Inclined Planes

Directions: Show the solutions (i.e. your work) to these on a separate sheet of paper. The answers on the side use the convention that positive (+) is up the plane, and negative (-) down. F|| is the component of the weight parallel to the plane, and Fperp is the component perpendicular.

|  |  |
| --- | --- |
| a) 12.1 N, 17.3 N  b) -5.63 m/s/s (down)  c) +12.1 N (up) | 1. A 2.15 kg block of wood is on a frictionless inclined plane that makes an angle of 35.0o with the horizontal. a) Find F||, and Fperp b) If the block is released on the plane, what will be its acceleration down the plane? c) What force in what direction would prevent it from accelerating down the plane? |
| a) 36 N, 33 N  b) -7.2 m/s/s (down)  c) 1.9 s  d) +58 N (up)  e) +13 N (up) | 2. A 5.00 kg block of wood is on a frictionless 13 m long inclined plane that makes an angle of 47o with the horizontal. a) Find F||, and Fperp b) If the block is released on the plane, what will be its acceleration down the plane? c) What time will it take to slide down the plane if it is released at the top from rest? d) What force in what direction will make the block accelerate up the plane at 4.50 m/s/s? e) What force in what direction will make the block accelerate down the plane at 4.50 m/s/s? |
| a) -5.6 m/s/s (down)  b) +2.2 m (up)  c) 1.8 s | 3. A block of Spam is on a frictionless inclined plane that makes an angle of 35o with the horizontal. a) If the Spam is released on the plane, what will be its acceleration down the plane? If the Spam is given a velocity of 5.0 m/s up the plane, b) how far up the plane will the block slide before coming back down, and c) what time will it take for the block to come back down to where it was released? |
| a) -7.2 m/s/s (down)  b) .94 s | 4. A thing is on a frictionless 3.2 m long inclined plane that makes an angle of 47o with the horizontal. a) If the thing is released on the plane, what will be its acceleration down the plane? b) What time will it take to slide down the plane if it is released at the top from rest? |
| a) 26.0 N, 41.6 N, 27.9 N, 14.1 N  b) No, +26.0 N (up)  c) -1.9 N (down)  d) -2.37 m/s/s (down)  e) +53.9 N (up)  f) -29.7 N (down)  g) +52.9 N (up) | 5. A 5.00 kg block of wood is on an inclined plane that makes an angle of 32.0o with the horizontal. There is a static coefficient of friction of .670 and a kinetic of .340 between the block and the plane. a) Find F||, Fperp, maximum Ffstatic, and Ffkinetic b) If the block is initially at rest on the plane, will it start to slide down the plane all by itself? What is the force of static friction that exists between the plane and the block when the block is at rest on the plane? c) What additional force is needed to make the block start to slide down the plane? d) Once it is started down the plane, what is its acceleration down the plane (with no applied force)? e) What force is needed to make the block start sliding up the plane if it is initially at rest? f) What force would make the block slide down the plane with an acceleration of 8.30 m/s/s(down the plane)? g) What force would make the block slide up the plane with an acceleration of 2.55 m/s/s(up the plane)? |
| a) 96 N, 68 N, 57 N, 44 N  b) Yup  c) -4.4 m/s/s (down)  d) +150 N (up)  e) +35 N (up)  f) +2.1 x 102 N (up) | 6. A 12.0 kg block of wood is on an inclined plane that makes an angle of 55o with the horizontal. There is a static coefficient of friction of .85 and a kinetic of .65 between the block and the plane. a) Find F||, Fperp, maximum Ffstatic, and Ffkinetic b) If the block initially at rest on the plane, will it start to slide down the plane all by itself? c) Once it is started down the plane, what is its acceleration down the plane? d) What force is needed to make the block start sliding up the plane if it is initially at rest? e) What force would make the block slide down the plane with an acceleration of 1.50 m/s/s(down the plane)? f) What force would make the block slide up the plane with an acceleration of 5.4 m/s/s(up the plane)? |
| a) -79.6 N (down)  b) .486  c) -4.45 m/s/s (down)  d) +436 N (up) | 7 It takes a force of 275 N to slide a 26.0 kg box up a 50.0o inclined plane at a constant velocity. a) What is the force of friction opposing the motion? b) What is the coefficient of friction between the box and the plane? c) If the box were to slide freely down the plane, what would be its acceleration? d) What force would make the box slide up the plane with an acceleration of 6.2 m/s/s(up the plane)? |
| a) Nope  b) -1.1 m/s/s (down)  c) +1.3 m (up)  d) 2.2 s  e) -1.7 m/s (down) | 8. A piece of candy is on an inclined plane that makes an angle of 23o with the horizontal. There is a static coefficient of friction of .72 and a kinetic of .30 between the candy and the plane. a) If the candy is initially at rest on the plane, will it start to slide down the plane all by itself? b) Once it is started down the plane, what is its acceleration down the plane? If it is given a shove up the plane at 4.15 m/s, c) how far up the plane does it go, d) and what time does it take from when it is shoved up the plane, to when it gets back down to the bottom? (assuming it does not stick at the top), and e) what is its velocity when it returns? |
| a) .662 | 9. A crate is sliding at 3.20 m/s down a 27.6o plane and is stopped by friction in a distance of 4.22 m. a) What is the coefficient of friction between the crate and the plane? |
|  | 10 – 14 are questions like the skill set and the problems on the test. |
| 32.7 N up the plane | 10. A 4.59 kg mass accelerates at 2.61 m/s/s up a 21.0o incline where the coefficient of kinetic friction is 0.110. (It is sliding up the plane) What other external force must be acting along the plane for this to happen? What direction is the force? |
| -0.383 m/s/s (Down the plane) | 11. A 6.23 kg mass is on a 15.0o incline with a kinetic coefficient of friction of .120. What is the acceleration of the mass if there is an external force of 6.35 N acting up the plane as it slides down the plane? What direction is the acceleration? |
| 9.77 N up the plane | 12. A 6.10 kg mass accelerates at 2.59 m/s/s down a 33.0o incline where the coefficient of friction is 0.140. What force must be acting along the plane for this to happen? What direction is the force? |
| -4.37 N (Down the plane) | 13. A 2.94 kg mass (sliding down the plane) accelerates at 4.69 m/s/s down a 31.0o incline when there is a coefficient of kinetic friction of .220. What other external force must be acting along the plane for this to happen? What direction is the force? |
| -5.87 m/s/s (down the plane) | 14. A 3.21 kg mass slides down a 36.0o incline where there is a coefficient of kinetic friction of 0.150. What is its acceleration if there is an external force of 4.16 N acting down the plane? What direction is the acceleration? |

Pulleys and Equilibrants

Directions: Show the solutions (i.e. your work) to these on a separate sheet of paper.

|  |  |  |
| --- | --- | --- |
| a) 44.4 N, 1.92 m/s/s  b) 9.81 N, 0.00382 m/s2  c) 9.79 N, 9.79 m/s/s  d) 16.6 kg  e) 47.8 N, 1.32 m/s/s | B    A | **5. The plane and pulley are frictionless**  **for a) – d). e) has a bit o’ friction**  a) If A has a mass of 23.1 kg, and B has a mass of 5.63 kg, what is the tension in the string, and the acceleration of the system?  b) If A has a mass of 2567 kg, and B has a mass of 1.00 kg, what is the tension in the string, and the acceleration of the system?  c) If A has a mass of 1.00 kg, and B has a mass of 500. kg, what is the tension in the string, and the acceleration of the system?  d) If A has a mass of 35.0 kg, What does Bneed to be so that the system has an acceleration of 3.15 m/s/s?  e) Answer part a) with a coefficient of friction of 0.0759 between block A and the plane. |
| a) 2.8 m/s/s, 35 N  b) -0.48 m/s/s, 18 N  c) 3.55 kg  d) 7.5 kg |  | **6. The plane and pulley are frictionless.**  a) If A and B both have a mass of 5.0 kg, and the plane makes an angle of 25o with the horizontal, what is the acceleration and the tension in the cable?  b) Solve as in problem a), but give A a mass of 5.0 kg, and B a mass of 1.78 kg.  c) Suppose A has a mass of 4.51 kg, and accelerates from rest 3.27 m up the ramp in 1.81 seconds. What must the mass of B be? (use 25.0o)  d) If the plane angle is 30o and A is 15 kg, what should the mass of B be to prevent acceleration? |

|  |  |  |
| --- | --- | --- |
| a) 6.43 m/s/s 14.6 N  b) .468 kg  c) 27.2 N |  | **7. The plane and pulley are frictionless, and the plane makes an angle of 21.0o with horizontal.**  a) If A has a mass of 5.00 kg, and B 4.30 kg, what are the acceleration and the tension in the cable?  b) If A has a mass of 3.12 kg, and the tension in the cable is 2.56 N, what must the mass of B be?  c) Using the masses from part a), suppose you observed an acceleration of only 3.50 m/s/s. What frictional force must exist between A and the plane? (assume the plane is not frictionless) |
| A = 606 N  B = 299 N |  | 8. Cable A makes an angle of 63.0o with the horizontal, and B makes an angle of 23.0o with the horizontal. What is the tension in each cable for there to be no acceleration of the system? |
| 23.16 N At 292.8o (Trig) (23 and 290 with SF) |  | 10. Find the third force (the equilibrant) that would prevent the system from accelerating. |
| 6.000 N At 348.9o (Trig) (6.0 and 350 with SF) |  | 11. Find the third force (the equilibrant) that would prevent the system from accelerating. |