P12 Unit 2 – Newton, Friction, Gravity – Worksheet #1

KEY

Name: _____

1. Weight is measured in _____ and also called _____

2. If you go to the moon, which changes, mass or weight?

→ mass is the amount of matter, it would only change if I chainsawed off a body part.

3. The two names for "g" are . . .

- accel due to gravity.
- gravitational field strength.

4. Write out Newton's three laws. If you can't remember them Google is your friend.

5. The coefficient of friction usually has a range of Approx. 0.001 — 0.99. The coefficient of friction represents …

Slippery surfaces have a coefficient around low 0.1 and grippy surfaces have a coefficient of around high 0.7 plus.

6. Calculate your weight in Newtons.

Take your made up weight in pounds, divide by 2.2 to get kilograms.

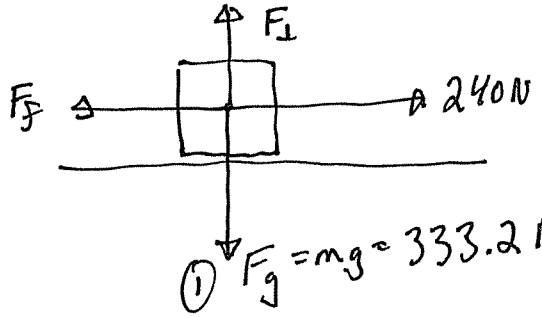
Multiply by 9.8 to get Newtons. Show your calculations.

7. Weight 5 common objects in pounds or grams or kilograms and then calculate the weight in Newtons. Show your calculations for each object. Two need to be smaller than a loaf of bread, one needs to be bigger than you.

8. Take a book, find on in the classroom. Find a force scale, use a loop of string and drag the book across the desk at a steady speed, this is your force of friction. Weigh the book, this is your Fg. Calculate the coefficient of friction.

Next take a piece of paper and put it under the book, re test for a new force of friction and re calculate the coefficient of friction. Show all your working.

9. A 34 kg block is pulled across a desk at a by a 240 N to the right. The coefficient of friction is 0.22. Calculate the acceleration.



① $F_g = mg = 333.2\ N$

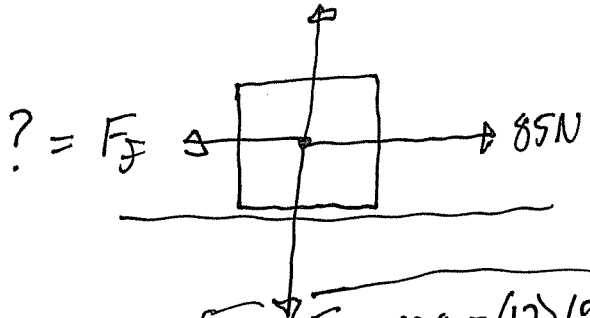
② $F_f = \mu F_\perp = \mu F_g = (.22)(333.2) = 73.304$

③ $F_{NET} = 240 - 73.304 = 166.696$

④ $accel = a = F/m = \frac{166.696}{34}$

$a = 4.90\ m/s^2$

10. A 12 kg block is pulled across a desk with a 85 N force. The block accelerates at 2.6 m/s^2. Find the force of friction on the block and the coefficient of friction.



① $F_{NET} = ma = (12)(2.6) = 31.2\ N$

② $F_g = mg = (12)(9.8) = 117.6 = F_\perp$

③ $F_{NET} = 85 - F_f$

$31.2 = 85 - F_f$

$F_f = 53.8\ N$

④ $F_f = \mu F_\perp \quad \mu = \frac{F_f}{F_g} = \frac{53.8}{117.6} = .457$

1200 kg

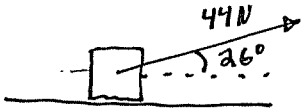
11. A car travelling at 22 m/s slams on it brakes and comes to rest in 76 m. Find the friction force needed to cause this acceleration. Find the coefficient of friction required.

$a = ?$ ① $V_f^2 = V_i^2 + 2ad$

$a = \frac{V_i^2}{2d} = \frac{22^2}{2 \times 76} = 3.1842 \text{ m/s}^2.$

② $F_{NET} = ma = (1200)(3.1842) = 3821 \text{ N}$

12. A 5 kg block is pulled to the right by a 44 N force angled at 26 degrees above the horizon. Calculate the acceleration.

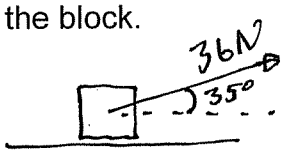


① $F_x = 44 \cos 26° = 39.547 \text{ N} = F_{NET}$

② $a = \frac{F_N}{m} = \frac{39.547}{5} = 7.9094 \text{ m/s}^2.$

$= 7.91 \text{ m/s}^2.$

13. A 3 kg block is pulled to the right by a 36 N force angled at 35 degrees above the horizon. The coefficient of friction is 0.24. Calculate the acceleration of the block.



① $F_x = 36 \cos 35 = 29.489 \text{ N}$ $F_y = 36 \sin 35 = 20.649 \text{ N}$

② $F_g = mg = (3)(9.8) = 29.4 \text{ N}$

③ $F_{up} = F_{down}$

$F_\perp + F_y = F_g$

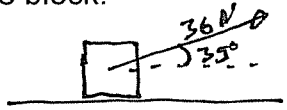
$F_\perp = 29.4 - 20.649 = 8.7512 \text{ N}$

④ $F_f = \mu F_\perp = (.24)(8.7512) = 2.100 \text{ N}.$

⑤ $F_{NET} = F_x - F_f = 29.489 - 2.100 = 27.389$

⑥ $a = \frac{F_{NET}}{m} = \frac{27.389}{3} = 9.13 \text{ m/s}^2.$

14. A 6 kg block is pulled to the right by a 36 N force angled at 35 degrees above the horizon. The coefficient of friction is 0.78. Calculate the acceleration of the block.



① $F_g = mg = 58.8\ N$

② $F_x = 36\cos 35° = 29.489\ N$ $F_y = 36\sin 35 = 20.649\ N$

③ $F_\perp = ?$ $F_{up} = F_{down}$

$F_y + F_\perp = F_g$

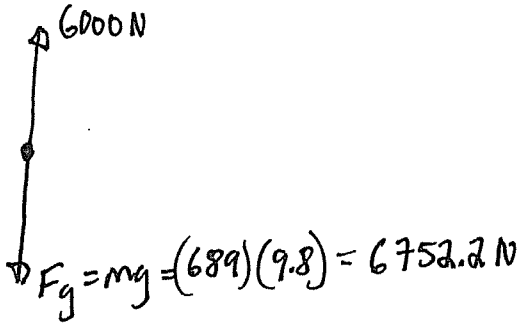
$20.649 + F_\perp = 58.8$

$F_\perp = 38.151\ N$

④ $F_f = \mu F_\perp = (.78)(38.151) = 29.757\ N$.

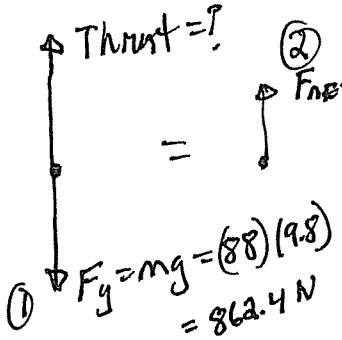
⑤ $F_f > F_x$ so no NET FORCE. $\therefore$ accel $= 0$!

15. A 689 kg rocket sitting on the launch pad has thrust of 6000 N. Find the acceleration of the rocket.



Not enough thrust to get off launch pad!

16. A 88 kg missile needs to have an acceleration upwards of 78 m/s^2. Find the required thrust.



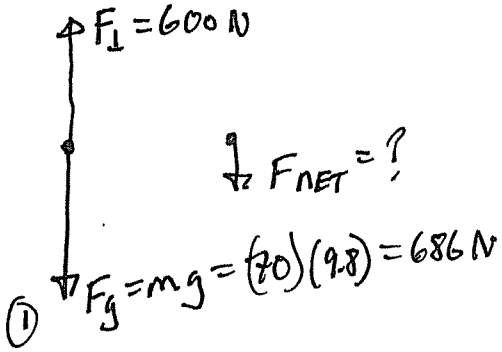
② $F_{NET} = ma = (88)(78) = 6864\ N$.

③ $F_{NET} = \text{Thrust} - F_g$

$6864 = \text{Thrust} - 862.4$

$\text{Thrust} = 7726.4\ N$

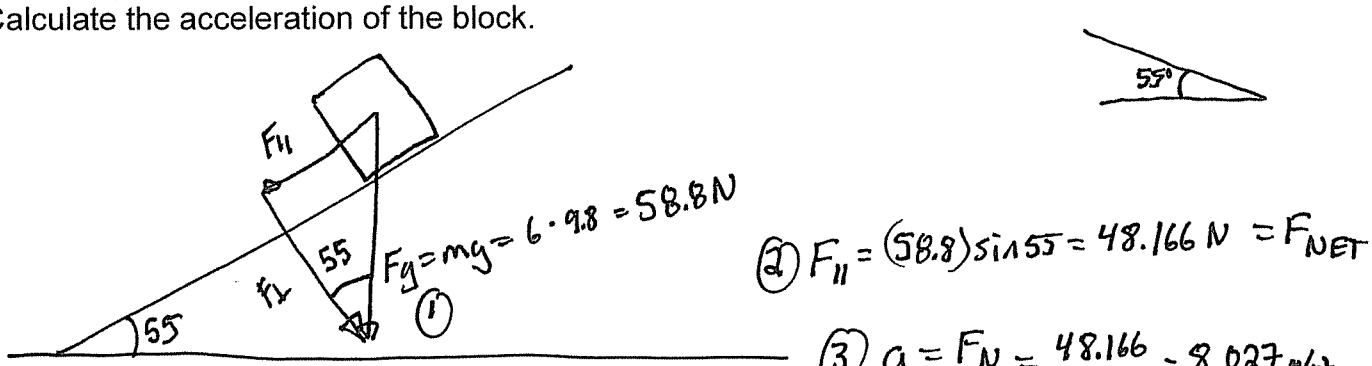
17. A 70 kg person riding in an elevator is standing on a scale. When the elevator starts to move the scale reads 600 N. Calculate the acceleration of the elevator.



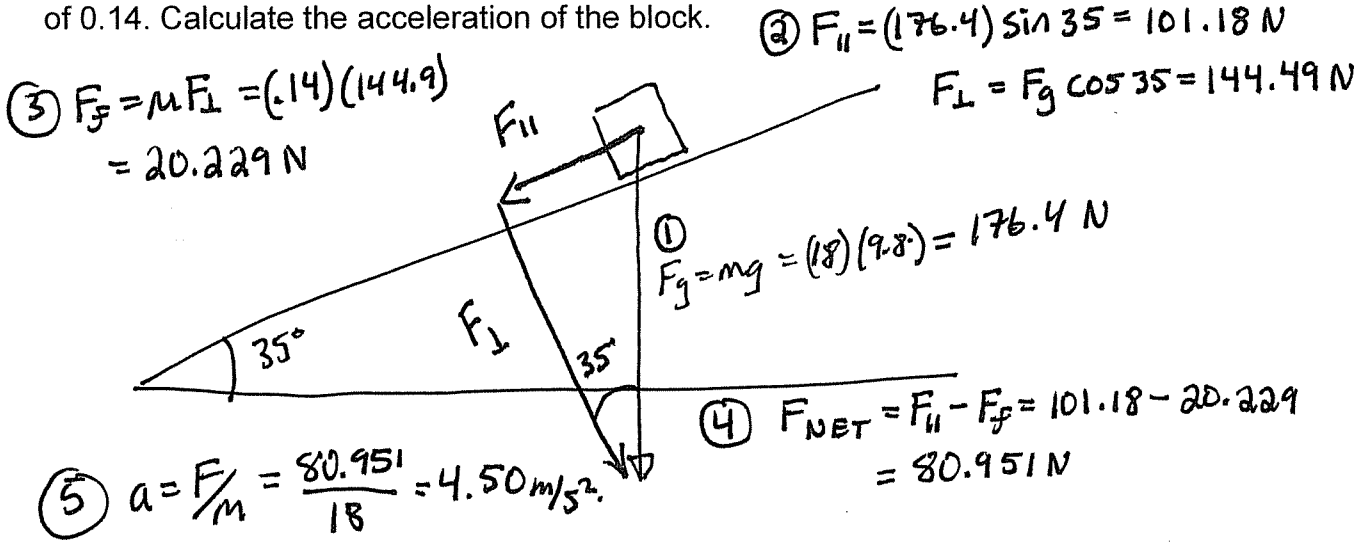
② $F_{NET} = 686 - 600 = 86\ N$

③ $a = \frac{F_N}{m} = \frac{86}{70} = 1.23\ m/s^2$.

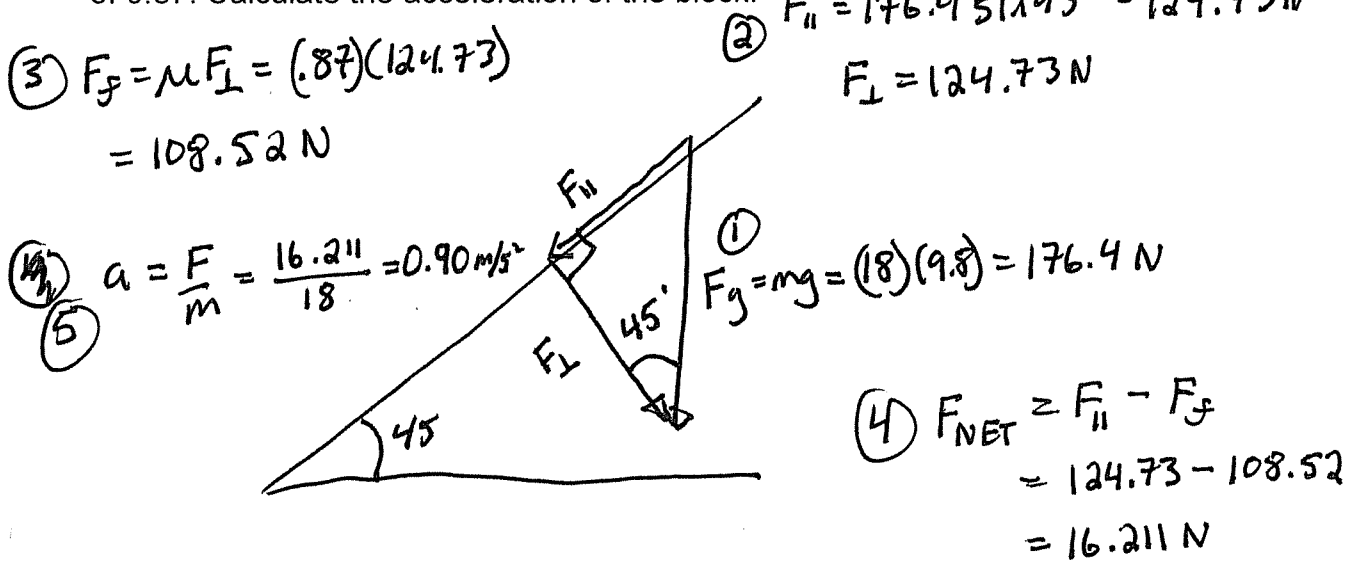
18. A 6 kg block is sitting on a slope tilted up at 55 degrees with no friction present. Calculate the acceleration of the block.



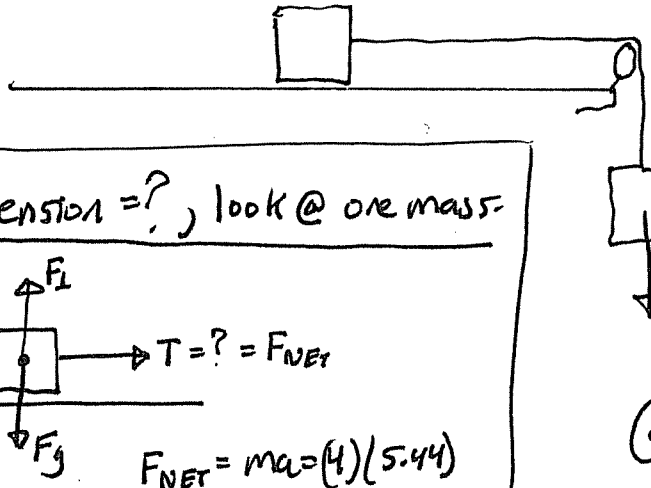
19. A 18 kg block is sitting on a slope tilted up at 35 degrees with a coefficient of friction of 0.14. Calculate the acceleration of the block.



20. A 18 kg block is sitting on a slope tilted up at 45 degrees with a coefficient of friction of 0.87. Calculate the acceleration of the block.



21. A 4 kg block is sitting on a flat frictionless table and attached to a 5 kg block hanging over a table. Calculate the acceleration of the system and the tension in the cord.



Tension = ? , look @ one mass

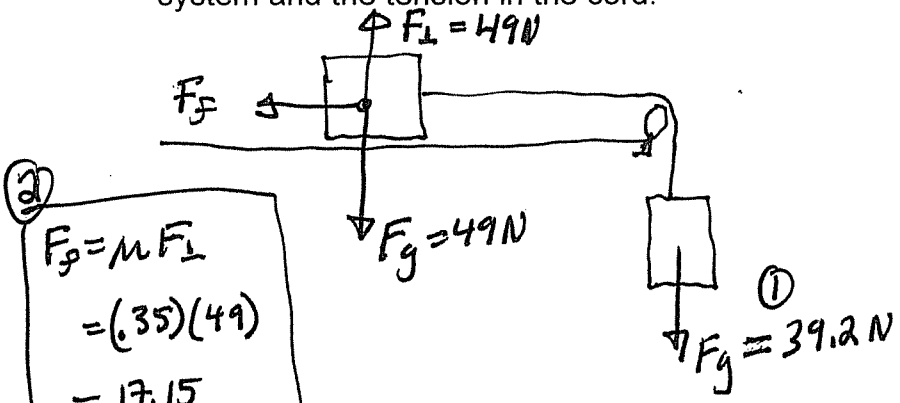
$F_{NET} = ma = (4)(5.44)$

$T = 21.8\ N$

① $F_g = mg = (5)(9.8) = 49\ N = F_{NET}$

② $a = \frac{F}{m} = \frac{49}{9} = 5.44\ m/s^2$

22. A 5 kg block is sitting on a flat table with a coefficient of friction of 0.35, a 4 kg block is hanging over the table and is attached by a light cord. Calculate the acceleration of the system and the tension in the cord.



② $F_f = \mu F_\perp$
$= (.35)(49)$
$= 17.15$

③ $F_{NET} = 39.2 - 17.15$
$= 22.05\ N$

④ $a = \frac{F_N}{m} = \frac{22.05}{9} = 2.45\ m/s^2$

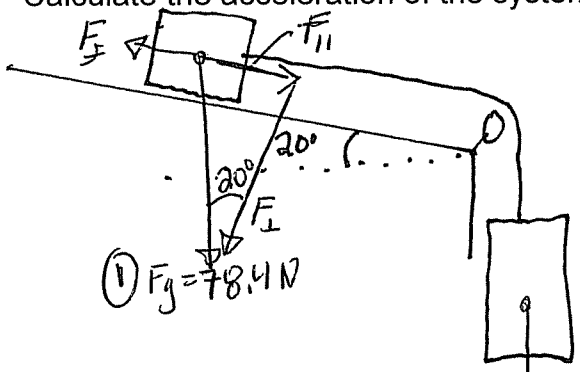
Tension = ? Look @ one mass

$F_{NET} = ma = (4)(2.45)$
$= 9.8$

$F_{NET} = 39.2 - T$

$T = 39.2 - 9.8 = 29.4\ N$

23. A 8 kg block is sitting on a table titled up at angle of 20 degrees with a coefficient of friction of 0.35, a 18 kg block is hanging over the table and is attached by a light cord. Calculate the acceleration of the system and the tension in the cord.



② $F_{11} = (78.4)\sin 20° = 26.814$ N

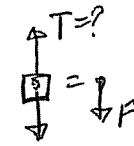
$F_\perp = (78.4)\cos 20° = 73.671$ N

③ $F_f = \mu F_\perp = (.35)(73.671) = 25.785$ N

④ $F_{NET} = F_g - F_f + F_{11}$
$= 176.4 - 25.785 + 26.814$
$= 177.43$ N

① $F_g = 176.4$ N

Tension, look @ one mass



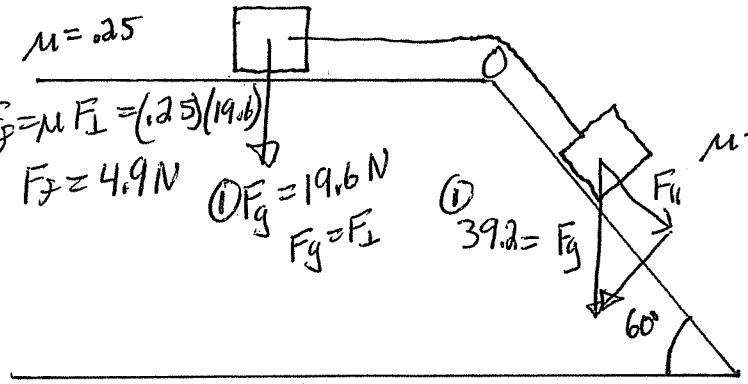
$F_{NET} = ma = (18)(6.82) = 122.84$ N

$F_{NET} = 176.4 - T$

$T = 176.4 - 122.84 = 53.6$ N

⑤ $a = \frac{F_N}{m} = \frac{177.43}{26} = 6.82\ m/s^2$

24. A 2 kg block is sitting on a flat table with a coefficient of friction of 0.25, a 4 kg block is on another table tilted up at 60 degrees and is attached by a light cord. Calculate the acceleration of the system and the tension in the cord.



② $F_f = \mu F_\perp = (.25)(19.6)$

$F_f = 4.9$ N

① $F_g = 19.6$ N

$F_g = F_\perp$

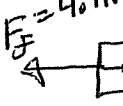
① $39.2 = F_g$

③ $F_{11} = (39.2)(\sin 60°) = 33.948$ N

④ $F_{NET} = F_{11} - F_f$
$= 33.948 - 4.9 = 29.048$ N

⑤ $a = \frac{F_N}{m} = \frac{29.048}{6} = 4.84\ m/s^2$

Tension



$F_{NET} = ma$
$= (2)(4.84) = 9.68$ N

$F_{NET} = T - F_f$

$9.68 = T - 4.9$

$T = 14.6$ N