Note: these answers have been generated by a machine algebra system called *Mathematica*. We will cover it in due course, but you may want to install and try running it now - it is really useful.

Problem 1

```
In[9]:= (2 + 3 i) + (4 - 5 i)
Out[9]= 6 - 2 i

In[10]:= (5 + 3 i) (3 - i)
Out[10]= 18 + 4 i

In[11]:= (1 - 3 i)^2
Out[11]= -8 - 6 i

In[12]:= (1 - 3 i) (1 + 3 i)
Out[12]= 10
```

Problem 2

```
In[13]:= z = 3 - 2 i;

In[14]:= Conjugate[z]
Out[14]= 3 + 2 i

In[15]:= z Conjugate[z]
Out[15]= 13

In[16]:= √(z Conjugate[z])
Out[16]= √13
```

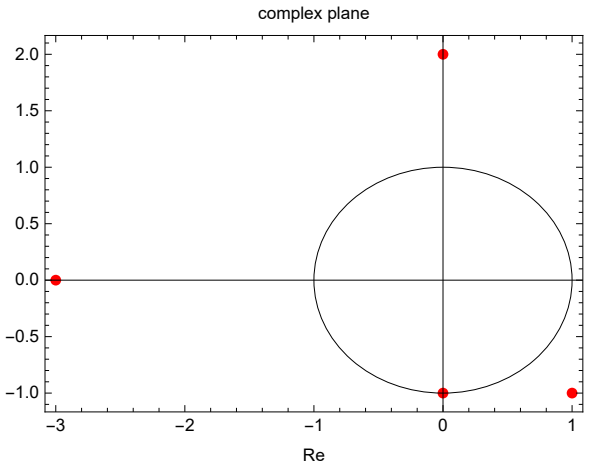
Problem 3

```
In[17]:= (1 - i)/(1 + i)
Out[17]= -i

In[18]:= 1/(5 + 3 i)
Out[18]= 5/34 - (3 i)/34

In[19]:= 1/5 - (3 - 4 i)/(3 + 4 i)
Out[19]= 12/25 + (24 i)/25
```

Problem 4

In[20]:=
```
numbers = {2 i, -3, 1 - i, 1 / i};
Show[Argand[numbers], Graphics@Circle[{0, 0}, 1]]
```

Out[21]=



In[22]:=
```
AbsArg[numbers]
```

Out[22]= $\left\{\left\{2, \frac{\pi}{2}\right\}, \{3, \pi\}, \left\{\sqrt{2}, -\frac{\pi}{4}\right\}, \left\{1, -\frac{\pi}{2}\right\}\right\}$

In[23]:=
```
PolarForm[numbers]
```

Out[23]= $\left\{2\, e^{\frac{i\pi}{2}}, 3\, e^{i\pi}, \sqrt{2}\, e^{-\frac{i\pi}{4}}, e^{-\frac{i\pi}{2}}\right\}$

Problem 5

In[24]:=
```
ReIm[3 x^2 + (1 + 2 i) x + 2 (i - 1)] // Simplify
```

Out[24]= $\left\{-2 + x + 3\, x^2, 2\,(1 + x)\right\}$

In[25]:=
```
Solve[{-2 + x + 3 x^2 == 0, 2 (1 + x) == 0}, x]
```

Out[25]= $\{\{x \to -1\}\}$

Problem 6

In[26]:=
```
numbers = {1 - i, Sqrt[3] + i, 2 i, -3};
```

In[27]:=
```
PolarForm[numbers]
```

Out[27]= $\left\{\sqrt{2}\, e^{-\frac{i\pi}{4}}, 2\, e^{\frac{i\pi}{6}}, 2\, e^{\frac{i\pi}{2}}, 3\, e^{i\pi}\right\}$

In[28]:=
```
PolarForm[Conjugate[numbers]]
```

Out[28]= $\left\{\sqrt{2}\, e^{\frac{i\pi}{4}}, 2\, e^{-\frac{i\pi}{6}}, 2\, e^{-\frac{i\pi}{2}}, 3\, e^{i\pi}\right\}$

In[29]:=
```
PolarForm[1 / numbers]
```

Out[29]=
$$\left\{\frac{e^{\frac{i\pi}{4}}}{\sqrt{2}}, \frac{1}{2}e^{-\frac{i\pi}{6}}, \frac{1}{2}e^{-\frac{i\pi}{2}}, \frac{e^{i\pi}}{3}\right\}$$

Problem 7

In[30]:=
```
Solve[{e^(i φ) == Cos[φ] + i Sin[φ], e^(-i φ) == Cos[φ] - i Sin[φ]}, {Cos[φ], Sin[φ]}] // Expand
```

Out[30]=
$$\left\{\left\{\text{Cos}[\varphi] \to \frac{e^{-i\varphi}}{2} + \frac{e^{i\varphi}}{2}, \text{Sin}[\varphi] \to \frac{1}{2}\,i\,e^{-i\varphi} - \frac{1}{2}\,i\,e^{i\varphi}\right\}\right\}$$

Problem 8

In[31]:=
```
ψ = C e^(i n φ);
Solve[{∫_0^(2 π) Conjugate[ψ] ψ dφ == 1, C > 0}, C]
```

Out[32]=
$$\left\{\left\{C \to \frac{1}{\sqrt{2\pi}}\right\}\right\}$$

In[33]:=
```
∫_0^(2 π) Conjugate[C e^(i n φ)] C e^(i m φ) dφ
```

Out[33]=
$$0$$

Problem 9

In[34]:=
```
∫_0^∞ e^(-x) Cos[2 x] dx
```

Out[34]=
$$\frac{1}{5}$$

In[35]:=
```
∫_0^∞ e^(-3 x) Sin[x] dx
```

Out[35]=
$$\frac{1}{10}$$