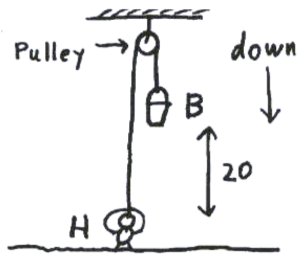
86-8. A computer hack, H, has a mass of 70 kg. He stands on the ground holding one end of a rope which passes up and over a pulley on the roof of the computer building, then down to a bucket, B, 20 m above his head. The bucket is loaded with used computer paper so that the total load, including the bucket, is 100 kg. The hack hangs on as he is pulled upward to meet the descending load. With what relative speed does the bucket slam into his head? (Answer in m/s)

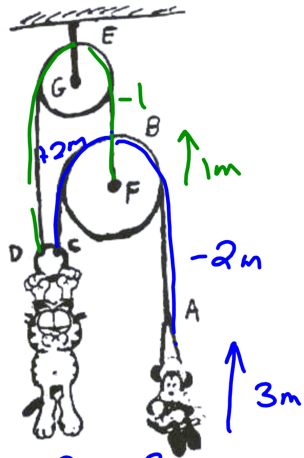


(A) 11.8 (B) 28.0 (C) 5.9 (D) 14.0 (E) 7.0

86-12 Garfield, a fat cat, screws four hooks into a level ceiling, one at each corner of a 125 cm square. Four identical ropes, one from each hook, stretch exactly 100 cm to a single small ring supported by them directly beneath the centre of the square. Garfield hangs from this ring. Calculate the maximum weight of the cat if the tension force in each rope must not exceed 66.7 N. Answer in N.

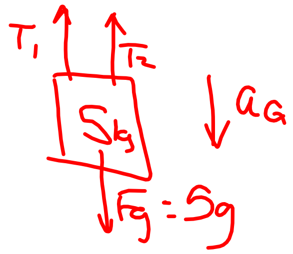
(A) 267 (B) 213 (C) 167 (D) 125 (E) 98.1

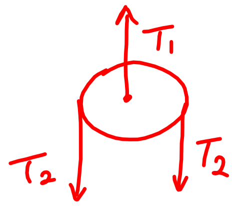
87-9 Mickey Mouse celebrates his sixtieth birthday this year. Garfield, a much younger fat cat, threatens him as follows. A light pulley is suspended from the ceiling by a frictionless axle G. A light rope DEF passes from a small ring tied at D up and over the first pulley at E and down to suspend a second light pulley by its frictionless axle F. A second light rope CBA passes from the same small right tied at C up and over the second pulley at B and down to A, where Mickey hangs on. Mickey has a mass of 1 kg. Garfield, who has a mass of 5 kg, hangs from both ropes by holding the ring CD. Calculate the magnitude of Mickey's acceleration as a fraction of "g". (For full hand marked credit, include its direction.)

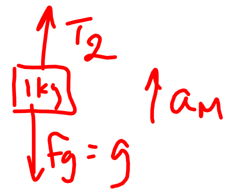


$a_m = 3a_G$

A) 0.234 B) 0.429 C) 0.571 D) 0.667 E) 1.714







$\Sigma F = 5g - T_1 - T_2 = 5a_G$

$\Sigma F = ☺$

$T_1 = 2T_2$

$\Sigma F = T_2 - 1g = 1a_M$

$T_2 - g = a_M$

$T_2 = a_M + g$

$5g - 3T_2 = \frac{5}{3}a_M$

$5g - 3a_M - 3g = \frac{5}{3}a_M$

$2g = \frac{14}{3}a_M$

$\frac{6}{14}g = a_M$

$\frac{3}{7}g =$

$\frac{3}{7} = 0.\overline{428571}$

$\frac{1}{1} = 1$

$\frac{1}{2} = 0.5$

$\frac{1}{3} = 0.\bar{3}$

$\frac{1}{4} = 0.25$

$\frac{1}{5} = 0.20$

$\frac{1}{6} = 0.1\bar{6}$

$\frac{1}{7} = 0.\overline{142857}$

$\frac{1}{8} = 0.125$

$\frac{1}{9} = 0.\bar{1}$

$\frac{1}{10} = 0.10$

$\frac{1}{11} = 0.\overline{09}$

$\frac{1}{12} = 0.08\bar{3}$

$\frac{1}{13} \approx 0.077$

$\frac{1}{14} = 0.0\overline{714285}$

$\frac{1}{15} = 0.0\bar{6}$

$\frac{1}{16} = 0.0625$

$\frac{1}{17} \approx 0.0575$

$\frac{1}{18} = 0.0\bar{5}$

$\frac{1}{19} \approx 0.053$

$\frac{1}{20} = 0.05$

$\frac{2}{11} = 0.\overline{18}$

$\frac{5}{11} = 0.\overline{45}$

$\frac{7}{11} = 0.\overline{63}$

$\pi^2 \approx g \approx 10$

9.86 9.807 10

$\sqrt{10} \approx \pi$

$\frac{2}{7} = 0.\overline{285714}$

$\frac{3}{7} = 0.\overline{428571}$

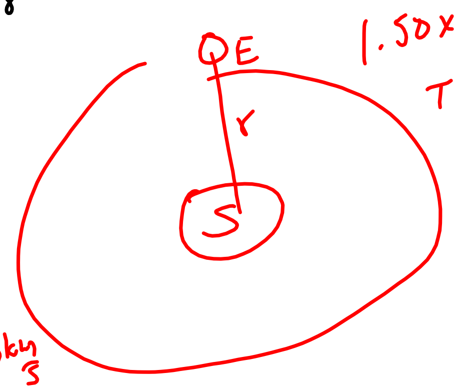
$\frac{4}{7} = 0.\overline{571428}$

$\frac{5}{7} = 0.\overline{714285}$

$\frac{6}{7} = 0.\overline{857142}$

1.50×10^{11} m

$T = 3.16 \times 10^{7}$ s



$v = \frac{2\pi r}{T}$

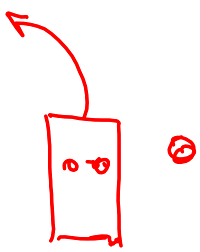
$= \frac{2\pi(1.5 \times 10^{11})}{3.16 \times 10^{7}}$

$= 3.0 \times 10^{4}$ m/s $= 30$ km/s

$= 29.8$ km/s

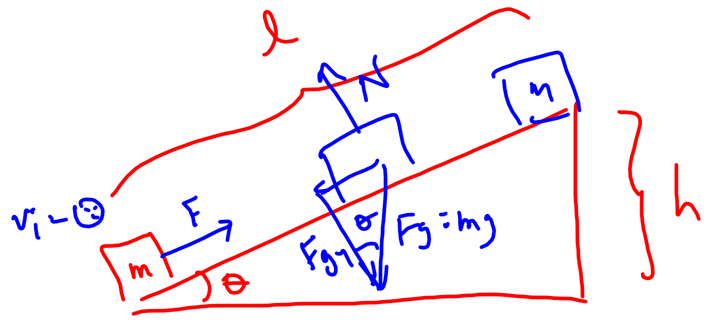
3.14...

3.16



Inclines and Energy

$\mu = \mu$



v at top of hill?

$$\cos\theta = \frac{\sqrt{\ell^2 - h^2}}{\ell}$$

$PE = 0$
$KE = 0$
$E_{T_i} = 0$

$+W - W_f$

$PE = mgh$
$KE = \frac{1}{2}mv^2$
$E_{T_f} = mgh + \frac{1}{2}mv^2$

$$E_{T_i} + W - W_f = E_{T_f}$$

$N = \mu mg\cos\theta$

$$F\ell - f\ell = mgh + \frac{1}{2}mv^2$$

$$F\ell - \mu mg\ell\cos\theta = mgh + \frac{1}{2}mv^2$$

$$F\ell - \frac{\mu mg\ell\sqrt{\ell^2 - h^2}}{\ell} = mgh + \frac{1}{2}mv^2$$

$$\sqrt{\frac{2\left(F\ell - \mu mg\sqrt{\ell^2 - h^2} - mgh\right)}{m}} = v$$