Teacher Answer Page

Activity 1

Question 1)

150 million kilometers / (3 days x 24 hours) = 2.1 million kilometers per hour.

Question 2)

The electrical event began at 2:45 AM and lasted 97 seconds.

Question 3)

The Quebec blackout lasted nine hours.

Question 4)

Students are being asked to consider what kinds of electrical systems can be affected by a blackout. The recent 2003 blackout which struck the East Coast of the US is a good resource for examples of situations that can arise during a blackout. Severe problems would involve hospital surgery wards losing power, people trapped in elevators in high-rise buildings among other situations.

Activity 2

Problem 1)

Eruption on Tuesday at 4:50 PM
Detection near Earth on Thursday at 3:36 AM

First day passes to Wednesday at 4:50 PM +24h
Now to get from Wednesday afternoon at 4:50 PM to Thursday morning at 3:36 AM Need to add an additional 5:10 + 3:36 = 8:46. Now add this to 24h to get the answer. **Answer: 32 hours and 46 minutes.**

Problem 2) 5:35 AM - 3:36 AM = **1 hour and 59 minutes**

Problem 3) 2:45 PM - 3:36 AM = 14:45 - 3:36 = **11 hours and 9 minutes**

Extra Credit) 150,000,000 / (32 h 46 minutes) = **4.58 million km/hour**

Activity 3

Problem 1) 828.3 - 17.6 = **810.7 gigawatts**
Problem 2) 48 x 17.6 = **844.8 gigawatts** compared to one storm with 828.3 gigawatts
Problem 3) **3,665.2 gigawatts** or 1.6652 trillion watts
Problem 4) 828.3/96.5 = **46.6 times greater**

Activity 4

The diameter of the partial Earth disk is about 60 millimeters. The scale of the photograph is therefore 13,000/60 = 217 kilometers per millimeter.

Problem 1) The diameter of the inside of the oval is about 20 millimeters or 20 x 217 = 4340 kilometers. The outside diameter of the oval is about 27 millimeters or 27 x 217 = 5860 kilometers.

Problem 2) The area of the oval is found by taking the difference of the larger and smaller circles. The area of the two circles with diameters of 5860 and 4340 kilometers is found by using the formula for the area of a circle, $A = \pi R^2$, with $\pi = 3.14$, and R = 5860/2 = 2930 kilometers for the larger circle and R = 4340/2 = 2170 kilometers for the smaller circle. The larger circle area is $A = 3.14 (2930)^2 = 2.69 \times 10^7$ square kilometers.
The smaller circle area is $A = 3.14 (2170)^2 = 1.48 \times 10^7$ square kilometers. Subtracting the larger from the smaller gives the oval area of 1.21×10^7 square kilometers, or 12.1 million square kilometers in the units requested.

Activity 5

A) [-20, +8]
B) -20
C) +8
D) Sorted -20 -15 -15 -15 -8 -2 +2 +4 +5 +5 +8
Median = -2 (In a list of 11 elements, the value in the 6th place 1/2 way between extremes)
Mode = -15 (most often measured)
E) (-20 -15 -15 -15 -8 -2 +2 +4 +5 +5 +8)/11 = -47/11 = -4.3

Activity 6

Problem 1) 931.0 kilometers per second
Problem 2) 379.0 kilometers per second
Problem 3) 8498/14 = 607 kilometers/second
Problem 4) (931) x (3600) x 0.62 = 2.08 million miles/hour
Problem 5) Fastest: 150,000,000/931.0 = 161,000 seconds or 44.75 hours
Slowest = 150,000,000/379.0 = 396,000 seconds or 110 hours

Activity 7

Problem 1) Maximum = 401, minimum = 214
Ordered = 214, 229, 232, 240, 241, 243, 268, 276, 290, 325, 335, 342 ,401
Median = 268
Mean = (214 + 229 + 232 + 240 + 241 + 243 + 268 + 276 + 290 + 325 + 335 + 342 + 401)/13 = 3436/13 = 264.3

Problem 2) Maximum = 16, Minimum = 5
Ordered = 5, 6, 7, 8, 9, 9, 13, 13, 14, 14, 15
Median = 9
Mean = (5 + 6 + 7 + 8 + 9 + 9 + 13 + 13 + 14 + 14 + 15)/11 = 113/11 = 10.3

Problem 3) Maximum = 219.4 Minimum = 39.8

Ordered = 39.8, 76.2, 86.2, 107.9, 112.4, 122.2, 153.9, 171.2, 219.4

Median = 112.4

Mean = (39.8 + 76.2 + 86.2 + 107.9 + 112.4 + 122.2 + 153.9 +171.2 + 219.4)/9 = 1089.2/9 = 121.0

Activity 8

Problem 1)
Maxima Table:

Year	Difference
2000	
1990	10
1980	10
1969	11
1957	12
1947	10
1937	10
1928	9
1917	11
1905	12
1893	12
1883	10
1870	13

Problem 2)
Minima Table:

Year	Difference
1996	
1986	10
1976	10
1964	12
1954	10
1944	10
1933	11
1923	10
1913	10
1901	12
1889	12
1879	10
1867	12

Problem 3)

Average time = (10 + 10 + 11 + 12 + 10 + 10 + 9 + 11 + 12 + 12 + 10 + 13)/12 = 130/12 = 10.8 years between sunspot maxima.

Problem 4)

Average time = (10 + 10 + 12 + 10 + 10 +11 + 10 + 10 + 12 + 12 + 10 + 12)/12 = 129/12 = 10.8 years between sunspot maxima.

Problem 5)

Average length = (10.8 + 10.8) / 2 = 10.8 years.

Activity 9

Problem 1) X1.2 on February 5 with a brightness of (1000) x 1.2 = 1,200.

Problem 2) C2.4 on February 6 with a brightness of (1.0) x 2.4 = 2.4

Problem 3) 1200/2.4 = 500 times brighter

Problem 4) There are a total of 22 flares in the table. There are 13 flares brighter than M1.0 but not equal to M1.0. The percentage is then (13/22) x 100% = 59%

Activity 10

Problem 1)

a) 5.99×10^{15} kilometers

b) 1.35×10^{-4} centimeters

c) 2.997945×10^{5} kilometers/second

d) 1.47×10^{8} kilometers

e) 1.65×10^{-33} centimeters

f) 3.1×10^{7} seconds

g) 1.458×10^{12} cubic kilometers

Problem 2)

a) 0.00145 centimeters
b) 3,100,000,000,000 cubic centimeters
c) 87,000 seconds
d) 29,900,000,000 centimeters/second
e) 0.0000000000000000000000000000000019 seconds
f) 5,400,000,000,000,000,000,000,000,000 kilograms
g) 89,000,000,000 watts

Activity 11

Problem 1) Answer = 6.8 grams per cubic centimeter

Problem 2) Answer = 5.44×10^{2} kilometers per second

Problem 3) Answer = 4.43×10^{13} grams per cubic centimeter

Problem 4) Answer = 4.28×10^{7} centimeters per second

Activity 12

Problem 1) Answer = 1.27×10^{41} ergs

Problem 2) Answer = 3.14×10^{7} seconds

Problem 3) Answer = 9.29×10^{15} centimeters

Problem 4) Answer = 5.74×10^{33} grams

Problem 5) Answer = 1.88×10^{22} stars

Activity 13

Date	**X**	**Y**	**Z**	**B^2**	**B**
1-7	10.9	-5.7	-1.0	152.3	12.3
1-10	-10.2	+11.4	-4.0	249.9	15.8
4-17	+9.6	-18.6	+14.5	648.3	25.5
5-23	-4.8	+22.2	+16.6	791.4	28.1
5-28	-0.88	+0.94	+0.18	1.68	1.29
7-11	-2.8	-3.6	+1.2	22.2	4.7

Activity 14

Encourage students to use scientific notation where appropriate, and to be careful of the number of significant figures after the decimal point when using a calculator.

Problem 1) $D = 5.5 + 25.7\ (15.7) + 1/2\ (32)\ (15.7)^2 = 5.5 + 403.5 + 3943.8 = \mathbf{4352.8}$

Problem 2) $E = 15\ (299792.5)^2 = \mathbf{1.35 \times 10^{12}}$

Problem 3) $L = 4\ (3.141)\ (6.9 \times 10^{10})^2\ (0.000058)(5770)^4 = \mathbf{3.85 \times 10^{33}}$

Problem 4) $M = (9.54 \times 10^{15})\ (3987.6)\ (30.5)^3 = \mathbf{1.08 \times 10^{24}}$

Activity 15

Problem 1)

There are a total of 108 solar flares spotted. If 34 solar flares happen at the same time as CMEs directed towards Earth are recorded, then there are (108-34) = 74 solar flares that happen when CMEs are not detected. The percentage = 74 x 100%/108 = 68%. So, 68% of all the major solar flares do not produce CMEs. In the very few words that a reporter often uses to describe the scientific concepts, the reporter says that solar flares produce CMEs. This statement is only true about 32% of the time. This means that, actually, most flares do NOT produce CMEs.

Problem 2)

a) Of the 55 CMEs directed towards Earth, 29 happen at the same time as the severe magnetic disturbances seen by the ACE satellite, so the percentage is 29/55 = 53%.

b) Of the 56 magnetic storms detected by the ACE satellite, 31 produce bright aurora seen by the IMAGE satellite so, 31/56 = 55% of the magnetic disturbances produce strong aurora.

Problem 3)

Of the 55 CME's that are detected heading towards Earth, 29 of these cause magnetic disturbances. But only 55% of the severe magnetic disturbances seen by the ACE satellite actually lead to strong aurora. This means that out of the CME's detected, only (29/55) x (55/100) = 0.29 or 29% caused strong aurora. This means that most CMEs do not produce disturbances near the Earth, and so the detection of CMEs headed towards Earth is not enough to help us reliably predict whether a strong aurora will be produced.