

ARITHMETIC DRILL

1. A certain airline bases its fares for tickets at the rate of .13 an air mile. Find the cost from NY to each of the following cities:
 - a) Boston 188 miles
 - b) Atlanta 748 miles
 - c) Dallas 1374 miles
 - d) LA 2451 miles
 - e) Moscow 4860 miles
2. In 1889, Nellie Bly flew from NY around the world. The trip took 72 days, 6 hours, and 11 minutes. Find the number of minutes in the entire trip.
3. Major Robert M. White, of the USAF, holds the world record for altitude in an aircraft. On July 17, 1962, he left Edwards AFB, California, flying a North American X-15-1 and reached an altitude of 314,750 feet.
 - a) What was his altitude to the nearest tenth of a mile? (5280 feet = 1 mile)
 - b) What was his altitude to the nearest hundredth of a rod? (320 rods = 1 mile)

The following table is to be used in answering problems 4-8.

Following is a table listing several bodies in space, the number of days each body takes to revolve about the sun, the surface gravity factor by which earth weight is multiplied to find weight on that body, and the average distance from the sun, in miles.

BODY	PERIOD/REVOLUTION	SURFACE GRAVITY	AVG. DISTANCE FROM SUN (miles)
Earth	365 days	1.00	93,000,000
Jupiter	11.9 days	2.64	483,000,000
Mars	1.88 days	.39	141,500,000
Mercury	88 days	.26	36,000,000
Moon	27 1/3 days	.17	
Neptune	165 days	1.12	2,793,000,000
Pluto	248 days	Unknown	3,670,000,000
Saturn	29.5 years	1.07	886,000,000
Sun		28.00	0
Uranus	84 years	.91	1,782,000,000
Venus	225 days	.86	67,000,000

4. Using the preceding table, complete the following table by finding the number of hours it takes for one complete revolution about the sun for each of the listed bodies:

<u>BODY</u>	<u>PERIOD OF REVOLUTION (in hours)</u>
Earth	
Mercury	
Moon	
Neptune	
Pluto	
Venus	

5. Using the table above, complete the following table by finding the number of days it takes for one complete revolution about the sun for each of the listed bodies:

<u>BODY</u>	<u>PERIOD OF REVOLUTION (in days)</u>
Jupiter	
Mars	
Saturn	
Uranus	

6. Find your weight on each of the listed bodies whose surface gravity factor is given.

7. Below are listed the weights of several individuals as measured on different bodies in space. Using the table, complete the table below by finding their weights on Earth:

Name	Body	Weight on Body	Weight on Earth
Richie Allen	Jupiter	501.6 lbs.	
Willis Reed	Mars	93.6	
Muhammed Ali	Mercury	57.2	
Ken Harrelson	Moon	25.5	
Wilt Chamberlain	Neptune	291.2	
Sherman Plunkett	Uranus	300.3	
Dave Debusschere	Saturn	240.75	
Tommy Agee	Sun	5600.00	
Frank Howard	Moon	47.6	
Walt Frazier	Uranus	185.55	
Joe Namath	Venus	172.00	
Roy White	Jupiter	422.4	

8. If light travels at the rate of 186,000 miles per second, find, to the nearest second, the length of time it takes for light to travel from the sun to each of the bodies listed in the table in item

SIGNED NUMBERS

9. Explain the meaning of NASA Control using the numbers "minus ten, minus nine, minus eight, minus seven, minus six, minus five, minus four, minus three, minus two, minus one, lift-off."

10. Consider a vertical lift-off of a spaceship:

- Set up a number line to represent its height at any time following lift-off.
- Choose a point on the number line to represent zero.
- Assign directions to the number line.
- Find the coordinate associated with a height of 4392 feet.
- Interpret the meaning of negative numbers on the number line.
- What, if any, should be the limits on the positive and negative directions on the number line? (The diameter of the earth is approximately 7900 miles).

ALGEBRAIC EXPRESSIONS

11. The speed of sound at sea level and a temperature of 59 degrees Fahrenheit is 760.0 miles per hour.

- If the rate of speed of a plane, in miles per hour, is indicated by the variable R, what is the domain of R if the fastest rate of the plane is the speed of sound?

- (b) If the letter s is used to represent the speed of sound at sea level and a temperature of 59 degrees Fahrenheit t , is s a variable or a constant?
12. If RT represents the distance covered by a plane flying at R miles per hour for T hours, find the distance covered by a plane whose rate is 650 mph, in 4 hours.
13. How many seats are there in a plane containing n rows with 6 seats in each row?
14. If a plane is flying at an elevation of 10,000 feet and the pilot begins to increase the elevation of the plane at the rate of 15 feet per second, what will the elevation of the plane be after 20 seconds?
15. The number of “g’s” pulling a body refers to the number of times the force of gravity is pulling on a body. The weight of a body is equal to the number of g’s pulling on it multiplied by the “normal” weight of the body under 1g.

ADDITION OF SIGNED NUMBERS

16. A ticket agent at Martin Airlines was given a list of 114 reservations for a group flight to Nigeria and then notified of 27 cancellations. How many reservations remained on the list?
17. A weather balloon was testing air turbulence while being controlled by an operator on the ground. The balloon was originally flying at an altitude of 7000 feet. The operator, wishing to test the turbulence at different altitudes, first raised the balloon 4000 feet, then lowered it 6000 feet, then raised it 9000 feet. What was the altitude of the balloon after these three changes in elevation?

MULTIPLICATION OF SIGNED NUMBERS

18. If an airline ticket office had 3 cancellations a day for one week what was the relationship between the number of reservations it had at the end of the week and the number of reservations it had at the beginning of the week?

SUBTRACTION OF SIGNED NUMBERS

19. How much time has elapsed between “liftoff” and “liftoff + 10”?
20. What is the difference between a plane flying at 25,000 feet altitude and a helicopter flying at feet altitude?

VERBAL PROBLEMS

21. A plane is flying into the wind. If the plane's velocity is 300 mph more than the wind velocity and the difference between the plane and the wind velocity is 250 mph, find the velocity. wind

22. The wingspan of a plane is 10 feet more than the length of the plane. The sum of the wingspan and the length of the plane is 130 feet. Find the length of the plane.

FUNCTIONS

23. In travel Mach 1 represents the speed of sound, Mach 2 represents twice the speed of sound, Mach 3 represents thrice the speed of sound, etc. A vehicle is said to be flying at subsonic speed if its velocity is less than Mach 0.75, transonic speed if its velocity is between Mach 0.75 and Mach 1.2, supersonic speed if its velocity is between Mach 1.2 and Mach 5.0, and hypersonic speed if its velocity is greater than Mach 5.0.

- (a) Represent the information as a function of velocity $f(v)$.
- (b) What is the domain of the function?
- (c) What is the range of the function?
- (d) According to the definition, what are the values of
 - $f(.75)$
 - $f(1.2)$
 - $f(5.0)$
- (e) How can this definition be improved?

24. Two airplanes start from the same airport at the same time and traveling opposite directions. One airplane travels at 300 mph and the other airplane travels at 350 mph.

- (a) Express the distance between the two airplanes as a function of time.
- (b) What is the domain of this function?
- (c) What is the range of this function?

ANGLE PROBLEMS

25. If the wind direction is considered to be horizontal the angle of attack of an aircraft is the angle between its air foil (such as its wing) and the wind direction. If this angle is too great the aircraft will not be able to fly. This angle, called the critical angle of attack (or burble point) causes turbulent flow of air and will produce no lift. If the burble point of an air foil is 42 degrees which is 4 more than twice the angle of attack, what is the angle of attack?

26. A spacecraft is being prepared for launching. Maintenance men, making last minute checkups on the vehicle have placed a long ladder from the ground up against the aircraft. The

angle between the ladder and the spacecraft is 6 degrees less than 5 times the angle between the ladder and the ground and the angles are complimentary. Find both angles.

UNIFORM MOTION PROBLEMS

27. Two aircraft flying in opposite directions pass each other in flight. If the first aircraft was flying at 350 mph and the second aircraft at 500 mph, in how many hours will they be 3400 miles apart?

28. Two aircraft are flying in the same direction. The faster plane passes the slower plane at 1400 hours. If the faster plane was flying at 500 mph and the slower plane was flying at 350 mph, at what time will the planes be 375 miles apart.

MIXTURE PROBLEMS

29. A pilot has a plane filled with fuel from two different pumps. If one pump the price of fuel was .35 a gallon and in the second pump the price of fuel was .40 a gallon. If his total bill was \$13.05 for which he received a total of 34 gallons of fuel, how many gallons of each type of fuel did he receive?

30. The radiator of an airport passenger bus contains 32 quarts of a mixture which is 80% water and 20% alcohol. How much pure alcohol must be added to produce a mixture that is 30% alcohol?

AREA PROBLEMS

31. The length of a rectangular runway is 940 feet more than its width. It is discovered that the area of the runway would be the same if the width was decreased by 20 feet and the length increased by 500 feet. Find the original dimensions of the runway.

WORK PROBLEMS

32. A man can send 100 coded messages a day. A machine can send 700 coded messages a day. How long would it take both working together to send 1400 messages?

VERBAL PROBLEMS INVOLVING QUADRATIC EQUATIONS

33. The length of one rectangular glider biplane is 35 feet more than its width and the area of the glider is 200 square feet. Find the dimensions of the glider.

34. A man in freefall will cover a distance, d , according to the formula $d = 16t^2$, where t represents time, in seconds, he is falling. How long will it take a man to fall 256 feet?

35. An airplane flew a distance of 600 miles. On its return trip its speed was increased by 40 mph. The return flight took 30 minutes less than the original flight. Find the original speed.

RATIO AND PROPORTION

36. Air is made up of many gases according to the following composition (rounded off to the given accuracy):

78.0% nitrogen	0.03% hydrogen
20.94% oxygen	0.0012% neon
0.94% argon	0.0004% helium
0.03% carbon dioxide	

Find the amount of each of its constituent gases in 500 cubic feet of air. (Answer to the nearest hundredth of a cubic foot)

37. The ratio of fuel to air is the most important single factor in determining the power output of an engine. This ratio is controlled by the pilot. If there are 17 parts of air to 1 part of gasoline, by weight:

- Find the fuel to air ratio.
- Find the percent of air in the mixture. (answer to the nearest tenth of a percent)
- In 120 pounds of mixture, find the number of pounds of fuel. (answer to the nearest tenth of a pound)

38. The federal excise tax on domestic flight is 8%. Find the total cost of a domestic flight where the cost of the ticket is \$135.00.

INTEREST PROBLEMS

39. In order to raise the money to purchase a private plane a man had to borrow \$6300. He was able to obtain one loan from a bank charging 6% interest. He obtained the balance of the money from a bank charging 7.5% interest. The total amount of interest paid was the same in each bank.

- How much money did he borrow from each bank?
- What was the amount of interest paid to each bank?

VERBAL PROBLEMS INVOLVING TWO VARIABLES

40. In order to profitably run a particular flight an airline calculates it would have to receive \$9900 in fares. However, passengers complained that the plane was too crowded. The airline discovered it could still receive \$9900 for the flight while reducing the number of passengers it carried by 10, if it raised its fare \$9. Find the original number of passengers it carried and the original fare.

41. An airplane flew back and forth between two cities that are 2400 miles apart. It took 6 hours on the initial flight flying against the wind and 4 hours and 54 minutes on the return flight flying with the wind. Find the rate of the plane in still air and the rate of the wind.

PYTHAGOREAN THEOREM

42. An airplane is on a flight from city A to city C with a stopover in city B. The distance from A to B is 80 miles and the distance from B to C is 150 miles. If the paths between A and B, and B and C are right angles, find the distance the airplane would cover on a direct flight from A to C.

PROPORTIONS

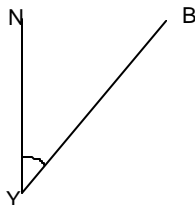
43. If 7 airplane flight tickets cost \$784.98, find the cost of 9 tickets.

SIMILAR TRIANGLES

44. If a vertical rocket 150 feet in height casts a shadow of 40 feet, how high is a nearby building that casts a shadow of 15 feet?

TRIGONOMETRY PROBLEMS

45. Find the height of a flight control tower if the angle of elevation from a point 50 feet from its base to the top of the tower is 65 degrees.



46. An airplane is flying low over the ocean at an elevation of 3000 feet. Find the angle of depression from the airplane to a ship at sea that is 500 feet away from a point directly below the airplane.

EVALUATING FORMULAS

47. The formula for changing from degrees on the Centigrade scale to degrees on the Fahrenheit scale is $C = \frac{5}{9}(F - 32)$, where **F** is the temperature in degrees Fahrenheit, and **C** is the temperature in degrees Centigrade. The temperature in the surface of Mercury on the side facing the sun is believed to be about 430 degrees Centigrade. Express this temperature on the Fahrenheit scale (to the nearest 10 degrees).

GEOMETRIC DRILL

(1) A pilot flying from New York to Boston must follow the direction represented by ray YB. The clockwise angle NYB, between a true north ray from New York and the direction of flight, is called the course of the plane. Find the angle measure of this angle with a protractor to determine the course the pilot would follow.

2) A pilot flying from New York to Washington would follow the direction represented by ray YW. The clockwise angle NYW, as indicated in the diagram, would be the course the plane would follow. Use a protractor to determine his course.

The magnetic compass is used to show the direction of flight. there are 360 degrees in the compass circle. North is 0 degrees. East is 90 degrees. South is 180 degrees. West is 270 degrees. Express the following directions in degrees of the compass.

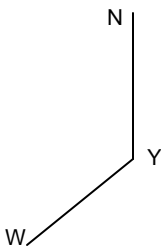
(3) Northeast

(4) Southeast

(5) Southwest

(6) Northwest

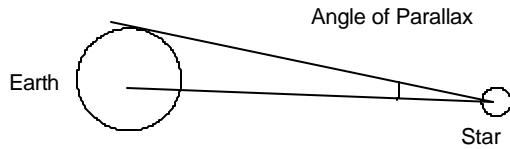
Magnetic forces in the Earth and in each aircraft affect the magnetic compass. The difference between true north and magnetic north is called variation. Compass error caused by magnetic forces in the aircraft itself is know as deviation. If, for example, a pilot desires o fly a true course of 90 degrees in an area where the variation is +10 degrees and his compass variation is -5 degrees, he must fly a



compass heading of 95 degrees to achieve his true course, since $90+10-5=95$. Determine the magnetic compass headings for each of the following flights:

	<u>True Course</u>	<u>Variation</u>	<u>Magnetic Heading</u>	<u>Deviation</u>	<u>Compass Heading</u>
(7)	0820	+4 ⁰		+ 2 ⁰	

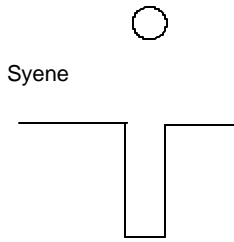
(8) 2740 + 9⁰
 - 5⁰



(9) 3500 + 7⁰
 - 4⁰

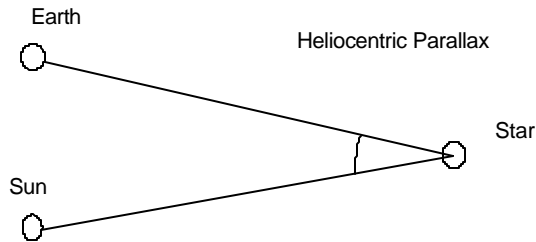
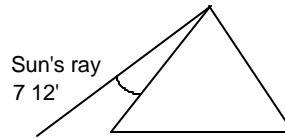
CONGRUENT TRIANGLES

An angle of parallax is the change in direction when a star is viewed from two different points. It may be the angle subtended at the star by the radius of the Earth.



For distant stars a heliocentric parallax is used. This is an angle formed by rays from the Sun and Earth.

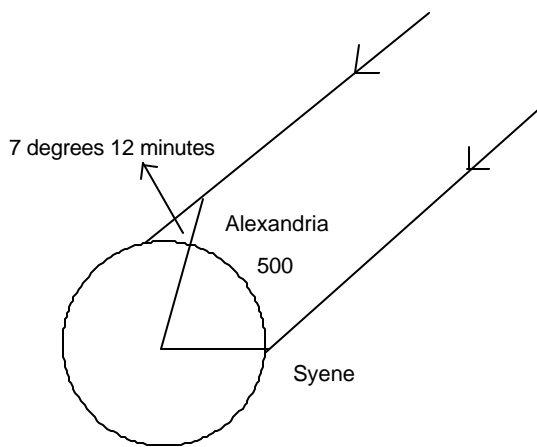
Alexandria



(10) If the heliocentric parallax of a star is 2° on September 1, what will it be on March 1, six months later? Assume the orbit of Earth about the Sun is circular.

ALTERNATE-INTERIOR ANGLES OF PARALLEL LINES

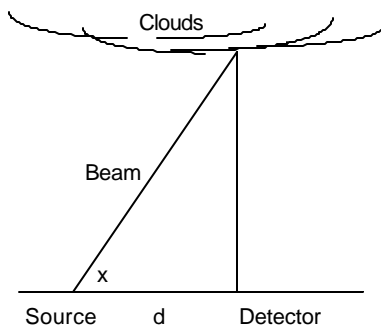
Many people claim that Columbus proved the Earth is round. However, a Greek scholar, Eratosthenes, who lived about 200 BC, which is almost 1700 before Columbus, did more than that. He found the approximate circumference of Earth. Eratosthenes first selected two places in Egypt to gather his information. One of these places was a well in Syene (now the city of Aswan). The other place was a pyramid in Alexandria. The well in Syene and the pyramid in Alexandria were approximately 500 miles apart. He waited until a certain day of the year when he knew the Sun was directly overhead because he could see its reflection on the bottom of the well. On that same day an observer in Alexandria noted the shadow cast by the pyramid and measured the angle formed by the Sun's rays and the pyramid as approximately 7 degrees 12 minutes.



(11) Assuming the rays of the Sun are parallel, what was Eratosthenes' measure of the circumference of Earth?

TRIGONOMETRY

A sweeping light beam is used with a light source detector to determine the height of clouds directly above the detector, as illustrated in the diagram.



The light beam sweeps from the horizontal (angle $x = 0$) to the vertical (angle $x = 90$). When the beam illuminates the base of the clouds directly above the detector, the angle x is

read, and with d , the distance between the light source and the light source detector, known, the height of the clouds can be computed.

(12) If the light source is 1000 ft from the light source detector and the light beam is reflected from the clouds when angle $x = 63$, find the height of the clouds.

(13) Find angle x if the clouds are 1200 feet high and the light source is 900 feet from the light source detector.

At many US National Weather Service stations two light sources are used to gain more reliable data. One light source is 800 feet from the detector and the other light source is 1600 feet from the detector.

(14) If the angle at the 800 foot light source is 51 when a cloud is 1000 feet high, what is the angle at the 1600 foot source?