PRIVATE PILOT

Calculations

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Cloud Base in AGL

Using E6B:

Step 1: Press WIND button.

Step 2: Select CLD BASE. Enter.

Step 3: Enter the temperature provided for OAT°C. Enter.

Step 4: Enter the dew point for DEW°C. Enter.

Step 5: Read the answer.

Note: You may need to convert from °F to °C for both temperature and dew point. To do this, enter °F as given, press CONV, press "C" key which converts °F → °C, continue with problem.

By Hand – Equation for °C:

$$\text{Cloud Base} = \frac{\textbf{Temperature}\ {}^{\circ}\mathrm{C} - \textbf{Dew Point}\ {}^{\circ}\mathrm{C}}{2.5} \times 1000$$

Weight & Balance

Equations:

$$\text{Weight} \times \text{Arm} = \text{Moment}$$

$$\text{Total Moment} \div \text{Total Weight} = \text{Center of Gravity}$$

Equations if using MOM/100:

$$(\text{Weight} \times \text{Arm}) \div 100 = \text{MOMENT/100}$$

$$(\text{Total Moment} \div \text{Total Weight}) \times 100 = \text{Center of Gravity}$$

Notes:

- Another word for ARM is DISTANCE.
- The abbreviation MOM means Moment.
- Empty Weight is typically provided as MOM/100 on the knowledge test.
- Oil is deducted (-) on the knowledge test, but in real-life situations, this depends on the specific model.

Weight & Balance – Set Up & Solve

Setup your grid like this: Item, Weight, Arm, Moment/100

Item	Weight	Arm	Moment/100

Input values and complete calculations:

Item	Weight	Arm	Moment/100
Front Seat Occupant	340	85	(340 x 85)/100=289
Rear Seat Occupant	295	121	(295 x 121)/100=357
Fuel (Main)	264	75	(264 x 75)/100=198
Baggage	36	140	(36 x 140)/100=50.4
Empty Weight	2015	-	1554.0 (Provided)
Totals	2,950 lbs		2,448.4 lbs-in

$$\frac{2448.4}{2{,}950} \times 100 = 82.99 \text{ CG}$$

Pressure & Density Altitude

Using E6B:

Step 1: Press [HDG/GS P-D/ALT] button.

Step 2: Select P-D/ALT. Enter.

Step 3: Input airport elevation as provided for IALT. Enter.

Step 4: Input altimeter as provided for BARO. Enter.

Step 5: Input temp as provided for T°C (may need to convert from °F to °C). Enter.

Step 6: Read the answers. Pressure altitude will be displayed on the top, "PALT" and density altitude on the bottom "DALT".

Note: You may need to convert from °F to °C. To do this, enter °F as given, press CONV, press "C" key which converts °F → °C, continue with problem.

By Hand - Pressure Altitude:

Step 1: Subtract the current altimeter setting from standard pressure of 29.92.

Step 2: Multiply that number by 1,000.

Step 3: If you have a negative number, subtract it from the field elevation. If you have a positive number, add it to the field elevation.

Pressure Altitude =
(29.92 – Current Altimeter) x 1000ft
If positive (+) number, add to field elevation
If negative (-) number, subtract from field elevation

When calculating by hand, the answer will vary slightly compared to when using the E6B.

By Hand - Density Altitude:

Step 1: Subtract ISA Temp (International Standard Temperature) from OAT (Outside Air Temperature).

(OAT°C– ISA°C)

Step 2: Times that number by 120.

[(OAT°C– ISA°C) x 120]

Step 3: Add that number to your pressure altitude.

Density Altitude =
[(OAT°C– ISA°C) x 120] + Pressure Altitude in Feet

ISA Temp is 15°C at sea level and falls at a rate of 2°C per 1,000ft.
Standard Atmosphere chart on the next page for reference →

**When calculating by hand, the answer will vary slightly compared to when using the E6B.*

International Standard Atmosphere (ISA) Chart:

Standard Atmosphere			
Altitude (ft)	Pressure (Hg)	Temperature	
		(°C)	(°F)
0	29.92	15.0	59.0
1,000	28.86	13.0	55.4
2,000	27.82	11.0	51.9
3,000	26.82	9.1	48.3
4,000	25.84	7.1	44.7
5,000	24.89	5.1	41.2
6,000	23.98	3.1	37.6
7,000	23.09	1.1	34.0
8,000	22.22	-0.9	30.5
9,000	21.38	-2.8	26.9
10,000	20.57	-4.8	23.3
11,000	19.79	-6.8	19.8
12,000	19.02	-8.8	16.2
13,000	18.29	-10.8	12.6
14,000	17.57	-12.7	9.1
15,000	16.88	-14.7	5.5
16,000	16.21	-16.7	1.9
17,000	15.56	-18.7	-1.6
18,000	14.94	-20.7	-5.2
19,000	14.33	-22.6	-8.8
20,000	13.74	-24.6	-12.3

Figure 4-3. *Properties of standard atmosphere.*

Source: FAA, Pilot's Handbook of Aeronautical Knowledge Figure 4-3

Pressure & Density Altitude – example problem:

Calculate both pressure & density altitude with a current altimeter setting of 29.86 and a field elevation of 940ft. OAT is 17°C.

Step 1: Pressure Altitude

Step 1: (29.92-29.86) = 0.06
Step 2: 0.06 x 1000 = 60ft
Step 3: 940ft + 60ft = 1,000ft
Pressure altitude is 1,000ft.
**E6B will get pressure altitude of 996ft.*

Step 2: Density Altitude

Step 1: 17°C-13°C = 4
Step 2: 4 x 120 = 480
Step 3: 1,000 + 480 = 1,480ft
Density Altitude if 1,480ft
**E6B will get density altitude of 1,445ft.*

Fuel Consumption

Using E6B:

Step 1: Press the REQUIRED button.

Step 2: Select FUEL. Enter.

Step 2: Enter the time as provided for TIME. Enter.

You may have to convert your time. For example, if you're given 2hr 20min on the knowledge test it would be entered as 2.33 since 20 minutes is 1/3 of an hour.

Step 3: Enter fuel used per hour as provided for FPH. Enter.

Step 4: Read answer.

By Hand – Fuel Consumption:

Example: If 18 gallons of fuel are used in 1 hour, how much fuel will be used in 2 hours and 20 minutes?

Step 1: 1 hour = 60 minutes
2 hours 20 minutes = 140 minutes

Step 2: 18 gallons/60 minutes = .3 gallons per minute

Step 3: 140 minutes x .3 gallons per minute = 42 gallons in 140 minutes

Example: 40 gallons of fuel have been consumed in 135 minutes. How much longer can the aircraft fly with 25 gallons of fuel and the same rate of consumption?

Step 1: 40 gallons/135 minutes = .2962 gallons per minute

Step 2: 25 gallons/.2962 gallons per minute = 84.40 minutes

Headwinds & Crosswinds

Using E6B:

Step 1: Press the WIND button.

Step 2: Select X/H-WIND. Enter.

Step 2: Enter your wind direction as provided for WD/R. Enter.

Step 3: Enter your wind speed as provided for WSPD. Enter.

Step 4: Enter your runway heading as provided for RWY. Enter.

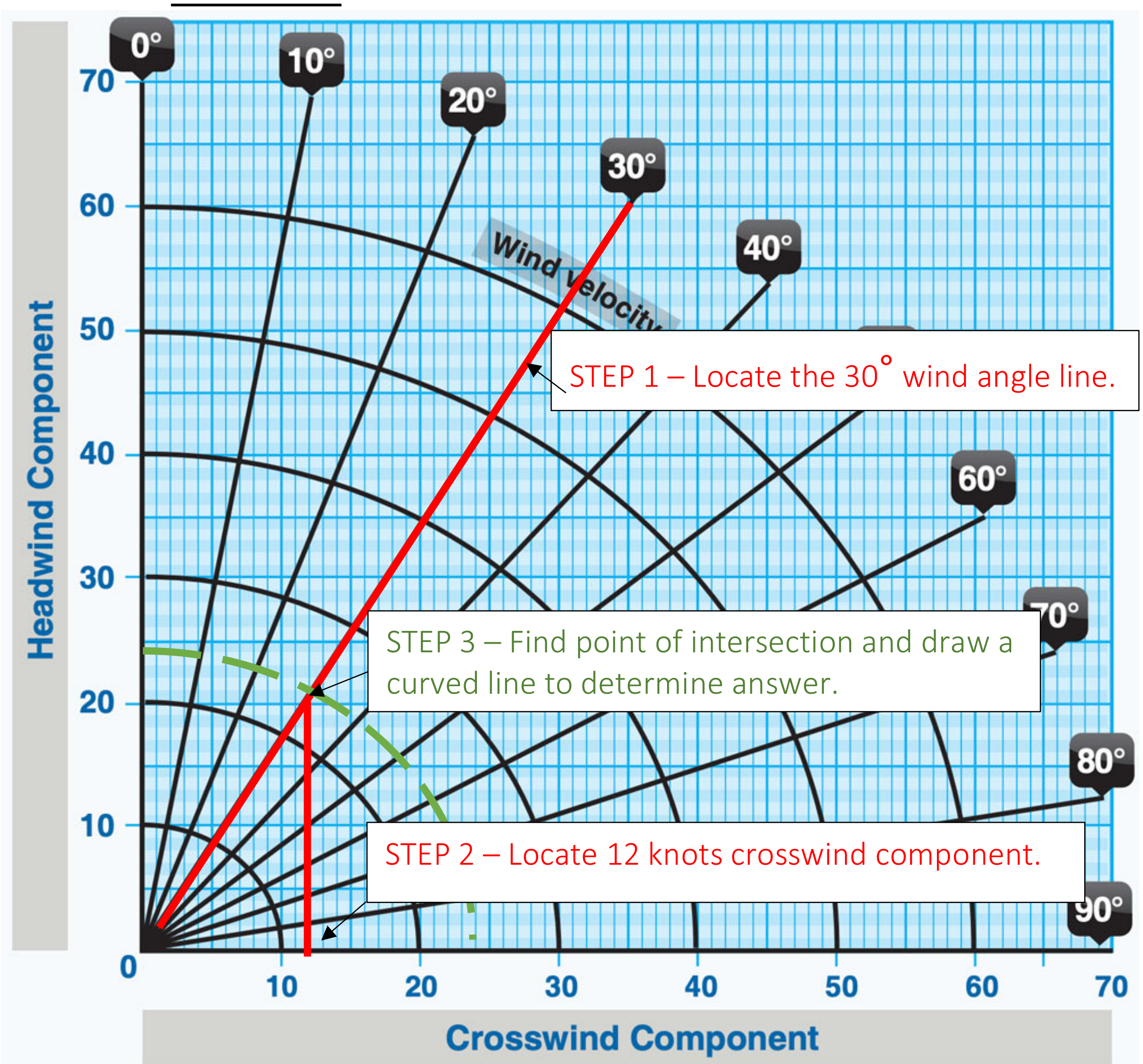
Step 5: Read answers. X- Wind (Crosswind) is on top and H-Wind (Headwind) is on bottom.

For test questions asking about the maximum wind velocity or which runway would be suitable in various conditions, you must you the Crosswind Component Graph. See next page →

Using Crosswind Component Graph:

Example: **3685.** What is the max wind velocity (y-axis) for a 30° crosswind if the max crosswind component (x-axis) for the plane is 12 knots?

Answer: 24 Knots



Source: FAA, Airplane Flying Handbook Figure 9-19

True Course (TC), Magnetic Course (MC), and Compass Course (CC)

Equations:

True Course =
When you draw a line between 2 points on a sectional and use your plotter to find the angle.

Magnetic Course =
True Course $\pm$ Magnetic Variation
Remember: East is Least (-), West is Best (+)

Compass Course =
Magnetic Course $\pm$ Compass Deviation

Steps:

Step 1: Plot the course between the two points on the sectional provided in the testing supplements.

Step 2: Measure the true course angle using a plotter.

Step 3: Calculate magnetic course by adding or subtracting the magnetic variation.

Step 4: Calculate the compass course by adding or subtracting the compass deviation.

True Course (TC) converted to True Heading (TH), Magnetic Heading (MH), and Compass Heading (CH) for XC planning.

Any course; true, magnetic, or compass, becomes a heading once it is corrected for wind.

Remember: Wind from the left is subtracted (-L). Wind from the right is added (+R).

Steps & Equations:

True Course = The angle between 2 points on a sectional, found by using your plotter.

↓

True Course ± WCA (-L/+R) = **True Heading**

↓

True Heading ± Magnetic Variation = **Magnetic Heading**

↓

Magnetic Heading ± Compass Deviation = **Compass Heading**

Wind Correction Angle (WCA) & Ground Speed (GS) & True Heading (HDG)

Using E6B:

Step 1: Press [HDG/GS P-D/ALT] button.

Step 2: Select HDG/GS. Enter.

Step 3: Enter the wind direction provided for WDIR.

Step 4: Enter the windspeed provided for WSPD.

Step 5: Enter true course for CRS.

Step 6: Enter true airspeed for TAS.

Step 7: Groundspeed (GS), True Heading (HDG), and Wind Correction Angle (WCA) will now be shown.

Equation for Ground Speed:

$$\text{Rate (Speed)} = \frac{\text{Distance}}{\text{Time}}$$

Time, Rate, Distance

Equations:

$$\text{Rate (Speed)} = \frac{\text{Distance}}{\text{Time}}$$

$$\text{Distance} = \text{Rate} \times \text{Time}$$

$$\text{Time} = \frac{\text{Distance}}{\text{Rate}}$$

Distance Example: How far does an aircraft travel in 2 hours and 15 minutes at a ground speed of 138 knots?

Step 1: Calculate that 2 hours and 15 minutes is 135 minutes (60 + 60 + 15)

Step 2: 138 knots ÷ 60 minutes = 2.3 nm per minute

Step 3: 135 minutes x 2.3 nm per minute = 310.5 nm

Fuel Flow & TAS using Cruise Power Setting Table

You need to use the **Airplane Power Settings Table** to answer any of these questions on the knowledge test, it is provided in the testing supplements.

Step 1: Use the chart to find the fuel flow and TAS.

Step 2: Use E6B or manually calculate time en route (Pg. 18).

Step 3: Use E6B or manually calculate fuel consumption (Pg. 11).

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Figure 35. Airplane Power Setting Table.

Cruise power settings
65% Maximum continuous power (or full throttle 2,800 pounds)

Press ALT.	ISA −20 °C (−36 °F)							
	IOAT		Engine speed	MAN. press	Fuel flow per engine		TAS	
Feet	°F	°C	RPM	IN HG	PSI	GPH	KTS	MPH
SL	27	−3	2,450	20.7	6.6	11.5	147	169
2,000	19	−7	2,450	20.4	6.6	11.5	149	171
4,000	12	−11	2,450	20.1	6.6	11.5	152	175
6,000	5	−15	2,450	19.8	6.6	11.5	155	178
8,000	−2	−19	2,450	19.5	6.6	11.5	157	181
10,000	−8	−22	2,450	19.2	6.6	11.5	160	184
12,000	−15	−26	2,450	18.8	6.4	11.5	162	186
14,000	−22	−30	2,450	17.4	5.8	10.5	159	183
16,000	−29	−34	2,450	16.1	5.3	9.7	156	180

Press ALT.	Standard day (ISA)							
	IOAT		Engine speed	MAN. press	Fuel flow per engine		TAS	
Feet	°F	°C	RPM	IN HG	PSI	GPH	KTS	MPH
SL	63	17	2,450	21.2	6.6	11.5	150	173
2,000	55	13	2,450	21.0	6.6	11.5	153	176
4,000	48	9	2,450	20.7	6.6	11.5	156	180
6,000	41	5	2,450	20.4	6.6	11.5	158	182
8,000	36	2	2,450	20.2	6.6	11.5	161	185
10,000	28	−2	2,450	19.9	6.6	11.5	163	188
12,000	21	−6	2,450	18.8	6.1	10.9	163	188
14,000	14	−10	2,450	17.4	5.6	10.1	160	184
16,000	7	−14	2,450	16.1	5.1	9.4	156	180

Press ALT.	ISA +20 °C (+36 °F)							
	IOAT		Engine speed	MAN. press	Fuel flow per engine		TAS	
Feet	°F	°C	RPM	IN HG	PSI	GPH	KTS	MPH
SL	99	37	2,450	21.8	6.6	11.5	153	176
2,000	91	33	2,450	21.5	6.6	11.5	156	180
4,000	84	29	2,450	21.3	6.6	11.5	159	183
6,000	79	26	2,450	21.0	6.6	11.5	161	185
8,000	72	22	2,450	20.8	6.6	11.5	164	189
10,000	64	18	2,450	20.3	6.5	11.4	166	191
12,000	57	14	2,450	18.8	5.9	10.6	163	188
14,000	50	10	2,450	17.4	5.4	9.8	160	184
16,000	43	6	2,450	16.1	4.9	9.1	155	178

Note: 1. Full throttle manifold pressure settings are approximate.
2. Shaded area represents operation with full throttle.

Source: FAA, Airmen Knowledge Testing Supplement Figure 35, 2-32

Steep Turns & G Loads

You will need to use the Load Factor Chart to answer these questions on the knowledge test, it is provided in the testing supplements and applies to level turns.

Angle of bank	Load factor n (G force)
0°	1.0
10°	1.015
30°	1.154
45°	1.414
60°	2.000
70°	2.923
80°	5.747
85°	11.473
90°	∞

Equation:

$$\text{Weight} = \text{Airplane Weight} \times \text{Load factor}$$

Example: **3215**. An airplane weighs 3,300lbs, what is the approx. weight (or load) the airplane structure would have to support in a 30° banked level turn?

Weight (load) = 3,300 x 1.154 = 3,808.2 pounds

Time (UTC/ZULU)

Coordinated Universal Time (UTC) = Zulu Time

You will need to use the **Time Conversion Table** to answer these test questions, it is provided in the testing supplements.

Time Conversion Table:

To convert from	To coordinated universal time
Eastern standard time	Add 5 hours
Eastern daylight time	Add 4 hours
Central standard time	Add 6 hours
Central daylight time	Add 5 hours
Mountain standard time	Add 7 hours
Mountain daylight time	Add 6 hours
Pacific standard time	Add 8 hours
Pacific daylight time	Add 7 hours

Example: **3571.** An aircraft departs an airport in the eastern daylight time zone at 0945 EDT for a 2-hour flight to an airport located in the central daylight time zone (CST). The landing should be at what coordinated universal time (UTC)?

Step 1: Convert the EDT takeoff time to UTC.

0945 EDT
+0400 UTC conversion per the table
1345 UTC / Zulu Time

Step 2: Add the flight time to the UTC/Zulu time.

1345 UTC
+0200 flight time
1545 UTC / Zulu Time

Therefore, the answer is **1545 UTC / Zulu Time** for time of landing.

Example: **3572**. An aircraft departs an airport in CST zone at 0930 CST, for a 2-hour flight to an airport in the MST zone. The landing should be at what time?

Step 1: Change the CST takeoff to UTC

0930 CST
+0600 UTC conversion per the table
1530 UTC takeoff time

Step 2: Add the flight time.

1530 UTC
+0200 flight time
1730 UTC time of landing

Step 3: Convert UCT to MST:

1730 UTC
-0700 conversion
1030 MST landing time

Medical Certificate Duration

Type	Duration		EKG
First	Under age 40	12 months	Annually
	Age 40 or older	6 months	
Second	12 months regardless of age		Never
Third	Under age 40	60 months	Never
	Age 40 or older	24 months	

*First, second and third class medicals expire on the last day of their respective expiration month.
*Once a first or second class medical expires, unless otherwise noted, it downgrades to a lower level of certification.

Example: A 29 year old gets a third class medical on July 1, 2023, it will expire on July 31, 2028.

Example: for a 45-year-old a first class medical has first class privileges for 6 months from the exam month, second class privileges for 12 months from the exam month and third class privileges for 24 months from the exam month.

Basic Med:

Type	Duration	EKG
Basic Med	CMEC completed by state-licensed physician every 48 months	Never
	Certifying course online every 24 months	

Required Maintenance Durations

Annual – An aircraft cannot be operated unless it has had an annual inspection performed by an A&P mechanic with an inspection rating within the preceding 12 months. This inspection will be documented in the aircraft's maintenance records. For example, if the aircraft's last inspection was on July 12, 2022, the next annual inspection will be due by midnight on July 31, 2023

An annual can take the place of a 100hr inspection, but not the other way around.

100 hr – A 100-hour inspection is required if the aircraft is used for hire. The inspection must be conducted by an A&P mechanic and may be overdue by up to 10 hours, provided that the additional time is used to move the aircraft to the mechanic. Any time over 100 hours does not count toward the calculation of the due date for the next 100-hour inspection.

A – Annual (Every 12 calendar months)
V – VOR (Every 30 days)
1 – 100 Hour (Every 100 hours)
A – Altimeter (Every 24 months)
T – Transponder (Every 24 months)
E – ELT (Every 12 months & battery replacement is required after 1hr of continuous use or after half of useful life)