

04356D Program Description I

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Program Title ENGINE OUT!

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Program Description, Equations, Variables Program will initialize itself (or can be changed by keying in seed--any number greater than 0) when A is pressed. The initial altitude is first display. This is altitude at which your engine has failed. It is assumed that all power is lost! Next is displayed the estimated glide ratio of the plane. That is, if CONTINUE is repeatedly used, the plane will follow this path all the way to the ground at the same speed. Of course, we want to "stretch" the glide to make it to the maximum distance (so we won't have to walk so far to telephone for help!). The pilot has control of the elevator to alter the glide of the aircraft by slightly more than $5\frac{1}{2}$ degrees up or down. A positive input pushes the "stick" forward (nose down to accelerate) and pulls backward are negative (nose up and reduces speed). The third display is the speed at which the plane was travelling just as power loss occurred. The final display is the stall speed. In applying negative operations, speed should be closely watched so that altitude is not needlessly lost. As in flying actual aircraft, stalling should be avoided on final approaches because recovery from stall may be fatal.

Now, it is time to decide whether to continue downward on the assumed glide path, or to use our elevator control. If you want to follow the path, press C, and you will get first displayed your new altitude, then the speed (which will be unchanged), and then the descent angle. Now, if you decide to use the elevator, key in a control operation. If this amount of control is beyond the range of travel of the "stick", the program reduces it to the maximum. Then, you will get the 3 displays again, and you are ready for the next action. Continue until 0.00000000 is displayed, in which case you have hit the ground. After this display, you will see how fast you were travelling when the ground was reached. Then, ~~operation continues with~~ the angle (negative, usually) at which you were coming down. Finally, the distance across the ground that was covered from the time power was lost until landing, or in some cases, impact!

If you inadvertently stall while coming down, this will be signalled by flashing the speed 3 times before continuing with the next display.

When distance is displayed, and you wish to try another glide, there is no need to clear that display; it can be used as a seed for the next glide. Any other seed can be used including 0.0 if the registers aren't cleared (not needed).

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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Sketch(es)



-7° (approx. descent angle)

Expressed as a "glide ratio", this descent angle may be thought of as travelling about 8 units forward for each unit downward. This is shown in the diagram below:

Glide ratio approx. 8:1.

Sample Problem(s) No seed used. Pressing START, obtain altitude of 1416 feet, a glide ratio of 8, an initial speed of 126 feet/second, and a stall speed of 55 feet/second.

"Par" glide would be $1416 \times 8 \div 5280 = 2.1$ miles. Should try to beat that, since that's the result obtained by following the glide path all the way to ground contact.

Solution(s) Keystrokes

Outputs

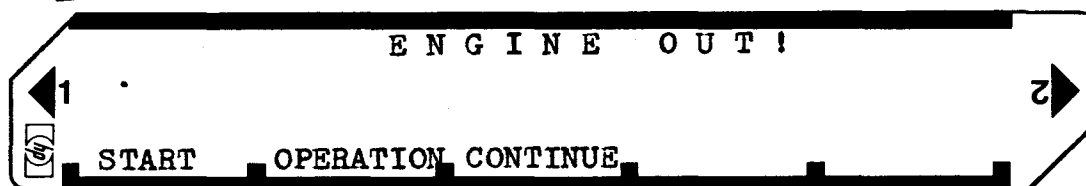
5.5 B	1168.	136.	-12.
5 B	797.	150.	-17.
-4 B	479.	161.	-13.
-4 B	239.	168.	-9.
-4.5 B	112.	162.	-5.
-1 B	16.	154.	-4.
-3.8 B	13.	143.	-.1
.1 B	8.	132.	-.2
-.1 B	5.	121.	-.1
.1 B	1.	110.	-.2
-.1 B	0.00000000	99.4	-.1 2.5

Ground contact at 99.4 ft/sec at -.1 degrees occurred $2\frac{1}{2}$ miles from point of power loss. Not bad, but I wasted a lot of speed since I was 44 ft/sec above stall.

XXXXXXXXX Ready for next try? Press A. Get altitude of 7956, glide ratio of 10, speed of 111, stall at 48. Press C. Get altitude: 7858, speed: 111, descent angle: -6. Now finish the glide.

Note that CONTINUE is just a shortcut for entering 0 B. So, if you are under the glide path, you will remain under the path and speed will increase accordingly. Conversely, if you are over the path, descent speed will reduce. Speed will remain the same only while on the glide path.

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[illegible]

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STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	f LBL A	31 25 11			g STK	32 84	
	1	01			h RTN	35 22	
	+	61			f LBL C	31 25 13	Continue
	f LN	31 52		060	0	00	New operatio
	h π	35 73			f LBL B	31 25 12	
	+	61			STO 5	33 05	
	f GSB 8	31 22 08			h ABS	35 64	
	EEX	43			5	05	
	4	04			.	83	
010	x	71	Generates altitude		6	06	Check for "stick" maximum
	STO 1	33 01			7	07	
	f $\sqrt{x}$	31 54			g $x \leq y$	32 71	
	f GSB 8	31 22 08			f GSB 0	31 22 00	
	9	09		070	RCL 5	34 05	
	.	83			STO - 6	33 51 06	
	1	01			RCL 8	34 08	
	1	01			RCL 6	34 06	
	x	71			g $x=y$	32 51	
	1	01			GTO 2	22 02	
020	.	83			g $x \leq y$	32 71	
	2	02	Generates glide path		f GSB 4	31 22 04	
	+	61			RCL 8	34 08	
	STO 2	33 02			RCL 6	34 06	
	h $1/x$	35 62		080	g $x \leq y$	32 71	
	g $\tan^{-1}$	32 64			GTO 9	22 09	
	CHS	42			h ABS	35 64	
	STO 8	33 08	Glide angle		RCL 8	34 08	
	STO 6	33 06			h ABS	35 64	
	CHS	42			-	51	
030	f $\sqrt{x}$	31 54			f sin	31 62	
	f GSB 8	31 22 08			h ABS	35 64	
	EEX	43			f $\sqrt{x}$	31 54	
	3	03			3	03	
	x	71		090	2	02	
	3	03			.	83	
	.	83			2	02	
	2	02			x	71	
	÷	81	Generates speed		STO - 3	33 51 03	
	EEX	43			RCL 6	34 06	
040	2	02			f $x=0$	31 51	
	g $x > y$	32 81			GTO 5	22 05	
	GTO A	22 11			f $x < 0$	31 71	
	h R↓	35 53			f GSB 4	31 22 04	
	STO 3	33 03		100	RCL 6	34 06	
	2	02			f $x < 0$	31 71	
	.	83			GTO 5	22 05	
	3	03	Generates stall		f GSB 4	31 22 04	
	÷	81			GTO 5	22 05	
	STO 4	33 04			h RTN	35 22	
050	0	00			f LBL 0	31 25 00	
	STO 7	33 07			RCL 5	34 05	
	DSP 0	23 00			f $x < 0$	31 71	
	RCL 1	34 01			GTO 1	22 01	
	RCL 2	34 02		110	5	05	
	RCL 3	34 03			.	83	
	RCL 4	34 04			6	06	

REGISTERS

0	1	2	3	4	5	6	7	8	9
seed	Altitude	Glide	Speed	Stall	Operation	Descent	Dist.	Angle	
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
A	B	C	D	E	I				

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STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
	7	07			RCL 4	34 04	
	STO 5	33 05		170	x > y	32 81	
	h RTN	35 22			GTO 6	22 06	
	f LBL 1	31 25 01			f LBL E	31 25 15	
	5	05			RCL 3	34 03	
	.	83			f -x-	31 84	
	6	06			RCL 6	34 06	
120	7	07			h RTN	35 22	
	CHS	42			f LBL 6	31 25 06	
	STO 5	33 05			RCL 3	34 03	
	h RTN	35 22			h PAUSE	35 72	Stall indicated
	f LBL 2	31 25 02		180	h PAUSE	35 72	
	f GSB 4	31 22 04			h PAUSE	35 72	
	GTO 5	22 05			2	02	
	f LBL 4	31 25 04			3	03	
	RCL 6	34 06			4	04	
	f sin	31 62			.	83	
130	RCL 3	34 03			5	05	
	x	71			6	06	
	9	09			STO - 1	33 51 01	
	.	83			RCL 1	34 01	
	1	01		190	f x < 0	31 71	
	x	71	Change alt.		GTO 7	22 07	
	STO + 1	33 61 01			GTO E	22 15	
	RCL 6	34 06			h RTN	35 22	
	f cos	31 63			f LBL 7	31 25 07	
	RCL 3	34 03			0	00	
140	x	71			DSP 9	23 09	
	8	08			f -x-	31 84	
	.	83			RCL 3	34 03	
	8	08			DSP 1	23 01	
	8	08		200	f -x-	31 84	
	x	71	Increase Dist.		RCL 6	34 06	
	STO + 7	33 61 07			f -x-	31 84	
	h RTN	35 22			RCL 7	34 07	
	f LBL 9	31 25 09			5	05	
	RCL 8	34 08			2	02	
150	h ABS	35 64			8	08	
	RCL 6	34 06			0	00	
	h ABS	35 64			.	81	
	-	51			h RTN	35 22	
	f sin	31 62		210	f LBL 8	31 25 08	
	h ABS	35 64			g FRAC	32 83	
	f $\sqrt{x}$	31 54			STO + 0	33 61 00	
	3	03			RCL 0	34 00	
	2	02			g FRAC	32 83	
	.	83			h RTN	35 22	
160	2	02					
	x	71					
	STO + 3	33 61 03					
	f LBL 5	31 25 05					
	RCL 1	34 01					
	f x < 0	31 71		220			
	GTO 7	22 07					
	f -x-	31 84					
	RCL 3	34 03					

LABELS					FLAGS	SET STATUS		
A START	B OPERATION	C CONTINUE	D	E used	0	FLAGS	TRIG	DISP
a	b	c	d	e	1	ON OFF		
0 used	1 used	2 used	3	4 alt & dist	2	0 ☐ ☒	DEG ☒	FIX ☒
5 used	6 stall	7 total D.	8 seed	9 alt	3	1 ☐ ☒	GRAD ☐	SCI ☐
						2 ☐ ☒	RAD ☐	ENG ☐
						3 ☐ ☒		n 0.1