Units and Significant Figures

7/7 points earned (100%)

Retake

Course Home

Excellent!

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1 / 1 points

[#121a] **Sig figs (part 1)**

How many significant figures are there in the number

1. 1.65×10^8?

3

Correct Response
There are 3 sig figs in the number 1.65×10^8

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1 / 1 points

[#121b] **Sig figs (part 2)**

How many significant figures are there in the number

2. 72?

2

Correct Response
There are 2 sig figs in the number 72.

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1 / 1 points

[#121c] **Sig figs (part 3)**

How many significant figures are there in the number

3. 3.14?

3

Correct Response
There are 3 sig figs in the number 3.14.

1 / 1 points

[#121d] **Sig figs (part 4)**

How many significant figures are there in the number

4. 0.000235?

3

Correct Response
There are 3 sig figs in the number 0.000235. It's not the number of digits after the decimal point, but the number of non-zero leading digits. Think about this and make sure you have understood it, because throughout the course, the quizzes will expect you to enter the correct number of significant figures in your answers.

1 / 1 points

5.
[#122] **Inches and cm**

Many electronic instruments are designed to fit in a 19 inch rack. Convert 19 inches to centimetres. (An inch is defined as 2.54 cm). For practice, write your answer formally using the 'multiply by 1' technique we've been using.

19 inches is equivalent to how many centimetres?

19 inches = _____ cm. (Use significant figures. Do NOT include units in the answer you type.)

48

Correct Response
$19\ \text{inches} \times \frac{2.54\ \text{cm}}{1\ \text{inch}} = 48\ \text{cm}$. Regarding the rack itself, there's some ambiguity about significant figures, because a 19 inch rack probably means a 19.0 inch rack, which is why we asked the question this way.

Important: In a hand-marked test, an answer with the wrong number of significant figures, but otherwise correct, would usually earn most of the marks for a question. However, this testing software does not allow for part marks. So we had to make a decision. If we give full marks for an answer that has the wrong number of significant figures, then we give the impression that sig figs are not important. So, in most cases, we decided that, to get the marks, you have to have the correct answer with the appropriate number of sig figs. We regularly give reminders about this. **Please take the time to learn about sig figs and please be careful with future questions.**

1 / 1 points

6.

[#123] **Latitude and miles**

The sketch is a cross section through the earth, showing two points that have a difference in latitude of angle θ. The mean radius R of the earth is 6.371×10^6 meters. A nautical mile is defined as 1852 meters exactly. Using these data, calculate how many nautical miles there are between two points on the earth's surface that have the same longitude but have latitudes that differ by 1.000 degree. (Just in case: the definition of angle, in radians, is the arc of a circle it subtends divided by the radius of the circle. A circle is 2π radians or 360°.)

There are = _____ nautical miles between two points with latitudes differing by 1.000°. (Enter your answer as a number, without exponents and without units, but with appropriate significant figures.)

60.04

Correct Response

Correct answer must have 4 sig figs.

Definition of angle: $\theta = \frac{s}{R}$ where θ is in radians.

$$s = R\theta \text{ where } \theta \text{ is in } \text{radians}.$$

2π radians $=$ one circle $= 360^\circ$, so, dividing both sides by 360,

$\frac{2\pi}{360}$ radians $= 1^\circ$.

$$s = R\theta = (6.371 \times 10^6\ m)(\tfrac{2\pi}{360})$$

Multiply both sides by $1 = \frac{(1 \text{ nautical mile})}{1852 \text{ meters}}$

$$s = R\theta = (6.371 \times 10^6\ m)(\tfrac{2\pi}{360})\ \frac{(1 \text{ nautical mile})}{(1852 \text{ meters})}$$

$$60.04 \text{ nautical miles}$$

Interesting facts: The nautical mile (used almost universally for navigation at sea and by air) was originally defined as 1 minute of latitude at sea level, i.e. (1/60)°. So the expected answer is 60.00 nautical miles. Sea level, however, is a little below the average radius of the earth. Note that the nautical mile is longer than the statute mile or land mile (used in the US), which is 1609.344 m. The word 'mile' comes from the Latin for one thousand: one thousand paces (on each foot, so 2000 steps) was a mile.

1 / 1 points

7.

[#124] **The speed of the earth**

The speed of light is exactly $c = 299792458\ \mathrm{m} \cdot \mathrm{s}^{-1}$. (Also written $299,792,458\ \mathrm{m} \cdot \mathrm{s}^{-1}$ or $2.99792458 \times 10^{8} \mathrm{m} \cdot \mathrm{s}^{-1}$. This is exact because it is the definition of the metre.)

It takes light 8.3 minutes to get from the sun to the earth. Assuming that the earth's orbit is exactly circular (an approximation) and that its speed is constant, and using the data in this question, calculate the speed of the earth in its orbit around the sun in $\mathrm{km} \cdot \mathrm{hr}^{-1}$. Practise writing your conversions clearly using the 'multiply by 1' technique.

Speed of the earth = _____ km per hour. Write your answer in standard (not scientific) notation, i.e. without using exponents, and without using commas. However, remember to use the correct number of significant figures. (Hint: which is the least precise of the given data?) Do not include units.

110000

Correct Response

First we use the given information (the speed of light and the time it takes light to reach the earth from the sun) to find r, the radius of the earth's orbit. Then we can use the value calculated for r to solve for the circumference of the earth's orbit. Finally, since we know it takes the earth 365.24 days to travel the distance along its full orbit, we can calculate the speed of the earth.

We write r for the radius of the orbit and c for the speed of light.

We know $r = 8.3\ \mathrm{min} \times \frac{60\ \mathrm{s}}{1\ \mathrm{min}} \times 299792458\ \frac{\mathrm{m}}{\mathrm{s}} \times \frac{1\ \mathrm{km}}{1000\ \mathrm{m}} = \frac{(8.3*60*299792458)}{1000}\ \mathrm{km}$,

and $1\ \mathrm{year} = 1\ \mathrm{yr} \times \frac{365.24\ \mathrm{days}}{1\ \mathrm{yr}} \times \frac{24\mathrm{hr}}{1\ \mathrm{day}} = (365.24 * 24)\ \mathrm{hours}$.

Thus we can solve for the speed of the earth as follows:

$\mathrm{Speed}_{\mathrm{earth}} = \frac{\text{distance travelled in 1 orbit}}{\text{time taken for 1 orbit}} = \frac{2\pi r}{1\mathrm{year}} = \frac{2\pi(8.3*60*299792458/1000)\mathrm{km}}{(365.24*24)\ \mathrm{hours}} = 110000\ \mathrm{km} \cdot \mathrm{hr}^{-1}$
(2 significant figures).

You probably could have solved the problem much more quickly than this – you may not have needed to use the 'multiply by 1' technique explicitly in this simple case. Later, however, you'll probably find it very useful. Also, you'll note that we kept all the digits until the end, and waited until the answer to write the quantity with the right number of significant figures. Here, it would save work if we replaced 299792458 m/s with $3.0*10^{8}$ m/s.

Congratulations, you've been through the quiz questions on significant figures. We know it's a nuisance, but it is important. So do remember sig figs as you do the test questions, too.

By the way, you may think it strange and unscientific that we ask you to enter the answer without units. So do we! But Coursera tells us that we cannot simply include units in answers. A pity. **In the real world and in high school and university tests, including the units is very important**.

(Interesting trivia, but not needed for this question: to five significant figures, a year is 365.24 days and not 365.25 days. This difference is related to the reason why George Washington changed his birthday. Can you see why?)