Slide Graphic Computer Manual

CAUTION: Plastic computers are designed for a long service life. Since all plastic materials are sensitive to extreme heat, do not store the computer in direct sunlight or in an area subject to high temperatures.

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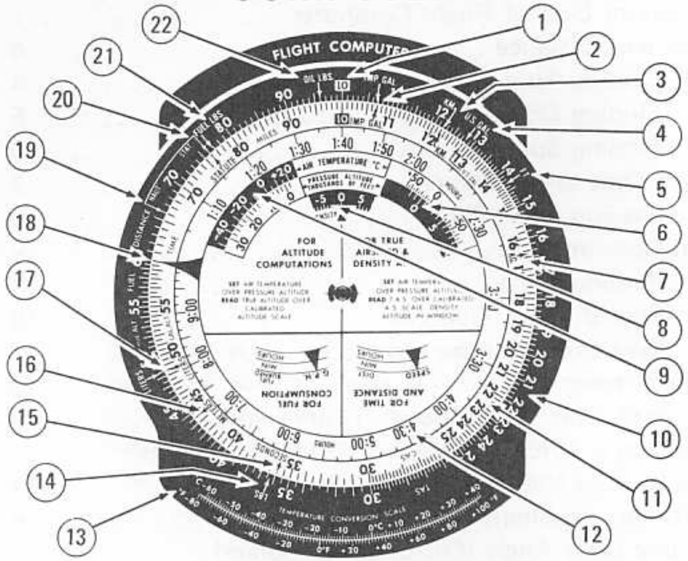

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Figure 1

INTRODUCTION

Congratulations, you have just purchased one of the finest computers on the market today. It is well designed to assist you in solving the planning and navigating problems associated with flying. It is simple to operate and adequate instructions and formulas are printed on the computer so that the user need not worry about forgetting how to work the computer.

FLIGHT COMPUTER

The flight computer has two sides; the calculator side is used to work problems involving time, distance, speed, fuel consumption, true airspeed, nautical to statute conversions, off-course, altitude, and multiplication and division. The wind side is used to determine the effect of wind on the aircraft. Ground speed, true heading, and unknown wind are solved on this side of the computer.

CALCULATOR SIDE OF THE FLIGHT COMPUTER

The main portion of the calculator side of the flight computer consists of three separate scales. The outer scale (10, fig. 1) is fixed to the computer. The second (11, fig. 1) and third (12, fig. 1) scales, inward, are printed on a disc that pivots in the center of the computer, thus permitting them to be rotated within the outer fixed scale. To simplify the explanation, the scales on the calculator side of the computer are referred to as "A", "B", and "C" scales. (See fig. 1.)

The "A" scale is used to represent miles, gallons, or true airspeed. When used as miles, the scale provides the distance traveled or speed of the aircraft in miles per hour. Gallons on this scale can represent two values: fuel consumption in gallons per hour, or total quantity of fuel used by the aircraft. "T.A.S." on the "A" scale is an abbreviation for true airspeed.

The graduations on the "B" scale are used for time in minutes or for "I.A.S." (Indicated Air Speed) in either miles per hour or knots. The "C" scale graduations represent hours and minutes only.

CHANGING VALUES

In order to accurately read the scales on the calculator side of the computer, it is necessary that the changing values of the graduations of these scales be understood.

When using the "A", "B", and "C" scales to solve problems, common sense must be used to determine the value of the numbers. If a short distance is involved, "25" on the "A" scale might be read as "2.5 miles". If a long distance is involved, zeros are added to the "25" to get the proper answer. For example, "25" might be "250" or "2500 miles".

First, let's examine the changing values of the "A" scale. (See fig. 2.) If the number "14" is used as 14, each graduation between "14" and "15" is equal to .1. If these numbers are used as 140 and 150, each graduation is equal to 1; if used as 1400 and 1500, they represent 10; and if used as 14000 and 15000, they are equal to 100.

Between the numbers "15" and "16," there are only five graduations as compared to the 10 graduations between "14" and "15". (See fig. 2.) When these numbers are used as 15 and 16 respectively, each graduation is equal to .2; when used as 150 and 160, each unit represents 2; when visualized as 1500 and 1600, each unit is equal to 20; and when used as 15000 and 16000, each graduation equals 200.

NOTE

The graduations on the "B" scale are identical with those on the "A" scale.

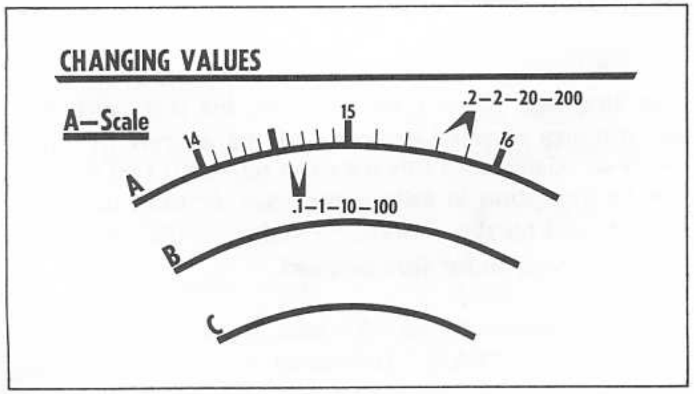


Figure 2

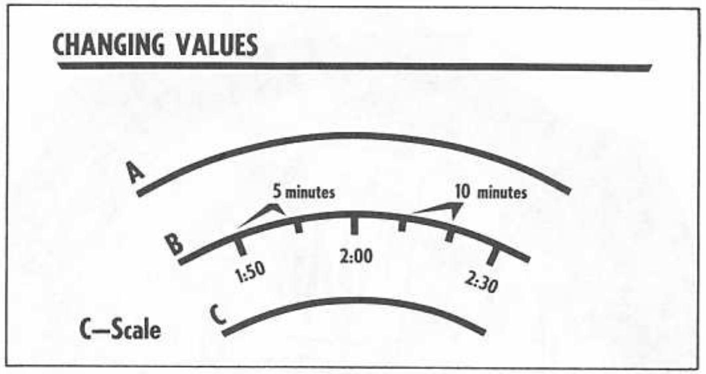


Figure 3

The changing values on the "C" scale are somewhat different than those on the "A" and "B" scales. (See fig. 3.) These graduations always represent minutes and are equal to five or ten minutes as shown by the arrows. For example: between 1:50 and 2:00, the graduations are equal to five minutes; and between 2:00 and 2:30, the graduations represent ten minutes.

The graduations on the "C" scale are very large in comparison with those on the "B" scale. As a result, there are times when finer graduations are needed than are provided on the "C" scale. When this happens, the smaller graduations on the "B" scale can be used to supplement the measurements on the "C" scale.

For example: in figure 4, the graduations on the "C" scale are equal to ten minutes, and the graduations on the "B" scale, immediately above, are equal to two minutes. Starting at the left, the values are 3:30 on the

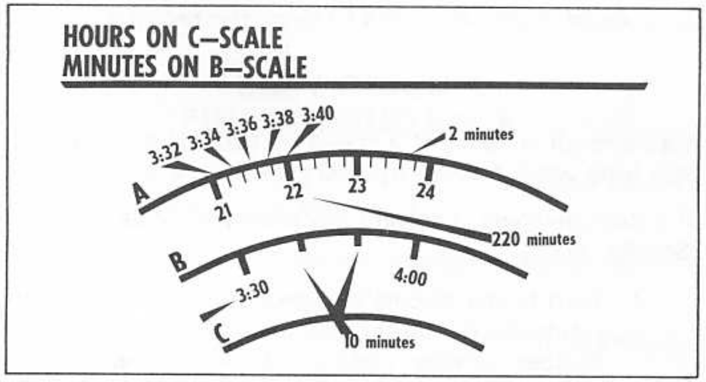


Figure 4

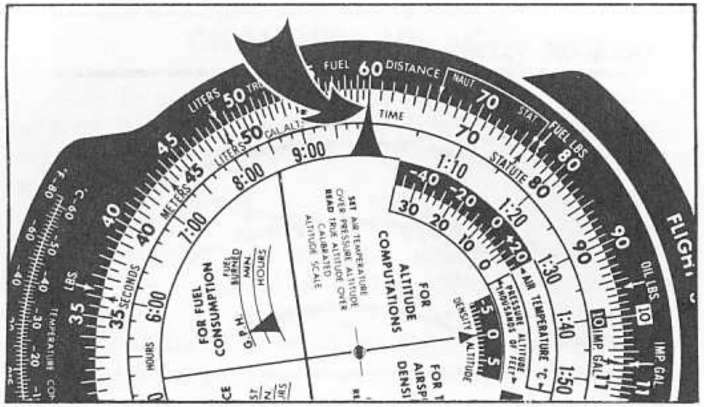


Figure 5

"C" scale; then, moving up to the "B" scale for 3:32, 3:34, 3:36, and 3:38; and then back to the "C" scale for 3:40. Notice that 3:40 on the "C" scale is equal to 220 minutes on the "B" scale.

SPEED INDEX

The speed index is a large triangular symbol on the "B" and "C" scales and is used as a reference in time and distance problems. (See fig. 5.) The speed index always represents 60 minutes or one hour. The graduations covered by this symbol are also used as 6, 60, 600, or 6000 on the "B" scale.

TIME AND DISTANCE

In time and distance problems, there are three items for which to solve: time, distance, and speed. Two of these items must be known to work the problem.

FINDING TIME

If an aircraft is flying at a speed of 120 miles per hour, how long will it take to fly 140 miles?

The steps involved in solving this problem are as follows: (See fig. 6.)

1. Turn to the calculator side of the computer and rotate the computer disc until the speed index is located directly under "12" which represents 120 miles per hour.

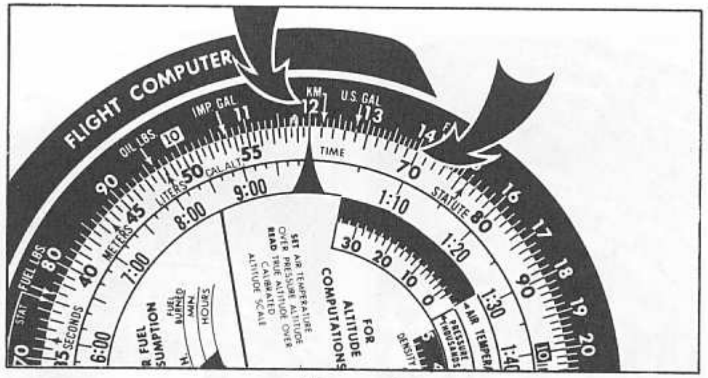


Figure 6

2. Move clockwise on the "A" scale to "14" which represents 140 miles in this problem. Look directly below "14" and find the answer to the problem. It takes 70 minutes on the "B" scale, or 1:10 on the "C" scale, to travel 140 miles at 120 miles per hour.

PRACTICE PROBLEMS — FINDING TIME

The following practice problems should be worked to gain experience in working time problems on the computer. Answers to these problems are given in the Apendix of this manual.

1. Speed — 180 m.p.h.; distance — 240 miles; how long will it take to make the trip?
2. Speed — 142 m.p.h.; distance — 370 miles; how long will it take to make the trip?
3. Speed — 110 m.p.h.; distance — 33 miles; what is the time?
4. Speed — 136 m.p.h.; distance — 86 miles; what is the time?

FINDING DISTANCE

If an aircraft flies at 110 m.p.h. for a two-hour period, how many miles will it fly?

The steps involved in solving this problem are as follows: (See fig. 7.)

1. Place speed index under "11" which represents 110 miles per hour.

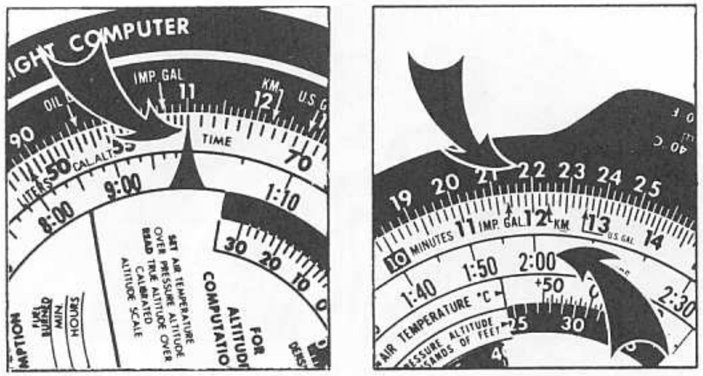


Figure 7

2. Move clockwise on the "C" scale to 2:00. Look directly above 2:00 and find "22" on the "A" scale. This represents 220 miles, the distance traveled, which is the answer to this problem.

PRACTICE PROBLEMS — FINDING DISTANCE

The answers to the following practice problems are given in the Appendix of this manual.

1. Speed — 100 m.p.h.; time — 1:30; what distance will be flown?
2. Speed — 126 m.p.h.; time — 2:05; what is the distance traveled?
3. Speed — 175 m.p.h.; time — 4:00; what is the distance?
4. Speed — 133 m.p.h.; time — 3:32; what is the distance?

FINDING SPEED

If an aircraft flies 210 miles in 1:30, what is the speed?

To solve this problem, proceed as follows: (See fig. 8.)

1. Position 1:30 on the "C" scale directly under 210 miles on the "A" scale.

2. Directly over the speed index is the answer, 140 miles per hour.

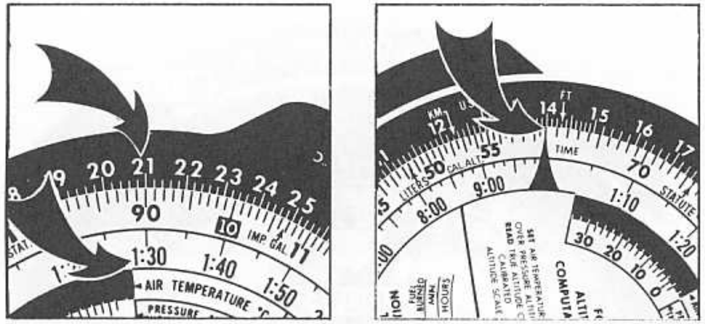


Figure 8

PRACTICE PROBLEMS — FINDING SPEED

The answers to the following practice problems are given in the Appendix of this manual.

1. Distance — 90 miles; time — 0:43; what is the speed?
2. Distance — 320 miles; time — 2:00; what is the speed?
3. Distance — 35 miles; time — 0:19; what is the speed?
4. Distance — 182 miles; time — 1:54; what is the speed?

SHORT TIME AND DISTANCE

A procedure called "short time and distance" is used on the computer to solve problems involving short distances, such as 2.5 miles. In these problems, a very small amount of time is involved in checking speed.

For the short time and distance procedure, "36" replaces the speed index. This "36" is equal to 3600 seconds in one hour. Figure 9 shows the "36" position on the rotating "B" scale of the computer.

When using the short time and distance procedure, all minutes on the "B" scale represent seconds. For example, figure 9 shows that at 101 m.p.h., 40 seconds are required to travel 1.12 miles. Similarly, the "C" scale is changed from hours to minutes. Figure 9 shows that at 101 m.p.h., it will take 5 minutes to fly 8.4 miles.

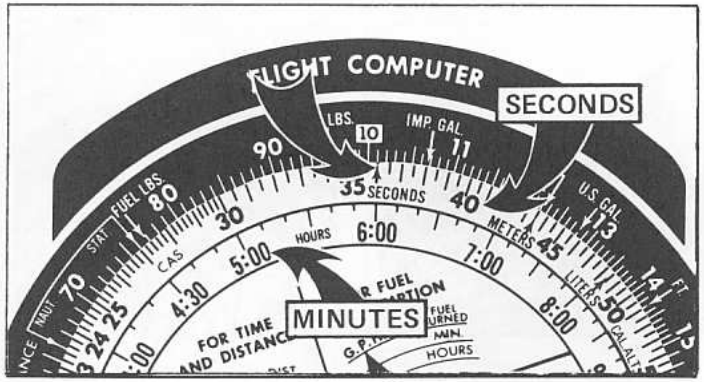


Figure 9

The speed of the aircraft is always placed on the "A" scale directly over the 3600 index on the "B" scale. Distance is always found on the "A" scale directly over time in seconds on the "B" scale, or over time in minutes on the "C" scale.

FINDING SHORT TIME

Flying at 120 m.p.h., for a distance of 1.5 miles, how much time will it take? This problem is solved as follows: (See fig. 10.)

1. Rotate the "B" scale until the "36" is directly under 120 m.p.h., on the "A" scale.
2. Then locate the number "15" on the "A" scale. For this problem, this number is actually "1.5" rather than "15".
3. Under "1.5", find, on the "B" scale, that the time to fly 1.5 miles is 45 seconds.

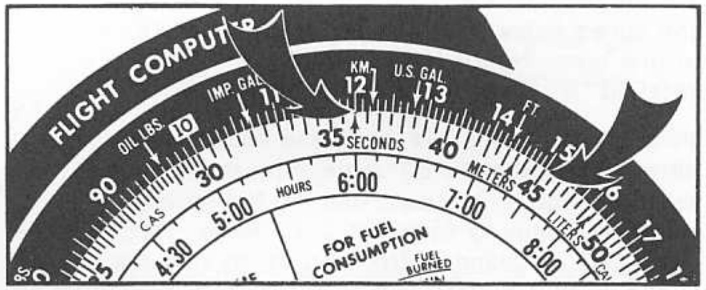


Figure 10

PRACTICE PROBLEMS — SHORT TIME

The answers to the following practice problems are given in the Appendix of this manual.

1. Speed — 140 m.p.h.; time — 3 minutes; how far would an aircraft fly?
2. Distance — 2.5 miles; time — one minute and 30 seconds; how fast is the aircraft traveling?

FUEL CONSUMPTION

Fuel consumption problems are solved in the same manner as time and distance problems, except that gallons per hour and gallons are used in lieu of miles per hour and miles.

FINDING TIME

If an aircraft burns fuel at the rate of nine gallons per hour and has 45 gallons of useable fuel on board, how long can the aircraft fly?

The steps involved in solving the problem are as follows: (See fig. 11.)

1. Rotate the computer disc until the speed index is directly under "90 ", which represents 9 gallons per hour in this problem.
2. Then, move clockwise on the "A" scale and locate "45 ", which represents the 45 gallons of useable fuel. Directly under this on the "C" scale is found 5:00. The answer to our problem is 5 hours.

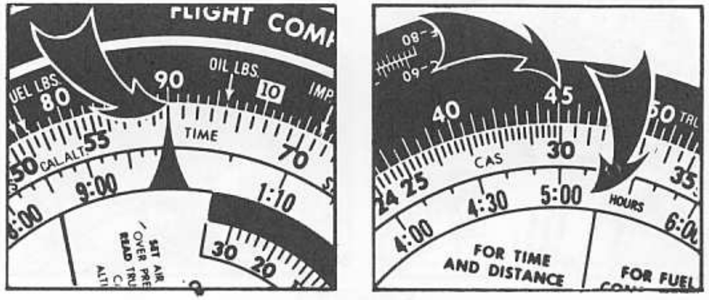


Figure 11

PRACTICE FUEL CONSUMPTION PROBLEMS — FINDING TIME

The answers to the following practice problems are given in the Appendix of this manual.

1. Fuel consumption — 12 g.p.h.; useable fuel — 30 gallons; how long can the aircraft stay in the air?
2. Fuel consumption — 18 g.p.h.; fuel burned — 68 gallons; what was the time?
3. Fuel consumption — 11 g.p.h.; fuel burned — 24 gallons; what was the time?
4. Fuel consumption — 15 g.p.h.; useable fuel — 35 gallons; how long can the aircraft stay in the air?

FUEL BURNED

If an aircraft burns 8½ gallons per hour for a period of 2:00, how many gallons of fuel were burned?

The problem is solved as follows: (See fig. 12.)

1. The "80" and "90" represent "8" and "9" respectively for this problem. Halfway between these two numbers is 8½ gallons. Place the speed index under this graduation.
2. Locate 2:00 on the "C" scale. Look directly over 2:00 and find the number of gallons burned on the "A" scale. The answer is 17 gallons.

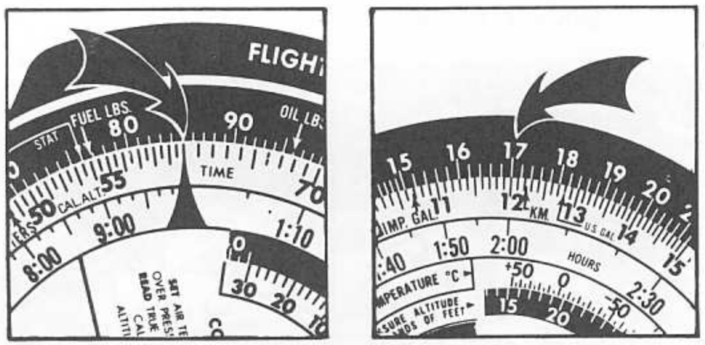


Figure 12

PRACTICE PROBLEMS — FUEL BURNED

The answer to the following problems are given in the Appendix of this manual.

1. Fuel consumption — 14 g.p.h.; time — 15 minutes; how much fuel was burned?

   Note: Don't forget to use care in determining the decimal point.
2. Fuel consumption — 21 g.p.h.; time — 2:40; how much fuel was burned?
3. Fuel consumption — 12½ g.p.h.; time — 1:35; how much fuel was burned?
4. Fuel consumption — 11 g.p.h.; time — 0:28; how much fuel was burned?

FUEL CONSUMPTION

If an aircraft burns 80 gallons of fuel in 2:30, how many gallons is it burning per hour?

The problem is solved as follows: (See fig. 13.)

1. Rotate the calculator disc until 2:30 on the "C" scale is directly under "80" on the "A" scale.
2. Rotate the complete computer and find the answer on the "A" scale above the speed index. The answer to the problem is 32 gallons per hour.

PRACTICE PROBLEMS — FUEL CONSUMPTION

The answers to the following problems are given in the Appendix of this manual.

1. Fuel burned — 7 gallons; time — 0:40; what is the fuel consumption?

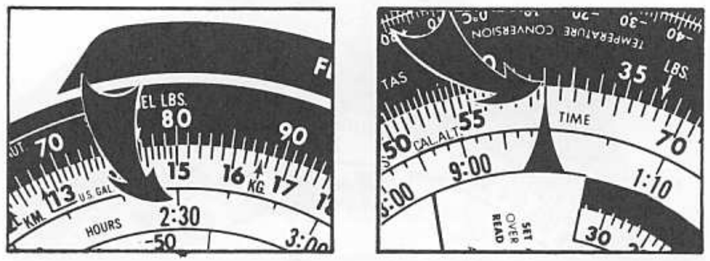


Figure 13

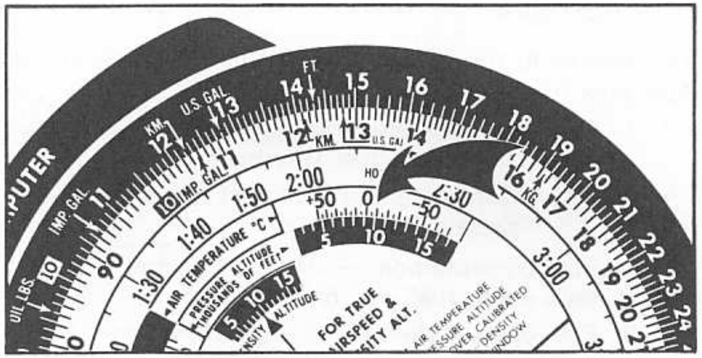


Figure 14

2. Fuel burned — 47 gallons; time — 2:10; what is the fuel consumption?
3. Fuel burned — 75 gallons; time — 3:15; what is the fuel consumption?
4. Fuel burned — 36 gallons; time — 4:11; what is the fuel consumption?

TRUE AIRSPEED

The true airspeed problem is solved on the calculator side of the computer as follows:

1. In the small window labeled "FOR TRUE AIRSPEED AND DENSITY ALTITUDE", place the altitude for the flight under the temperature for the flight on the scale labeled "AIR TEMPERATURE ° C". (See fig. 14.)
2. Without moving any scales, locate the indicated airspeed on the "B" scale. The "B" scale is labeled "C.A.S." (calibrated airspeed) which, for all practical purposes, is equivalent to "indicated airspeed". (See fig. 15.)

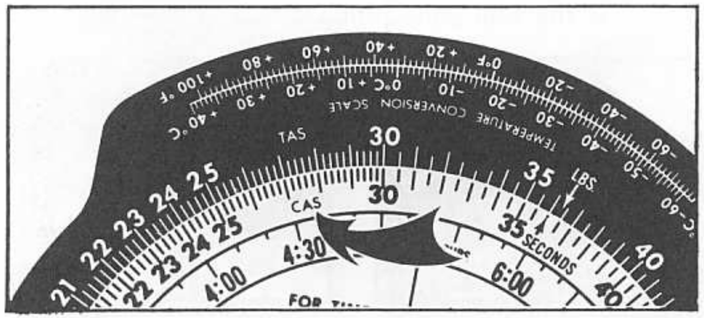


Figure 15

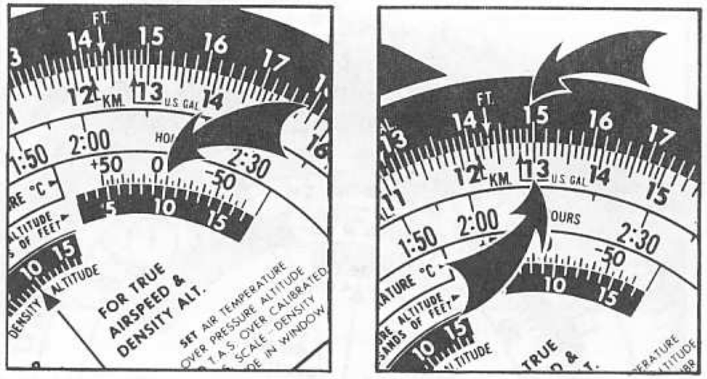


Figure 16

3. Find the true airspeed on the "A" scale immediately above the indicated airspeed value.

For example: what is the T.A.S. under the following conditions: altitude, 10,000 feet; temperature, -10° C.; and I.A.S., 130 m.p.h.?

The problem is solved as follows: (See fig. 16.)

1. Rotate the computer disc until -10° C. is located directly over 10,000 feet.
2. Then refer to the "B" scale and locate "13" which represents 130 miles per hour indicated airspeed for this problem.
3. Look directly over 130 m.p.h. on the "B" scale and find that the true airspeed is 150 miles per hour. This is the answer to this problem.

PRACTICE PROBLEMS — FINDING T.A.S.

The answers to the following problems are given in the Appendix of this manual.

1. Altitude — 5,000 feet; temperature — +15° C.; I.A.S. — 125 m.p.h.; what is the T.A.S.?
2. Altitude — 8,000 feet; temperature — 0° C.; I.A.S. — 110 m.p.h.; what is the T.A.S.?
3. Altitude — 12,000 feet; temperature — minus 5° C.; I.A.S. — 149 m.p.h.; what is the T.A.S.?
4. Altitude — 3,000 feet; temperature — +15° C.; I.A.S. — 105 m.p.h.; what is the T.A.S.?

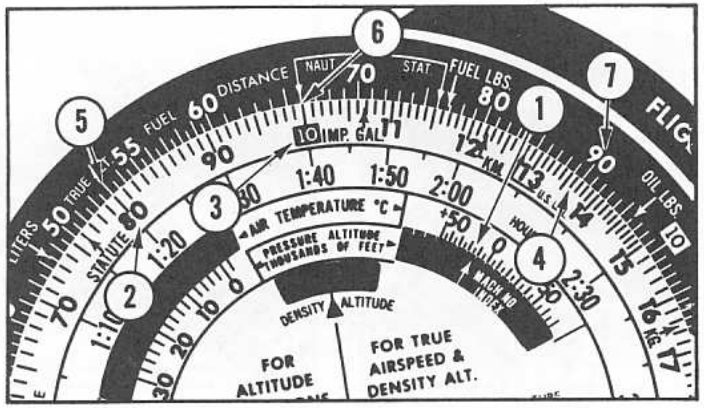


Figure 17

CONVERTING MACH NUMBER TO TRUE AIRSPEED

To convert mach number to true airspeed in knots, use the following procedure:

1. Align the outside air temperature, in degrees Celsius (centigrade), with the mach number index as shown in figure 17, item 1.
2. Read the true airspeed, in knots, on the "A" scale opposite the mach number on the "B" scale. Figure 17 points out several mach numbers and the corresponding true airspeeds at an air temperature of +15° C. The readings are:

Mach Number	True Airspeed
0.8 (item 2)	528 knots (item 5)
1.0 (item 3)	661 knots (item 6)
1.36 (item 4)	898 knots (item 7)

CHANGING NAUTICAL VALUES TO STATUTE EQUIVALENTS, STATUTE TO NAUTICAL, AND STATUTE TO KILOMETERS

Another use for the calculator side of the computer is for converting nautical miles to statute miles, or knots to miles per hour. This type of problem is made very simple by a small conversion scale consisting of two arrows labeled "NAUT" (nautical) and "STAT" (statute)

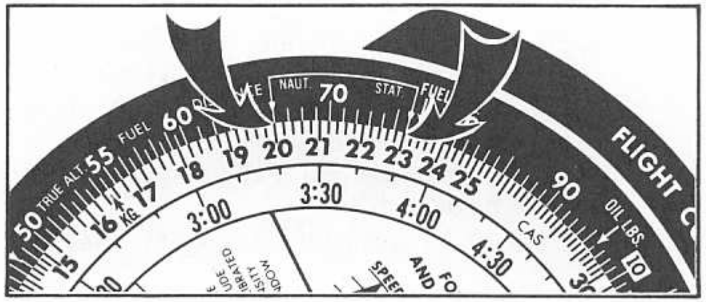


Figure 18

respectively. These arrows are located on the "A" scale and point toward the "B" scale.

NOTE

Knots (nautical miles per hour) are changed to statute miles per hour in exactly the same manner.

For example: to change 20 nautical miles to statute miles, the problem is solved as follows: (See fig. 18.)

1. First, rotate the calculator disc until 20 nautical miles is lined up with the nautical arrow.
2. Then, read the equivalent value, in statute miles, directly under the statute arrow. The answer is 23 statute miles.

The conversion scale can be used to change statute to nautical miles by placing the statute value under the statute arrow and reading the nautical equivalent under the nautical arrow.

In addition, another statute index arrow is included on the "B" scale. It can be used to convert statute miles on the "B" scale to nautical miles or kilometers on the "A" scale. (See fig. 19 and 20.)

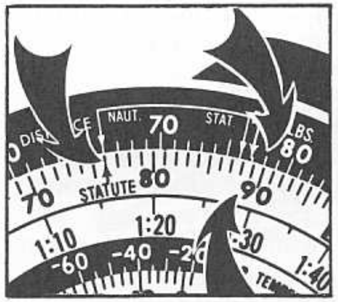


Figure 19

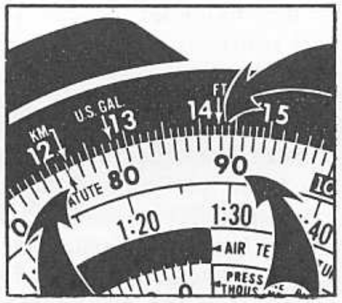


Figure 20

To convert statute to nautical equivalents: (See fig. 19.)

1. Align statute index on the "B" scale directly under the nautical index on the "A" scale.
2. Directly over the statute value on "B" scale, read the equivalent nautical value on the "A" scale. For example, 90 statute miles is equal to 78.2 nautical miles.

To convert statute to kilometer equivalents: (See fig. 20.)

1. Align statute index on the "B" scale directly under the kilometer index on the "A" scale.
2. Directly over the statute value on the "B" scale, read the equivalent kilometer value on the "A" scale. For example, 90 statute miles is equal to 144.5 kilometers.

PRACTICE PROBLEMS — NAUTICAL TO STATUTE, STATUTE TO NAUTICAL, STATUTE TO KILOMETERS

1. 140 nautical miles is equal to________statute miles.
2. 25 knots, wind velocity, is equal to_______m.p.h.
3. 77 statute miles is equal to______nautical miles.
4. 17 knots is equal to_______m.p.h.
5. 133 statute miles is equal to_______kilometers.
6. 40 kilometers is equal to______statute miles.

MULTI-PART PROBLEMS

In practice, the pilot solves a series of interrelated problems leading to a final solution, which may be considered one multi-part problem. A good example of a multi-part problem is finding fuel consumption for an anticipated flight.

The following multi-part problems are provided to emphasize the order of information required to determine the total fuel consumption. In each case, the ground speed is determined first, then the time en route, and finally, the fuel consumed. In each case, assume that I.A.S. is equal to C.A.S. The answers to the problems are given in the Appendix of this manual.

1. Wind — 0 m.p.h.; ground speed — 120 m.p.h.; distance — 320 miles; fuel consumption — 9 g.p.h.; how much fuel will be burned?
2. Altitude — 7,500 feet; I.A.S. — 105 m.p.h.; temperature — +15° C.; distance — 256 miles; fuel consumption — 11.5 g.p.h.; wind — 0 m.p.h.; how much fuel will be burned?
3. Altitude — 9,000 feet; I.A.S. — 115 m.p.h.; temperature — -10° C.; distance — 335 miles; fuel consumption — 8.5 g.p.h.; wind — 0 m.p.h.; how much fuel will be burned?
4. Ground speed — 135 m.p.h.; wind — 0 m.p.h.; temperature — -20° C.; altitude — 9,000 feet; distance — 425 miles; fuel consumption — 12 g.p.h.; how much fuel will be burned?

FINDING DRIFT ANGLE (OFF-COURSE PROBLEM)

The computer can be used to find the drift angle when the aircraft drifts off course due to a wind shift, erroneous wind information, or navigation error. This is often known as an off-course problem.

Figure 21 shows a typical problem: 120 miles from departure and 18 miles off course to the right; what is the drift angle?

1. On the calculator side, set the number of miles the aircraft has flown, 120, on the "B" scale

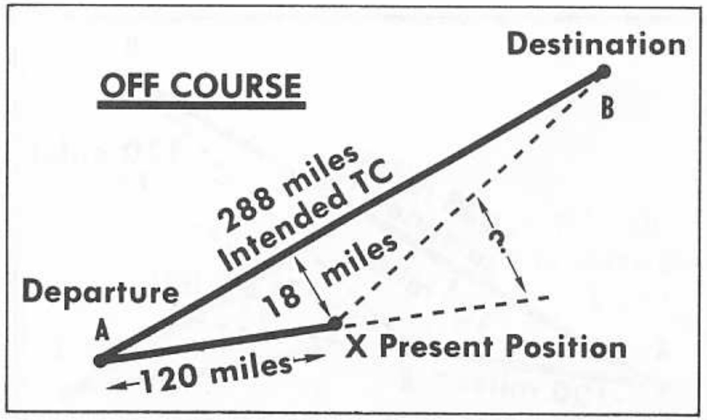


Figure 21

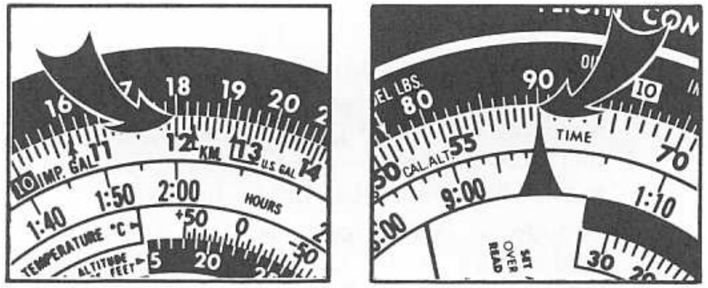


Figure 22

directly under the number of miles off course, 18, on the "A" scale. (See fig. 22.)

2. Above the speed index is the drift angle, 9 degrees, (See fig. 22), which is also the number of degrees to change heading to the left in order to parallel the intended true course between Point A and Point B, as shown in figure 23.
3. To find the additional angle needed to further correct the course from Point X to Point B, set the 170 miles to go on the "B" scale, under 18, the number of miles off course, on the "A" scale (See fig. 24). (The number of "miles to go" is measured on the chart.)
4. Above the speed index is the additional angle needed to arrive at the destination (See fig. 24.) Use the nearest whole number, 6, as the answer.
5. Add the 9 degrees needed to parallel the intended true course and the additional 6 degrees

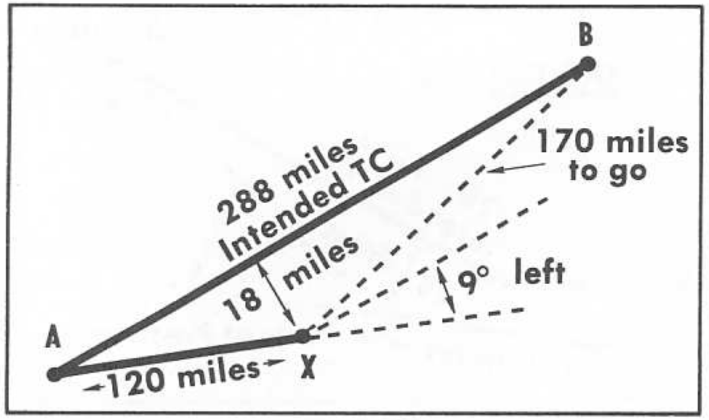


Figure 23

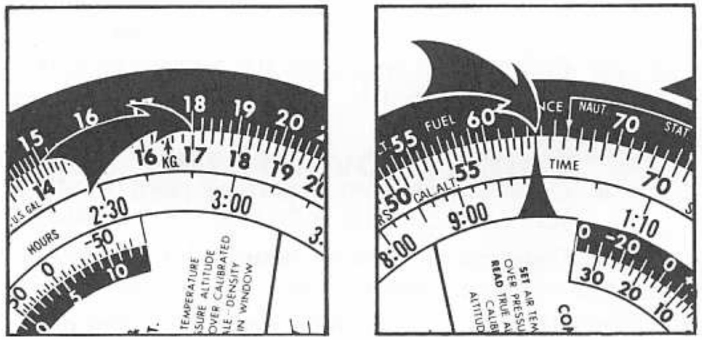


Figure 24

for a total of 15 degrees heading correction to the left, necessary to fly from Point X to the destination, Point B. (See fig. 25.)

PRACTICE PROBLEMS — OFF-COURSE

Refer to the Appendix for answers to these problems.

1. GIVEN:
   a. Distance out from departure point — 110 stat. miles;
   b. Distance to left of intended true course — 13 stat. miles;
   c. Distance to destination from off course position — 200 stat. miles.

   PROBLEM:
   a. How many degrees should the aircraft be turned to parallel the intended course?.

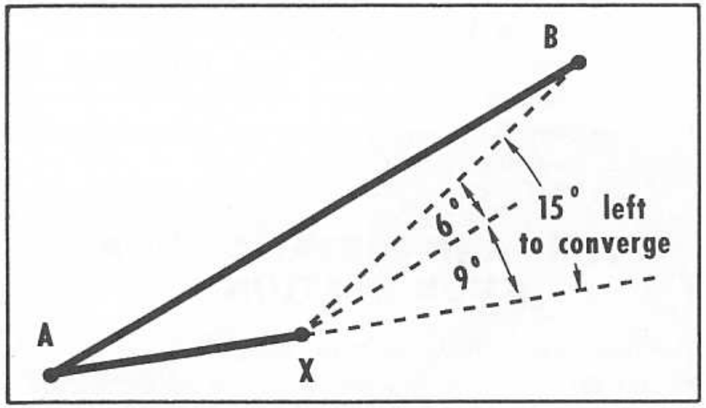


Figure 25

b. How many total degrees should the aircraft be turned to converge on the destination?

c. Which direction should the aircraft be turned (right or left)?

2. GIVEN:

a. Distance out from departure point — 150 stat. miles;

b. Distance to right of intended true course — 20 stat. miles;

c. Distance to destination from off course position — 140 stat. miles.

PROBLEM:

a. How many degrees should the aircraft be turned to parallel the intended true course?

b. How many degrees should the aircraft be turned to converge on the destination?

c. Which direction should the aircraft be turned (right or left)?

3. GIVEN:

a. Distance out from departure point — 90 stat. miles;

b. Distance to left of intended true course — 6 stat. miles;

c. Distance to destination from off course position — 180 stat. miles.

PROBLEM:

a. How many degrees must the aircraft be turned to parallel the intended true course?

b. How many degrees must the aircraft be turned to converge on the destination?

c. Which direction should the aircraft be turned (right or left)?

TIME AND DISTANCE TO A VOR STATION

The time and/or distance from the airplane to a VOR station can be computed easily on the calculator side of the computer. These problems are based on the pilot

taking a time check to make a measured bearing change with a VOR radio. In this procedure, the pilot flies perpendicular to the VOR radials involved with the time check.

TIME TO A VOR STATION

To find the time to a VOR station:

1. Set the time to make the bearing change, in minutes, on the "C" scale directly under the number of degrees of bearing change on the "A" scale.
2. Find the answer on the "B" scale directly under the unit index (10) on the "A" scale.

For example: what is the time to the station when it takes 2 minutes 30 seconds to accomplish five degrees of bearing change? (See fig. 26.) This problem is solved as follows:

1. Place the time (two minutes and thirty seconds --- 2:30) on the "C" scale directly under the degrees of bearing change (5) on the "A" scale.
2. Read the time to the station on the "B" scale directly under the unit index (10) located on the "A" scale. The answer is 30 minutes to the station.

DISTANCE TO A VOR STATION

To find distance to a VOR station, ground speed must also be known in addition to the time to make a bearing change. The solution to this problem involves the following steps:

1. First, solve for time to the station.

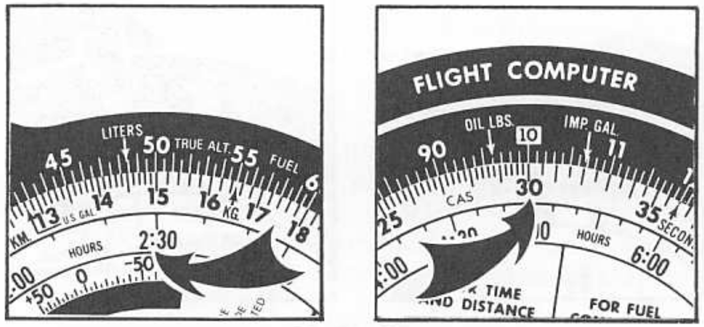


Figure 26

2. Then, set the speed index under the ground speed.

3. Next, locate the time to the station, in minutes, on the "B" scale. Look directly over this value and find the distance to the station.

For example: Using the time to the station found in the previous problem (ref. fig. 26) and a ground speed of 142 m.p.h., what is the distance to the station? The solution is determined as follows: (See fig. 27.)

1. Place speed index under ground speed of 142 m.p.h. on the "A" scale.

2. Locate the time to the station, 30 minutes on the "B" scale.

3. Read distance to station on the "A" scale directly above 30 minutes on the "B" scale. The answer is 71 miles to the station.

If the time to the station is less than 10 minutes, the problem is worked in the same way, except that the short time and distance method is used. The short time speed index "36" is used in lieu of the triangular speed index, and the time in minutes and seconds are placed on the "C" scale. For example: Time to station — 4 minutes, 30 seconds; ground speed — 127 m.p.h.; what is the distance to the station? (See fig. 28.)

1. Set "36" under 127 m.p.h.

2. Locate "4:30" on "C" scale and read distance directly above on the "A" scale, 9.5 miles.

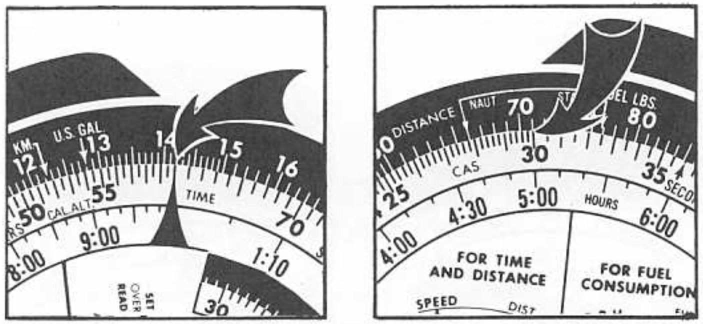


Figure 27

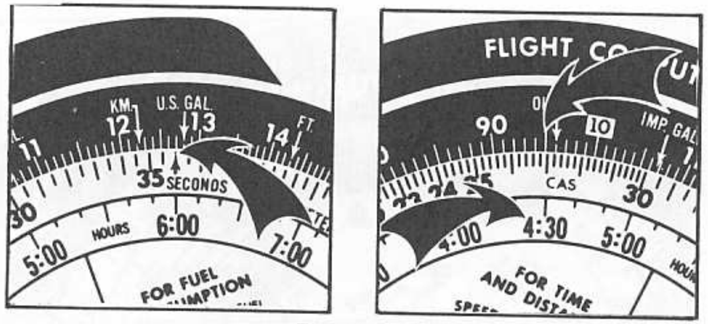


Figure 28

PRACTICE PROBLEMS — TIME AND DISTANCE TO A VOR STATION

Refer to the Appendix for answers to these problems.

	Degrees of Bearing Change	Time Between Bearings	Aircraft Ground Speed	Time To Station	Distance To Station
1.	5°	3 min.	110 mph	_____	_____
2.	10°	5 min.	95 mph	_____	_____
3.	5°	20 sec.	135 mph	_____	_____
4.	15°	9 min.	75 mph	_____	_____
5.	20°	1 min. 50 sec.	140 mph	_____	_____

TRUE ALTITUDE

True altitude is obtained by using the window labeled "FOR ALTITUDE COMPUTATIONS" which incorporates temperature and pressure altitude scales. Pressure altitude is indicated on the altimeter when the barometric scale is set to the atmospheric standard pressure of 29.92 inches of mercury.

True altitude problems can be solved by following these steps:

If an aircraft is flying at 12,500 feet with an outside air temperature of -20°C. and the altimeter set on 30.42 inches of mercury, what is the true altitude? This problem is solved as follows:

1. Referring to the altimeter, note the altimeter barometric reading of 30.42 and record it on a work sheet.
2. Now, rotate the barometric scale on the altimeter to 29.92. Note that the pressure altitude is 12,000 feet.

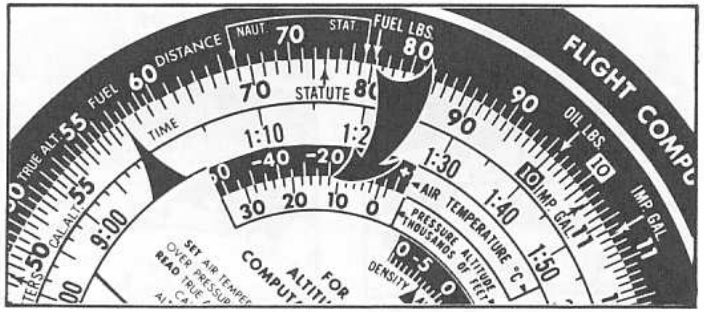


Figure 29

3. Next, refer to the altitude computation window and place -20°C. on the temperature scale directly over the pressure altitude of 12,000 feet. (See fig. 29.)
4. Move to the "B" scale of the computer and locate the original indicated or calibrated altitude, 12,500 feet. Look directly over this value and find the true altitude is 12,000 feet. (See fig. 30.) This is the answer to the problem. The aircraft is actually flying 500 feet lower than the altitude originally indicated on the altimeter.

PRACTICE PROBLEMS — TRUE ALTITUDE

Refer to the Appendix for answers to these problems:

1. Pressure altitude, 7,000 feet; indicated altitude, 6,500 feet; temperature, -10°C. What is the true altitude?
2. Pressure altitude, 9,000 feet; indicated altitude, 10,000 feet; temperature -20°C. What is the true altitude?

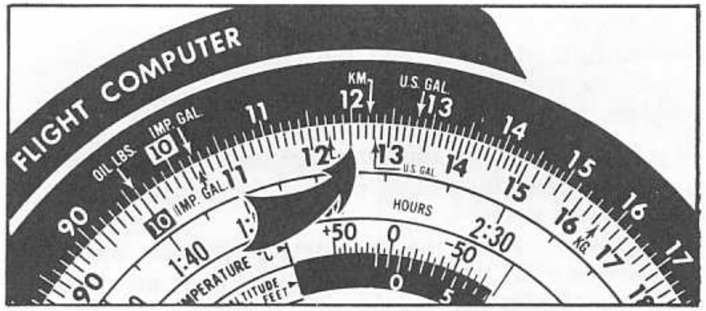


Figure 30

3. Pressure altitude, 6,000 feet; indicated altitude, 5,500 feet; temperature -10°C. What is the true altitude?

NOTE

Figure answers to closest 50-foot increment.

DENSITY ALTITUDE

Density altitude problems are solved on the calculator side of the computer through the use of the window labeled "FOR TRUE AIRSPEED AND DENSITY ALT." The procedure for solving this type of problem is shown in the following example:

Flying at 10,000 feet pressure altitude with outside air temperature at -20°C., what is the density altitude? This problem is solved as follows:

1. Place -20°C directly over 10,000 feet pressure altitude in the airspeed and density altitude window. (See fig. 31.)
2. Refer to the density altitude window and find that the density altitude is 8,000 feet.

PRACTICE PROBLEMS — DENSITY ALTITUDE

Refer to the Appendix for answers to these problems.

1. Pressure altitude, 10,000 feet; temperature, -20°C.; what is the density altitude?
2. Pressure altitude, 15,000 feet; temperature, -30°C.; what is the density altitude?
3. Pressure altitude, 4,000 feet; temperature, -25°C.; what is the density altitude?

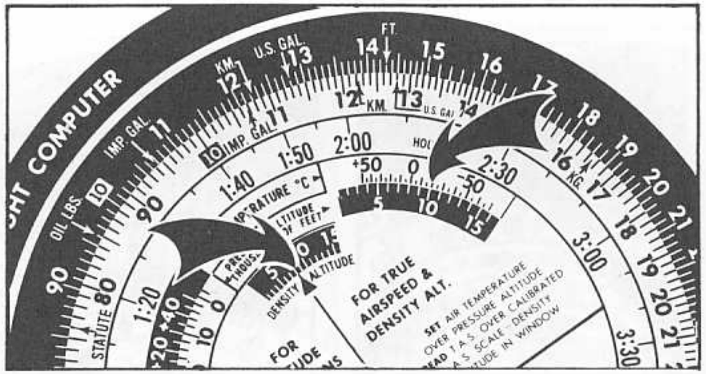


Figure 31

MULTIPLICATION AND DIVISION

The computer can also be used for multiplication and division. The index for these problems is the "10" in the small box. (1, fig. 1.)

To Multiply:

1. Rotate the "B" scale until the index "10" is directly under the number to be multiplied.
2. Without moving the scales, locate the multiplier on the "B" scale.
3. Look directly over the multiplier and find the answer on the "A" scale.

To Divide:

1. Locate the number to be divided on the "A" scale.
2. Rotate the "B" scale until the divisor is located directly under the number to be divided.
3. Without moving the scales, find the answer on the "A" scale directly over the index "10 ".

MULTIPLICATION

Climbing at 450 feet per minute for 8 minutes, how much altitude would be gained? This problem is solved by multiplying 450 f.p.m. x 8 minutes. (See fig. 32.)

1. Place 450 on the "A" scale directly over "10" in the box on the "B" scale.
2. Find 8 minutes on the "B" scale and, looking directly over this, find that we would climb 3,600 feet in the 8 minutes.

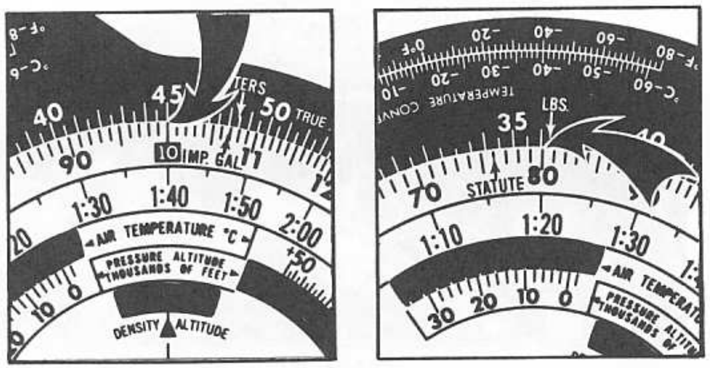


Figure 32

DIVISION

An aircraft has to lose 8,000 feet in 19 minutes. What is the rate-of-descent? (See fig. 33.)

1. Place 8,000 feet on the "A" scale directly over 19 minutes on the "B" scale.
2. Look directly over the "10" and find that the aircraft should descend at 420 f.p.m. to lose 8,000 feet in 19 minutes.

PRACTICE PROBLEMS — MULTIPLICATION AND DIVISION

Refer to the Appendix for answers to these problems:

1. Rate-of-climb, 450 f.p.m.; time in climb, 18 minutes; what is the altitude gained?
2. Rate-of-descent, 600 f.p.m.; time in descent, 4½ minutes; what is the altitude lost?
3. Altitude to lose, 6,500 feet; time to lose altitude, 9 minutes; what is the rate-of-descent?
4. Altitude to gain, 9,000 feet; time to gain altitude, 21 minutes; what is the rate-of-climb?
5. Aircraft cargo arm, 55 inches; cargo weight, 226 pounds; what is the approximate cargo moment?
6. Total aircraft moment, 162,000 pound-inches; total aircraft weight, 3,000 pounds; what is the center-of-gravity arm?

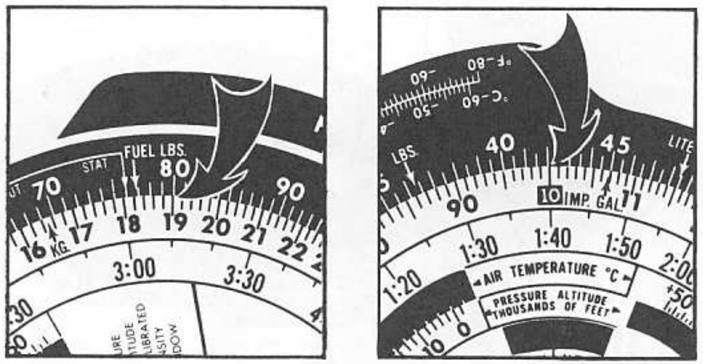


Figure 33

CONVERTING FEET PER NAUTICAL MILE TO FEET PER MINUTE

Certain IFR departure procedures require a minimum climb rate to assure proper obstruction clearance. However, the minimum climb requirement is stated in terms of feet to be gained per nautical mile. The pilot can easily convert this "feet per nautical mile" figure to a "feet per minute" figure on the calculator side of the computer. The following example outlines the procedure: (See fig. 34.)

1. Set the speed index at the appropriate ground speed in knots. (Figure 34 shows the speed index set at a ground speed of 120 knots.)
2. All figures on the "B" scale will represent the minimum climb requirement in feet per nautical mile. All figures on the "A" scale will represent the equivalent vertical velocity in feet per minute and are read directly over the minimum climb requirement figures.

For example: Ground speed — 120 knots; climb requirement — 250 feet per nautical mile; what is the rate of climb in feet per minute? To solve this problem: (See fig. 34.)

1. First set the speed index at 120 knots.
2. Then, directly above the 250 on the "B" scale, find the answer, 500 feet per minute, on the "A" scale.

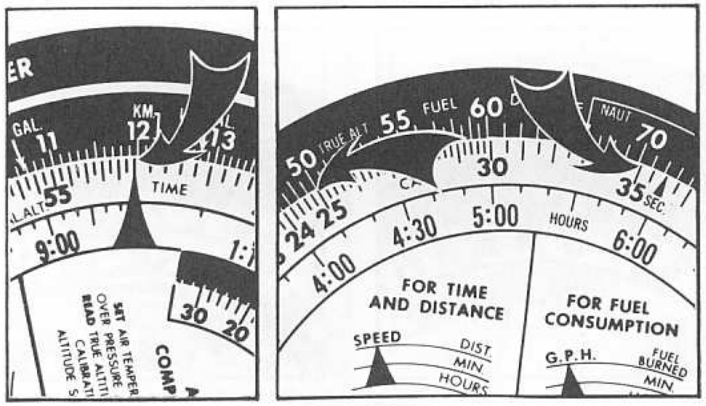


Figure 34

NOTE

At the same ground speed, the climb requirement of 350 feet per nautical mile is equivalent to a vertical speed of 700 feet per minute.

PRACTICE PROBLEMS — CONVERTING FEET PER NAUTICAL MILE TO FEET PER MINUTE

Answers to these problems are found in the Appendix of this manual.

	Ground Speed	Climb Requirement in Feet/Nautical Mile	Required Minimum Vertical Speed
1.	100 knots	240	______f.p.m.
2.	80 knots	300	______f.p.m.
3.	140 knots	300	______f.p.m.
4.	105 knots	400	______f.p.m.

CONVERTING FAHRENHEIT TO CELSIUS (CENTIGRADE)

In some instances, the pilot may know the temperature in degrees Fahrenheit but not know its equivalent in the Celsius scale. Since the computer uses Celsius to obtain T.A.S., it is important that the pilot have a means of converting Fahrenheit to Celsius.

The flight computer described in this manual incorporates a temperature conversion scale on the calculator side of the computer. Temperature conversions can be read directly from this scale. For example: Figure 35 shows how 50° F. is converted to 10° C.

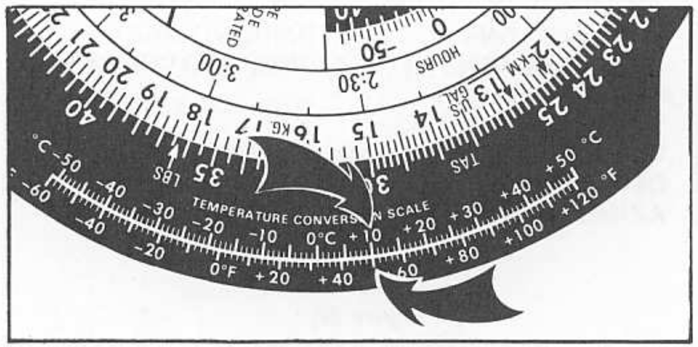
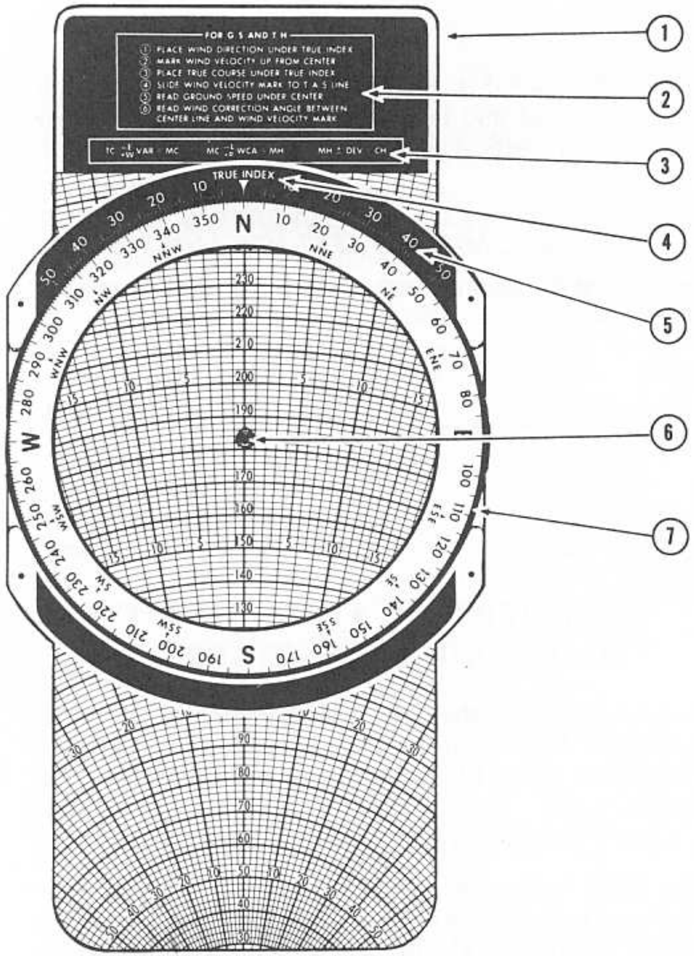


Figure 35



① SLIDING GRID
② INSTRUCTIONS FOR FINDING GROUND SPEED AND TRUE HEADING
③ INSTRUCTIONS FOR DETERMINING MAGNETIC COURSE, MAGNETIC HEADING, AND COMPASS HEADING.
④ TRUE INDEX.
⑤ WIND CORRECTION ANGLE SCALE.
⑥ CENTER.
⑦ AZIMUTH.

Figure 36

WIND SIDE OF COMPUTER

The wind side of the computer consists of a rotating azimuth and a rectangular grid that slides up and down through the azimuth. (See fig. 36.)

SLIDING GRID

The sliding grid is nothing more than a section taken from a large graduated circle. (See fig. 37.) The lines, projecting from the center of the grid and radiating outward, represent degrees right or left of the center line. The lines that form the arcs around the center of the circle represent distance from the center and are labeled in miles.

The computer grid has two sides, a high speed side and a low speed side. (See fig. 38.) Since most private aircraft operate in the speed range below 250 m.p.h., the low speed side is generally used because of its smaller graduations and greater accuracy. The low speed side should be used for all wind problems given in this course.

AZIMUTH

The azimuth circle rotates freely and is graduated into 360°. The transparent portion is frosted so that it can be written on with a pencil. The center, a small circle, lies directly over the centerline of the sliding grid.

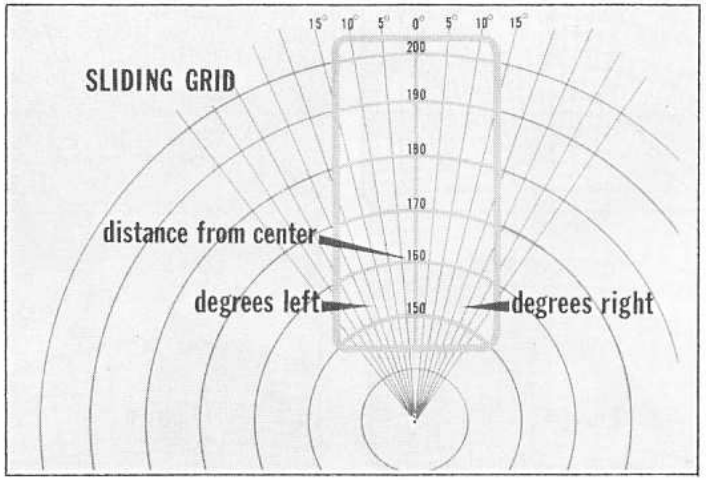
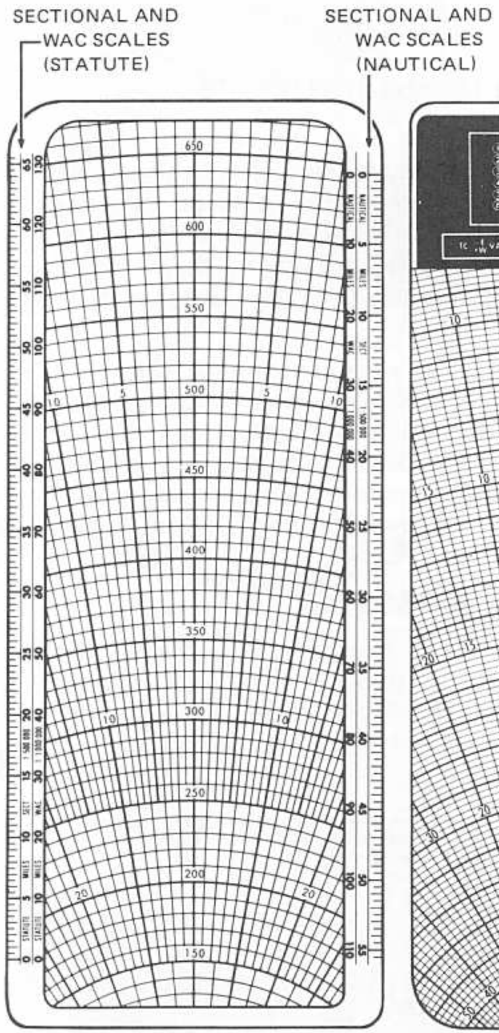
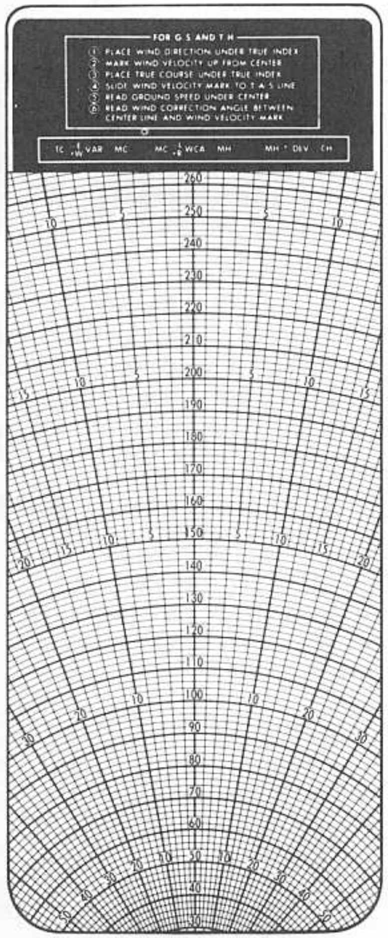


Figure 37



HIGH SPEED SIDE

Figure 38



LOW SPEED SIDE

Figure 39

DETERMINING GROUND SPEED AND TRUE HEADING

To maintain a specific true course, the pilot must determine the wind correction angle and adjust the aircraft heading accordingly. The time en route, an important factor in any flight, is influenced by wind velocity because it affects ground speed.

To determine the total affect of wind on a flight, the true course, true airspeed, and wind velocity must be known.

The operation of the wind side of the computer is described in the determination of true heading and ground speed in the following problem:

GIVEN:

True course—030°
True airspeed—170 m.p.h.
Wind —080° at 20 m.p.h.

DETERMINE:
True Heading ___________
Ground Speed___________

The solution is as follows:

1. Rotate the azimuth until the wind direction of 080° is located directly under the true index. (See fig. 40.)
2. Next, slide the grid through the computer until the center is on any one of the heavy lines extending from right to left on the grid. For this problem, the 160-mile grid line has been arbitrarily chosen. (See fig. 40.)

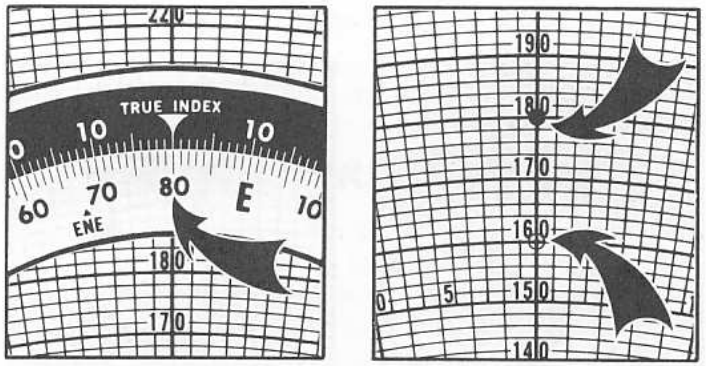


Figure 40

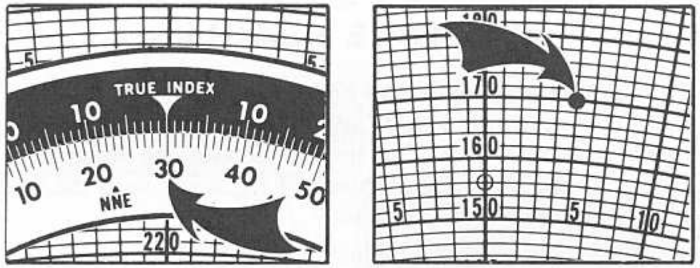


Figure 41

3. Then, place the wind velocity on the azimuth by moving up from the center 20 miles and placing a pencil mark on the grid centerline. (See fig. 40.)
4. Now, place the true course of 30° under the true index. (See fig. 41.)
5. With the true course under the true index, slide the grid through the computer until the pencil mark, or wind dot, is positioned on the true airspeed line of 170 miles per hour. (See fig. 41.)
6. Find the wind correction angle by checking the number of degrees to the right or left between the grid centerline and the wind dot. In this problem, the wind correction angle is 5° to the right. (See fig. 42.)
7. To find true heading, the scales on either side of the true index are used. Since the wind correction angle is 5° right, start at the true index symbol, count five units to the right, and directly below this graduation, find the true heading of 35° on the azimuth scale. (See fig. 42.) If wind dot is to left, count left for true heading; if wind dot is to right, count right.

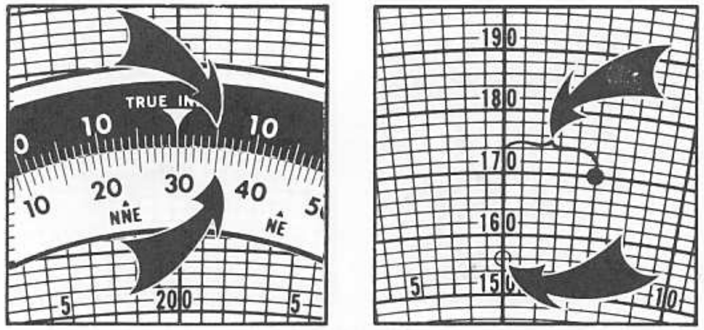


Figure 42

NOTE

Another method is: If the wind correction angle is to the right, add the wind correction angle to the true course value; if the wind correction angle is to the left, subtract it from the true course.

8. Without moving the computer setting, read the ground speed under the center. The ground speed for this problem is 156 miles per hour. (See fig. 42.)

PRACTICE PROBLEMS — TRUE HEADING AND GROUND SPEED

For answers, refer to the Appendix of this manual.

1. True course – 310°, T.A.S. – 120 m.p.h.; wind – 180° at 16 m.p.h.; what is the true heading and ground speed?
2. True course – 178°, T.A.S. – 135 m.p.h.; wind – 045° at 23 m.p.h.; what is the true heading and ground speed?
3. True course – 050°, T.A.S. – 155 m.p.h.; wind – 165° at 18 knots; what is the true heading and ground speed?
4. True course – 270°, T.A.S. – 130 knots; wind – 344° at 18 knots; what is the true heading and ground speed? 130 mph
5. True course – 095°, I.A.S. – 111 m.p.h.; temperature – +25° C.; altitude – 7,500 feet; wind – 360° at 10 knots; what is the true heading and ground speed?

FINDING UNKNOWN WIND

Another problem that can be solved on the wind side of the computer is finding the unknown wind. To solve this problem, four factors are required: true course, ground speed, true heading, and true airspeed.

To find the unknown wind direction and speed, use the wind side of the computer and proceed as follows:

1. Place true course under true index.
2. Place the line representing the ground speed under the center of the azimuth.
3. Determine the wind correction angle, which is the difference between the true course and the true heading, and note whether it is a left or right correction.
4. Locate the true airspeed line on the computer and count the number of degrees, left or right, necessary to correct for wind. At the intersection of these two lines, make a pencil mark to represent the wind dot.
5. Rotate the azimuth until the wind dot is located on the centerline directly above the center of the azimuth. The wind speed is the difference between the center and the dot. The wind direction, in degrees, is under the true index.

EXAMPLE PROBLEM — FINDING UNKNOWN WIND

True course — 120°; ground speed — 140 m.p.h.; true heading — 115°; true airspeed — 150 m.p.h.; what is the wind direction and speed?

This problem is solved as follows: (See fig. 43 and 44.)

1. First, place the true course of 120° under the true index. (See fig. 43.)
2. Next, position the grid until the center of the azimuth is over the line representing the ground speed of 140 m.p.h. (See fig. 43.)

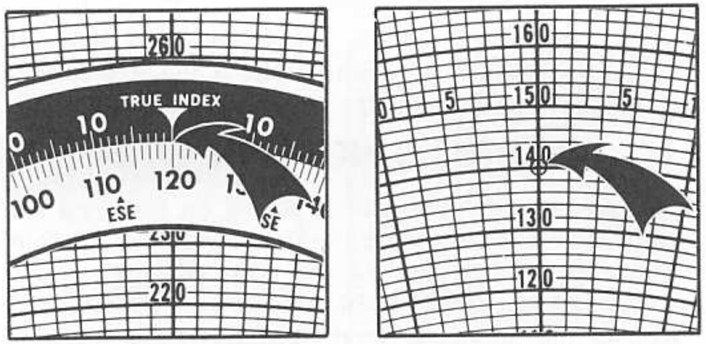


Figure 43

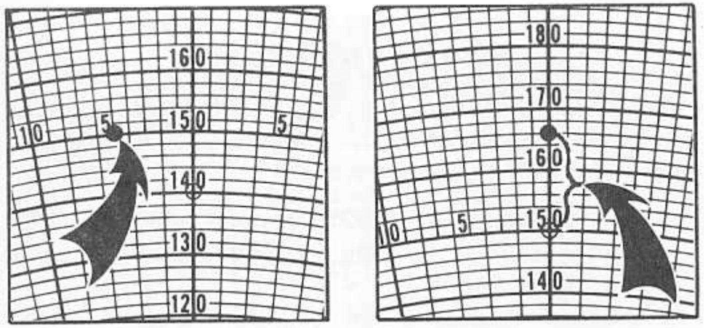


Figure 44

3. Subtract true heading from true course and find that the true heading is 5° less than the true course, which means that the 5° is a left wind correction angle.
4. With the center on 140, the ground speed, move up the grid to the true airspeed line of 150 m.p.h. Then, move to the left 5° and make a pencil mark, or wind dot, on the 150 m.p.h. line. (See fig. 44.)
5. Rotate the azimuth until the wind dot is resting directly on the centerline. (See fig. 44.)
6. By checking the number of miles between the center of the azimuth and the wind dot, find that the wind speed is 16 m.p.h. (See fig. 44.)
7. To find the wind direction, look under the true index. In this problem, the wind direction is 065° . (See fig. 45.)

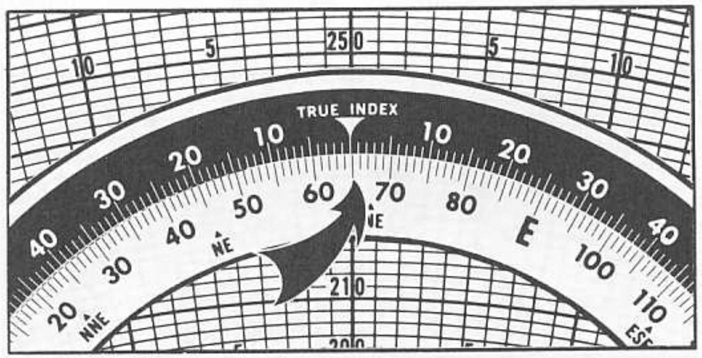


Figure 45

PRACTICE PROBLEMS — FINDING UNKNOWN WIND

What is the wind direction and speed for the following conditions? Refer to the Appendix for answers to these problems.

1. True course — 190° ; ground speed — 110 m.p.h.; true heading — 185° ; true airspeed — 115 m.p.h.
2. True course — 355° ; ground speed — 130 m.p.h.; true heading — 003° ; true airspeed — 120 m.p.h.
3. True course — 067° ; ground speed — 184 m.p.h.; true heading — 050° ; true airspeed — 168 m.p.h.

FINDING ALTITUDE FOR MOST FAVORABLE WINDS

The wind side of the computer can be used to determine the best altitude to obtain the highest ground speed for a given course. This is accomplished by comparing the winds aloft with the course to be flown, as follows:

1. The wind forecasts for each altitude are plotted on the rotating disc in the same manner as in a ground speed-true heading problem. The only difference, of course, is that more than one wind is plotted. (See fig. 46.)
2. Identify each wind dot with the appropriate altitude.
3. Rotate the azimuth to place the true course at the true index mark.

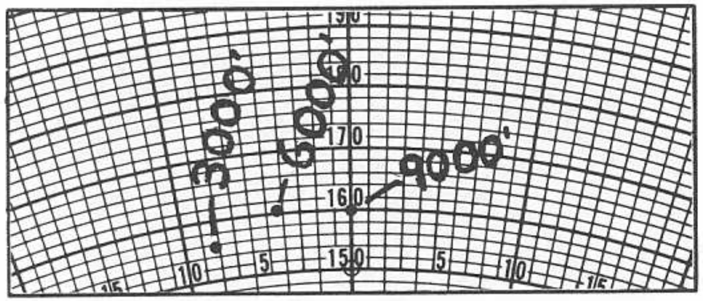


Figure 46

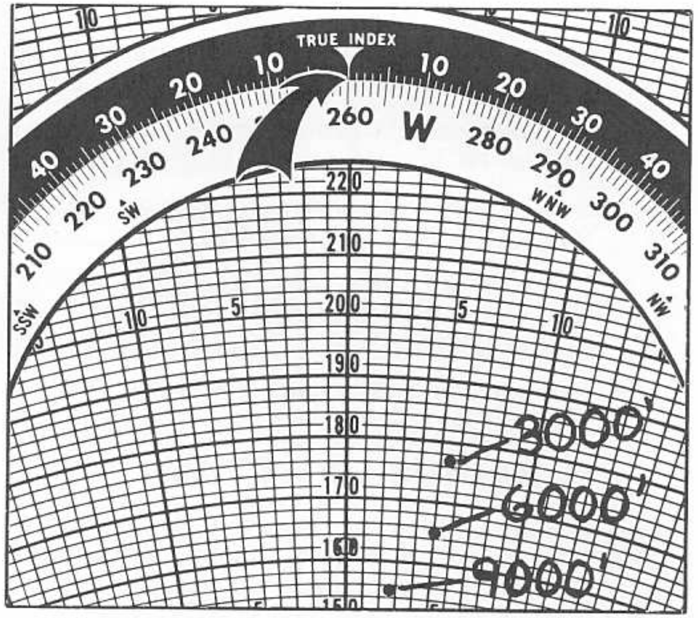


Figure 47

4. To examine the wind effect on ground speed, position the curved line representing the appropriate true airspeed for that altitude under each wind dot. Read the ground speed under the center of the azimuth for each wind to determine the highest ground speed.

For example, in figure 47 is shown a true course of 260° and winds: 3,000 ft., 310° at 22 m.p.h.; 6,000 ft. 340° at 15 m.p.h.; and 9,000 ft., 030° at 10 m.p.h. With a true airspeed of 156 m.p.h., the altitude for the most favorable winds is 9,000 ft., where the ground speed will be 162 m.p.h. Headwinds would be realized at 6,000 and 3,000 ft.

PRACTICE PROBLEMS — FINDING ALTITUDE FOR MOST FAVORABLE WINDS

Answers to these problems are in the Appendix of this manual.

WINDS ALOFT:
3,000 ft. – from 300° true, at 21 knots (24 m.p.h.)
6,000 ft. – from 330° true, at 12 knots (14 m.p.h.)
9,000 ft. – from 030° true, at 12 knots (14 m.p.h.)

Based on the above winds, determine:

1. Best altitude and ground speed for: T.C. — 045° at T.A.S. — 110 m.p.h._____ft._____G.S.
2. Best altitude and ground speed for: T.C. — 330° at T.A.S. — 100 m.p.h._____ft._____G.S.
3. Best altitude and ground speed for: T.C. — 120° at T.A.S. — 160 m.p.h._____ft._____G.S.
4. Best altitude and ground speed and smallest wind correction angle for: T.C. — 170° at T.A.S. — 130 m.p.h._____ft.,_____G.S.,_____W.C.A.
5. Best altitude and ground speed for: T.C. — 295° at T.A.S. — 110 m.p.h._____ft._____G.S.

RADIUS OF ACTION

Radius of action means the time or distance that an airplane can fly out on a given course, turn around, and have enough fuel to return to the departure point.

A radius of action problem is solved as follows:

1. First, measure the true course outbound from the departure point and the true course back to the departure point.

   NOTE

   The course back will be the reciprocal.

2. Determine the ground speed out, and then the ground speed back.

   NOTE

   Wind and true airspeed must be known for this step.

3. Find number of hours of fuel on board the aircraft.

   NOTE

   Fuel consumption and useable fuel must be known for this step.

4. Add the ground speed out to the ground speed back.
5. Locate the total of ground speed out and ground speed back on the "A" scale of the computer.
6. Rotate the center of the computer until the fuel duration, in hours on the "C" scale, is directly under the total of ground speeds out and back.

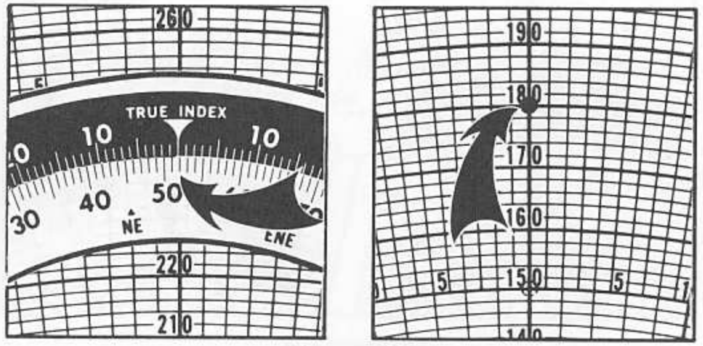


Figure 48

7. Move along the "A" scale and locate the ground speed back. Look directly under this and find the time to turn. This is the number of hours and minutes that the aircraft can fly outbound on the course before it has to turn around for the return trip.

EXAMPLE PROBLEM — RADIUS OF ACTION

True course — 060°; true airspeed — 120 m.p.h.; wind — 052° at 30 m.p.h.; useable fuel — 48 gallons; and fuel consumption — 6 g.p.h. How long can this plane fly outbound before having to turn and come back to the departure point?

This problem is worked as follows:

1. Using the wind side of the computer, place the wind direction of 052° under the true index. (See fig. 48.)
2. Plot up from the center the wind speed of 30 m.p.h. on the centerline of the grid.
3. Rotate the azimuth until the true course of 060° is directly under the true index. (See fig. 49.)
4. To find the ground speed, slide the grid until the wind dot is on the 120 m.p.h. line, which is the true airspeed. Then, check the center of the azimuth for the ground speed, which

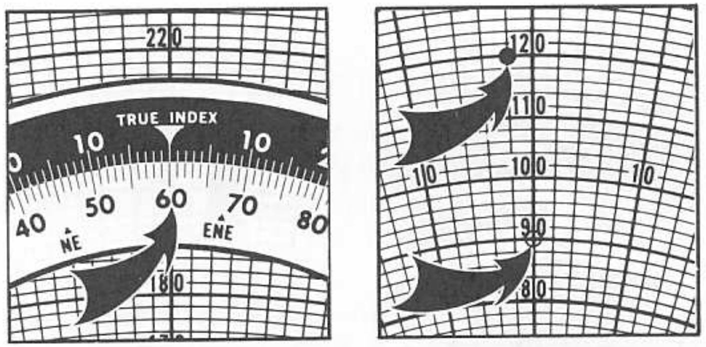


Figure 49

is 90 m.p.h. (See fig. 49.) Record this value for use later in the solution to this problem.

5. Now, reverse the azimuth on the wind side of the computer and place 240º, the true course back to the departure point, under the true index. (See fig. 50.)
6. Slide the grid until the wind dot rests on 120 m.p.h., the true airspeed. By checking the center of the azimuth, find that the ground speed to the departure point will be 150 m.p.h. (See fig. 50.)
7. Add ground speed outbound to ground speed back to the departure point (90 + 150 = 240 m.p.h.). The total is 240 m.p.h.
8. Next, change fuel in gallons to fuel in hours as follows:
   a. On the calculator side of the computer, place 6 g.p.h., our fuel consumption, on the "A" scale over the speed index. (See fig. 51.)

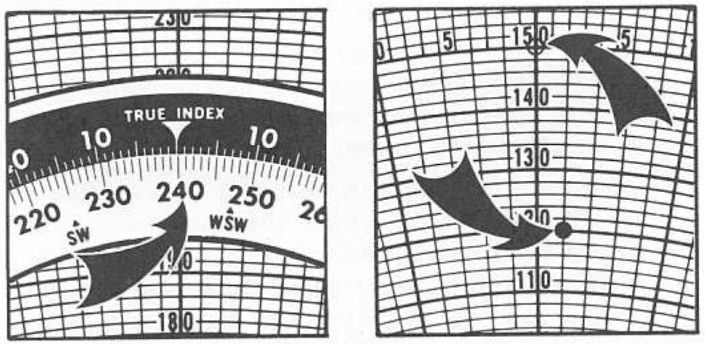


Figure 50

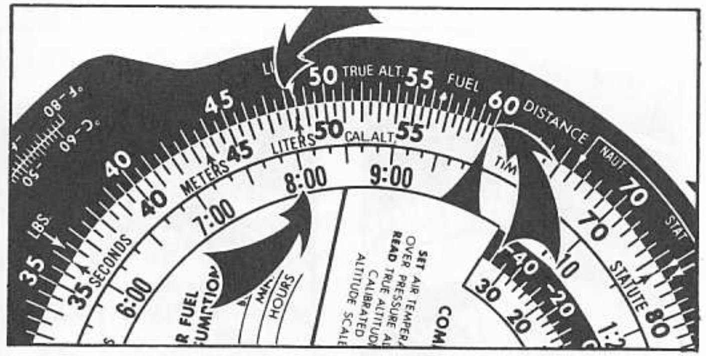


Figure 51

   b. Look directly under useable fuel, 48 gals. on the "A" scale, and find, on the "C" scale, that the total useable fuel is 8 hours. (See fig. 51.)
9. Now place the 240, which is the total of the ground speed out and the ground speed back, directly over the 8 hours of fuel available. (See fig. 52.)

   Move around the "A" scale to the ground speed back of 150 m.p.h. Next, look directly under 150 and find that, at the end of 5 hours, the aircraft should start back to its departure point so as to have enough fuel to make the return trip.
10. The answer to the problem is: time to turn — 5 hours. Time is converted to distance as follows:
    a. Place the ground speed out, 90 m.p.h., over the speed index. (See fig. 53.)

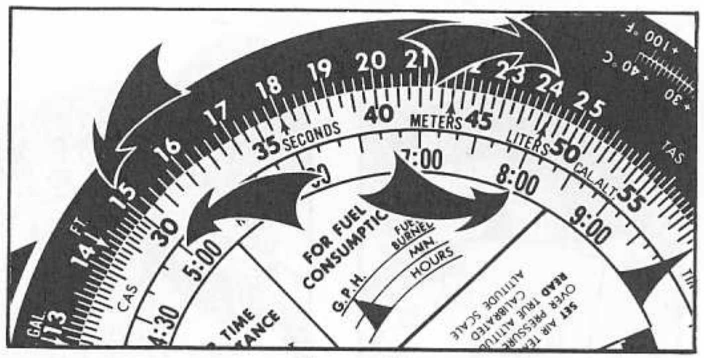


Figure 52

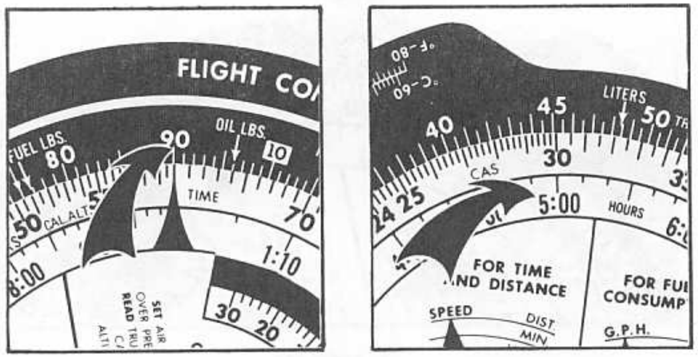


Figure 53

b. Look directly over 5 hours on the "C" scale and find that the aircraft will travel 450 miles in this length of time. (See fig. 53.) 450 miles is the radius of action in miles. 5 hours is the radius of action in time.

11. To check the problem, find the time required to fly back over the 450-mile course with the ground speed back of 150 miles per hour as follows:

a. Place the speed index under 150, our ground speed back. (See fig. 54.)

b. Look directly under 450 miles on the "A" scale and find that it will take 3 hours for the aircraft to make the return trip. (See fig. 54.)

c. This is the final check. Add time out, 5 hours, to the time back of 3 hours for a total of 8 hours. This time is equal to the fuel aboard when the problem solution is correct.

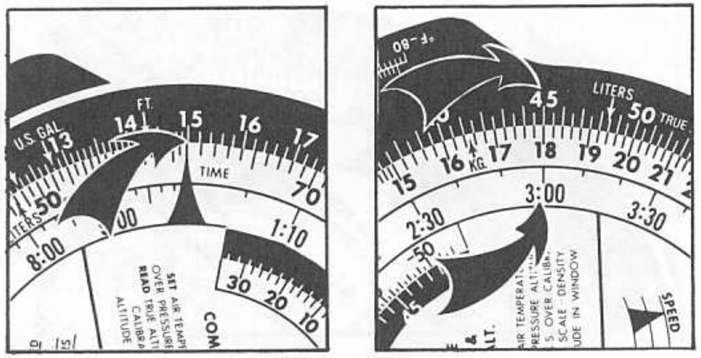


Figure 54

PRACTICE PROBLEMS — RADIUS OF ACTION

Refer to the Appendix for answers to these problems:

1. GIVEN:
   a. Wind, 230° at 18 m.p.h.
   b. T. C. out, 270° .
   c. T. C. back, 090° .
   d. Fuel available, 38 gal. (not counting reserve.)
   e. Fuel consumption, 8 g.p.h.
   f. T. A. S., 124 m.p.h.

   PROBLEM:
   a. What is the time to turn?
   b. What is the radius of action in statute miles?
   c. What is the total time out and back?

2. GIVEN:
   a. Ground speed out, 140 m.p.h.
   b. Ground speed back, 165 m.p.h.
   c. Fuel available, 46 gal. (not counting reserve.)
   d. Fuel consumption, 11 g.p.h.

   PROBLEM:
   a. What is the time to turn?
   b. What is the radius of action in statute miles?
   c. What is the total time out and back?

3. GIVEN:
   a. Wind, 030° at 14 knots.
   b. T. C. from points "A" to "B ", 170° .
   c. Fuel available, 68 gal. (not counting reserve.)
   d. Fuel consumption, 12 g.p.h.
   e. T. A. S., 164 m.p.h.

   PROBLEM:
   a. What is the time to turn?
   b. What is the radius of action in statute miles?
   c. What is the total time out and back?

METRIC CONVERSIONS

KILOMETER TO STATUTE OR NAUTICAL MILE

Kilometer-statute mile and kilometer-nautical mile conversions are accomplished by aligning the proper arrows on the B and A scales. The conversion arrow for kilometers, labeled KM, is located near 12 on the B scale. When this arrow is aligned with the STATUTE arrow on the A scale (at 76), all values on the B scale, in kilometers, will be aligned with their corresponding values on the A scale, in statute miles. When the KM arrow on the B scale is aligned with the NAUTICAL arrow on the A scale (at 66), all of the kilometer values on the B scale will be aligned with their corresponding nautical mile values on the A scale.

EXAMPLE PROBLEM — NAUTICAL MILES TO KILOMETERS

GIVEN: 132 nautical miles

DETERMINE: Kilometers

The problem is worked as follows:

1. Set the nautical arrow on the A scale opposite the KM arrow on the B scale. (See fig. 55.)
2. Read 244 kilometers on the B scale opposite 132 NM on the A scale.

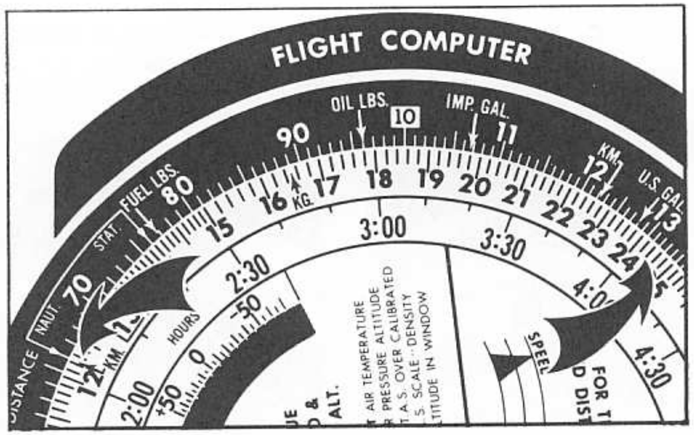


Figure 55

U.S. GALLONS — IMPERIAL (BRITISH) GALLONS

Near the number 11 on each scale, an arrow indicates imperial gallons, and near the number 13 another arrow indicates U. S. gallons. The imperial gallon, used in Great Britian and Canada, is equal to approximately 1.2 U. S. gallons. To convert U. S. to imperial gallons or vice versa, line up the imperial gallon arrow on one scale with the U. S. gallon arrow on the other scale. Read imperial gallons on the same scale as the imperial gallon arrow and U. S. gallons on the same scale as the U. S. gallon arrow. Check the answer to see that the number of U. S. gallons is larger than the corresponding number of imperial gallons.

EXAMPLE PROBLEM — U.S. GALLONS TO IMPERIAL GALLONS

GIVEN: 15 imperial gallons

DETERMINE: U. S. gallons

This problem is solved as follows:

1. Set IMP. GAL. arrow on A Scale opposite U. S. GAL. arrow on B scale. (See fig. 56.)
2. Read 18 U. S. gallons on B scale opposite 15 on A scale.

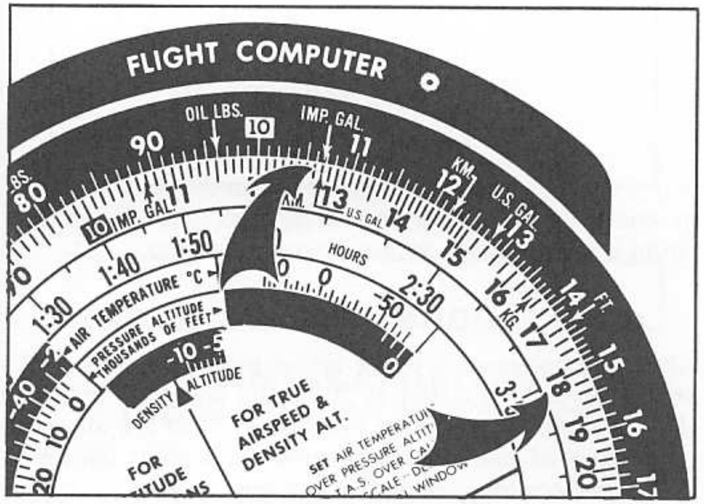


Figure 56

OTHER CONVERSIONS
GALLONS—LITERS; FEET—METERS; POUNDS—KILOGRAMS

A process similar to that used in the previous conversions is used for changing liters to gallons, feet to meters, pounds to kilograms, or vice versa. Line up the two arrows, one on the outside and one on the inside scale, corresponding to the units of measure you wish to convert. Read each value on the scale containing the arrow for the corresponding unit of measure. Be sure to check the answer for the proper relation of the larger with the smaller value.

The conversion arrows are located as follows:

Liters—near 48.5 on inside and outside scales
Feet—near the figure 14 on the outside scale
Meters—near 43.5 on inside scale
Pounds—near 36 on outside scale
Kilograms—near the figure 16 on inside scale

Note that the arrows for feet, meters, pounds, and kilograms each appear on only one scale. Hence, in the conversion of feet to meters or pounds to kilograms, and vice versa, there is only one way of matching the arrows in each problem.

NOTE
1 imp. gal. = 1.2 U. S. gal.
4 liters = approx. 1 U. S. gal.
1 kg. = approx. 2 lbs.
1 meter = approx. 3 ft.

In countries using the metric system, the liter is the liquid measure which approximates one quart.

FUEL—POUNDS AND GALLONS

When the conversion index arrow marked FUEL LBS. on the A scale (located at 76.8) and an arrow marked U.S. GAL. on the B scale (located at 128) are aligned, each value of fuel in gallons on the B scale is opposite its corresponding weight in pounds on the A scale. Gallons can be converted to pounds at a glance in this way as shown in Figure 57. Similarly, pounds can be converted to gallons.

One Gallon of Fuel weighs 6 pounds.

EXAMPLE PROBLEM— FUEL IN GALLONS TO POUNDS

GIVEN: Fuel, 22.5 gallons

DETERMINE: Fuel weight in pounds

This problem is solved as follows:

1. Set FUEL LBS. on A scale opposite U.S. GAL. on B scale. (See fig. 57.)
2. Read 135 lbs. on A scale opposite 22.5 GAL. on B scale.

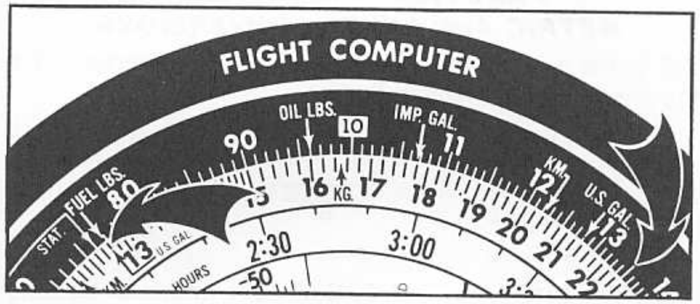


Figure 57

OIL—POUNDS AND GALLONS

The procedure for obtaining oil weight is similar to that for fuel. When the OIL LBS. arrow on the A scale (located at 96) is placed over the U.S. GAL. arrow, each value of oil in gallons is set on the B scale directly under its corresponding weight in pounds on the A scale. Figure 58 shows an example of the conversion of oil in gallons to oil weight in pounds.

Oil weighs 7.5 pounds per gallon.

EXAMPLE PROBLEM— OIL IN QUARTS TO POUNDS

GIVEN: Oil, 12 quarts (3 gallons)

DETERMINE: Oil weight in pounds.

1. Set OIL LBS. on A scale opposite U.S. GAL. on B scale. (See fig. 58.)
2. Read Oil Wt. (22.5 lbs.) opposite 3 Gal. on B scale.

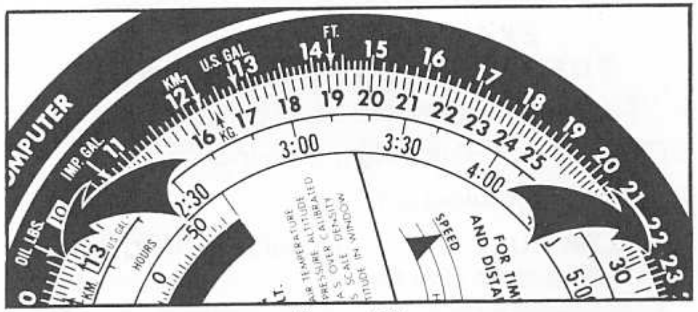


Figure 58

PRACTICE PROBLEMS— METRIC AND OTHER CONVERSIONS

Fill in the missing values and check your answers against the answers in the Appendix.

	Kilometers	Statute Miles	Nautical Miles
1.	1,450	______	______
2.	______	8	______
3.	______	______	54
	Liters	**U. S. Gallons**	**Imperial Gallons**
4.	______	1,165	______
5.	______	______	550
6.	9	______	______
7.	______	100	______
	Feet	**Meters**	
8.	56	______	
9.	______	70	
	Pounds	**Kilograms**	
10.	______	24	
11.	11	______	
12.	143	______	
	Fuel, Gallons	**Pounds**	**Oil, Gallons**
13.	20	______	______
14.	150	______	______
15.		______	4
16.		______	7

APPENDIX I

ANSWERS TO PRACTICE PROBLEMS

FINDING TIME (Page 5)

1. 1:20
2. 2:36
3. 18 minutes
4. 38 minutes

FINDING DISTANCE (Page 6)

1. 150 miles
2. 262 miles
3. 700 miles
4. 470 miles

FINDING SPEED (Page 7)

1. 126 m.p.h.
2. 160 m.p.h.
3. 110 m.p.h.
4. 96 m.p.h.

SHORT TIME (Page 9)

1. 7 miles
2. 100 m.p.h.

FUEL CONSUMPTION — FINDING TIME (Page 10)

1. 2:30
2. 3:46
3. 2:11
4. 2:20

FUEL BURNED (Page 11)

1. 3½ gal.
2. 56 gal.
3. 19.8 gal.
4. 5.15 gal.

FUEL CONSUMPTION (Pages 11 and 12)

1. 10½ g.p.h.
2. 21.6 g.p.h.
3. 23 g.p.h.
4. 8.6 g.p.h.

T.A.S. (Page 13)

1. 137 m.p.h.
2. 124 m.p.h.
3. 180 m.p.h.
4. 111 m.p.h.

NAUTICAL-STATUTE, STATUTE-NAUTICAL, AND STATUTE-KILOMETER (Page 16)

1. 161 miles
2. 28.8 m.p.h.
3. 67 nautical miles
4. 19.6 m.p.h.
5. 214 kilometers
6. 24.8 statute miles

MULTI-PART PROBLEMS (Page 17)

1. time — 2:40; 24 gallons
2. T.A.S. — 121 m.p.h.; time — 2:07; 24.4 gallons
3. T.A.S. — 130 m.p.h.; time — 2:34; 21.8 gallons
4. time — 3:09; 37.8 gallons

OFFCOURSE (Pages 19 and 20)

1. a. 7°
   b. 11°
   c. Right
2. a. 8°
   b. 17°
   c. Left
3. a. 4°
   b. 6°
   c. Right

TIME & DISTANCE TO A VOR STATION (Page 23)

1. 36 min., 66 miles
2. 30 min., 47.6 miles
3. 4 min., 9 miles
4. 36 min., 45 miles
5. 5.5 min., 12.85 miles

TRUE ALTITUDE (Pages 24 and 25)

1. 6,250 feet
2. 9,400 feet
3. 5,250 feet

DENSITY ALTITUDE (Page 25)

1. 8,000 feet
2. 13,000 feet
3. Sea Level

MULTIPLICATION AND DIVISION (Page 27)

1. 8,100 feet
2. 2,700 feet
3. 720 f.p.m.
4. 430 f.p.m.
5. 12,400 pound-inches
6. 54 inches

CONVERTING FEET PER NAUTICAL MILE TO FEET PER MINUTE (Page 29)

1. 400 f.p.m.
2. 400 f.p.m.
3. 700 f.p.m.
4. 700 f.p.m.

TRUE HEADING AND GROUND SPEED (Page 35)

1. True heading — 304°
   Ground speed — 130 m.p.h.
2. True heading — 171°
   Ground speed — 149 m.p.h.
3. True heading — 052°
   Ground speed — 133 m.p.h.
   Wind velocity — 23 m.p.h.
4. True heading — 278°
   Ground speed — 143 m.p.h. or
   124 knots
5. True heading — 91°
   Ground speed — 131 m.p.h.
   T.A.S. — 130 m.p.h.

FINDING UNKNOWN WIND (Page 38)

1. 125° at 11 m.p.h.
2. 119° at 20 m.p.h.
3. 311° at 55 m.p.h.

FINDING ALTITUDE FOR MOST FAVORABLE WINDS (Page 39 and 40)

1. 3,000 ft., 115 m.p.h.
2. 9,000 ft., 92 m.p.h.
3. 3,000 ft., 183 m.p.h.
4. 6,000 ft., 143 m.p.h., 2° right
5. 9,000 ft., 110 m.p.h.

RADIUS OF ACTION (Page 45)

1. a. 2.38
   b. 290 miles
   c. 4:45
2. a. 2:15
   b. 315 miles
   c. 4:10
3. a. 2:37
   b. 462 miles
   c. 5:40

METRIC AND OTHER CONVERSIONS (Page 50)

1. 900 SM, 782 NM
2. 13 KM, 7 NM
3. 100 KM, 62 SM
4. 4,400 liters, 970 imp. gal.
5. 2,500 liters, 660 U. S, gal.
6. 2.4 U. S. gal., 2 imp. gal.
7. 378 liters, 83 imp. gal.
8. 17 meters
9. 230 feet
10. 53 pounds
11. 5 kilograms
12. 65 kilograms
13. 120 pounds
14. 900 pounds
15. 30 pounds
16. 52.5 pounds

APPENDIX II
GLOSSARY OF TERMS

AIRSPEED. The speed of an aircraft relative to the air.

CALIBRATED (CAS).
Indicated airspeed corrected for pitot-static installation and instrument errors.

INDICATED (IAS).
The uncorrected reading obtained from the airspeed indicator.

TRUE (TAS).
Calibrated airspeed corrected for density altitude (pressure and temperature).

ALTITUDE. The height of an aircraft above mean sea level or above the terrain.

ABSOLUTE (AA).
True altitude corrected for terrain elevation; the vertical distance of the aircraft above the terrain.

CALIBRATED (CA).
Indicated pressure altitude corrected for instrument error. Also known as flight-level pressure altitude.

DENSITY (DA).
Calibrated altitude corrected for temperature; the vertical distance of the aircraft above the standard datum plane.

PRESSURE ALTITUDE (PA).
The reading of the pressure altimeter with the barometric window set at 29.92.

TRUE.
The density altitude corrected for pressure altitude variation (PAV); the vertical distance above mean sea level.

COURSE. The direction of the intended path of the aircraft over the earth; or the direction of a line on a chart representing the intended aircraft path, expressed as the angle measured from a specific reference datum clockwise from 0° through 360° to the line.

MAGNETIC (MC).
The course of an aircraft measured with reference to the north magnetic pole.

TRUE (TC).
The course of an aircraft measured with reference to the true north, or geographic, pole. (The true course is always represented by the centerline of the flight computer grid.)

GROUND SPEED. The speed of the aircraft relative to the ground. (Ground speed is always represented by the center of the azimuth of the flight computer.)

HEADING. The angular direction of the longitudinal axis of an aircraft measured clockwise from a reference point.

COMPASS (CH).
The reading taken directly from the compass.

MAGNETIC (MH).
The heading of an aircraft with reference to magnetic north.

TRUE (TH).
The heading of an aircraft with reference to grid north.

MACH NUMBER. The speed of a moving object compared to the speed of sound within the same medium of movement. A speed of Mach 2.5 would be two and one-half times the speed of sound in the same medium.

NAUTICAL MILE (NM). A unit of distance used in navigation, 6080 feet; the mean length of one minute of longitude on the equator; approximately 1 minute of latitude; 1.15 statute miles.

STATUTE MILE (SM). 5,280 feet or .827 nautical miles.

WIND CORRECTION ANGLE. The number of degrees that the aircraft longitudinal axis must be displaced, to the right or left of the true course and the true heading. (The wind correction angle is always displayed on the computer between the centerline of the grid and the wind dot.)

NOTES