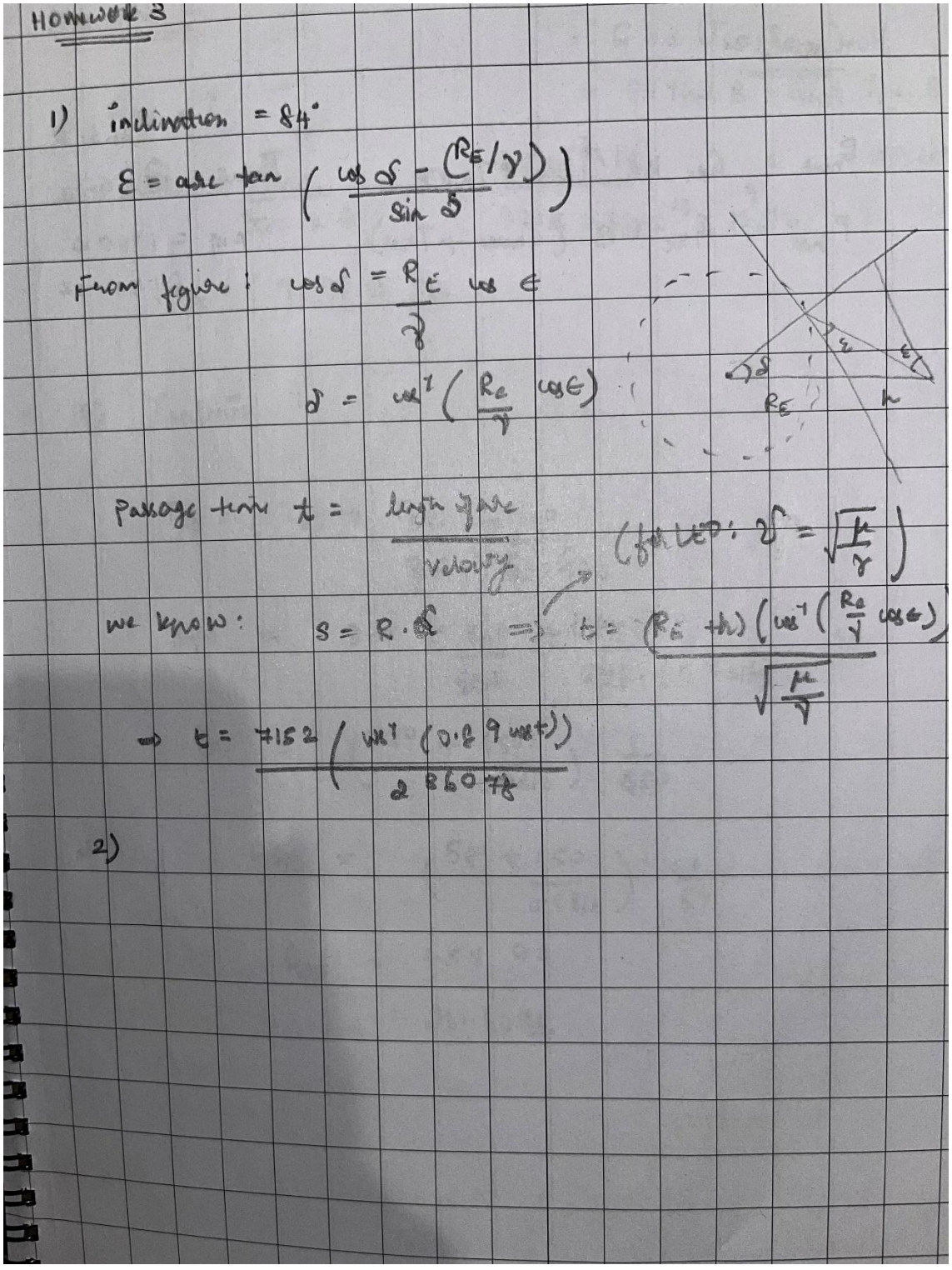
HOMEWORK 3

1.


Homework 3
1) inclination = 84°
ε = arc tan ((cos δ − (R_E/γ)) / sin δ)
From figure: cos δ = (R_E / γ) cos ε
γ = cos⁻¹ ((R_E / γ) cos ε)
Passage time t = length of arc / velocity
(for LEO: v = √(μ/γ))
we know: s = R · θ
⇒ t = (R_E + h)(cos⁻¹ ((R_E / γ) cos ε)) / √(μ/γ)
⇒ t = 7152 (cos⁻¹ (0.89 cos ε)) / 26078
2)
δ
ε
ε
R_E
h

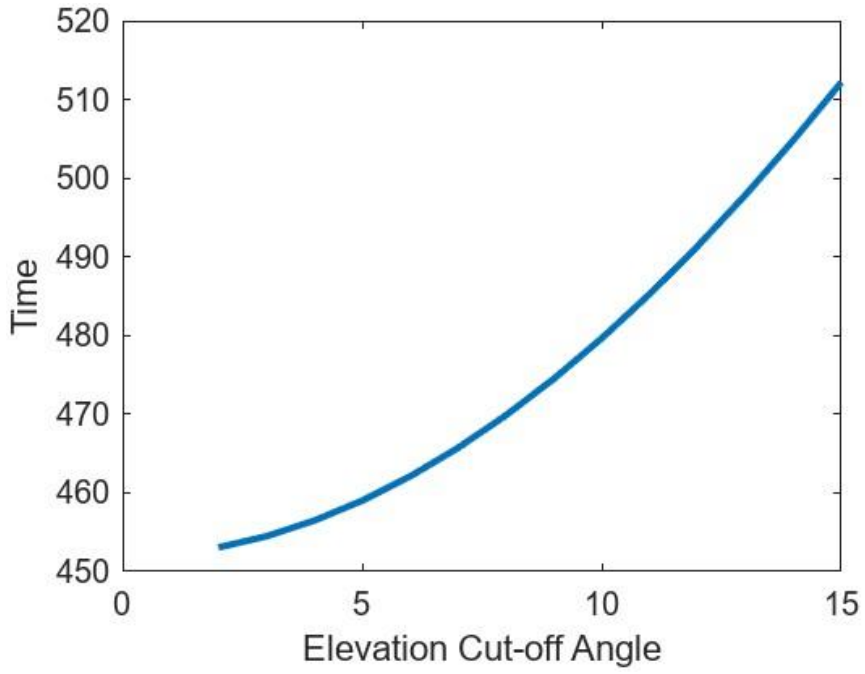
2. Simulation from matlab:

Code:

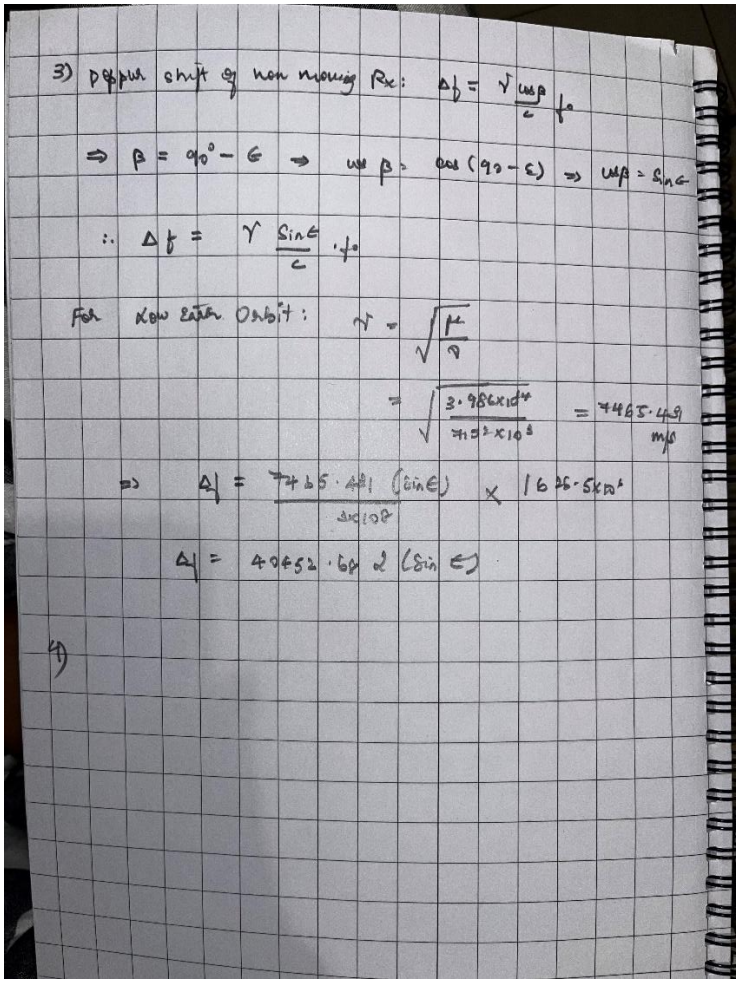
```
Re = 6371 * 1000;
h = 781 * 1000;
r = Re + h;
mu = 3.986e14;
v = sqrt(mu / r);
theta_degrees = 2:15;
theta_radians = deg2rad(theta_degrees);

%formula
cos_theta = cos(theta_radians);
cos_delta = (Re * cos_theta) / r;
delta = acos(cos_delta);  % Central angle in radians
s = r * delta;  % Arc length
t = s / v;  % Passage time in seconds

%plot
figure;
plot(theta_degrees, t, 'LineWidth', 2, 'MarkerSize', 5);
xlabel('Elevation Cut-off Angle');
ylabel('Time');
```



3.



4. Matlab simulation

```
f0 = 1626.5e6;
c = 3e6;
v = 7465.431;


elevation_angles = linspace(0, 90, 90);
doppler_shifts = 40452.682*sind(elevation_angles)


figure;
plot(elevation_angles, doppler_shifts, 'LineWidth', 2);
xlabel('Elevation Angle ');
ylabel('Doppler Shift');
```

```
doppler_shifts = 1×90
10^4 ×
         0    0.0714    0.1428    0.2141    0.2853 ...
```