

Program Description I Page 1 of 5

Program Title EQUATIONS OF PARTICLE MOTION

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Program Description, Equations, Variables HERE ALL VARIABLES ARE IN y, BUT ALL y's COULD BE REPLACED WITH x's.

nr1 $y = \frac{1}{2}(V_{y0} + V_y)t$

nr2 $y = V_{y0}t + \frac{1}{2}a_y t^2$ $V_{y0} = V_y - a_y t$ [nr10]

nr3 $y = \frac{V_y^2 - V_{y0}^2}{2a_y}$ $V_{y0} = \frac{2y}{t} - V_y$ [nr11]

nr4 $t = \frac{V_y - V_{y0}}{a_y}$ $V_{y0} = \frac{y}{t} - \frac{a_y t}{2}$ [nr12]

nr5 $t = \frac{2y}{V_{y0} + V_y}$ $V_{y0} = \sqrt{V_y^2 - 2a_y y}$ [nr13]

nr6 $t = (-V_{y0} \pm \sqrt{V_{y0}^2 + 2a_y y})/a_y$

nr7 $V_y = V_{y0} + a_y t$ $a_y = \frac{V_y - V_{y0}}{t}$ [nr14]

nr8 $V_y = \frac{2y}{t} - V_{y0}$ [nr15] $a_y = 2 \left(\frac{y - V_{y0}t}{t^2} \right)$

nr9 $V_y = \sqrt{V_{y0}^2 + 2a_y y}$ [nr16] $a_y = \frac{V_y^2 - V_{y0}^2}{2y}$

y = DISTANCE COVERED BY PARTICLE IN TIME t

t = TIME IN WHICH PARTICLE MOVES

V_y = VELOCITY AT TIME t

V_{y0} = VELOCITY AT TIME 0

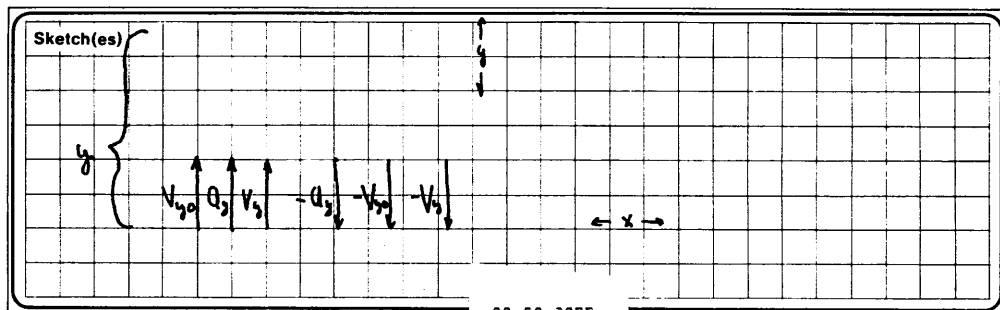
a_y = ACCELERATION (AVERAGE OVER TIME t) THAT PARTICLE IS EXPERIENCING IN TIME t

PROGRAM, GIVEN ANY THREE OUT OF THE ABOVE FIVE, WILL SOLVE THE ABOVE EQUATIONS FOR THE OTHER TWO.

Operating Limits and Warnings IF YOU ARE SOLVING FOR V-INITIAL, YOU MUST STORE THE VALUE YOU GET BY PRESSING [D] BEFORE SOLVING FOR THE OTHER UNKNOWN. THIS IS BECAUSE V_{y0} IS IN ALL THE OTHER EQUATIONS. IF THE DISPLAY COMES UP ERROR WHEN YOU ARE SOLVING FOR t , YOU HAVE AN IMAGINARY ROOT. SIMPLY SWITCH TO PROGRAM MODE, PRESS [SST] AND SWITCH BACK TO RUN AND PRESS [R/S]

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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Sample Problem(s) TEST
 EACH EQTN. GIVEN
 ON PREVIOUS SHEET.

Clear everything GSBe

Initial vel. 256.00 GSBD

Final vel. 17.00 GSBC

Time (seconds) 8.60 GSBB

Solve for y 1.00 GSBd

1173.96 ***

GSBe

159.00 GSBD

4.80 GSBB

g down + -9.80 GSBE

Solve for dist. 1.00 GSBd

650.30 ***

GSBe

12.00 GSBC

19.00 GSBD

-9.80 GSBE

1.00 GSBd

11.07 ***

Solve for time GSBe

29.00 GSBD

0.00 GSBC

-32.30 GSBE

2.00 GSBd

0.90 ***

0.00 GSBe

47.00 GSBA

28.00 GSBD

7.00 GSBC

2.00 GSBd

2.69 ***

GSBe

Quad roots

pause +

Solve for V_g

Solve for V_{y0}

88.00 GSBD

-32.30 GSBE

12.00 GSBA

2.00 GSBd

5.31 ***

0.14 ***

GSBe

15.00 GSBD

-9.80 GSBE

2.50 GSBB

3.00 GSBd

-9.50 ***

GSBe

7.00 GSBA

1.80 GSBB

12.00 GSBD

3.00 GSBd

-4.22 ***

GSBe

-9.80 GSBE

5.00 GSBA

23.00 GSBD

3.00 GSBd

20.76 ***

GSBe

19.00 GSBC

-9.80 GSBE

.38 GSBB

4.00 GSBd

22.72 ***

GSBe

14.80 GSBA

2.71 GSBB

0.00 GSBC

4.00 GSBd

10.92 ***

GSBe

118.00 GSBA

4.965 GSBB

-32.30 GSBE

4.00 GSBd

103.95 ***

GSBe

-33.00 GSBC

-32.30 GSBE

15.70 GSBA

4.00 GSBd

45.86 ***

Solve for a

GSBe

24.70 GSBC

44.30 GSBD

2.00 GSBB

5.00 GSBd

-9.80 ***

y down +

GSBe

3.00 GSBA

18.00 GSBD

2.50 GSBE

5.00 GSBd

-13.44 ***

GSBe

17.00 GSBC

39.00 GSBD

9.00 GSBA

5.00 GSBd

-68.44 ***

Reference(s) PHYSICS BY RESNICK AND HALLIDAY CHAP 3 PAGE 49

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11		057	*LBL9	21 09	
002	1	01		058	RCL0	36 00	
003	CF0	16 22 00	NR OF REG DIS IS STORED AT	059	RCL5	36 05	
004	GT00	22 00		060	=	-24	
005	*LBLB	21 12		061	RTN	24	
006	2	02	NR OF REG TIME IS STORED AT	062	*LBL2	21 02	
007	CF1	16 22 01		063	RCL5	36 05	
008	GT00	22 00		064	Pi	16-24	
009	*LBLE	21 13		065	X=Y?	16-33	
010	3	03	V FINAL NR REG	066	GT06	22 06	
011	CF2	16 22 02		067	F0?	16 23 00	
012	GT00	22 00		068	GT07	22 07	
013	*LBLD	21 14		069	RCL4	36 04	
014	4	04	V INITIAL NR REG	070	X ²	53	
015	GT00	22 00		071	RCL5	36 05	
016	*LBLE	21 15		072	RCL1	36 01	
017	5	05	TACC NR REG	073	2	02	
018	*LBL0	21 00		074	x	-35	
019	STOI	35 46		075	x	-35	
020	R+	-31		076	+	-55	
021	STOI	35 45	STORE NR. IN REG	077	JX	54	
022	RCL3	36 03		078	STO9	35 09	
023	X ²	53		079	RCL4	36 04	
024	RCL4	36 04		080	CHS	-22	
025	X ²	53		081	+	-55	
026	-	-45		082	LSTX	16-63	
027	2	02		083	RCL9	36 09	
028	=	-24		084	-	-45	
029	STO0	35 00		085	RCL5	36 05	
030	CLX	-51		086	=	-24	
031	RTN	24		087	PSE	16 51	
032	*LBL1	21 01		088	LSTX	16-63	
033	F1?	16 23 01		089	X*Y	-41	
034	GT09	22 09	DONT HAVE TIME	090	R+	-31	
035	F2?	16 23 02		091	=	-24	
036	GT06	22 06	DONT HAVE Vfinal	092	RTN	24	
037	RCL4	36 04		093	*LBL7	21 07	
038	RCL3	36 03		094	RCL3	36 03	
039	+	-55		095	RCL4	36 04	
040	RCL2	36 02		096	-	-45	
041	x	-35		097	RCL5	36 05	
042	2	02		098	=	-24	
043	=	-24		099	RTN	24	
044	RTN	24		100	*LBL6	21 06	
045	*LBL8	21 08		101	RCL1	36 01	
046	RCL4	36 04		102	2	02	
047	RCL2	36 02		103	x	-35	
048	x	-35		104	RCL3	36 03	
049	RCL2	36 02		105	RCL4	36 04	
050	X ²	53		106	+	-55	
051	RCL5	36 05		107	=	-24	
052	x	-35		108	RTN	24	
053	2	02		109	*LBL3	21 03	
054	=	-24		110	F0?	16 23 00	
055	+	-55		111	GT09	22 09	
056	RTN	24		112	F1?	16 23 01	

REGISTERS								
0 V ₂ - V ₀	1 DIST.	2 TIME	3 V _{FINAL}	4 V _{INITIAL}	5 ACCELER.	6	7	8
S0	S1	S2	S3	S4	S5	S6	S7	S8
A	B	C	D	E	F	G	H	I
								NR OF LABEL + REG

CALCULATE Y
USING FORMULA
NR 3

NO Acc

NO y

QUAD ROOT
EVALUATION
FOR t
USING FORMULA
NR 6CALCULATE T
USING FORMULA
NR 4CALCULATE T
USING FORMULA
NR 5

NO y

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
113	GTOa	22 16 11	NO t	169	RCL5	36 05	CALCULATE V_f USING FORMULA NR 13
114	RCL1	36 01	CALCULATE V_f USING FORMULA NR 8	170	RCL1	36 01	
115	2	02		171	2	02	
116	x	-35		172	x	-35	
117	RCL2	36 02		173	x	-35	
118	÷	-24	CALCULATE V_f USING FORMULA NR 7	174	-	-45	CALCULATE V_{f0} USING FORMULA NR 11
119	RCL4	36 04		175	JX	54	
120	-	-45		176	RTN	24	
121	RTN	24		177	*LBL8	21 08	
122	*LBL9	21 09		178	RCL1	36 01	
123	RCL4	36 04	CALCULATE V_f USING FORMULA NR 9	179	2	02	CALCULATE Q USING FORMULA NR 15
124	RCL5	36 05		180	x	-35	
125	RCL2	36 02		181	RCL2	36 02	
126	x	-35		182	÷	-24	
127	+	-55		183	RCL3	36 03	
128	RTN	24	CALCULATE V_f USING FORMULA NR 9	184	-	-45	CALCULATE Q USING FORMULA NR 14
129	*LBLa	21 16 11		185	RTN	24	
130	RCL4	36 04		186	*LBL5	21 05	
131	X ²	53		187	F0?	16 23 00	
132	RCL1	36 01		188	GTO7	22 07	CALCULATE Q USING FORMULA NR 16
133	RCL5	36 05	CALCULATE V_{f0} USING FORMULA NR 12	189	F1?	16 23 01	
134	2	02		190	GTO6	22 06	
135	x	-35		191	RCL1	36 01	
136	x	-35		192	RCL4	36 04	
137	+	-55	CALCULATE V_{f0} USING FORMULA NR 10	193	RCL2	36 02	RESET BY SETTING FLAGS, IT IN R ₅
138	JX	54		194	x	-35	
139	RTN	24		195	-	-45	
140	*LBL4	21 04		196	RCL2	36 02	
141	F0?	16 23 00		197	X ²	53	CALCULATE VARIABLE i IN ROUTINE i
142	GTO6	22 16 12	NO y	198	÷	-24	
143	F1?	16 23 01	NO t	199	2	02	
144	GTOc	22 16 13	CALCULATE V_{f0} USING FORMULA NR 10	200	x	-35	
145	RCL5	36 05		201	RTN	24	
146	Pi	16-24		202	*LBL7	21 07	
147	X=Y?	16-33		203	RCL3	36 03	
148	GTO8	22 08	CALCULATE V_{f0} USING FORMULA NR 10	204	RCL4	36 04	
149	RCL1	36 01		205	-	-45	RESET BY SETTING FLAGS, IT IN R ₅
150	RCL2	36 02		206	RCL2	36 02	
151	÷	-24		207	÷	-24	
152	RCL5	36 05		208	RTN	24	
153	RCL2	36 02	CALCULATE V_{f0} USING FORMULA NR 10	209	*LBL6	21 06	RESET BY SETTING FLAGS, IT IN R ₅
154	x	-35		210	RCL0	36 00	
155	2	02		211	RCL1	36 01	
156	÷	-24		212	÷	-24	
157	-	-45		213	RTN	24	
158	RTN	24	CALCULATE V_{f0} USING FORMULA NR 10	214	*LBLc	21 16 15	RESET BY SETTING FLAGS, IT IN R ₅
159	*LBLb	21 16 12		215	SF0	16 21 00	
160	RCL3	36 03		216	SF1	16 21 01	
161	RCL5	36 05		217	SF2	16 21 02	
162	RCL2	36 02		218	Pi	16-24	CALCULATE VARIABLE i IN ROUTINE i
163	x	-35	CALCULATE V_{f0} USING FORMULA NR 10	219	ST05	35 05	
164	-	-45		220	0	00	
165	RTN	24		221	RTN	24	
166	*LBLc	21 16 13		222	*LBLd	21 16 14	
167	RCL3	36 03	CALCULATE V_{f0} USING FORMULA NR 10	223	ST01	35 46	
168	X ²	53		224	GTOi	22 45	

LABELS

SET STATUS

A	B	C	D	E	F	G	H	I
STORE DIS	STORE TIME	STORE V_f	STORE V_{in}	STORE A_{cc}	SET IF DIS HAS NOT ENTERED	FLAGS	TRIG	DISP
USED	USED	USED	SOLVE	RESET	1 SET IF TIME HAS NOT ENTERED	ON OFF		
STORAGE	CALC DIS	CALL TIME	CALL V_f	CALL V_{in}	2 SET IF V_f HAS NOT ENTERED	0 ☒ ☐	DEG ☒	FIX ☒
CALL A_{cc}	USED	USED	USED	USED	3	1 ☒ ☐	GRAD ☐	SCI ☐
						2 ☒ ☐	RAD ☐	ENG ☐
						3 ☐ ☐		n <u>2</u>