

04464D

Program Description I

Program Title **MODIFIED MOON ROCKET LANDER**

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Program Description, Equations, Variables You are in command of a newly designed Rocket Lander to be used for the exploration of the Earth's solar system. This craft is preprogramed for safely landing on five "nearby" planets, the Earth's moon, or a space docking station. The craft is capable of more distant exploration provided the gravitational constant of the surface is given. This craft is somewhat unique as a bio-mass fuel system is used thereby providing a near constant mass and nearly inexhaustable fuel supply. Fuel is dependant on units per time.

After the surface has been specified, or a gravitational constant specified, the on board computer will program the fuel supply system to produce adequate burn units of fuel, adjust the hydraulic shock absorber system, and control the descent to a safe "Manual Control" altitude and velocity. Thus, the lander will have been preset for a safe landing on the surface. At this time, the craft will hover until you take manual control and complete the landing operation. Final outcome of the mission rests in your ability to control the lander for a safe touchdown.

Operating Limits and Warnings AN ENGINE RESTART REQUIRES 5 FUEL BURN UNITS

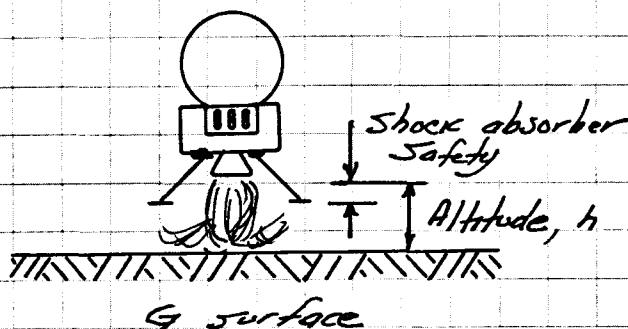
1. Bio-mass fuel cells are preset to provide adequate fuel supply for a safe landing based on the gravitational constant of the surface. Exceeding the burn units will result in a crash.
2. A safe landing implies no damage to the shock absorber system. If the impact velocity exceeds the preset safety value, damage to the exhaust funnel may result preventing future lift-off.

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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Program Description II

Sketch(es)



EQUATIONS

$$(1) \quad v = v_0 + at$$

$$(2) \quad v^2 = v_0^2 + 2gh$$

$$(3) \quad h = h_0 + v_0 t + \frac{1}{2} a t^2$$

in above, $t=1$ for $h>0$

$$(4) \quad t = \frac{m \sqrt{v_0^2 \pm \sqrt{v_0^2 - 2ah_0}}}{h \leq 0} \quad a$$

Sample Problem(s)		MOON LANDING #1		MOON LANDING #2
E	5.			E 5.
A	-50.0500/60.0/3/2/1/0			A -50.0500/60.0/3/2/1/0
	-55.0448/60.0/3/2/1/0			-55.0448/60.0/3/2/1/0
	-60.0390/60.0/3/2/1/0			continue to free-fall until
20	-25.0348/40.0/3/2/1/0			-80.0110/60.0/3/2/1/0
	-30.0320/40.0/3/2/1/0	20		-45.0048/40.0/3/2/1/0
	-35.0288/40.0/3/2/1/0	15		-20.0015/25.0/3/2/1/0
15	-10.0265/25.0/3/2/1/0	10		-5.0003/15.0/3/2/1/0
	-15.0235/25.0/3/2/1/0	5		0.111
	-20.0235/25.0/3/2			0.11111
15 TOO EARLY	8/0.8/0.08/0.008			0.1111111
				0.11111111
Restart: B	-40.0115/20.0/3/2/1/0			0.0
	-45.0073/20.0/3/2/1/0			A perfect touchdown!!
25	0.0/-31.6/0.0/-31.6			<u>NOTATION OF EXAMPLES</u>
	Excessive burn has damaged the bio-mass system, and a crash at 31.6 feet per sec. has resulted.	Key-in Value	Hit key	Display Sequence
	To attempt another landing on the same surface, Hit A.			

Reference(s)

Hewlett-Packard Standard Pac Program SD-11A.

MODIFIED MOON ROCKET LANDER

1
[dy]

↑ GRAV.
CNTRL

DOCK RESTART

VENUS
MARS

**SATURN
JUPITER**

EARTH
E. MOON

2 ▶

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
	Load both sides of the program card.		[] []	0.
*	LANDING DISPLAY SEQUENCE:		[] []	
	-Vel.Alt where - is descent. Fuel.0		[] [] [] []	
	3. 2. 1. 0. countdown for fuel burn an early burn will require the bio-mass fuel system to provide more burn units than available. Engines are shut down to prevent damage to the fuel system. A restart will require 5 units.		[] [] [] [] [] [] [] [] [] [] [] []	
* STATUS DISPLAYS:			[] []	
	8./0.8/0.08 etc. Early burn has shut down the engines. A restart is required You are free-falling!!! -xx.x You have crashed @ x velocity. 0.0/-xx.x Damaged bio-mass system by excessive burn. Crashed @ x vel. 0.111/0.1111 Safe landing. Lander Systems are shutting down. 0.111111 Touchdown velocity. A perfect landing is 0.0 -XX.X		[] [] [] [] [] [] [] [] [] [] [] [] [] [] [] []	
* GAME INSTRUCTIONS:			[] []	
1	Select landing surface by hitting any key except A, B, or fA. -OR-		[] []	Grav.
	Specify gravitational constant of surface: G		f A	G.
2	Switch to Manual control. (Landing display sequence will start.)		A [] [] [] [] []	
3	When you desire a fuel burn, wait for the bio-mass counter to reach zero, then key in burn desired. Fractional burns are available. CAUTION: An early burn will cause the engines to be shut down.		[] [] [] [] [] [] [] [] [] []	
4	To restart the engines.... CAUTION: 5 burn units of fuel are required to restart the engines. If less than 5 units remain, a crash is imminent.		B [] [] [] [] [] [] []	
5	To replay on the same surface as before		A [] [] [] [] [] [] [] [] []	Grav.
			[] [] [] [] [] [] [] []	

STEP KEY ENTRY KEY CODE

```

001 *LBL6 21 06
002 ST05 35 05
003 R/S 51
004 *LBLA 21 11
005 RCL5 36 05
006 CF0 16 22 00
007 CF1 16 22 01
008 CF3 16 22 03
009 1 01
010 2 02
011 x -35
012 ST03 35 08
013 RCL5 36 05
014 1 01
015 0 00
016 CHS -22
017 x -35
018 ST07 35 07
019 LSTX 16-63
020 x -35
021 ST06 35 06
022 8 08
023 ST04 35 04
024 0 00
025 ST01 35 46
026 *LBL9 21 09
027 RCL6 36 06
028 DSP4 -63 04
029 EEX -23
030 4 04
031 = -24
032 RCL7 36 07
033 CF2 16 22 02
034 X<0? 16-45
035 SF2 16 21 02
036 ABS 16 31
037 INT 16 34
038 + -55
039 F2? 16 23 02
040 CHS -22
041 F1? 16 23 01
042 GT08 22 00
043 PRTX -14
044 RCL8 36 08
045 DSP1 -63 01
046 GSB1 23 01
047 DSP0 -63 00
048 3 03
049 GSB1 23 01
050 2 02
051 GSB1 23 01
052 1 01
053 GSB1 23 01
054 GT00 22 00
055 *LBL1 21 01
056 PSE 16 51

```

COMMENTS

Store Grav. Cnst

Manual Control

Prepare Lander

FORM:

Vel.Alt

= Vel.Alt display

STEP KEY ENTRY KEY CODE

```

057 F3? 16 23 03
058 GT08 22 08
059 RTN 24
060 *LBL0 21 00
061 0 00
062 PSE 16 51
063 CF3 16 22 03
064 DSP1 -63 01
065 *LBL5 21 05
066 RCL8 36 08
067 X*Y -41
068 X>Y? 16-34
069 GT02 22 02
070 ST-8 35-45 00
071 2 02
072 x -35
073 RCL5 36 05
074 - -45
075 ST09 35 09
076 2 02
077 ÷ -24
078 RCL6 36 06
079 + -55
080 RCL7 36 07
081 + -55
082 X<0? 16-45
083 GT03 22 03
084 X=0? 16-43
085 GT03 22 03
086 RCL9 36 09
087 ST+7 35-55 07
088 R↓ -31
089 ST06 35 06
090 GT09 22 09
091 *LBL3 21 03
092 RCL7 36 07
093 X² 53
094 RCL9 36 09
095 2 02
096 x -35
097 RCL6 36 06
098 x -35
099 - -45
100 JX 54
101 RCL7 36 07
102 CHS -22
103 X*Y -41
104 - -45
105 ENT↑ -21
106 ENT↑ -21
107 LSTX 16-63
108 2 02
109 x -35
110 + -55
111 X>Y? 16-34
112 X*Y -41

```

COMMENTS

Early Burn?

Good Burn

Excessive Burn?

Alt Test

If+ go for
new burn

Calc t@h=0

REGISTERS

0	1	2	3	4	5	6	7	8	9
				Restart	Grav.	Alt.	Vel.	Fuel	Accel.
S0	S1	S2	S3	S4 EX	S5 EX²	S6 EX³	S7 EX⁴	S8 EXY	S9 X
A	B	C	D	E	t @ X=0				

Program Listing II

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STEP KEY ENTRY KEY CODE

113	RCL9	36 09
114	=	-24
115	ST01	35 46
116	RCL9	36 09
117	x	-35
118	RCL7	36 07
119	+	-55
120	RCL5	36 05
121	2	02
122	=	-24
123	CHS	-22
124	XZY	-41
125	XZY?	16-35
126	GT04	22 04
127	9	09
128	1/X	52
129	DSP3	-63 03
130	PSE	16 51
131	DSP5	-63 05
132	PSE	16 51
133	DSP7	-63 07
134	PSE	16 51
135	DSP9	-63 09
136	PSE	16 51
137	XZY	-41
138	DSP1	-63 01
139	R/S	51
140	*LBL2	21 02
141	RCL8	36 08
142	RCL5	36 05
143	2	02
144	=	-24
145	-	-45
146	ST+6	35-55 06
147	2	02
148	x	-35
149	ST+7	35-55 07
150	RCL6	36 06
151	1	01
152	0	00
153	x	-35
154	RCL7	36 07
155	X ²	53
156	+	-55
157	JX	54
158	CHS	-22
159	SF0	16 21 00
160	0	00
161	GT04	22 04
162	*LBL8	21 08
163	RCL4	36 04
164	DSPi	-63 45
165	PSE	16 51
166	ISZI	16 26 46
167	1	01
168	0	00

COMMENTS

Vel less than
shock setting?

Safe Landing

Excessive Burn
Calc. Crash Vel.

Restart Prompt
& free-fall

STEP KEY ENTRY KEY CODE

169	=	-24
170	ST04	35 04
171	SF1	16 21 01
172	0	00
173	GT05	22 05
174	*LBLB	21 12
175	CF3	16 22 03
176	5	05
177	ST-8	35-45 08
178	CF1	16 22 01
179	8	08
180	ST04	35 04
181	0	00
182	ST01	35 46
183	GT05	22 05
184	*LBL4	21 04
185	PSE	16 51
186	F0?	16 23 00
187	XZY	-41
188	GT04	22 04
189	RTN	24
190	*LBLC	21 13
191	1	01
192	3	03
193	GT06	22 06
194	*LBLc	21 16 13
195	2	02
196	9	09
197	GT06	22 06
198	*LBLD	21 14
199	8	08
200	7	07
201	GT06	22 06
202	*LBLd	21 16 14
203	3	03
204	9	09
205	GT06	22 06
206	*LBLc	21 16 15
207	3	03
208	2	02
209	GT06	22 06
210	*LBLE	21 15
211	5	05
212	GT06	22 06
213	*LBLa	21 16 11
214	F3?	16 23 03
215	GT06	22 06
216	R/S	51
217	GT0a	22 16 11
218	*LBLb	21 16 12
219	Pi	16-24
220	GT06	22 06
221	R/S	51

COMMENTS

Restart

Flash Display

Mars

Venus

Jupiter

Saturn

Earth

E. Moon

Specified

Docking Sta.

LABELS

SET STATUS

A	B	C	D	E	F	FLAGS	TRIG	DISP
CNTRL	RESTART	Mars	Jupiter	Moon	Burn F	ON OFF		
^a Grav.	^b Dock	^c Venus	^d Saturn	^e Earth	¹ freefall	0 ☐ ☒	DEG ☒	FIX ☒
⁰ Burn ok	¹ Count Dn	² Fuel	³ t@X=0	⁴ Flash	² Sign	1 ☐ ☒	GRAD ☐	SCI ☐
⁵ Burn	⁶ Inial.	⁷	⁸ Restart	⁹ Vel.Dsp	³ Crash	2 ☐ ☒	RAD ☐	EN ☐
						3 ☐ ☒		n <u>0</u>