Practice Problems

name: SOLUTIONS

Force / Work

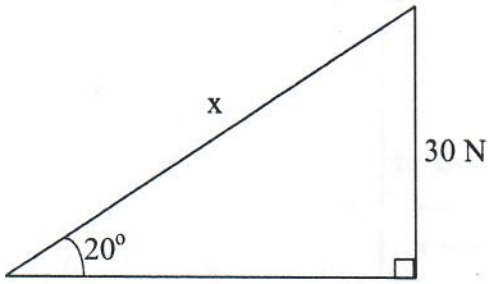
1) a) What is the mass your mass on the Earth's surface? 65 Kg } Answers will vary

   b) What is your mass on the surface of the moon? 65 Kg

2) a) What is the weight of a 32kg child on the Earth's surface? 313.6N (32 • 9.8)

   b) What is the weight of a 32kg child on the moon's surface? 53.4N (32 • 1.67)

3) Use trigonometry to solve for x

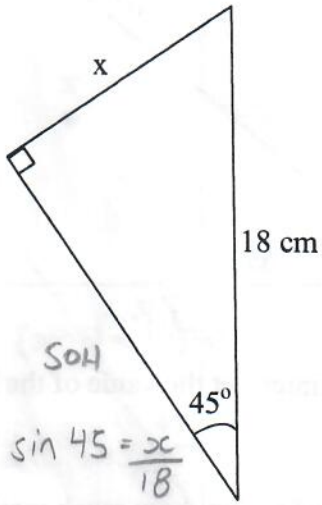


SOH

$\sin 20 = \frac{30}{x}$

$0.342 = \frac{30}{x}$

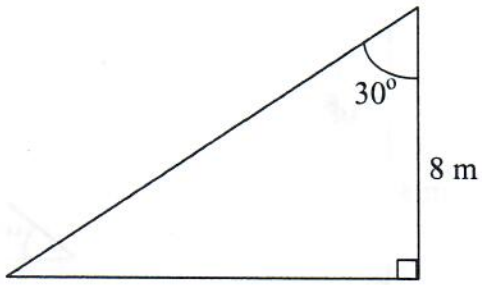
$87.7N = x$



SOH

$\sin 45 = \frac{x}{18}$

$x = 12.73\ cm$



TOA

$\tan 30 = \frac{x}{8}$

$0.577 = \frac{x}{8}$

$x = 4.62\ cm$

4) The force responsible for moving an object in a certain direction is called EFFECTIVE FORCE. This force is in the same direction of the movement.

5) Charlie drags a heavy box across the floor using 30N of force directed 35° above the horizontal.

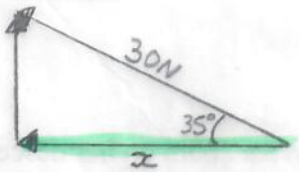
   a) Using trigonometry, calculate the effective force.

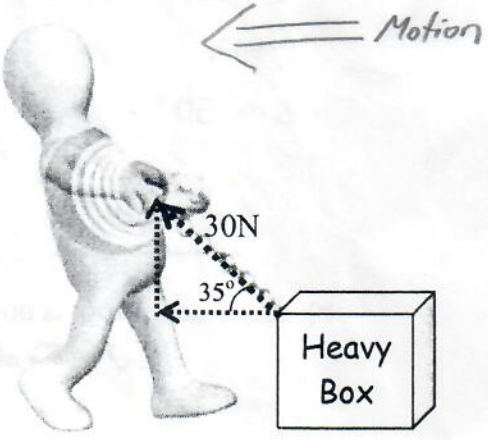
Effective Force = x

CAH

$\cos 35 = \frac{x}{30}$

$x = 24.57N$





   b) How much work is done if this box is dragged 4m across the room?

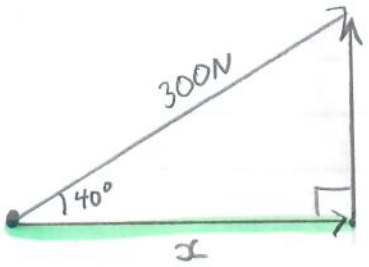
$W = F \cdot d$ $W = (24.57)(4)$

$W = 98.3\ J$

6) A child pulls a toy across the floor with a force of 300N at an angle of 40° from the horizontal.

Use the space provided below to draw a representation of this situation with all component forces.

Motion →



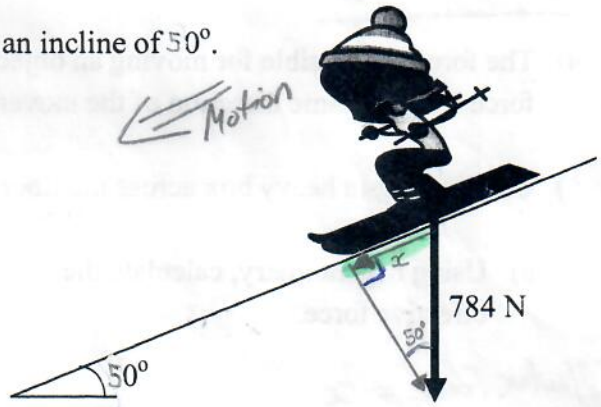
a) From the information in your drawing, interpret the value of the Effective Force.

CAH = $\cos\theta = \frac{Adj}{hyp}$ $\cos 40 = \frac{x}{300}$ $0.766 = \frac{x}{300}$ $x = 230\,N$

b) If the child displaces the toy by 13m, how much work was done ?

$W = F \cdot d$ (same direction)
$W = 230(13)$
$W = 2990\ J$

7) Jane weighs 784N. He goes skiing down a hill with an incline of 50°.



a) Using trigonometry, calculate the effective force.

Effective Force = x

SOH

$\sin 50° = \frac{x}{784}$

$x = 600\,N$

b) How much work is done if Jane covers 200m on her descent?

$W = F \cdot d$ $W = 600(200)$

$W = 120\,000\ J$

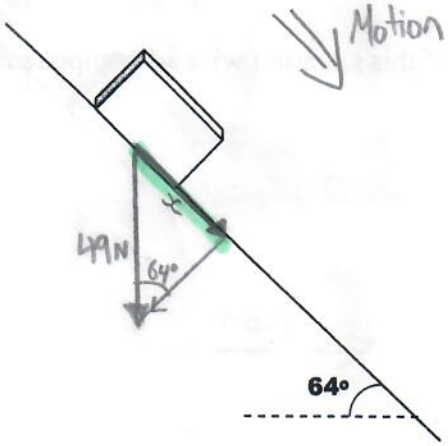
8) How much work is done by a horse pulling a chariot with 8N of force over a distance of 2km. → 2000m

(Force + displacment are in same direction)

$W = F \cdot d$
$W = 8(2000)$ $W = 16000\ J$

9) An object with a mass of 5kg is placed on an inclined plane (64° from horizontal) and begins to slide in the direction of the slope. Calculate the effective force.

(diagram is not drawn to scale)



$W = F \cdot g$

$W = 5(9.8)$

$W = 49N$ (straight down)

Effective force = x

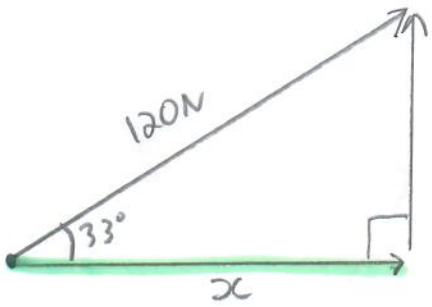
SOH

$\sin 64° = \frac{x}{49}$

$x = 44N$

10) A student drags his heavy schoolbag across the floor of his bedroom with a force of 120N at an angle of 33° from the floor.

Use the space provided below to draw a representation of this situation with all component forces.



CAH

$\cos\theta = \frac{Adj}{hyp}$ $\cos 33 = \frac{x}{120}$

$0.838 = \frac{x}{120}$

$0.838(120) = x$

$x = 100\ N$

a) Find the value of the Effective Force.

b) If the bag is dragged by 4m, how much work was done ?

$W = F \cdot d$ (same direction)

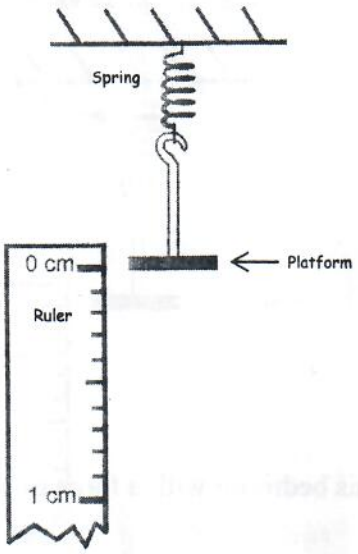
$W = 100(4)$

$W = 400\ J$

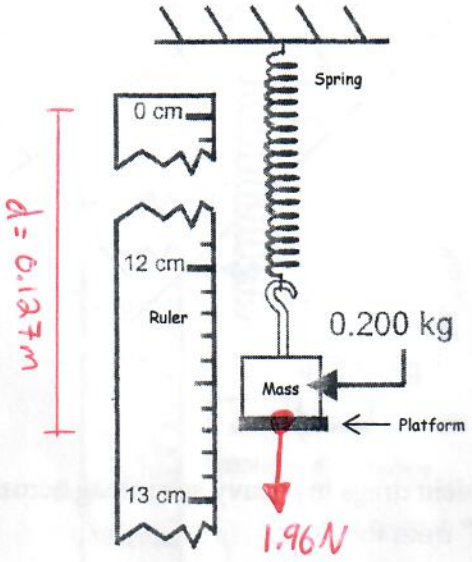
11) A student is investigating the properties of objects which are commonly found in a physics lab.

The student places a block with a mass of 0.200kg on a platform suspended by a spring. The spring is attached to the ceiling of the room.

Before Mass is Added (initial spring position)



After Mass is Added (final spring position)



Calculate the amount of work done by the spring ? *(show all necessary work and formulas)*

① $d = 12.7\text{cm} = 0.127\text{m}$

② $W = mg$

$W = (0.200)(9.8)$

$W = 1.96\text{N}$

③ $W = F \cdot d$ (same direction)

$W = 1.96\,(0.127)$

$W = 0.249\text{ J}$

12) If 840 J of work must be done to pull the heavy box 12m (see below). What force must be applied to the rope attached at one end of the box?

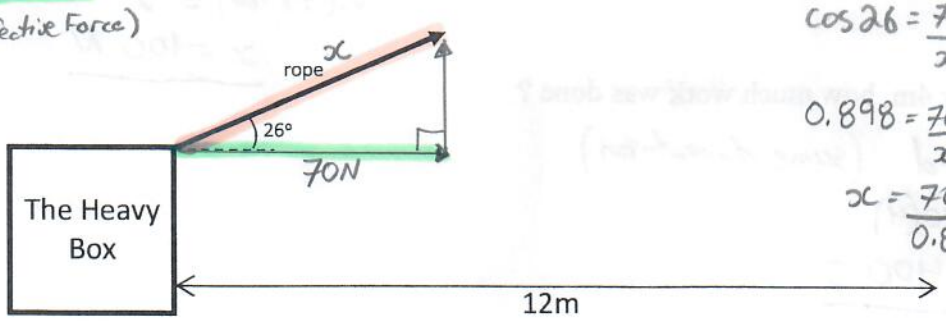
① $W = F \cdot d$ (same direction)

$840 = F \cdot (12)$

$F = 70\text{N}$

(effective Force)

Motion →



② (solve for hyp)

CAH

$\cos\theta = \frac{\text{Adj}}{\text{hyp}}$

$\cos 26 = \frac{70}{x}$

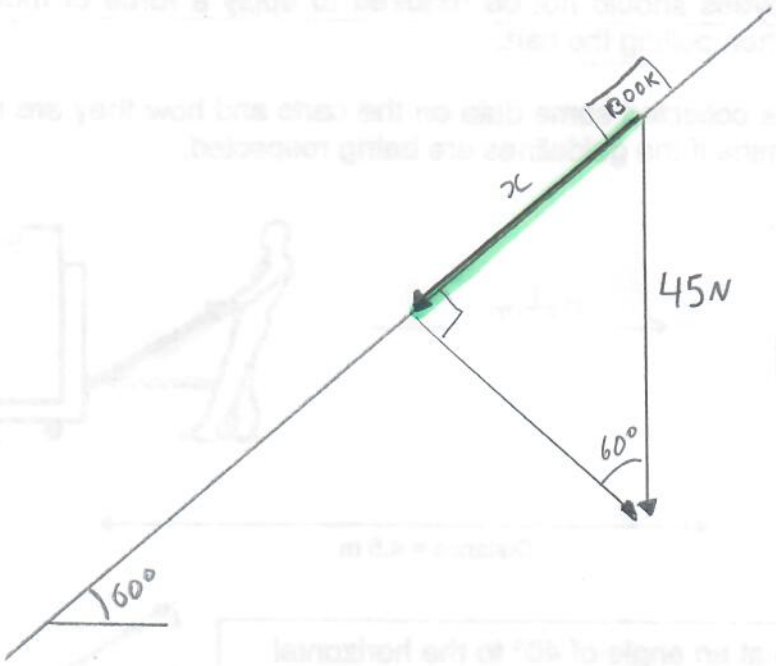
$0.898 = \frac{70}{x}$

$x = \frac{70}{0.898}$

$x = 77.9\text{N}$

13) An architect places a book weighing 45N on top of his drafting table. The table is inclined at 60°.

Use the space provided to draw a representation of this situation with all component forces.



a) Using the information in your representation calculate the effective force?

SOH
$\sin\theta = \frac{opp}{hyp}$

$\sin 60° = \frac{x}{45}$

$0.866 = \frac{x}{45}$

$x = 39N$

b) If the book slides down 55cm, how much work was done ?

$W = F \cdot d$ (force + displacement → same direction)

$W = 39(0.55)$

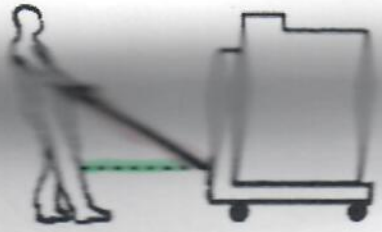
$W = 21.45\ J$

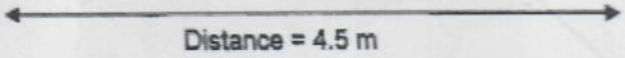
14) **Enforcing the Rules**

One of the tasks in the store is to receive the delivery of food. An employee will help unload the food delivery onto a cart and then use the cart to pull the goods to the shelves in the storeroom.

The grocer must respect the guidelines from the Workplace Health and Safety Board on the prevention of injuries at work. These guidelines state that his employees should not be required to apply a force of more than 85 Newtons when pulling the cart.

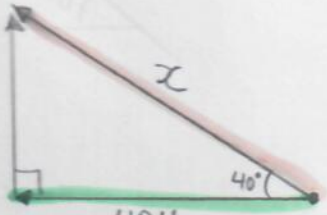
The grocer has collected some data on the carts and how they are used in order to determine if the guidelines are being respected.





- The handle is at an angle of 40° to the horizontal
- The cart is pulled for 4.5 m
- The effective force is 40 N

Assume that the floor is frictionless.



a) Determine whether or not the use of the cart as described above respects the guidelines of a maximum applied force of 85 N.

solve for hypotenuse

CAH

$\cos 40 = \frac{40}{x}$ $\quad x = \frac{40}{0.766}$

$0.766 = \frac{40}{x}$ $\quad x = 52.2\,N$

$52.2_N < 85_N$

SAFE

b) Calculate the how much work is done when the cart is used as described above.

$W = F \cdot d$ (same direction)

$W = 40(4.5)$

$W = 180\ J$