

Worksheet 3.1

Forces in 2D and 1D Review

1) A 75 kg criminal wants to escape from the 5th storey window of the jail, 24 m above the ground. He has a rope but it can only support a tension force of 650 N.

- a. What is the maximum acceleration he can have as he lowers himself? (1.1 m/s²)
- b. How fast is he traveling when he hits the ground below? (7.3 m/s)

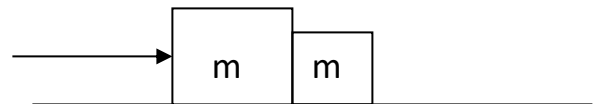
2) A working boy pushes a 15 kg lawnmower at constant speed with a force of 90.0 N directed along the handle which is at an angle of 30° below the horizontal.

- a) Calculate the friction force the boy is overcoming. (78 N)
- b) Calculate the normal reaction force on the mower from the ground. (1.9 x 10² N)

BONUS) Calculate the coefficient of friction between the mower wheels and the ground. (0.41)

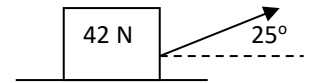
BONUS 2) Calculate how hard the boy would have to push on the handle to give the mower an acceleration of 0.80 m/s². (1.1 x 10² N)

3) Two blocks (m₁ = 6.8 kg, m₂ = 5.2 kg) are in contact with each other while sitting on a frictionless surface as shown in the diagram. A horizontal force of 85 N is applied to m₁.



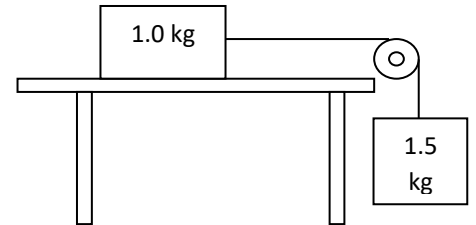
- a. What is the acceleration of the system? (7.1 m/s²)
- b. What is the force that m₁ exerts on m₂? (37 N)

4) A 42 N block is pulled along a horizontal surface by a force of 28 N as shown. What is the normal force on the block? If the coefficient of friction is 0.256, what is the acceleration of the block?

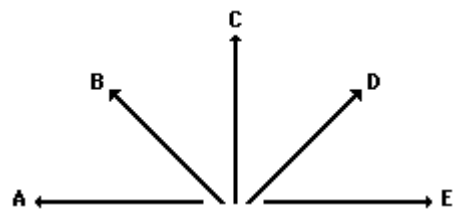


- (30. N)
- (4.1m/s²)

5) A 1.0kg box on a frictionless surface is attached to a 1.5 kg box as shown. What is the acceleration of the 1.0 kg box? (5.9 m/s²)



6) Consider the following five force vectors. Sketch the following and draw the resultant (R). Do not draw a scaled vector diagram; merely make a sketch. Label each vector. Clearly label the resultant (R).

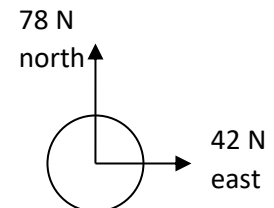


- i) B + D
- ii) E + B
- iii) A + C + D

iv) B + E + D

7) A 2.4 kg soccer ball is kicked by two players simultaneously as shown.

- a. Find the force on the ball. (89 N 28° E of N)
- b. Find the ball's acceleration. (37 m/s² 28° E of N)



8) Two children pull a third child on a toboggan (shown from the top, assume up is north). If they pull on ropes that are parallel to the ground determine the magnitude of the force exerted on the toboggan.

[174 N, 6.3° S of E]

