National Aeronautics and
Space Administration

INSTRUCTOR'S GUIDE

NASA Space Communications and Navigation

Measurement and Conversion of Measurements

GRADES 3–5

Answer Key

1. What is the total weight of the satellite?

Take the subtotals of the weights of each group of components:

200 kg × 1 structure	= 200 kg
20 kg × 3 cameras	= 60 kg
12 kg × 4 solar panels	= 48 kg
57 kg × 2 batteries	= 114 kg
90 kg × 2 computers	= 180 kg
42 kg × 1 radio transmitter	= 42 kg

Then add the subtotals together:

200 kg + 60 kg + 48 kg + 114 kg + 180 kg + 42 kg

= **644 kg total weight**

2. Optical transmitters, which use lasers instead of radio waves to downlink more data, weigh less and need less power. If the lighter optical transmitter weighs 7 kg, how much *less* does it weigh than the radio transmitter?

Subtract the weight of the optical transmitter from the weight of the radio transmitter:

42 kg – 7 kg = 35 kg

The optical transmitter weighs 35 kg less than the radio transmitter.

3. If we remove the radio transmitter and replace it with an optical transmitter, what is the new total weight of the satellite?

You could arrive at this answer a couple of different ways, either by recalculating the weight of the entire satellite or by subtracting the difference between the two transmitters from the initial weight.

The new total weight of the satellite is 609 kg.

4. Since our new optical transmitter uses less power, we can also remove one solar panel and one battery.

a. What is the new total weight of the satellite?

You could approach this problem a few ways. One example follows, repeating the previous steps by taking subtotals of the weight of each group of components:

200 kg × 1 structure	= 200 kg
20 kg × 3 cameras	= 60 kg
12 kg × 3 solar panels	= 36 kg
57 kg × 1 battery	= 57 kg
90 kg × 2 computers	= 180 kg
7 kg × 1 optical transmitter	= 7 kg

Then add the subtotals together:

200 kg + 60 kg + 36 kg + 57 kg + 180 kg + 7 kg
= **540 kg total new weight**

b. How much weight have we removed since we started?

Subtract old weight from the new weight:

644 kg – 540 kg = 104 kg

The modified satellite weighs 104 kg less than the first satellite.

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For more opportunities to explore STEM at NASA, visit: *https://www.nasa.gov/stem.*

Do you have feedback on this activity? Email us at *gsfc-scan-engagement@mail.nasa.gov.*