

Name: \_\_\_\_\_

Due Date: \_\_\_\_\_

Teacher: \_\_\_\_\_

Parent Sign: \_\_\_\_\_

1. A typical concentration of red blood cells (RBCs) is  $5.0 \times 10^6$  cells per microliter (  $\mu\text{L}$  ). How many RBCs are in 5.0 liters of blood? (1 L =  $10^6$   $\mu\text{L}$ )
2. If a person has  $4.8 \times 10^6 \frac{\text{RBC}}{\mu\text{L}}$  and their blood volume is 4.5 L, how many RBCs do they have in total?
3. A lab reports  $6.0 \times 10^{12}$  RBC per liter of blood. How many RBCs are in 4.2 L of blood?
4. Bone marrow produces about  $2.4 \times 10^6$  RBC every second. How many RBCs are produced in one day? (1 day = 86,400 s)
5. Using the same production rate ( $2.4 \times 10^6 \frac{\text{RBC}}{\text{s}}$ ), how many RBCs are produced in one year? (Use 365 days)
6. If the average diameter of an RBC is  $7.0 \times 10^{-6}$  meters, what is its radius in meters (in scientific notation)?
7. Estimate the volume of one RBC by treating it as a sphere with radius from problem 6. Use  $V = (\frac{4}{3}) r^3$ . Give your answer in scientific notation ( $m^3$ ).
8. If each RBC contains about  $2.5 \times 10^8$  hemoglobin molecules, how many hemoglobin molecules are in  $2.5 \times 10^{13}$  RBC?
9. If each hemoglobin molecule can carry 4 oxygen molecules, how many oxygen molecules can be carried by the total hemoglobin from problem 8?
10. If a patient's RBC count drops by  $1.2 \times 10^{12}$  cells from a total of  $2.5 \times 10^{13}$ , what fraction (and percent) of the total is the drop? Give the fraction in scientific notation.
11. Person A has  $4.2 \times 10^{13}$  RBC and person B has  $2.8 \times 10^{13}$  RBC. How many more RBC does A have than B? Give the answer in scientific notation.
12. If the body maintains a steady total of  $2.5 \times 10^{13}$  RBC and each RBC lives about 120 days, how many RBC must be produced per second to maintain that steady number? (1 day = 86,400 s)
13. A 2.0 mL blood sample has a concentration of  $5.0 \times 10^9$  RBC per mL. How many RBC are in the sample?
14. A microscope image shows one RBC occupies about  $4.0 \times 10^{-11} m^2$  of area. How many such RBC areas fit into  $1.0 \times 10^{-6} m^2$ ?
15. A transfusion adds 500 mL of blood with RBC concentration  $5.0 \times 10^{12}$  RBC per liter. How many RBC are added? (1 L = 1000 mL)
16. A lab mixes three 2-mL samples with concentrations  $1.2 \times 10^9$ ,  $3.4 \times 10^9$ , and  $5.6 \times 10^9 \frac{\text{RBC}}{\text{mL}}$ . What is the total number of RBC in the combined sample?
17. A test needs  $1.0 \times 10^8$  RBC. If a sample has  $2.0 \times 10^9$  RBC per mL, what volume in microliters (  $\mu\text{L}$  ) is required? (1 mL = 1000  $\mu\text{L}$ )

Sub-topic B — U.S. national debt (18–33)

(For these problems use: assume U.S. national debt =  $3.4 \times 10^{13}$  dollars and U.S. population =  $3.3 \times 10^8$  people unless a different number is given in the problem.)

18. Express the assumed national debt  $3.4 \times 10^{13}$  dollars in trillions of dollars (scientific or standard form).
19. Using debt =  $3.4 \times 10^{13}$  and population =  $3.3 \times 10^8$ , what is the debt per person? Give your answer in scientific notation and standard dollars.
20. If the GDP is  $2.1 \times 10^{13}$  dollars, what is the ratio (debt  $\div$  GDP)? Give the answer in scientific notation and as a percent.

## Math Worksheet for 8th Grade

### Scientific notation word problems

21. If interest on the debt is 2.0% per year, how much interest must be paid in one year on  $3.4 \times 10^{13}$  dollars?
22. If the government wants to pay off  $3.4 \times 10^{13}$  dollars in 10 equal yearly payments (ignore interest), how much must be paid each year?
23. If the government paid equal monthly amounts to clear  $3.4 \times 10^{13}$  in 30 years, how much would each monthly payment be? (30 years = 360 months)
24. If the deficit adds  $5.0 \times 10^{10}$  dollars to the debt every day, how much is added in one year (365 days)?
25. If there are  $2.1 \times 10^8$  taxpayers and the debt  $3.4 \times 10^{13}$  must be split evenly among taxpayers, how much would each taxpayer owe?
26. If population grows to  $3.5 \times 10^8$  while debt stays  $3.4 \times 10^{13}$ , what is the new per-person share?
27. Country A has debt  $1.2 \times 10^{14}$  dollars and country B has  $3.4 \times 10^{13}$  dollars. How many times larger is A's debt than B's?
28. If the government repays  $1.0 \times 10^{11}$  dollars per month, how many months (and how many years) will it take to pay off  $3.4 \times 10^{13}$ ?
29. If the debt increases by  $4.0 \times 10^9$  dollars each day, how many years will it take for the debt to increase by an additional  $3.4 \times 10^{13}$  dollars (i.e., to double)?
30. If the total annual income of taxpayers is (average income  $5.2 \times 10^4$  dollars)  $\times$  ( $2.1 \times 10^8$  taxpayers), what is the total income? How many times larger is the debt ( $3.4 \times 10^{13}$ ) than this total income?
31. If the government imposes a one-time tax of  $5.0 \times 10^4$  dollars on each of  $1.7 \times 10^8$  people, how much money is collected in total?
32. If there are  $1.3 \times 10^8$  households, what is the debt per household for a debt of  $3.4 \times 10^{13}$ ?
33. Convert a debt of  $3.4 \times 10^{13}$  dollars into cents (scientific notation).

#### Sub-topic C — Speed of light (34–50)

(Use speed of light  $c = 3.00 \times 10^8 \frac{m}{s}$  and 1 light-year =  $9.46 \times 10^{15}$  meters unless otherwise stated.)

34. The average Earth–Sun distance is  $1.496 \times 10^{11}$  meters. How long does light take to travel from the Sun to the Earth? Give the answer in seconds and in minutes:seconds.
35. How far does light travel in exactly one minute? Give your answer in meters (scientific notation).
36. How far does light travel in one day? (24 hours) Give your answer in meters (scientific notation).
37. Express the speed of light in kilometers per second ( $\frac{km}{s}$ ).
38. A spaceship can travel  $2.5 \times 10^7 \frac{m}{s}$ . What fraction of light speed is that? Give the fraction in decimal and scientific notation.
39. The average Earth–Moon distance is  $3.84 \times 10^8$  meters. How long does light take to travel from Earth to the Moon (in seconds)?
40. A radio message takes 4 hours to reach a distant probe. How far away is the probe in meters? (1 hour = 3600 s)
41. How many meters are in 4 light-years? (Use  $1 \text{ ly} = 9.46 \times 10^{15} \text{ m}$ )
42. Proxima Centauri is about 4.24 light-years away. Using  $c = 3.00 \times 10^8 \frac{m}{s}$ , how many meters away is Proxima Centauri? (You may combine scientific constants directly.)

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43. How many kilometers (km) are in 100 light-years? ( $1 \text{ km} = 10^3 \text{ m}$ )
44. Use the Earth–Sun distance  $1.496 \times 10^{11} \text{ m}$  and  $c = 3.00 \times 10^8 \frac{\text{m}}{\text{s}}$  to convert the light travel time from the Sun to Earth into minutes and seconds (show the conversion).
45. When Mars is at closest approach it can be  $5.5 \times 10^{10} \text{ m}$  away. How many minutes does a light signal take to travel that distance?
46. The Earth's equatorial circumference is about  $4.0 \times 10^7$  meters. How long would it take light to travel once around the equator?
47. A pulsed laser emits a flash every  $2.0 \times 10^{-3}$  seconds. How far does light travel between flashes (in meters)?
48. Voyager 1 is about  $2.3 \times 10^{13}$  meters from Earth. How long (in hours) does it take for a light signal to reach Voyager 1?
49. A galaxy is observed at a distance of  $1.0 \times 10^9$  light-years. How old is the light in seconds? (Use  $1 \text{ year} = 3.154 \times 10^7 \text{ s}$ )
50. If a light wave has frequency  $6.0 \times 10^{14} \text{ Hz}$ , what is its wavelength in meters? (Use  $\lambda = \frac{c}{f}$  with  $c = 3.00 \times 10^8 \frac{\text{m}}{\text{s}}$ )