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#include <stdio.h>
#include <stdlib.h>
#include <math.h>

#define h0 39045 //m
#define m 70 //kg
#define Re 6371e3 //Radius of the Earth
#define g 9.8 //m/s^2
#define P0 1.225 //kg/m^3
#define H 10.4e3 //m
#define Vs 343 //Speed of Sound in m/s
#define A 0.120 //m^2

double P(double h){
    return (double)(P0*exp(-h/H));
}

double C(double v){
    if(v<=0.6*Vs){
        return 0.65;
    }
    else if(v>0.6*Vs && v<=1.1*Vs){
        return 0.65+0.55*pow((v/Vs)-0.6 , 2);
    }
    else {
        return 0.7875-0.32*((v/Vs)-1.1);
    }
}

double dv_dt(double v, double h){
    return (double)( g/(pow(1+(h/Re),2))-(A/(2*m))*C(v)*P(h)*pow(v,2) );
}

double dh_dt(double v){
    return -1*v;
}

int main()
{
    FILE *output_h, *output_v, *output_vh;
    output_h=fopen("h_VS_t.txt","w");
    output_v=fopen("v_VS_t.txt","w");
    output_vh=fopen("v_VS_h.txt","w");

    double h=h0, v=0.0, dt=0.1;
    fprintf(output_h, "%e\t%e\n",h,0.0);
    fprintf(output_v, "%e\t%e\n",v,0.0);
    fprintf(output_vh, "%e\t%e\n",v,h);

    for(double t=dt;h>=0;t+=dt){

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h=h+dt*dh_dt(v);  
v=v+dt*dv_dt(v,h);  
fprintf(output_h, "%e\t%e\n",h,t);  
fprintf(output_v, "%e\t%e\n",v,t);  
fprintf(output_vh, "%e\t%e\n",v,h);
```

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}
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return 0;
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}
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