Lunar LEM Rocket

This game in its many different versions and names (ROCKET, LUNAR, LEM, and APOLLO) is by far and away the single most popular computer game. It exists in versions that start you anywhere from 500 feet to 200 miles above the moon, or other planets, too. Some allow the control of directional stabilization rockets and/or the retro rocket. The three versions presented here represent the most popular of the many variations.

In most versions of this game, the temptation is to slow up too soon and then have no fuel left for the lower part of the journey. This, of course, is disasterous (as you will find out when you land your own capsule)!

LUNAR was originally in FOCAL by Jim Storer while a student at Lexington High School and subsequently converted to BASIC by David Ahl. ROCKET was written by Eric Peters at DEC and LEM by William Labaree II of Alexandria, Virginia.

In this program, you set the burn rate of the retro rockets (pounds of fuel per second) every 10 seconds and attempt to achieve a soft landing on the moon. 200 lbs/sec really puts the brakes on, and 0 lbs/sec is free fall. Ignition occurs at 8 lbs/sec, so *do not* use burn rates between 1 and 7 lbs/sec. To make the landing more of a challenge, but more closely approximate the real Apollo LEM capsule, you should make the available fuel at the start (N) equal to 16,000 lbs, and the weight of the capsule (M) equal to 32,500 lbs in Statement 15.

Some versions of BASIC object to the series expansion calculations in Statements 420 and 430 (as you near the lunar surface, these numbers get very small). If your does, substitute the following expanded form for the expansion in Statement 420:

```
-Q*(1+Q*(1/2+Q*(1/3+Q*(1/4+Q/5))))
```

You should be able to figure the other one out yourself.

```
                LUNAR
CREATIVE COMPUTING  MORRISTOWN, NEW JERSEY

THIS IS A COMPUTER SIMULATION OF AN APOLLO LUNAR
LANDING CAPSULE.

THE ON-BOARD COMPUTER HAS FAILED
SO YOU HAVE TO LAND THE CAPSULE MANUALLY.

SET BURN RATE OF RETRO ROCKETS TO ANY VALUE BETWEEN
0 (FREE FALL) AND 200 (MAXIMUM BURN) POUNDS PER SECOND.
SET NEW BURN RATE EVERY 10 SECONDS.

CAPSULE WEIGHT 32,500 LBS; FUEL WEIGHT 16,500 LBS.

GOOD LUCK

SEC           MI + FT       MPH           LB FUEL       BURN RATE

 0             120  0        3600          16500         ? 0
 10            109  5015     3636          16500         ? 0
 20            99   4223     3672          16500         ? 0
 30            89   2903     3708          16500         ? 0
 40            79   1055     3744          16500         ? 0
 50            68   3959     3780          16500         ? 0
 60            58   1055     3816          16500         ? 0
 70            47   2903     3852          16500         ? 200
 80            37   1883     3482.87       14500         ? 200
 90            28   1191     3086.71       12500         ? 200
 100           20   1251     2659.65       10500         ? 200
 110           13   2549     2196.95       8500          ? 200
 120           8    370      1692.63       6500          ? 100
 130           3    3778     1440.59       5500          ? 75
ON MOON AT 139.926 SECONDS - IMPACT VELOCITY 1253.25 MPH
SORRY THERE WERE NO SURVIVORS.  YOU BLEW IT!
IN FACT, YOU BLASTED A NEW LUNAR CRATER 347.15 FEET DEEP!

TRY AGAIN??
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```
10 PRINT TAB(33);"LUNAR"
20 PRINT TAB(15);"CREATIVE COMPUTING  MORRISTOWN, NEW JERSEY"
25 PRINT:PRINT:PRINT
30 PRINT "THIS IS A COMPUTER SIMULATION OF AN APOLLO LUNAR"
40 PRINT "LANDING CAPSULE.": PRINT: PRINT
50 PRINT "THE ON-BOARD COMPUTER HAS FAILED (IT WAS MADE BY"
60 PRINT "XEROX) SO YOU HAVE TO LAND THE CAPSULE MANUALLY."
70 PRINT: PRINT "SET BURN RATE OF RETRO ROCKETS TO ANY VALUE BETWEEN"
80 PRINT "0 (FREE FALL) AND 200 (MAXIMUM BURN) POUNDS PER SECOND."
90 PRINT "SET NEW BURN RATE EVERY 10 SECONDS.": PRINT
100 PRINT "CAPSULE WEIGHT 32,500 LBS; FUEL WEIGHT 16,500 LBS."
110 PRINT: PRINT: PRINT: PRINT "GOOD LUCK"
120 L=0
130 PRINT: PRINT "SEC","MI + FT","MPH","LB FUEL","BURN RATE":PRINT
140 A=120:V=1:M=33000!:N=16500:G=1E-03:Z=1.8
150 PRINT L,INT(A);INT(5280*(A-INT(A))),3600*V,M-N,:INPUT K:T=10
160 IF M-N<1E-03 THEN 240
170 IF T<1E-03 THEN 150
180 S=T: IF M>=N+S*K THEN 200
190 S=(M-N)/K
200 GOSUB 420: IF I<=0 THEN 340
210 IF V<=0 THEN 230
220 IF J<0 THEN 370
230 GOSUB 330: GOTO 160
240 PRINT "FUEL OUT AT";L;"SECONDS":S=(-V+SQR(V*V+2*A*G))/G
250 V=V+G*S: L=L+S
260 W=3600*V: PRINT "ON MOON AT";L;"SECONDS - IMPACT VELOCITY";W;"MPH"
270 IF W<=1.2 THEN PRINT "PERFECT LANDING!": GOTO440
280 IF W<=10 THEN PRINT "GOOD LANDING (COULD BE BETTER)":GOTO440
282 IF W>60THEN300
284 PRINT "CRAFT DAMAGE... YOU'RE STRANDED HERE UNTIL A RESCUE"
286 PRINT "PARTY ARRIVES.  HOPE YOU HAVE ENOUGH OXYGEN!"
288 GOTO 440
300 PRINT "SORRY THERE WERE NO SURVIVORS.  YOU BLEW IT!"
310 PRINT "IN FACT, YOU BLASTED A NEW LUNAR CRATER";W*.277;"FEET DEEP!"
320 GOTO 440
330 L=L+S: T=T-S: M=M-S*K: A=I: V=J: RETURN
340 IF S<5E-03 THEN 260
350 D=V+SQR(V*V+2*A*(G-Z*K/M)):S=2*A/D
360 GOSUB420: GOSUB 330: GOTO 340
370 W=(1-M*G/(Z*K))/2: S=M*V/(Z*K*(W+SQR(W*W+V/Z)))+.05:GOSUB 420
380 IF I<=0 THEN 340
390 GOSUB 330: IF J>0 THEN 160
400 IF V>0 THEN 370
410 GOTO 160
420 Q=S*K/M: J=V+G*S+Z*(-Q-Q*Q/2-Q^3/3-Q^4/4-Q^5/5)
430 I=A-G*S*S/2-V*S+Z*S*(Q/2+Q^2/6+Q^3/12+Q^4/20+Q^5/30):RETURN
440 PRINT:PRINT:PRINT:PRINT "TRY AGAIN??": GOTO 70
```

This is the most comprehensive of the three versions and permits you to control the time interval of firing, the thrust, and the attitude angle. It also allows you to work in the metric or English system of measurement. The instructions in the program dialog are very complete, so you shouldn't have any trouble.

```
LEM CREATIVE COMPUTING  MORRISTOWN, NEW JERSEY
LUNAR LANDING SIMULATION
HAVE YOU FLOWN AN APOLLO/LEM MISSION BEFORE (YES OR NO)? NO
WHICH SYSTEM OF MEASUREMENT DO YOU PREFER?
 1=METRIC     0=ENGLISH
ENTER THE APPROPRIATE NUMBER? 1

  YOU ARE ON A LUNAR LANDING MISSION.  AS THE PILOT OF
THE LUNAR EXCURSION MODULE, YOU WILL BE EXPECTED TO
GIVE CERTAIN COMMANDS TO THE MODULE NAVIGATION SYSTEM.
THE ON-BOARD COMPUTER WILL GIVE A RUNNING ACCOUNT
OF INFORMATION NEEDED TO NAVIGATE THE SHIP.

THE ATTITUDE ANGLE CALLED FOR IS DESCRIBED AS FOLLOWS.
+ OR -180 DEGREES IS DIRECTLY AWAY FROM THE MOON
-90 DEGREES IS ON A TANGENT IN THE DIRECTION OF ORBIT
+90 DEGREES IS ON A TANGENT FROM THE DIRECTION OF ORBIT
0 (ZERO) DEGREES IS DIRECTLY TOWARD THE MOON

       -180,180
          ^
    -90 < -+- > 90
          !
          0
<< DIRECTION OF ORBIT <<

    SURFACE OF MOON
ALL ANGLES BETWEEN -180 AND 180 DEGREES ARE ACCEPTED.

1 FUEL UNIT = 1 SEC. AT MAX THRUST
ANY DISCREPANCIES ARE ACCOUNTED FOR IN THE USE OF FUEL
FOR AN ATTITUDE CHANGE.
AVAILABLE ENGINE POWER: 0 (ZERO) AND ANY VALUE BETWEEN
10 AND 100 PERCENT.

NEGATIVE THRUST OR TIME IS PROHIBITED.
INPUT: TIME INTERVAL IN SECONDS ------ (T)
       PERCENTAGE OF THRUST ---------- (P)
       ATTITUDE ANGLE IN DEGREES ----- (A)

FOR EXAMPLE:
T,P,A? 10,65,-60
TO ABORT THE MISSION AT ANY TIME, ENTER 0,0,0

OUTPUT: TOTAL TIME IN ELAPSED SECONDS
        HEIGHT IN FEET
        DISTANCE FROM LANDING SITE IN FEET
        VERTICAL VELOCITY IN FEET/SECOND
        HORIZONTAL VELOCITY IN FEET/SECOND
        FUEL UNITS REMAINING
  0       111168      -5.87625E+06   0          1615.6     750
T,P,A? 500,0,0
  500     106292      -5.11633E+06  -19.2028    1619.92    750
T,P,A? 100,0,0
  600     104194      -4.96362E+06  -22.7246    1621.78    750
T,P,A? 50,90,-90
  650     102916      -4.89021E+06  -30.3757    1484.58    705
T,P,A? 100,23,0
  750     101907      -4.75003E+06   10.3519    1485.42    682.001
T,P,A? 50,90,-90
  800     101993      -4.68314E+06  -8.76788    1341.57    637.001
T,P,A? 100,40,-90
  900     98339.8     -4.5622E+06   -67.3979    1213.07    597.002
T,P,A? 50,10,0
  950     94511.6     -4.50472E+06  -85.7323    1215.63    592.002
T,P,A? 50,100,0
  1000    93320.2     -4.44704E+06   38.8868    1216.44    542.002
T,P,A? 50,100,-90
  1050    94322.6     -4.3933E+06   -.608409    1041.58    492.002
T,P,A? 50,100,-90
  1100    93090       -4.34794E+06  -50.2899    862.287    442.002
T,P,A? 50,100,-90
  1150    89146.7     -4.31115E+06  -108.811    677.922    392.002
T,P,A? 100,100,-90
  1250    71572.2     -4.26382E+06  -246.665    290.396    292.002
T,P,A? 50,100,0
  1300    62205.7     -4.24981E+06  -126.903    291.928    242.002
T,P,A? 100,50,0
  1400    52014.2     -4.22147E+06  -75.8944    293.614    192.002
T,P,A? 100,40,-90
  1500    36711.6     -4.20102E+06  -231.305    116.821    152.002
T,P,A? 50,50,90
  1550    23159.8     -4.19258E+06  -310.782    232.752    127.002
T,P,A? 50,50,90
  1600    5635.9      -4.17824E+06  -390.108    352.728    102.002
T,P,A? 10,0,0
  1610    1655.62     -4.17471E+06  -405.96     353.546    102.002
T,P,A? 10,100,0
  1614.5  -142.239     -4.17312E+06  -393.08     353.917    97.5017

CRASH !!!!!!!!!!!!!!!!
YOUR IMPACT CREATED A CRATER 142.239 METERS DEEP.
AT CONTACT YOU WERE TRAVELING 1904.15  KILOMETERS/HR
DO YOU WANT TO TRY IT AGAIN (YES/NO)?
? NO THANKS!
DO YOU WANT TO TRY IT AGAIN (YES/NO)?
? NO
TOO BAD, THE SPACE PROGRAM HATES TO LOSE EXPERIENCED
ASTRONAUTS.
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2 PRINT TAB(34);"LEM"
4 PRINT TAB(15);"CREATIVE COMPUTING  MORRISTOWN, NEW JERSEY"
7 REM ROCKT2 IS AN INTERACTIVE GAME THAT SIMULATES A LUNAR
8 REM LANDING IS SIMILAR TO THAT OF THE APOLLO PROGRAM.
9 REM THERE IS ABSOLUTELY NO CHANCE INVOLVED
10 Z$="80"
15 B1=1
20 M=17.95
25 F1=5.25
30 N=7.5
35 R0=926
40 V0=1.29
45 T=0
50 H0=60
55 R=R0+H0
60 A=-3.425
65 R1=0
70 A1=8.84361E-04
75 R3=0
80 A3=0
85 M1=7.45
90 M0=M1
95 B=750
100 T1=0
105 F=0
110 P=0
115 N=1
120 M2=0
125 S=0
130 C=0
135 IF Z$="YES" THEN 1150
140 PRINT
145 PRINT "LUNAR LANDING SIMULATION"
150 PRINT
155 PRINT "HAVE YOU FLOWN AN APOLLO/LEM MISSION BEFORE";
160 PRINT " (YES OR NO)";
165 INPUT Q$
170 IF Q$="YES" THEN 190
175 IF Q$="NO" THEN 205
180 PRINT "JUST ANSWER THE QUESTION, PLEASE, ";
185 GOTO 160
190 PRINT
195 PRINT "INPUT MEASUREMENT OPTION NUMBER";
200 GOTO 225
205 PRINT
210 PRINT "WHICH SYSTEM OF MEASUREMENT DO YOU PREFER?"
215 PRINT " 1=METRIC     0=ENGLISH"
220 PRINT "ENTER THE APPROPRIATE NUMBER";
225 INPUT K
230 PRINT
235 IF K=0 THEN 280
240 IF K=1 THEN 250
245 GOTO 220
250 Z=1852.8
255 M$="METERS"
260 G3=3.6
265 N$=" KILOMETERS"
270 G5=1000
275 GOTO 305
280 Z=6080
285 M$="FEET"
290 G3=.592
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295 N$="N.MILES"
300 G5=Z
305 IF B1=3 THEN 670
310 IF Q$="YES" THEN 485
315 PRINT
320 PRINT "  YOU ARE ON A LUNAR LANDING MISSION.  AS THE PILOT OF"
325 PRINT "THE LUNAR EXCURSION MODULE, YOU WILL BE EXPECTED TO"
330 PRINT "GIVE CERTAIN COMMANDS TO THE MODULE NAVIGATION SYSTEM."
335 PRINT "THE ON-BOARD COMPUTER WILL GIVE A RUNNING ACCOUNT"
340 PRINT "OF INFORMATION NEEDED TO NAVIGATE THE SHIP."
345 PRINT
350 PRINT
355 PRINT "THE ATTITUDE ANGLE CALLED FOR IS DESCRIBED AS FOLLOWS."
360 PRINT "+ OR -180 DEGREES IS DIRECTLY AWAY FROM THE MOON"
365 PRINT "-90 DEGREES IS ON A TANGENT IN THE DIRECTION OF ORBIT"
370 PRINT "+90 DEGREES IS ON A TANGENT FROM THE DIRECTION OF ORBIT"
375 PRINT "0 (ZERO) DEGREES IS DIRECTLY TOWARD THE MOON"
380 PRINT
385 PRINT TAB(30);"-180,180"
390 PRINT TAB(34);"^"
395 PRINT TAB(27);"-90 < -+- > 90"
400 PRINT TAB(34);"!"
405 PRINT TAB(34);"0"
410 PRINT TAB(23);"<< DIRECTION OF ORBIT <<"
415 PRINT
420 PRINT TAB(27);"SURFACE OF MOON"
425 PRINT
430 PRINT
435 PRINT "ALL ANGLES BETWEEN -180 AND 180 DEGREES ARE ACCEPTED."
440 PRINT
445 PRINT "1 FUEL UNIT = 1 SEC. AT MAX THRUST"
450 PRINT "ANY DISCREPANCIES ARE ACCOUNTED FOR IN THE USE OF FUEL"
455 PRINT "FOR AN ATTITUDE CHANGE."
460 PRINT "AVAILABLE ENGINE POWER: 0 (ZERO) AND ANY VALUE BETWEEN"
465 PRINT "10 AND 100 PERCENT."
470 PRINT
475 PRINT"NEGATIVE THRUST OR TIME IS PROHIBITED."
480 PRINT
485 PRINT
490 PRINT "INPUT: TIME INTERVAL IN SECONDS ------ (T)"
495 PRINT "       PERCENTAGE OF THRUST ---------- (P)"
500 PRINT "       ATTITUDE ANGLE IN DEGREES ----- (A)"
505 PRINT
510 IF Q$="YES" THEN 535
515 PRINT "FOR EXAMPLE:"
520 PRINT "T,P,A? 10,65,-60"
525 PRINT "TO ABORT THE MISSION AT ANY TIME, ENTER 0,0,0"
530 PRINT
535 PRINT "OUTPUT: TOTAL TIME IN ELAPSED SECONDS"
540 PRINT "        HEIGHT IN ";M$
545 PRINT "        DISTANCE FROM LANDING SITE IN ";M$
550 PRINT "        VERTICAL VELOCITY IN ";M$;"/SECOND"
555 PRINT "        HORIZONTAL VELOCITY IN ";M$;"/SECOND"
560 PRINT "        FUEL UNITS REMAINING"
565 PRINT
570 GOTO 670
575 PRINT
580 PRINT "T,P,A";
585 INPUT T1,F,P
590 F=F/100
595 IF T1<0 THEN 905
600 IF T1=0 THEN 1090
605 IF ABS(F-.05)>1 THEN 945
610 IF ABS(F-.05)<.05 THEN 945
615 IF ABS(P)>180 THEN 925
620 N=20
625 IF T1<400 THEN 635
630 N=T1/20
635 T1=T1/N
640 P=P*3.14159/180
645 S=SIN(P)
650 C=COS(P)
655 M2=M0*T1*F/B
660 R3=-.5*R0*((V0/R)^2)+R*A1*A1
665 A3=-2*R1*A1/R
670 FOR I=1 TO N
675 IF M1=0 THEN 715
680 M1=M1-M2
685 IF M1>0 THEN 725
690 F=F*(1+M1/M2)
695 M2=M1+M2
700 PRINT "YOU ARE OUT OF FUEL."
705 M1=0
710 GOTO 725
715 F=0
720 M2=0
725 M=M-.5*M2
730 R4=R3
735 R3=-.5*R0*((V0/R)^2)+R*A1*A1
740 R2=(3*R3-R4)/2+.00526*F1*F*C/M
745 A4=A3
750 A3=-2*R1*A1/R
755 A2=(3*A3-A4)/2+.0056*F1*F*S/(M*R)
760 X=R1*T1+.5*R2*T1*T1
765 R=R+X
770 H0=H0+X
775 R1=R1+R2*T1
780 A=A+A1*T1+.5*A2*T1*T1
785 A1=A1+A2*T1
790 M=M-.5*M2
795 T=T+T1
800 IF H0<3.287828E-04 THEN 810
805 NEXT I
810 H=H0*Z
815 H1=R1*Z
820 D=R0*A*Z
825 D1=R*A1*Z
830 T2=M1*B/M0
835 PRINT " ";T;TAB(10);H;TAB(23);D;
840 PRINT TAB(37);H1;TAB(49);D1;TAB(60);T2
845 IF H0<3.287828E-04 THEN 880
850 IF R0*A>164.4736 THEN 1050
855 IF M1>0 THEN 580
860 T1=20
865 F=0
870 P=0
875 GOTO 620
880 IF R1<-8.21957E-04 THEN 1020
885 IF ABS(R*A1)>4.931742E-04 THEN 1020
890 IF H0<-3.287828E-04 THEN 1020
895 IF ABS(D)>10*Z THEN 1065
900 GOTO 995
905 PRINT
910 PRINT "THIS SPACECRAFT IS NOT ABLE TO  VIOLATE THE SPACE-";
915 PRINT "TIME CONTINUUM."
920 GOTO 575
925 PRINT
930 PRINT "IF YOU WANT TO SPIN AROUND, GO OUTSIDE THE MODULE"
935 PRINT "FOR AN E.V.A."
940 GOTO 575
945 PRINT
950 PRINT "IMPOSSIBLE THRUST VALUE ";
955 IF F<0 THEN 985
960 IF F-.05<.05 THEN 975
965 PRINT "TOO LARGE"
970 GOTO 575
975 PRINT "TOO SMALL"
980 GOTO 575
985 PRINT "NEGATIVE"
990 GOTO 575
995 PRINT
1000 PRINT "TRANQUILITY BASE HERE -- THE EAGLE HAS LANDED"
1005 PRINT "CONGRATULATIONS -- THERE WAS NO SPACECRAFT DAMAGE"
1010 PRINT "YOU MAY NOW PROCEED WITH SURFACE EXPLORATION."
1015 GOTO 1100
1020 PRINT
1025 PRINT "CRASH !!!!!!!!!!!!!!!!"
1030 PRINT "YOUR IMPACT CREATED A CRATER";ABS(H);M$;" DEEP."
1035 X1=SQR(D1*D1+H1*H1)*G3
1040 PRINT "AT CONTACT YOU WERE TRAVELING";X1;N$;"/HR"
1045 GOTO 1100
1050 PRINT
1055 PRINT "YOU HAVE BEEN LOST IN SPACE WITH NO HOPE OF RECOVERY."
1060 GOTO 1100
1065 PRINT "YOU ARE DOWN SAFELY - "
1075 PRINT
1080 PRINT "BUT MISSED THE LANDING SITE BY";ABS(D/G5);N$
1085 GOTO 1100
1090 PRINT
1095 PRINT "MISSION ABENDED"
1100 PRINT
1105 PRINT "DO YOU WANT TO TRY IT AGAIN (YES/NO)?"
1110 INPUT Z$
1115 IF Z$="YES" THEN 20
1120 IF Z$="NO" THEN 1130
1125 GOTO 1105
1130 PRINT
1135 PRINT "TOO BAD, THE SPACE PROGRAM HATES TO LOSE EXPERIENCED"
1140 PRINT "ASTRONAUTS."
1145 STOP
1150 PRINT
1155 PRINT "OK, DO YOU WANT THE COMPLETE INSTRUCTIONS OR THE INPUT -"
1160 PRINT "OUTPUT STATEMENTS?"
1165 PRINT "1=COMPLETE INSTRUCTIONS"
1170 PRINT "2=INPUT-OUTPUT STATEMENTS"
1175 PRINT "3=NEITHER"
1180 INPUT B1
1185 Q$="NO"
1190 IF B1=1 THEN 205
1195 Q$="YES"
1200 IF B1=2 THEN 190
1205 IF B1=3 THEN 190
1210 GOTO 1165
1215 END
```

In this version, you start 500 feet above the lunar surface and control the burn rate in 1-second bursts. Each unit of fuel slows your descent by 1 ft/sec. The maximum thrust of your engine is 30 ft/sec/sec.

```
                ROCKET
CREATIVE COMPUTING  MORRISTOWN, NEW JERSEY

LUNAR LANDING SIMULATION
----- ------- ----------

DO YOU WANT INSTRUCTIONS (YES OR NO)? YES

YOU ARE LANDING ON THE MOON AND HAVE TAKEN OVER MANUAL
CONTROL 500 FEET ABOVE A GOOD LANDING SPOT.  YOU HAVE A
DOWNWARD VELOCITY OF 50 FT/SEC.  120 UNITS OF FUEL REMAIN.

HERE ARE THE RULES THAT GOVERN YOUR SPACE VEHICLE:
(1) AFTER EACH SECOND, THE HEIGHT, VELOCITY, AND REMAINING
    FUEL WILL BE REPORTED.
(2) AFTER THE REPORT, A '?' WILL BE TYPED.  ENTER THE
    NUMBER OF UNITS OF FUEL YOU WISH TO BURN DURING THE
    NEXT SECOND.  EACH UNIT OF FUEL WILL SLOW YOUR DESCENT
    BY 1 FT/SEC.
(3) THE MAXIMUM THRUST OF YOUR ENGINE IS 30 FT/SEC/SEC OR
    30 UNITS OF FUEL PER SECOND.
(4) WHEN YOU CONTACT THE LUNAR SURFACE, YOUR DESCENT ENGINE
    WILL AUTOMATICALLY CUT OFF AND YOU WILL BE GIVEN A
    REPORT OF YOUR LANDING SPEED AND REMAINING FUEL.
(5) IF YOU RUN OUT OF FUEL, THE '?' WILL NO LONGER APPEAR,
    BUT YOUR SECOND-BY-SECOND REPORT WILL CONTINUE UNTIL
    YOU CONTACT THE LUNAR SURFACE.

BEGINNING LANDING PROCEDURE.....

G O O D   L U C K ! ! !


SEC  FEET   SPEED   FUEL     PLOT OF DISTANCE

 0   500     50      120     I                                          *
? 0
 1   447.5   55      120     I                                    *
? 0
 2   390     60      120     I                                *
? 0
 3   327.5   65      120     I                          *
? 0
 4   260     70      120     I                    *
? 10
 5   192.5   65      110     I              *
? 5
 6   127.5   65      105     I         *
? 25
 7   72.5    45      80      I     *
? 25
 8   37.5    25      55      I  *
? 25
 9   22.5    5       30      I*
? 7
 10  18.5    3       23      I*
? 7
 11  16.5    1       16      I*
? 4
 12  15      2       12      I*
? 3
 13  12      4       9       I*
? 3
 14  7       6       6       I*
? 6
**** OUT OF FUEL****
 15  1.5     5       0       I*
**** CONTACT ****
TOUCHDOWN AT 15.2649 SECONDS.
LANDING VELOCITY = 6.32456 FEET/SEC.
 0 UNITS OF FUEL REMAINING.
***** SORRY, BUT YOU BLEW IT!!!!
APPROPRIATE CONDOLENCES WILL BE SENT TO YOUR NEXT OF KIN.
ANOTHER MISSION? NO THANKS!

CONTROL OUT.
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```
10 PRINT  TAB(33);"ROCKET"
20 PRINT TAB(15);"CREATIVE COMPUTING  MORRISTOWN, NEW JERSEY"
30 PRINT:PRINT:PRINT
70 PRINT "LUNAR LANDING SIMULATION"
80 PRINT "----- ------- ----------": PRINT
100 INPUT "DO YOU WANT INSTRUCTIONS (YES OR NO)";A$
110 IF A$="NO" THEN 390
160 PRINT
200 PRINT "YOU ARE LANDING ON THE MOON AND HAVE TAKEN OVER MANUAL"
210 PRINT "CONTROL 500 FEET ABOVE A GOOD LANDING SPOT.  YOU HAVE A"
220 PRINT "DOWNWARD VELOCITY OF 50 FT/SEC.  120 UNITS OF FUEL REMAIN."
225 PRINT
230 PRINT "HERE ARE THE RULES THAT GOVERN YOUR SPACE VEHICLE:"
240 PRINT "(1) AFTER EACH SECOND, THE HEIGHT, VELOCITY, AND REMAINING"
250 PRINT "    FUEL WILL BE REPORTED."
260 PRINT "(2) AFTER THE REPORT, A '?' WILL BE TYPED.  ENTER THE"
270 PRINT "    NUMBER OF UNITS OF FUEL YOU WISH TO BURN DURING THE"
280 PRINT "    NEXT SECOND.  EACH UNIT OF FUEL WILL SLOW YOUR DESCENT"
290 PRINT "    BY 1 FT/SEC."
310 PRINT "(3) THE MAXIMUM THRUST OF YOUR ENGINE IS 30 FT/SEC/SEC OR"
320 PRINT "    30 UNITS OF FUEL PER SECOND."
330 PRINT "(4) WHEN YOU CONTACT THE LUNAR SURFACE, YOUR DESCENT ENGINE"
340 PRINT "    WILL AUTOMATICALLY CUT OFF AND YOU WILL BE GIVEN A"
350 PRINT "    REPORT OF YOUR LANDING SPEED AND REMAINING FUEL."
360 PRINT "(5) IF YOU RUN OUT OF FUEL, THE '?' WILL NO LONGER APPEAR,"
370 PRINT "    BUT YOUR SECOND-BY-SECOND REPORT WILL CONTINUE UNTIL"
380 PRINT "    YOU CONTACT THE LUNAR SURFACE.": PRINT
390 PRINT "BEGINNING LANDING PROCEDURE.....": PRINT
400 PRINT "G O O D   L U C K ! ! !"
420 PRINT:PRINT
430 PRINT "SEC  FEET   SPEED   FUEL     PLOT OF DISTANCE"
450 PRINT
455 T=0:H=500:V=50:F=120
490 PRINT T;TAB(4);H;TAB(12);V;TAB(20);F;TAB(29);"I";TAB(H/12+29);"*"
500 INPUT B
510 IF B<0 THEN 650
520 IF B>30 THEN B=30
530 IF B>F THEN B=F
540 V1=V-B+5
560 F=F-B
570 H=H-.5*(V+V1)
580 IF H<=0 THEN 670
590 T=T+1
600 V=V1
610 IF F>0 THEN 490
615 IF B=0 THEN 640
620 PRINT "**** OUT OF FUEL****"
640 PRINT T;TAB(4);H;TAB(12);V;TAB(20);F;TAB(29);"I";TAB(H/12+29);"*"
650 B=0
660 GOTO 540
670 PRINT "**** CONTACT ****"
680 H=H+.5*(V+V1)
690 IF B=5 THEN 720
700 D=(-V+SQR(V*V+H*(10-2*B)))/(5-B)
710 GOTO 730
720 D=H/V
730 V1=V+(5-B)*D
760 PRINT "TOUCHDOWN AT";T+D;"SECONDS."
770 PRINT "LANDING VELOCITY =";V1;"FEET/SEC."
780 PRINT F;"UNITS OF FUEL REMAINING."
790 IF V1<>0 THEN 810
800 PRINT "CONGRATULATIONS!  A PERFECT LANDING!"
805 PRINT "YOUR LICENSE WILL BE RENEWED.....LATER"
810 IF ABS(V1)<2 THEN 840
820 PRINT "***** SORRY, BUT YOU BLEW IT!!!!"
830 PRINT "APPROPRIATE CONDOLENCES WILL BE SENT TO YOUR NEXT OF KIN."
840 PRINT: PRINT : PRINT
850 INPUT "ANOTHER MISSION";A$
860 IF A$="YES" THEN 390
870 PRINT: PRINT "CONTROL OUT.": PRINT
999 END
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