1

a)

b) $0 + 8j = 8j$

c) $6 + 0j = 6$

d) $(3 + 4j)(-3 + 4j) = -9 + 12j - 12j - 16 = -9 - 16 = -25$

e) $\dfrac{3 + 4j}{-3 + 4j} = \dfrac{3 + 4j}{-3 + 4j} \cdot \dfrac{3 + 4j}{3 + 4j} = \dfrac{(3 + 4j)^2}{-25} = \dfrac{9 + 12j + 12j - 16}{-25}$

$= \dfrac{-5}{-25} + \dfrac{24}{25}j = \dfrac{1}{5} - \dfrac{24}{25}j$

f) $|z_1| = \sqrt{3^2 + 4^2} = \sqrt{9 + 16} = \sqrt{25} = 5$

g) $|z_2| = \sqrt{(-3)^2 + 4^2} = \sqrt{9 + 16} = 5$

h) $\tan\phi_1 = \dfrac{4}{3}$ $\phi_1 = \tan^{-1}\left(\dfrac{4}{3}\right) = 0.927$

i) $\phi_2 = \tan^{-1}\left(\dfrac{4}{-3}\right) = -0.927$

j) $z_1 = 5\cos(0.927) + i\,5\sin(0.927)$

$z_2 = 5\cos(-0.927) + i\,5\sin(-0.927)$

2:2

$$e^{j\phi} = \cos\phi + j\sin\phi$$

$$e^{j-\phi} = \cos-\phi + j\sin-\phi = \cos\phi - j\sin\phi$$

$$e^{j\phi} + e^{-j\phi} = (\cos\phi + j\sin\phi) + (\cos\phi - j\sin\phi)$$

$$e^{j\phi} + e^{-j\phi} = 2\cos\phi$$

$$\cos\phi = \frac{e^{j\phi} + e^{-j\phi}}{2}$$

2:3

$$e^{j\phi} = \cos\phi + j\sin\phi$$

$$\frac{e^{j\phi} - \cos\phi}{j} = \sin\phi$$

$$\frac{e^{j\phi} - \left(\frac{e^{j\phi} + e^{-j\phi}}{2}\right)}{j} = \sin\phi$$

$$\frac{2e^{j\phi}}{2j} - \frac{e^{j\phi}}{2j} - \frac{e^{-j\phi}}{2j} = \sin\phi$$

$$\frac{e^{j\phi} - e^{-j\phi}}{2j} = \sin\phi$$

3

a) $4 \cdot \cos \phi_1 \cdot 4 \cos \phi_2 = 16 (\cos \phi_1 \cdot \cos \phi_2)$

$= 16 \left(\dfrac{e^{j\phi_1} + e^{-j\phi_1}}{2} \cdot \dfrac{e^{j\phi_2} + e^{-j\phi_2}}{2} \right)$

$= 16 \left(\dfrac{e^{j\phi_1 + j\phi_2} + e^{j\phi_1 - j\phi_2} + e^{-j\phi_1 + j\phi_2} + e^{-j\phi_1 - j\phi_2}}{4} \right)$

$= 8 \left(\dfrac{e^{j(\phi_1 + \phi_2)} + e^{-j(\phi_1 + \phi_2)}}{2} + \dfrac{e^{j(\phi_1 - \phi_2)} + e^{j(\phi_1 - \phi_2)}}{2} \right)$

$= 8 \left(\cos(\phi_1 + \phi_2) + \cos(\phi_1 - \phi_2) \right)$

$= 8 \left(\cos(2\pi f_1 t + 2\pi f_2 t - \phi) + \cos(2\pi f_1 t - 2\pi f_2 t - \phi) \right)$

$= 8 \left(\cos(2\pi t (f_1 + f_2) - \phi) + \cos(2\pi t (f_1 - f_2) - \phi) \right)$

$\underbrace{\qquad}_{f_+} \qquad\qquad \underbrace{\qquad}_{f_-}$
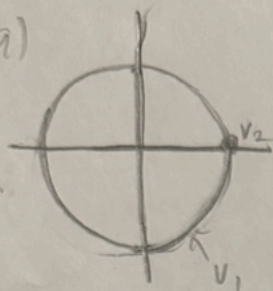
Total phase shift 2ϕ

3 b) $4\cos(2\pi f t) \quad 4\cos(2\pi f t)$

$P(t) = 16 \cos^2(2\pi f t)$

$P_{max} = P(0) = 16$

4 a)

$$\bar{e}^{j\phi} = \cos{-\phi} + j\sin{\phi}$$
$$= \cos{\phi} - j\sin{\phi}$$

$$r_2 = 1 \quad \theta_2 = 0$$
$$r_1 = 1 \quad \theta_1 = -\phi$$

b) $V_1 = 0 + e^{-j\phi}$

$V_2 = 1$

$V_{sum} = 1 + e^{-j\phi}$

c) $1 + e^{-j\frac{\pi}{2}} = 1.707 - 0.707j$

$1 + e^{-j\,0} = 2$

$1 + e^{-j\pi} = 0$

```
%problem 3:1
clear;
close;
home;
x = randn(10000,1);
figure(1);
hist(x,30);
figure(2);
plot(x);
axis([-1 10001 -10 10]);

dt = 0.01;
t = 0:dt:1;
m = mean(x);
s = std(x);

p =(1/(sqrt(2*pi*(s^2)))) .* exp(-(((t - m) ./ s).^2));

figure(3);
plot(p);


dt = 0.1;
t = 0:dt:10;
x = randn(size(t));

a = 1;
f = a.*sin(t);

figure(4);
plot(f + x);
```

```
%problem 3:2
clear;
close;
home;

n = 100;
r = zeros(1000);
for i=0:n
        r=r+rand(1000);
endfor
hist(r);
```

```
%problem 4:1
clear;
close;
home;

f = 100.0;
fs = 200.0;
dt = 1/fs;

t = 0.0:dt:2*f;

s = sin((1/f)*2*pi.*t);
figure(1);
plot(s);
```