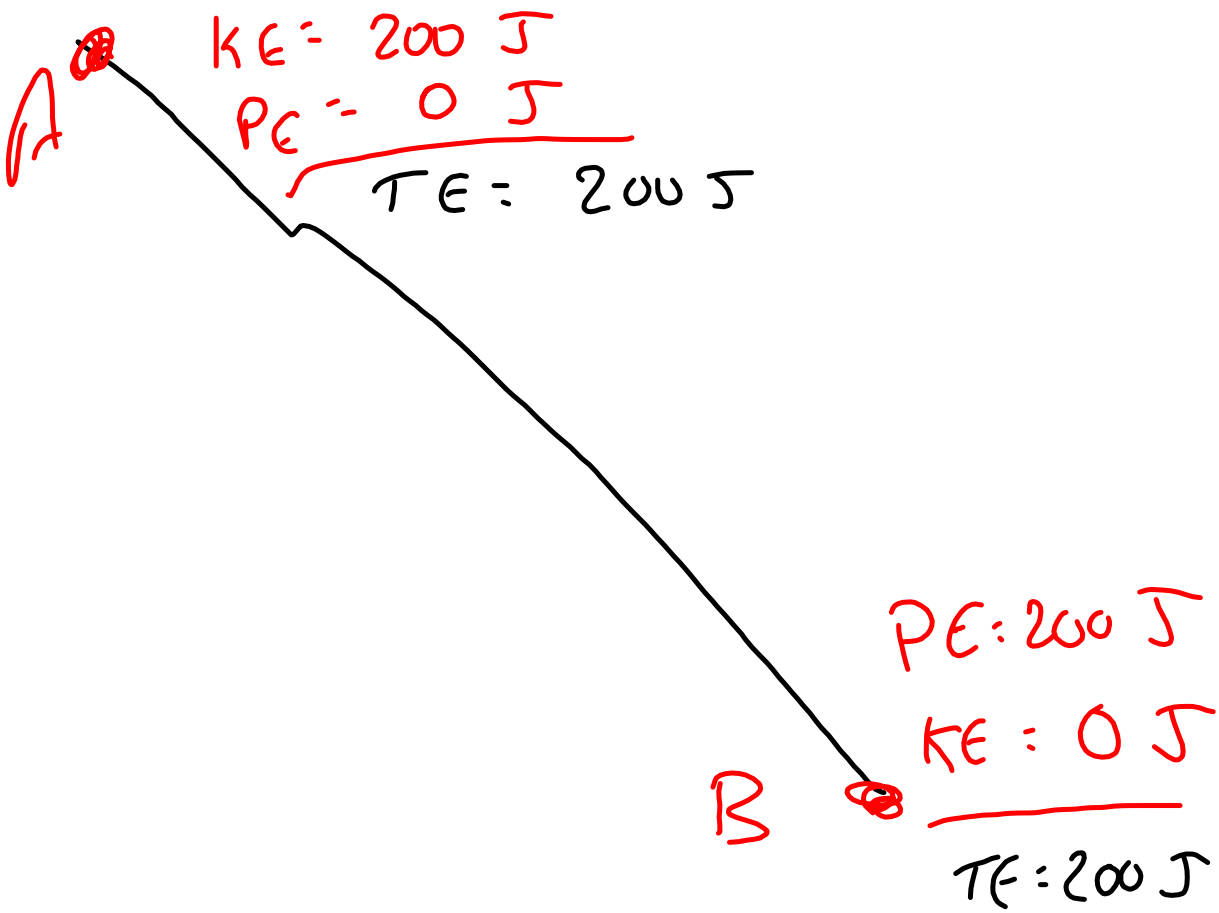
Physics 112

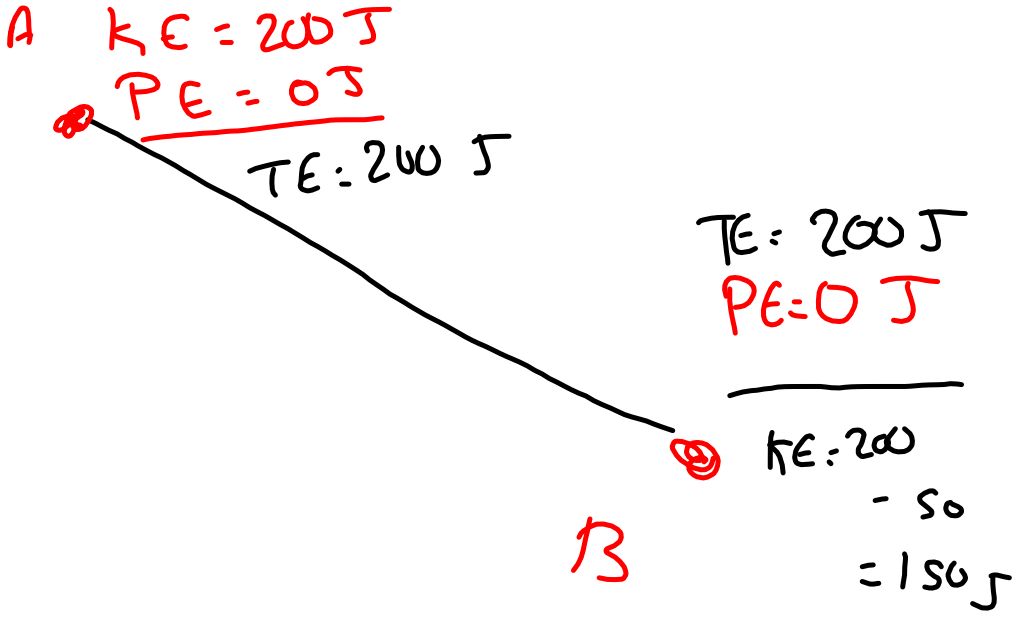
Monday Dec 11th

Total Energy & Friction

Sometimes there are frictional losses between two positions. We must take these into account when we are working out conservation of energy questions.


A
KE: 200 J
PE: 0 J
TE: 200 J
B
PE: 200 J
KE: 0 J
TE: 200 J

What if there were frictional energy loses (50 J) between points A and B



If we start at position A with a total of 200 J we normally, under ideal conditions have a total of 200 J at position B. If friction (heat) use up 50 J on the way from position A to position B, then our total is now 150 J at position B.

P 308 (18, 19, 20, 24)

18. A

$PE = mgh$

$= 206(9.81)15$

$= 29\,430\ J$

$KE = \frac{1}{2}mv^2$

$= \frac{1}{2}(200)(4)^2$

$= 1600\ J$

$TE = PE + KE$

$= 29430\ J + 1600\ J$

$= 31\,030\ J$

Point C

$PE = mgh$

$= 200(9.81)8$

$= 15\,696\ J$

A - B lost 3400 J

B - C lost 400 J

TE_A

$KE = 31030 - 15\,696 - 3400 - 400$

$= 11\,534\ J$

PE_C A-B lost energy, B-C lost e

$KE = \frac{1}{2} m v^2$

$11\,534 = \frac{1}{2}(200)v^2$

$11\ m/s = V_c$

19. Top

$PE = mgh$
$= 70(9.81)12$
$= 8240\ J$

$KE = \frac{1}{2}mv^2$
$= \frac{1}{2}(70)8^2$
$= 2240\ J$

$TE = 10480\ J$

X

$PE = mgh$

$= 70(9.81)(3)$

$= 2060\ J$

Friction losses $= 1220\ J$

$KE = 10480 - 2060 - 1220$

$= 7200\ J$

$KE = \frac{1}{2}mv^2$

$7200 = \frac{1}{2}(70)v^2$

$14.3\ m/s = v$

20. $KE = \frac{1}{2}mv^2$

$= \frac{1}{2}(70)(15.6)^2$

$= 8\,517.60$ J

↑ total at bottom → no PE

Point B

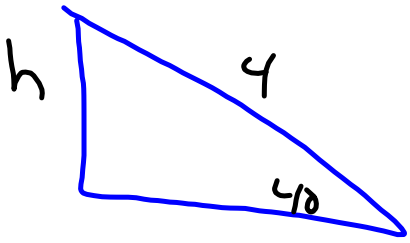
$TE = 10\,480 - 1220$

$= 9260$ J

Frictional losses $= 9\,260 - 8\,517.60$

$= 740$ J

24. $m = 15$ kg



$\sin 40 = \frac{h}{4}$

$2.57 \text{ m} = h$

$PE = mgh$

$= 15(9.81)(2.57)$

$= 378 \text{ J}$

$KE = \frac{1}{2}mv^2$

$= 0 \text{ J}$

$TE = 378 \text{ J}$

Bottom

$PE = 0\ J$

$KE = \frac{1}{2}mv^2$

$= \frac{1}{2}(15)(3.2)^2$

$= 76.80\ J$

$TE = 76.80\ J$

Joules lost to friction

$TE_{top} - TE_{bottom}$

$378\ J - 76.80\ J$

$301.20\ J$

Equal to the work done by friction.

$W = F d$

$301.20 = F(4)$

$\frac{301.20}{4} = F$

$75 N = F$