A bright sun with prominent rays is positioned in the upper center of the frame against a clear blue sky. Below the sun, a vast expanse of water is covered with numerous ice floes of various sizes, suggesting a melting ice field. The text is overlaid in the center of the image.

Global Warming

Lecture 1.4

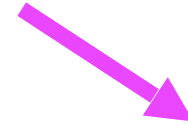
Global Warming and Security

Energy

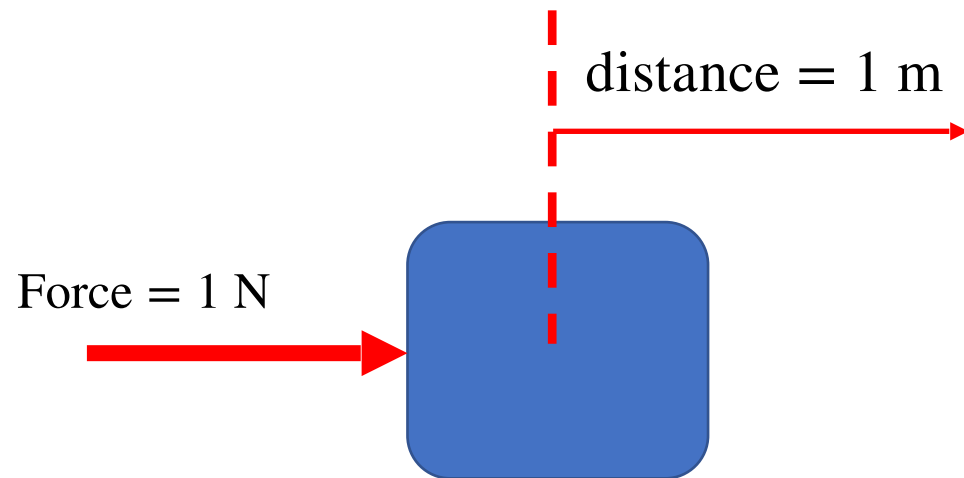
SI unit of energy: Joule (J)

$$1 \text{ J} = 1 \text{ kg} \cdot \text{m}^2 \cdot \text{s}^{-2}$$

$$1 \text{ J} = 1 \text{ N} \cdot \text{m} \quad (1 \text{ N} = 1 \text{ kg} \cdot \text{m} \cdot \text{s}^{-2})$$



apply a force of 1N on an object and move it for 1m distance, 1 J = the energy it takes to do this

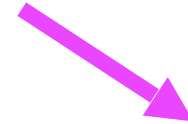


Energy

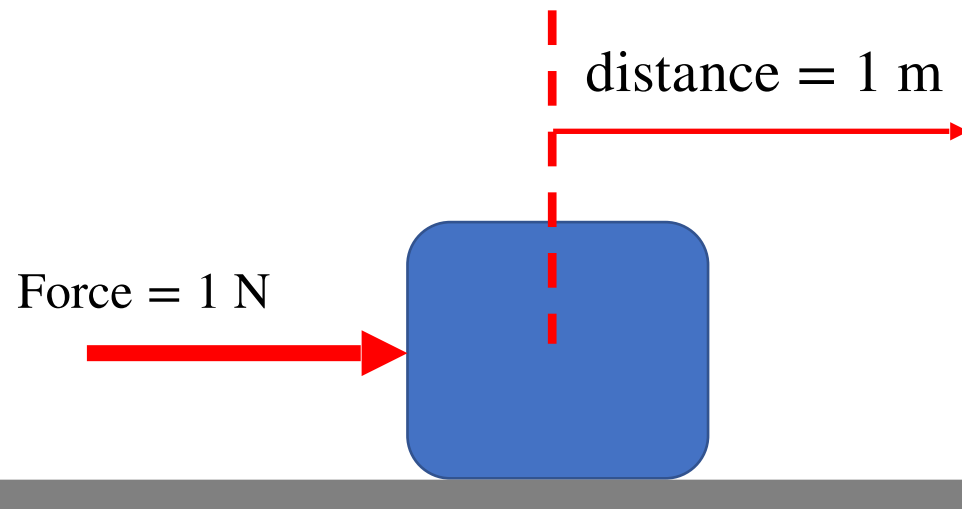
SI unit of energy: Joule (J)

$$1 \text{ J} = 1 \text{ kg} \cdot m^2 \cdot s^{-2}$$

$$1 \text{ J} = 1 \text{ N} \cdot m \quad (1 \text{ N} = 1 \text{ kg} \cdot m \cdot s^{-2})$$



apply a force of 1N on an object and move it for 1m distance, 1 J = the energy it takes to do this



do this in
one second

Power: energy consumed/produced per unit time

SI unit of power: Watts (W)

$$1 \text{ W} = 1 \text{ J/s}$$

$$1 \text{ W} = 1 \text{ N} \cdot m \cdot s^{-1}$$

Energy

SI unit of energy: Joule (J)

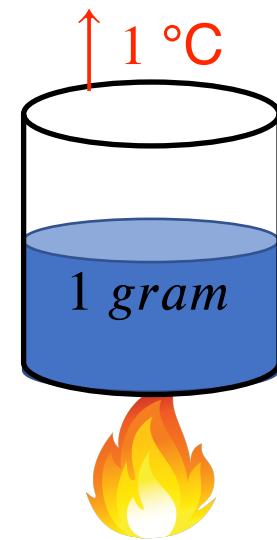
$$1 \text{ J} = 1 \text{ kg} \cdot m^2 \cdot s^{-2}$$

$$1 \text{ J} = 1 \text{ N} \cdot m$$

Calories:

$$4.184 \text{ J} = 1 \text{ calorie}$$

heat 1 gram of water and
let its temperature
increase 1°C ,
1 cal = the heat needed for
this.



Energy

SI unit of energy: Joule (J)

$$1 \text{ J} = 1 \text{ kg} \cdot m^2 \cdot s^{-2}$$

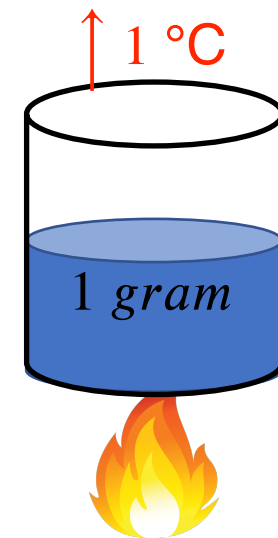
$$1 \text{ J} = 1 \text{ N} \cdot m$$

Calories:

$$4.184 \text{ J} = 1 \text{ calorie}$$

$$1 \text{ dietary Calorie} = 1000 \text{ calorie}$$

heat 1 gram of water and
let its temperature
increase 1°C ,
 $1 \text{ cal} =$ the heat needed for
this.



Energy

SI unit of energy: Joule (J)

$$1 \text{ J} = 1 \text{ kg} \cdot \text{m}^2 \cdot \text{s}^{-2}$$

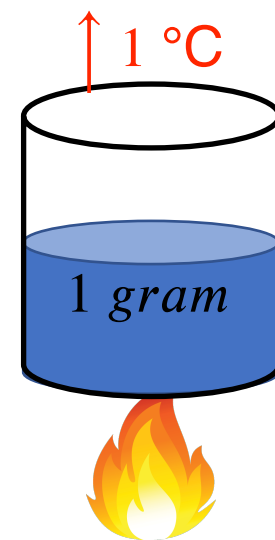
$$1 \text{ J} = 1 \text{ N} \cdot \text{m}$$

Calories:

$$4.184 \text{ J} = 1 \text{ calorie}$$

$$1 \text{ dietary Calorie} = 1000 \text{ calorie}$$

heat 1 gram of water and
let its temperature
increase 1°C ,
 $1 \text{ cal} =$ the heat needed for
this.



A typical human needs 2000 Calories per day to survive.

Energy

SI unit of energy: Joule (J)

$$1 \text{ J} = 1 \text{ kg} \cdot \text{m}^2 \cdot \text{s}^{-2}$$

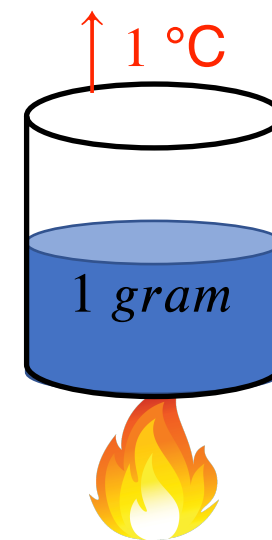
$$1 \text{ J} = 1 \text{ N} \cdot \text{m}$$

Calories:

$$4.184 \text{ J} = 1 \text{ calorie}$$

$$1 \text{ dietary Calorie} = 1000 \text{ calorie}$$

heat 1 gram of water and
let its temperature
increase 1°C ,
 $1 \text{ cal} =$ the heat needed for
this.



A typical human needs 2000 Calories per day to survive.

$$2000 \frac{\text{Calories}}{\text{day}}$$

=

Power
 $1 \text{ W} = 1 \text{ J/s}$
 \downarrow
 $\frac{\text{J}}{\text{s}}$

Energy

SI unit of energy: Joule (J)

$$1 \text{ J} = 1 \text{ kg} \cdot \text{m}^2 \cdot \text{s}^{-2}$$

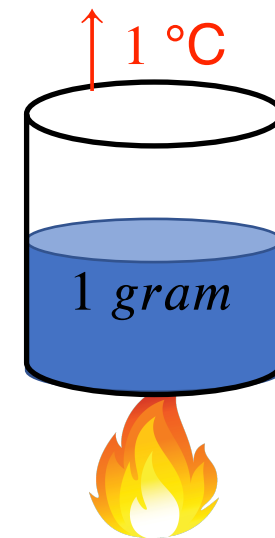
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Power
 $1 \text{ W} = 1 \text{ J/s}$

$$2000 \frac{\text{Calories}}{\text{day}} \times \frac{1000 \text{ calories}}{1 \text{ Calorie}} \times$$

=

$$\frac{\text{J}}{\text{s}}$$

Energy

SI unit of energy: Joule (J)

$$1 \text{ J} = 1 \text{ kg} \cdot \text{m}^2 \cdot \text{s}^{-2}$$

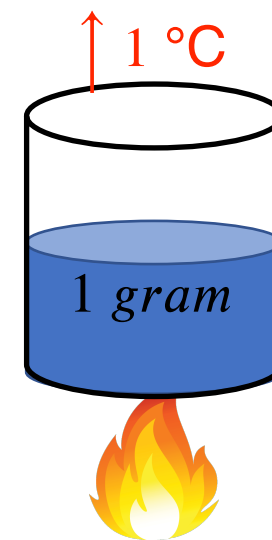
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Power
 $1 \text{ W} = 1 \text{ J/s}$

$$2000 \frac{\text{Calories}}{\text{day}} \times \frac{1000 \text{ calories}}{1 \text{ Calorie}} \times \frac{4.184 \text{ J}}{1 \text{ calorie}} = \frac{\text{J}}{\text{s}}$$

Energy

SI unit of energy: Joule (J)

$$1 \text{ J} = 1 \text{ kg} \cdot \text{m}^2 \cdot \text{s}^{-2}$$

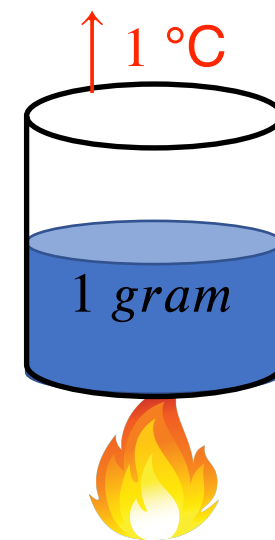
$$1 \text{ J} = 1 \text{ N} \cdot \text{m}$$

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A typical human needs 2000 Calories per day to survive.

Power
 $1 \text{ W} = 1 \text{ J/s}$

$$2000 \frac{\text{Calories}}{\text{day}} \times \frac{1000 \text{ calories}}{1 \text{ Calorie}} \times \frac{4.184 \text{ J}}{1 \text{ calorie}} \times \frac{1 \text{ day}}{24 \text{ hours}} = \frac{\text{J}}{\text{s}}$$

Energy

SI unit of energy: Joule (J)

$$1 \text{ J} = 1 \text{ kg} \cdot \text{m}^2 \cdot \text{s}^{-2}$$

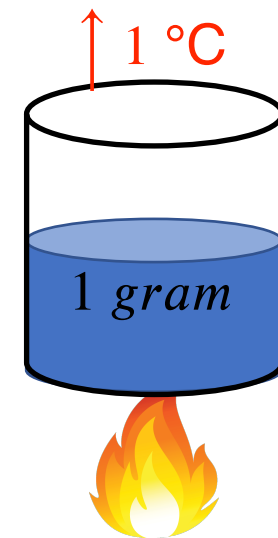
$$1 \text{ J} = 1 \text{ N} \cdot \text{m}$$

Calories:

$$4.184 \text{ J} = 1 \text{ calorie}$$

$$1 \text{ dietary Calorie} = 1000 \text{ calorie}$$

heat 1 gram of water and
let its temperature
increase 1°C ,
1 cal = the heat needed for
this.



A typical human needs 2000 Calories per day to survive.

Power
 $1 \text{ W} = 1 \text{ J/s}$

$$2000 \frac{\text{Calories}}{\text{day}} \times \frac{1000 \text{ calories}}{1 \text{ Calorie}} \times \frac{4.184 \text{ J}}{1 \text{ calorie}} \times \frac{1 \text{ day}}{24 \text{ hours}} \times \frac{1 \text{ hour}}{3600 \text{ s}} = 97 \frac{\text{J}}{\text{s}}$$

Energy

SI unit of energy: Joule (J)

$$1 \text{ J} = 1 \text{ kg} \cdot \text{m}^2 \cdot \text{s}^{-2}$$

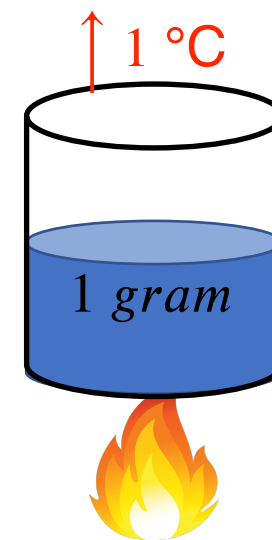
$$1 \text{ J} = 1 \text{ N} \cdot \text{m}$$

Calories:

$$4.184 \text{ J} = 1 \text{ calorie}$$

$$1 \text{ dietary Calorie} = 1000 \text{ calorie}$$

heat 1 gram of water and
let its temperature
increase 1°C ,
1 cal = the heat needed for
this.



A typical human needs 2000 Calories per day to survive.

Power
 $1 \text{ W} = 1 \text{ J/s}$

$$2000 \frac{\text{Calories}}{\text{day}} \times \frac{1000 \text{ calories}}{1 \text{ Calorie}} \times \frac{4.184 \text{ J}}{1 \text{ calorie}} \times \frac{1 \text{ day}}{24 \text{ hours}} \times \frac{1 \text{ hour}}{3600 \text{ s}} = 97 \frac{\text{J}}{\text{s}} = 97 \text{ W}$$