PROGRAM SUBMITTAL

☒ New Program ☐ Revision to Program

Model No. ☐ 67 ☐ 97 ☒ 41C

Program Title EQUATIONS OF PARTICLE DYNAMICS

No. of Steps/Lines ~~159~~ 161 Category No. 560

Category Name PHYSICS

Abstract — 50 Word Maximum GIVEN ANY THREE OF THE FOLLOWING, THIS PROGRAM WILL SOLVE THE OTHER 2 WITH THE PRESS OF A SINGLE KEY: DISTANCE, TIME, INITIAL VELOCITY, FINAL VELOCITY, ACCELERATION.

Necessary Accessories: NONE

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Company

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If my program is accepted, my bonus choice is:

☐ FOUR PROGRAMS OR ☒ CREDIT FOR FOUR PROGRAMS*

* No partial credit will be given. Select all four programs at the same time.

Submittal Checklist: Please use the checklist below to insure submittal of all proper program documentation.

☒ Program Submittal ☒ Program Description II ☒ Program Listing(s) ☒ Registers, Status ...

☒ Program Description I ☒ User Instructions ☒ Magnetic Card(s) ☒ Keyboard, Card Labeling (optional)

ACKNOWLEDGMENT AND AGREEMENT

To the best of my knowledge, I have the right to contribute this program material without breaching any obligation concerning nondisclosure of proprietary or confidential information of other persons or organizations. I am contributing this program material on a nonconfidential nonobligatory basis to Hewlett-Packard Company ("HP") for inclusion in its program library, and I agree that HP may use, duplicate, modify, publish, and sell the program material, and authorize others to do so without obligation or liability of any kind. HP may publish my name and address, as the contributor, to facilitate user inquiries pertaining to this program material.

Signature David Hayden Date 4/13/81

PROGRAM DESCRIPTION I

Program Title EQUATIONS OF PARTICLE DYNAMICS

Contributor's Name DAVID HAYDEN

Address 38 WASHINGTON STREET

City ROCKY HILL **State/Country** N.J. **Zip Code** 08553

Program Description, Equations, Variables For an object undergoing constant acceleration, the following equations are true:

$$X=V(0)t+\frac{At^2}{2} \qquad V(f)^2=V(0)^2+2AX$$

Where: X=total distance traveled.
V(0)=initial velocity
V(f)=final velocity
t=time
A=average acceleration

PROBLEM: Given any three the five at right, solve for the other 2.

From these 2 come the following equations used in the program:

$$X=\frac{(V(0)+V(f))t}{2} \quad : \quad t=\frac{V(f)-V(0)}{A} \quad : \quad t=\frac{2X}{V(f)+V(0)} \quad : \quad A=\frac{V(f)-V(0)}{t}$$

$$V(f)=V(0)+At = \frac{2X}{t}-V(0) = \sqrt{V(0)^2+2AX}$$

$$V(0)=V(f)-At = \frac{2X}{t}-V(f) = \frac{X}{t}-\frac{At}{2} = \sqrt{V(f)^2-2AX}$$

Necessary Accessories NONE

Operating Limits and Warnings When given the distance X, the acceleration A, and either velocity, there are 2 solutions for the other velocity and time. You must initialize the program prior to the first calculation. Thereafter the program automatically reinitializes after each calculation

Reference(s) This program was inspired by #00766D by Erik Goetze.

PROGRAM DESCRIPTION II

Sample Problem (Sketch if Desired)

A) A boy throws a ball up in the air with initial velocity 30m/s. when is the ball 20m above him and how fast is it going at that time?

B) A train starting at rest accelerates to a speed of 100m/s over a distance of 1200m. How long did it take and what was the acceleration?

SOLUTION:

	Input	Function	Display	Comments
A		XEQ e		INITIALIZE
	30	XEQ D	30.000	V(0)
	-9.8	XEQ E	-9.800	ACCELERATION FROM GRAVITY
	20	XEQ A	20.000	DISTANCE X
		XEQ a	VF=22.539	CALCULATOR BEEPS SIGNALING
			T=0.761	DUAL SOLUTION.
			T=5.361	THE SOLUTIONS ARE:
				1) VF=22.539 ; T=0.761
				2) VF=-22.539 ; T=5.361
B	100	XEQ C	100.000	V(f). NOTE THERE WAS NO NEED TO REINITIALIZE.
	0	XEQ D	0.000	V(0)
	1200	XEQ A	1,200.000	DISTANCE X
		XEQ a	T=24.000	SOLVE
			A=4.167	

USER INSTRUCTIONS

SIZE: (HP-41C) 007

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1.	LOAD PROGRAM AND INITIALIZE		XEQ e	
2.	INPUT ANY THREE OF THE FOLLOWING			
	1 DISTANCE X	X	XEQ A	X
	2 TIME t	t	XEQ B	t
	3 FINAL VELOCITY V(f)	V(f)	XEQ C	V(f)
	4 INITIAL VELOCITY V(0)	V(0)	XEQ D	V(0)
	5 ACCELERATION A	A	XEQ E	A
3.	SOLVE FOR THE OTHER 2		XEQ a	OTHER 2
4.	FOR A NEW CASE, GO TO STEP 2			
	NOTE: IF YOU GIVE X, A, AND EITHER V, THERE WILL BE TWO SOLUTIONS FOR t AND THE OTHER V. IN THIS CASE, THE CALCULATOR WILL DISPLAY V, BEEP, DISPLAY T1, AND DISPLAY T2. THE SOLUTIONS ARE V, T1 AND -V, T2. T1IS STORED IN R00 AND T2 IN R02 SO THAT YOU MAY CALL THEM UP IF YOU MISSED ONE OR BOTH.			
	NOTE: AFTER THE CALCULATIONS, ALL VARIABLES ARE STORED AS FOLLOWS: R01=X R02=t R03=V(f) R04=V(0) R05=A R00=T1 (SEE ABOVE NOTE)			

PROGRAM LISTING

☐ 67 ☐ 97 ☒ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
	01*LBL "EPD		
	02*LBL A		
	03 STO 01		
	04 1		
	05 GTO 01		
	06*LBL B		STORE DATA
	07 STO 02		AND ACCUMULATE
	08 2		POINTER
	09 GTO 01		
	10*LBL C		
	11 STO 03		
	12 4		
	13 GTO 01		
	14*LBL D		
	15 STO 04		
	16 8		
	17 GTO 01		
	18*LBL E		
	19 STO 05		
	20 16		
	21*LBL 01		
	22 ST+ 06		
	23 X<>Y		
	24 RTN		
	25*LBL a		
	26 XEQ IND		SOLVE FIRST
06			
	27 GTO IND		SOLVE SECOND
Y			
	28*LBL 30		
	29 RCL 03		SOLVE X
	30 RCL 04		FROM
	31 +		t, V(f),
	32 RCL 02		V(0), A
	33 *		
	34 2		
	35 /		
	36 1		
	37 STO 01		
	38 "X"		
	39 GTO 01		
	40*LBL 29		
	41 BEEP		SOLVE V(f)
	42 XEQ 28		FROM
	43 RCL Z		X,T,V(0),A
	44 STO 00		
	45 -1		
	46 ST* 03		
	47*LBL 28		SOLVE t
	48 RCL 03		FROM
	49 RCL 04		V(f),V(0),
	50 -		A
	51 RCL 05		
	52 /		
	53 GTO 00		
	54*LBL 13		
	55 RCL 01		SOLVE t
	56 2		FROM
	57 *		X,V(f),V(0)
	58 RCL 03		
	59 RCL 04		
	60 +		
	61 /		
	62*LBL 00		
	63 STO 02		
	64 "T"		
	65 2		POINTER
	66 GTO 01		INCREMENT=2
	67*LBL 27		
	68*LBL 26		SOLVE V(f)
	69 RCL 05		FROM
	70 RCL 02		V(0),t,A
	71 *		
	72 RCL 04		
	73 +		
	74 GTO 00		
	75*LBL 11		
	76 RCL 01		SOLVE V(f)
	77 2		FROM
	78 *		V(0),X,t
	79 RCL 02		
	80 /		
	81 RCL 04		
	82 -		
	83 GTO 00		
	84*LBL 25		
	85 RCL 05		SOLVE V(f)
	86 2		FROM
	87 *		V(0),A,t
	88 RCL 01		
	89 *		
	90 RCL 04		
	91 X↑2		
	92 +		
	93 SQRT		

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

PROGRAM LISTING

☐ 67 ☐ 97 ☒ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
94	↑LBL	00	
95	STO	03	
96	"VF"		
97	4		POINTER INCREMENT=4
98	GTO	01	
99	↑LBL	22	
100	↑LBL	23	SOLVE V(0) FROM t,V(f),A
101	RCL	03	
102	RCL	05	
103	RCL	02	
104	*		
105	-		
106	GTO	00	
107	↑LBL	07	SOLVE V(0) FROM X,t,V(f)
108	RCL	01	
109	2		
110	*		
111	RCL	02	
112	/		
113	RCL	03	
114	-		
115	GTO	00	
116	↑LBL	19	SOLVE V(0) FROM X,t,A
117	RCL	01	
118	RCL	02	
119	/		
120	RCL	05	
121	RCL	02	
122	*		
123	2		
124	/		
125	-		
126	GTO	00	
127	↑LBL	21	SOLVE V(0) FROM X,V(f),A
128	RCL	03	
129	X↑2		
130	RCL	05	
131	2		
132	*		
133	RCL	01	
134	*		
135	-		
136	SQRT		
137	↑LBL	00	
138	STO	04	
139	"V0"		
140	8		
141	GTO	01	
142	↑LBL	14	
143	↑LBL	15	SOLVE A FROM V(f),V(0),t
144	RCL	03	
145	RCL	04	
146	-		
147	RCL	02	
148	/		
149	STO	05	
150	"A"		
151	16		
152	↑LBL	01	
153	"⊢="		
154	ARCL	X	DISPLAY ANSWER
155	AVIEW		
156	RCL	06	NEW POINTER
157	+		
158	↑LBL	e	
159	0		RESET
160	STO	06	
161	END		

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90

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REGISTERS, STATUS, FLAGS, ASSIGNMENTS

DATA REGISTERS

00 T1
01 DISTANCE X
02 TIME t
03 FINAL VELOCITY
04 INITIAL VEL.
05 ACCELERATION
06 POINTER

STATUS

SIZE 007 TOT. REG. 39 USER MODE
ENG FIX SCI ONXX OFF
DEG RAD GRAD

FLAGS

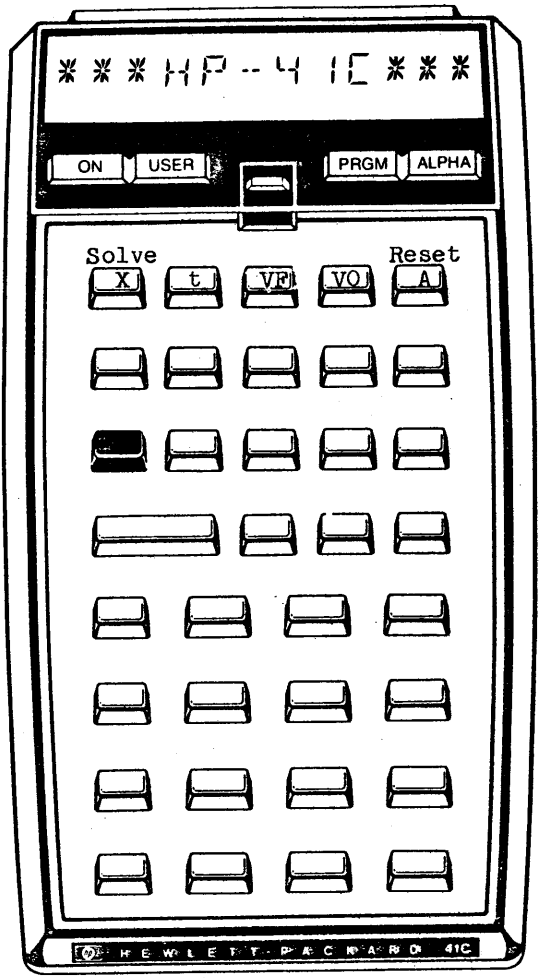
#	INIT S/C	SET INDICATES	CLEAR INDICATES

ASSIGNMENTS

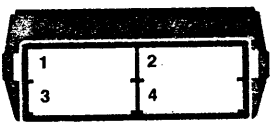
FUNCTION	KEY	FUNCTION	KEY

KEYBOARD CARD LABELING

KEYBOARD



SYSTEM CONFIGURATION



CARD