Problem 1

a

Out[•]=

$$ct \to 1 - e^{-5\,t}$$

Out[•]=

$$\tau \to \frac{1}{5}$$

Out[•]=

$$tr \to 0.44$$

Out[•]=

$$ts \to \frac{4}{5}$$

b

Out[•]=

$$ct \to 1 - e^{-20\,t}$$

Out[•]=

$$\tau \to \frac{1}{20}$$

Out[•]=

$$tr \to 0.11$$

Out[•]=

$$ts \to \frac{1}{5}$$

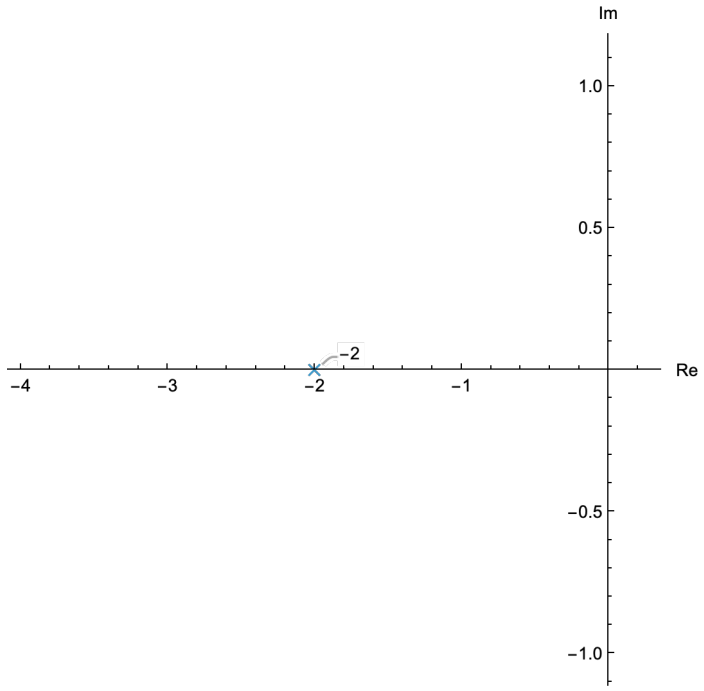
Problem 2

a

Out[16]=

$$\{\{s \to -2\}\}$$

Out[18]=



Out[20]=

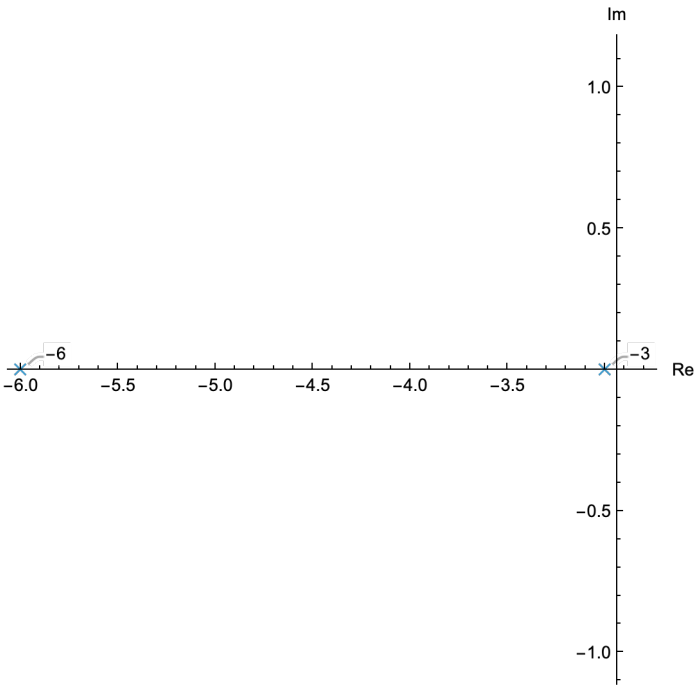
$$2\, e^{-2\,t}$$

b

Out[25]=

$$\{\{s \to -6\}, \{s \to -3\}\}$$

Out[27]=



Out[29]=

$$-\frac{5}{3} e^{-6t} + \frac{5 e^{-3t}}{3}$$

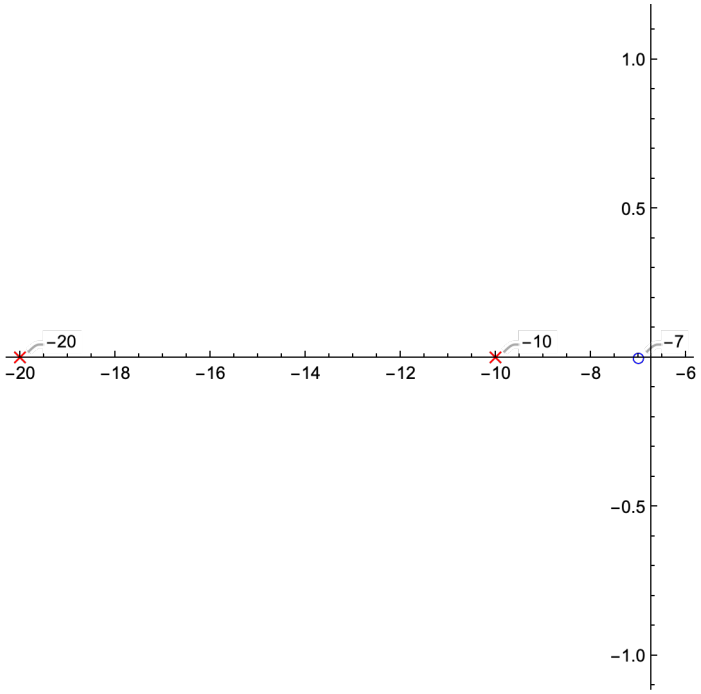
Overdamped

C

Out[101]=

$$\{\{s \to -20\}, \{s \to -10\}\}$$

Out[104]=



Out[106]=

$$13\, e^{-20\,t} - 3\, e^{-10\,t}$$

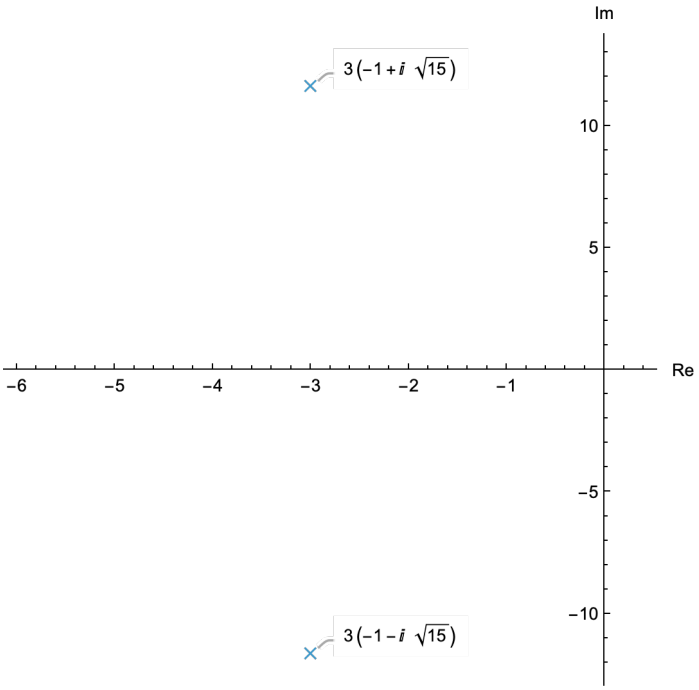
Overdamped

d

Out[139]=

$$\left\{\left\{s \to 3\left(-1-i\sqrt{15}\right)\right\},\left\{s \to 3\left(-1+i\sqrt{15}\right)\right\}\right\}$$

Out[141]=



Out[143]=

$$\frac{4}{3}\sqrt{\frac{5}{3}}\,e^{-3t}\,\text{Sin}\left[3\sqrt{15}\,t\right]$$

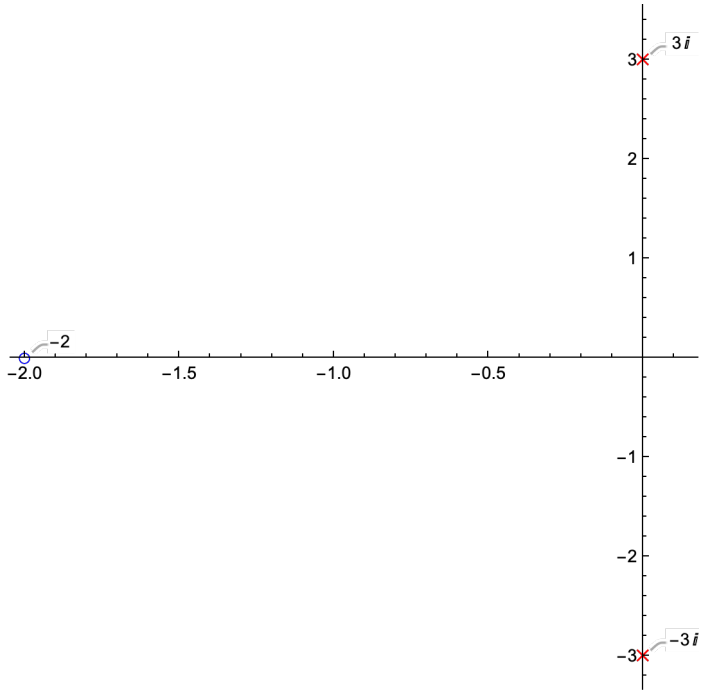
Underdamped

e

Out[327]=

$$\{\{s \to -3\,i\},\ \{s \to 3\,i\}\}$$

Out[330]=



Out[338]=

$$\frac{1}{3}\sqrt{13}\,\text{Cos}[0.588003 - 3\,t]$$

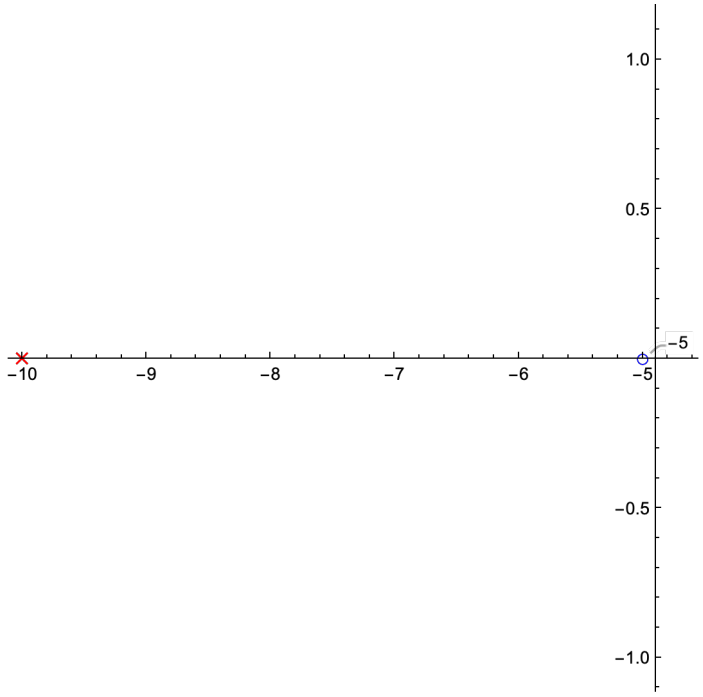
Undamped

f

Out[373]=

```
{{s → -10}, {s → -10}}
```

Out[376]=



Out[378]=

$$e^{-10\,t} - 5\,e^{-10\,t}\,t$$

Critically damped

Problem 3

Out[•]=

```
{{s → -5.49165}, {s → -0.317313},
 {s → -0.095516 - 1.06705 i}, {s → -0.095516 + 1.06705 i}}
```

Problem 4

a

Out[•]=

$$\omega n \to 4$$

Out[•]=

$$\zeta \to \frac{3}{8}$$

Out[•]=

$$ts \to \frac{8}{3}$$

Out[•]=

$$tp \to 0.847225$$

Out[•]=

$$os \to 28.0597$$

Out[•]=

$$tr \to 0.356326$$

b

Out[•]=

$$0.2 \to 0.2$$

Out[•]=

$$0.05 \to 0.05$$

Out[•]=

$$ts \to 400.$$

Out[•]=

$$tp \to 15.7276$$

Out[•]=

$$os \to 85.4468$$

Out[•]=

$$tr \to 5.30139$$

c

Out[•]=
$$\omega n \to 3240.37$$

Out[•]=
$$\zeta \to 0.246885$$

Out[•]=
$$ts \to 0.005$$

Out[•]=
$$tp \to 0.00100049$$

Out[•]=
$$os \to 44.9154$$

Out[•]=
$$tr \to 0.000387638$$

Problem 5

Out[•]=
$$\zeta \to 0.554916$$

Out[•]=
$$\omega n \to 7.2083$$

Out[•]=
$$\frac{51.9596}{51.9596 + 8.\, s + s^2}$$

Out[•]=
$$\frac{1}{1 + 0.153966\, s + 0.0192457\, s^2}$$

Problem 6

a

Out[•]=
$$gs \to \frac{0.934579}{1.79439 + 1.2549\, s + 1.\, s^2}$$

b

Out[ ]=
$$\omega n \to 1.33955$$

Out[ ]=
$$\zeta \to 0.468405$$

Out[ ]=
$$tp \to 2.65447$$

Out[ ]=
$$os \to 18.9087$$

Out[ ]=
$$ts \to 6.375$$

Problem 7

a

Out[381]=
$$\omega n \to 0.52915$$

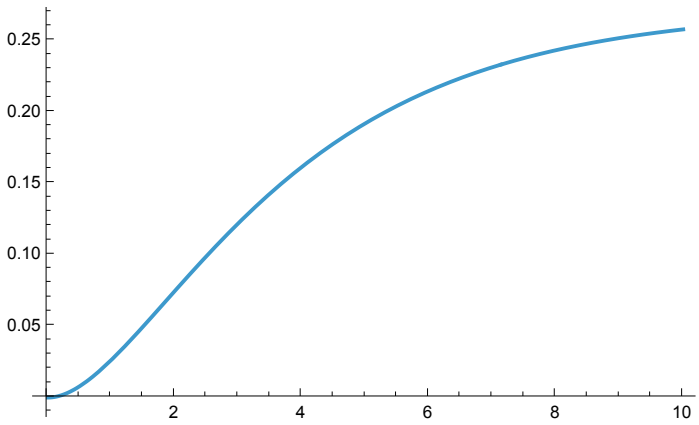
Out[383]=
$$\zeta \to 1.08665$$

b

Out[384]=
$$max \to 54.5$$

c

Out[390]=



d

Out[391]=

$$\{\{\text{percentIso} \to 3.66972\}\}$$

Problem 8

Out[•]=

$$\zeta \to 0.357857$$

Out[•]=

$$\omega n \to 3.72588$$

Out[•]=

$$j \to 0.375$$

Out[•]=

$$k \to 5.20582$$