① Forward Euler: $R(z) = 1 + z$

★ Assuming h to be positive ★

$|1 - 10h| \le 1 \Rightarrow \boxed{h \le .2}$

Backward Euler: $R(z) = \frac{1}{1-z}$

$\left|\frac{1}{1+10h}\right| \le 1 \Rightarrow \boxed{h \ge 0}$

Trapezoidal/midpoint: $R(z) = \frac{\left(1 + \frac{z}{2}\right)}{\left(1 - \frac{z}{2}\right)}$

$\left|\frac{1 - \frac{10h}{2}}{1 + \frac{10h}{2}}\right| \le 1 \Rightarrow \left|\frac{1-5h}{1+5h}\right| \le 1 \Rightarrow \boxed{h \ge 0}$

RK2: $R(z) = 1 + z + z^2/2$

$\left|1 - 10h + \frac{100h^2}{2}\right| \Rightarrow |1 - 10h + 50h^2| \le 1 \Rightarrow \boxed{h \le .2}$

RK4: $R(z) = 1 + z + z^2/2 + z^3/6 + z^4/24$

$\left|1 - 10h + 50h^2 - \frac{500}{3}h^3 + \frac{10{,}000}{24}h^4\right| \le 1 \Rightarrow \boxed{h \le .279}$

AB2: $R^2 - \left(1 + \frac{3z}{2}\right)R + z/2 = 0$

$R^2 - (1 - 15h)R - 5h = 0 \Rightarrow R = \frac{(1-15h) \pm \sqrt{(1-15h)^2 + 20h}}{2}$

For positive root: $\boxed{h \ge 0}$

For negative root: $\boxed{h \le .1}$

Method	Stability Range
Forward Euler	$h \le .2$
Backward Euler	$h \ge 0$
Trapezoidal/midpoint	$h \ge 0$
RK2	$h \le .2$
RK4	$h \le .279$
AB2	$h \le .1$

```matlab
clc; clear all; close all;

h = linspace(0,.3,100);
z = -10.*h;

r = {
    1+z,                                              ... % fwd
    1./(1-z),                                         ... % bwd
    (1+z./2)./(1-z./2),                               ... % trap and mid
    1+z+(z.^2)./2,                                    ... % rk2
    1+z+(z.^2)./2+(z.^3)./6+(z.^4)./24,              ... % rk4
    ((1-15.*h)+sqrt((1-15.^h).^2+20.*h))./2,         ... % ab2
    ((1-15.*h)-sqrt((1-15.^h).^2+20.*h))./2          ... % ab2
};


figure(1)
for i = 1:length(r)
    x = h;
    y = abs(r{i});
    plot(x,y)
    xlim([0 0.3])
    ylim([0 1])
    hold on
end
legend('Forward','Backward','Trapezoidal and Midpoint','RK2','RK4','AB2','AB2')
title('R Value with Increasing h')
xlabel('Step size (h)')
ylabel('|R(-10h)|')
```