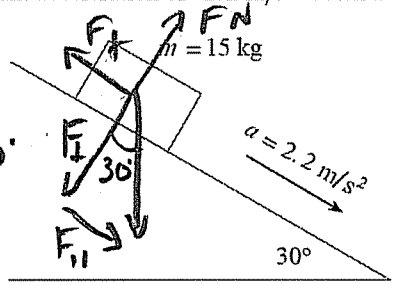
PHYSICS 12

NAME: _____

Incline Problems

1. A 15 kg block has a constant acceleration of 2.2 m/s^2 down a 30° incline.



$F_\perp = mg\cos\theta$
$= (15)(9.8)\cos 30°$
$= 127.3\,N$

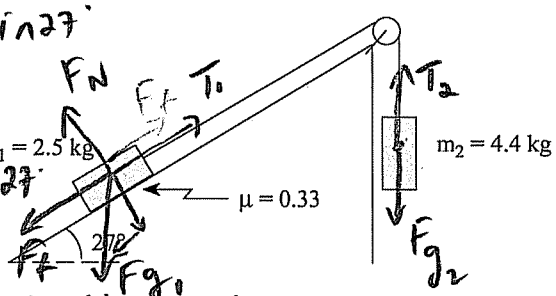
$F_{net} = F_{||} - F_f$
$ma = F_{||} - F_f$
$(15)(2.2) = 73.5N - F_f$

What is the magnitude of the friction force on the block?

$F_f = 40.5\,N$

$F_{||} = mg\sin\theta$
$= (15)(9.8)\sin 30°$
$= 73.5\,N$

2. Two masses are connected by a light string which passes over a frictionless pulley as shown. The coefficient of friction between the 2.5 kg mass and the surface is 0.33.



$F_{g_{||}} = 2.5(9.8)\sin 27°$
$= 11.1\,N$

$F_{g_\perp} = 2.5(9.8)\cos 27°$
$= 21.8\,N$

$F_f = \mu F_N$
$= \mu F_{g_\perp}$
$= (.33)(21.8\,N)$
$= 7.2\,N$

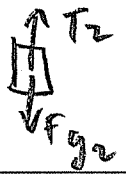
$F_{g_2} = m_2 g$
$= (4.4)(9.8)$
$= 43.1\,N$

a) Find the acceleration of the system of masses. **(7 marks)**

$F_{net} = F_{g_2} - T_2 + T_1 - F_f - F_{g_{||}}$
$ma = 43.1N - 7.2N - 11.1N$
$(6.9)a = 24.82$
$a = 3.60\,m/s^2$

b) Find the tension in the string

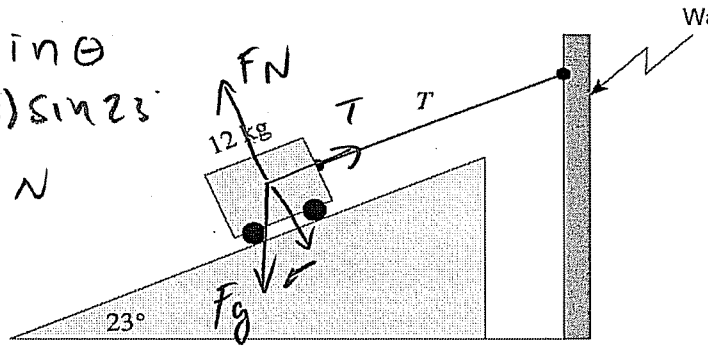
Isolate m_2



$F_{net} = F_{g_2} - T_2$
$4.4(3.6) = 43.1 - T_2$
$T_2 = 27.3\,N$

3. A 12 kg cart on a 23° frictionless incline is connected to a wall as shown.

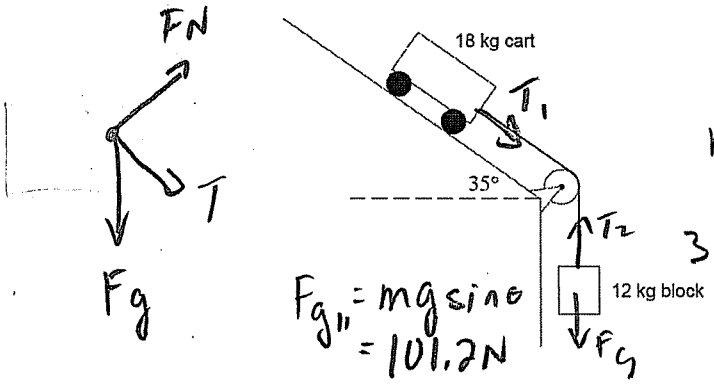
$F_{g\parallel} = mg\sin\theta$
$= (12)(9.8)\sin 23$
$= 45.9\ N$



$F_{net} = F_{g\parallel} - T$
$12(0) = F_{g\parallel} - T$
$T = F_{g\parallel}$
$= 45.9N$

What is the tension T in the cord?

4. An 18 kg cart is connected to a 12 kg hanging block as shown. (Ignore friction.)



$F_{g\parallel} = mg\sin\theta$
$= 101.2N$

$F_{Net} = F_{g\parallel} + T_1 - T_2 + F_{g_2}$
$ma = 101.2 + 12(9.8)$
$30a = 218.8$
$a = 7.29\ m/s^2$

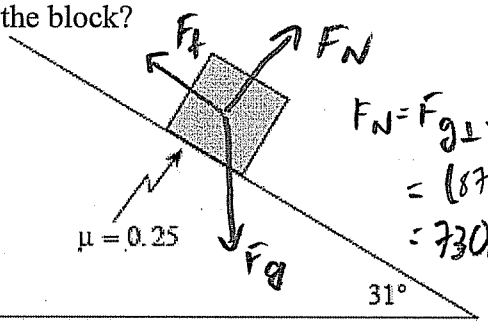
a) Draw and label a free body diagram for the 18 kg cart. **(2 marks)**

b) What is the magnitude of the acceleration of the cart? **(5 marks)**

5. An 87 kg block slides down a 31° slope as shown in the diagram below. The coefficient of friction between the block and the surface is 0.25. What is the acceleration of the block?

$F_{net} = F_{g\parallel} - F_f$
$ma = 439N - 183N$
$87(a) = 256$
$a = 2.94\ m/s^2$

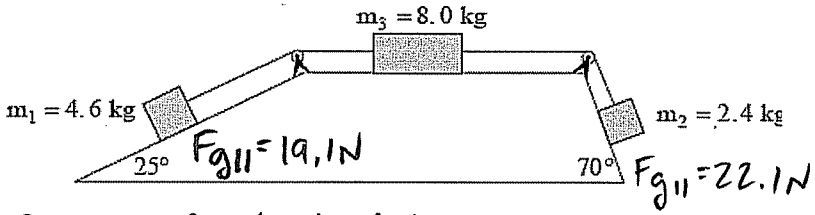
$F_{g\parallel} = mg\sin\theta$
$= 439.1$
$F_f = \mu F_N$
$= .25(730.8)$
$= 183N$



$F_N = F_{g\perp} = mg\cos\theta$
$= (87)(9.8)\cos 31$
$= 730.8N$

6. Three masses connected by a light string are arranged on frictionless surfaces, as shown in the diagram below. The strings pass over frictionless pulleys. Determine the direction and magnitude of the acceleration of $\mathbf{m_1}$.

	DIRECTION OF $\mathbf{m_1}$	ACCELERATION (m/s^2)
A.	up incline ✓	0.20 ✓
B.	down incline	0.20
C.	up incline ✓	0.43
D.	down incline	0.43



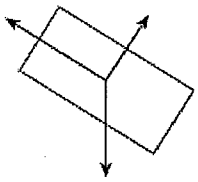
$F_{g11} = 19.1N$

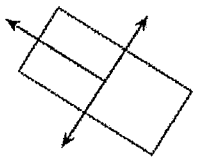
$F_{g11} = 22.1N$

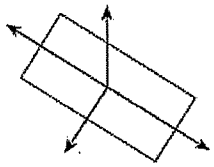
$F_{net} = 22.1N - 19.1N$

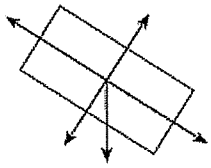
$(15kg)(a) = 3N \quad a = 0.20 m/s^2$

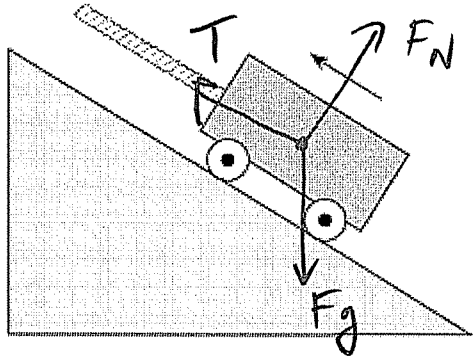
7. The diagram below shows a cart being pulled up a frictionless slope by a rope. Which of the following **best** represents the free body diagram for the cart?

A. 

B. 

C. 

D. 



8. A 4.0 kg block has a speed of 9.0 m/s at **X**.

What is the maximum distance, *d*, travelled by the block? Ignore friction.

A. 0.92 m
B. 1.6 m
C. 4.1 m
D. 7.2 m

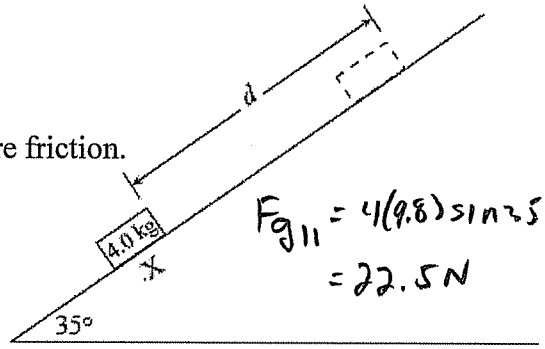
$F_{net} = F_{g11}$

$4(a) = 22.5N$

$a = 5.62 m/s^2$ (down ramp)

$V_f^2 = V_0^2 + 2ad$.

$0 = 9^2 + 2(-5.62)d \quad , d = 7.2m$



$F_{g11} = 4(9.8)\sin 35°$

$= 22.5N$

9. A 2.0 kg block is sliding down a 15° incline. The coefficient of friction is 0.62. At some position the block has a speed of 7.0 m/s. What distance *d* will this block move before coming to rest?

A. 2.5 m
B. 4.0 m
C. 4.2 m
D. 7.4 m

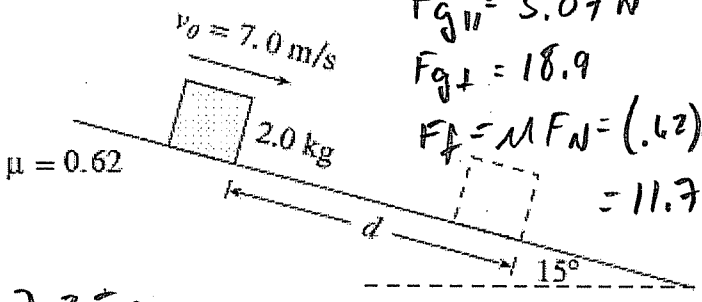
$F_{net} = F_{g11} - F_f$

$2(a) = 5.07 - 11.7$

$a = -3.33 m/s^2$

$V_f^2 = V_0^2 + 2ad$

$0 = 7^2 + 2(-3.33)d \quad d = 7.35m$



$F_{g11} = 5.07N$

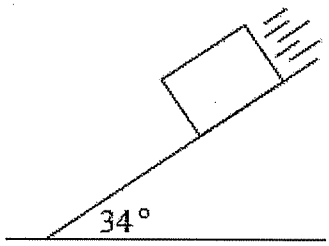
$F_{g\perp} = 18.9$

$F_f = \mu F_N = (.62)(18.9)$

$= 11.7$

10. A 5.0 kg concrete block accelerates down a 34° slope at 4.2 m/s^2. Find the coefficient of friction between the block and the slope.

A. 0.13
B. 0.16
C. 0.43
D. 0.67



$F_{net} = F_{g\parallel} - F_f$

$ma = F_{g\parallel} - F_f$

$5(4.2) = 27.4 - F_f$

$F_f = 6.4N = \mu F_N$

$F_{g\parallel} = mg\sin\theta = 27.4N$

$F_{g\perp} = mg\cos\theta = 40.6$

$F_N = 40.6$

$\mu = \frac{F_f}{F_N} = \frac{6.4}{40.6} = .157$

Answers: 1. 41 N , 2. 3.6m/s^2, 27.3 N , 3. 46 N , 4. 7.3m/s^2 , 5. 2.9 m/s^2 , 6. A , 7. A , 8. D , 9. D , 10. B