring as shown below. What is the *velocity* of the ball the instant it makes contact with the spring? What is the *spring´s constant*? ***Answer: a) 5.4 m/s. b) 15680 N/m.***



25. Based on the information diagramed below. Answer the following questions:



a) What is the *speed of the wagon* when the spring is compressed *5 meters*? b) At which *compression distance* of the spring is the *speed* of the wagon *half* of what was at the instant it hit the spring? ***A: a) 6.7 m/s. b) 5.2 m.***