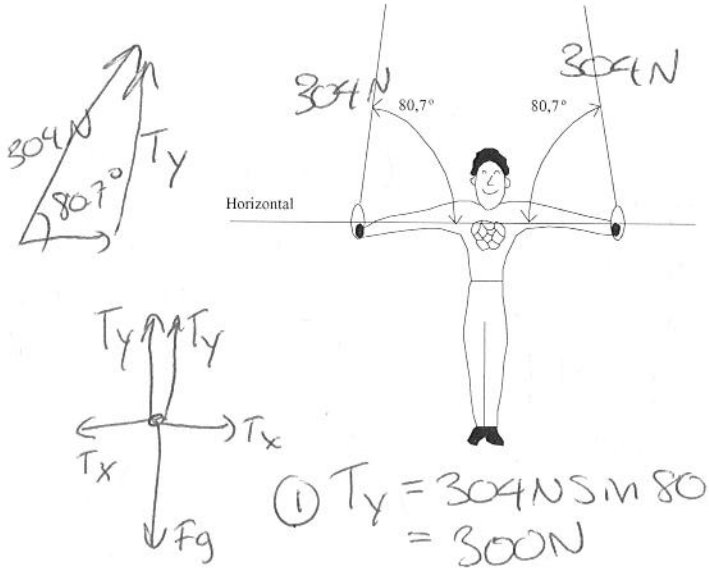
Physics 504 **QUIZ #1: ADVANCED FORCES** Name: Answers

1) A gymnast, in training for the Olympic Games, holds the position shown in the diagram below. The tension in each string is 304 N. **What is the mass of the gymnast?**



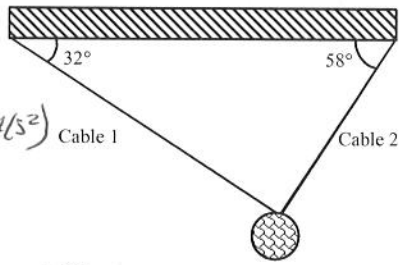
① $T_y = 304\,N \sin 80.7°$
$= 300\,N$

② $T_y + T_y = F_g$
$F_g = 300N + 300N$
$= 600\,N$

③ $F_g = mg$
$m = \frac{F_g}{g}$
$= \frac{600\,N}{9.8\,m/s^2}$

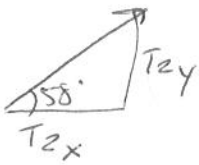
$m = 61.2\,kg$

2) The 100 kg suspended mass in the diagram below is stationary.

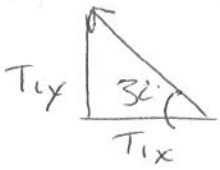


① $F_g = mg$
$= (100kg)(9.8\,m/s^2)$
$= 980\,N$

What is the tension in cables 1 and 2?

② 

$T_{2x} = T_2 \cos 58°$
$T_{2y} = T_2 \sin 58°$



$T_{1x} = T_1 \cos 32°$
$T_{1y} = T_1 \sin 32°$

③ $T_{1x} = T_{2x}$

$T_1 \cos 32° = T_2 \cos 58°$

$T_1 = \frac{T_2 \cos 58°}{\cos 32°}$

$T_1 = 0.625 T_2$

④ $T_{1y} + T_{2y} = F_g$

$T_1 \sin 32° + T_2 \sin 58° = 980\,N$

$(0.625 T_2) \sin 32° + T_2 \sin 58° = 980\,N$

$0.331 T_2 + 0.848 T_2 = 980\,N$

$1.179 T_2 = 980\,N$

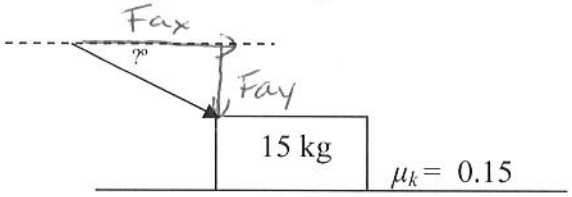
$T_2 = \frac{980\,N}{1.179}$

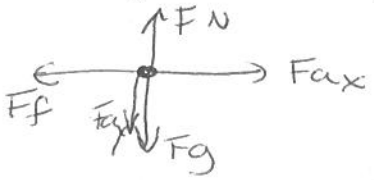
$T_2 = 831\,N$

⑤ $T_1 = 0.625 T_2$
$= 0.625 (831N)$

$T_1 = 519\,N$

3) A 15 kg box is pushed using a force at angle below the horizontal. The box accelerates at a rate of 4.15 m/s^2. The coefficient of friction between the box and the floor is 0.15, and the force of friction has a magnitude of 28.4 N. **With what angle is the box being pushed?**





① $F_g = mg$
$= (15kg)(9.8 m/s^2)$
$= 147N$

② $F_f = \mu F_N$
$F_N = \frac{F_f}{\mu}$
$= \frac{28.4N}{0.15}$
$= 189N$

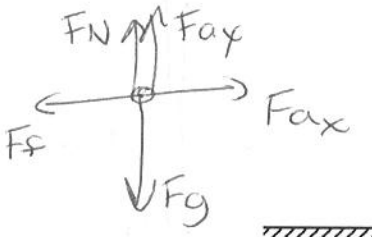
③ $F_N = F_{ay} + F_g$
$F_{ay} = F_N - F_g$
$= 189N - 147N$
$\boxed{F_{ay} = 42N}$

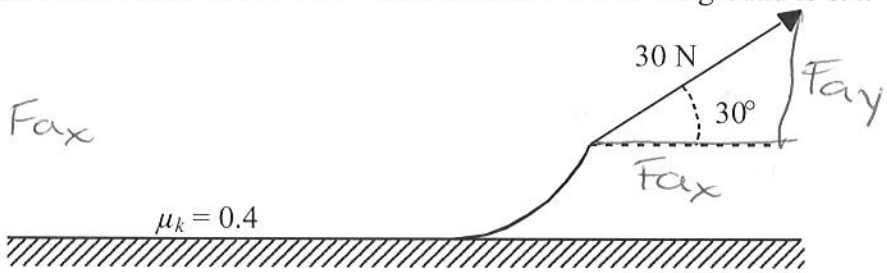
④ $F_{net} = ma$
$= (15kg)(4.15 m/s^2)$
$= 62.25N$

⑤ $F_{net} = F_{ax} - F_f$
$F_{ax} = F_{net} + F_f$
$= 62.25N + 28.4$
$\boxed{F_{ax} = 90.65N}$

⑥ $\theta = \tan^{-1}\left(\frac{F_{ay}}{F_{ax}}\right)$
$= \tan^{-1}\left(\frac{42}{90.65}\right)$
$\boxed{\theta = 25°}$

4) A 4.0 kg sled is pulled by a cord with a force of 30 N inclined at an angle of 30° to the horizontal. The coefficient of kinetic friction between the sled and the ground is 0.4.





What is the acceleration of the sled?

① $F_g = mg$
$= (4.0kg)(9.8 m/s^2)$
$= 39.2N$

② $F_{ax} = 30N \cos 30°$
$= 26N$

$F_{ay} = 30N \sin 30°$
$= 15N$

③ $F_g = F_N + F_{ay}$
$F_N = F_g - F_{ay}$
$= 39.2N - 15N$
$= 24.2N$

④ $F_f = \mu F_N$
$= (0.4)(24.2N)$
$= 9.68N$

⑤ $F_{net} = F_{ax} - F_f$
$= 26N - 9.68N$
$= 16.32N$

⑥ $F_{net} = ma$
$a = \frac{F_{net}}{m}$
$= \frac{16.32N}{4.0kg}$
$\boxed{a = 4.08 m/s^2}$