UChicago 2020
Machines B Key
January 17, 2020

Total: 70 points

Page 1 (35 points)

Problem 1 [5 pts]. Five Simple Machines for Div B

Lever, Inclined Plane, Wedge, Wheel and Axle, Pulleys

Problem 2 [5 pts]. Bus wheel/Car Wheel

Answer: rb/rc = 22/18 = 11/9 = 1.222222

Problem 3 [5+5+5=15 pts]. Simple Pulley (aka Double Tackle)

i. 4

ii. ~~1.64 (= 1024/625)~~ 2.316 (=1476/625)

3.2 is what you get if the whole system has an efficiency of 80% rather than each pulley

iii. 5

Problem 4 [5+5=10 pts]. Another pulley system

i. 16

ii. 40/3 = 13.33 N (accept 40 N -- ignores top two ropes)

Page 2 (25 points)

Problem 5 [5 pts]. Pulley System

10

Problem 6 [2.5 x 4 = 10 pts]. Vinyl Record

i. 24 minutes = 1440 seconds

ii. 2π *6 in * 1s/1.8s = 20.944 in. (= $20\pi/3$)

iii. 2π *2 in * 1s/1.8s = 6.981 in. (=$20\pi/9$)

iv. beginning

Problem 7 [2 x 5=10 pts]. Identifying lever classes

i. 3

ii. 2, 3

iii. 1, accept 2

iv. 3

v. 1

Page 3 (10 points)

Problem 8 [5 pts]. Bike Chain

1 (a bit of a trick question) -- NOT 2 or 1/2

Problem 9 [5 pts]. High ground

$W = h * F_A = L * F_O$ (same work)

$F_A/F_O = L/h$ (inclined plane IMA -- Person A doesn't use the machine)