Question 1

A. 100ml of 0.0250 M solution of codeine (Mw = 299.37 g/mol)

   M=n/V so, n= M*V= 0.0250 M*0.1L= 0.0025 moles of codeine.
   Amount= n*Mw= (0.0025 moles*299.37g)/1 mol= **0.7484g of codeine.**

B. C1V1=C2V2
   C1= 0.0250 M
   V1= x
   C2= 0.001M
   V2= 0.250 L

   V1=(C2V2)/C1= (0.001*0.250)/ 0.0250= **0.01L= 10mL**

Question 2

A) 100 ml of 1 mg/mL solution= 100*1= 100 mg
B) 10 ml of 10 mg/mL =10*10= 100 mg
C) 20 ml of 20 mg/L solution = 0.02L*20 mg/L = 0.4 mg
D) 50 ml of a 10 mg/mL solution = 50*10= 500mg

D contains the highest amount of drug

Question 3

A = εlc so c= A/(εl)
A=0.345
ε= 569 L/(mol*cm)
l= 2cm

c (mol*L-1)= 0.345/ (569 L/(mol*cm) *2cm) = $3.03*10^{-4}mol*L^{-1}$
As 4 liters = $3.03*10^{-4}mol*L^{-1}$ *4L= 0.001213 mol

Amount= c*Mw= 0.001213 mol *185g/mol = **0.224 g**

Question 4

Na_2CO_3 = 250 mL*0.005mmol/mL= 1.25 mmol/2= 0.625 mmol= $6.25x10^{-4}$ mol *105.99 g= 0.066g Na_2CO_3

Dissolving 0.066g Na_2CO_3 in water and diluting 250 mL

Question 5

HCL + NaOH -> NaCL + H20

0.105M x
0.005 L 0.0186 L

M=n/V so, n= M*V= 0.105*0.005= 5.25x10-4 mol HCL
NaOH 1:1 HCl so, 5.25x10-4 mol HCL= 5.25x10-4 mol NaOH
M NaOH = 5.25x10-4 mol NaOH/0.0186= **0.028M NaOH**

Question 6

Kd= 4.0
Vo= 50 mL
Va= 100mL

$$F = \frac{Kd}{Kd + \left(\frac{Va}{Vo}\right)} = \frac{4}{4 + \left(\frac{100}{50}\right)} = \frac{4}{6} = 0.6667 = \mathbf{66.67}\%$$

Question 7

1 mg in 100 ml iron
40% light
0.5 mg iron in 100 ml

A=-log(I/Io)=-log(40/100)= -log(0.4)= 0.398
0.398*0.5= 0.199
T= $10^{-0.199}$ = 0.6324 = **63.24%**

Question 8

Accuracy defines how close the result is to the true value. Precision is a measure of repeatability, quoted as absolute standard deviation (S) or relative standard deviation (RSD).

Average= 3.9875g
Theoretical value= 5mL of 0.78 g/mL solution= 3.9g

Relative error= $\left(\frac{experimental\ value - theoretical\ value}{theoretical\ value}\right) * 100$ = $\left(\frac{3.9875g-3.9g}{3.9875g}\right) * 100 = 2.24\%$

The lower the relative error is, the more accurate the pipette is.

S=[∑ (X i−X)^2/ (N −1)]$^{1/2}$

∑ (X i−X)^2= 2(3.9-3.9875)^2+3(4-3.9875)^2+(3.8-3.9875)^2+(4.2-3.9875)^2+(4.1-3.9875)^2 = 0.10875
S=[∑ (X i−X)^2/ (N −1)]$^{1/2}$= (0.10875/7)^{½}= 0.125

RSD= (s/average)*100 = (0.125/3.9875)*100= 3.135%

Looking at the low value of the results, the pipettes are acceptable regarding their accuracy and precision.

Question 9

$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_20$
20mL 14.5 mL
x 0.150M

M=n/V so, n= M*V=0.150*0.0145= 0.002175 moles NaOH
H_2SO_4 1: 2 NaOH -> 0.002175
mole
0.002175 moles NaOH -> 1mol H_2SO_4 / 2mol NaOH= 0.002175 moles NaOH/2= $1.0875x10^{-3}$ moles H_2SO_4

M= $1.0875x10^{-3}$ moles H_2SO_4/ 0.0206 L = **$5.279x10^{-2}$M H_2SO_4**

Question 10

i. Concentration (in mg/L) of this standard iron solution
c= 0.1483 g in 250 mL= 0.5932 g/L =**593.2 mg/L**

ii. 1 mL of 0.5 mg/L stock solution
C_1= 0.5 mg/L
V_1=1 mL = 0.001
C_2= x
V_2= 100 mL = 0.1L

$$C1 * V1 = C2 * V2 \rightarrow C2 = \frac{C1 * V1}{V2} = \frac{0.001 * 0.5}{0.1} = \mathbf{0.005\ mg/L}$$

3 mL of 0.5 mg/L stock solution
C_1= 0.5 mg/L
V_1= 3 mL = 0.003 L
C_2= x
V_2= 100 mL = 0.1L

$$C1 * V1 = C2 * V2 \rightarrow C2 = \frac{C1 * V1}{V2} = \frac{0.003 * 0.5}{0.1} = \mathbf{0.015\ mg/L}$$

5 mL of 0.5 mg/L stock solution
C_1= 0.5 mg/L
V_1= 5 mL = 0.005 L
C_2= x
V_2= 100 mL = 0.1L

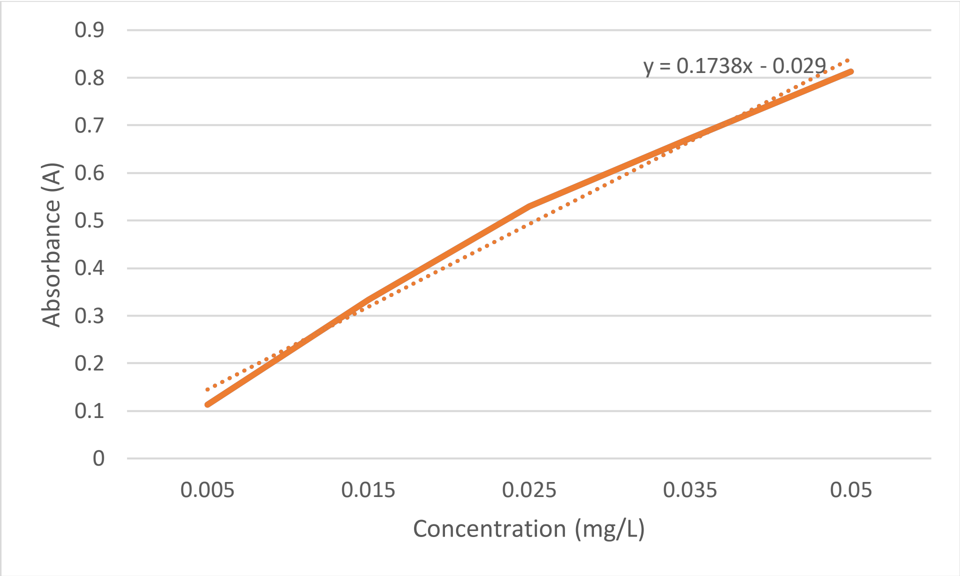
$$C1 * V1 = C2 * V2 \rightarrow C2 = \frac{C1 * V1}{V2} = \frac{0.005 * 0.5}{0.1} = \mathbf{0.025\ mg/L}$$

7 mL of 0.5 mg/L stock solution
C_1= 0.5 mg/L
V_1= 7 mL = 0.007 L
C_2= x
V_2= 100 mL = 0.1L

$$C1 * V1 = C2 * V2 \rightarrow C2 = \frac{C1 * V1}{V2} = \frac{0.007 * 0.5}{0.1} = \mathbf{0.035\ mg/L}$$

10 mL of 0.5 mg/L stock solution
C_1= 0.5 mg/L
V_1= 10 mL = 0.010 L
C_2= x
V_2= 100 mL = 0.1L

$$C1 * V1 = C2 * V2 \rightarrow C2 = \frac{C1 * V1}{V2} = \frac{0.010 * 0.5}{0.1} = \mathbf{0.05\ mg/L}$$

iii.


Line equation: y=0.1738 L*mg-1*Abs-1x-0.029 Abs

iv. Concentration of the Unknown sample= (0.375 Abs +0.029 Abs)/ 0.1738 L*mg-1*Abs-1 = **2.325 mg/L**
Y=mx+c
y-c=mx
X=(y-c)/m

Question 11

Kd = 5.32
Va= 100 ml
Vo= 30 ml
N= 3

$$F = 1 - \left(\frac{Va}{Kd * Vo + Va}\right)^3 = 1 - \left(\frac{100}{5.32 * 30 + 100}\right)^3 = 0.9428 = \mathbf{94.28}\%$$

Question 12

Question 13

Solution 1

C_1= 20 μg/L
V_1=x
C_2= 10 μg/L
V_2= 20 mL

$$C1 * V1 = C2 * V2 \rightarrow V1 = \frac{C2 * V2}{C1} = \frac{10 * 20}{20} = \mathbf{10}\boldsymbol{mL}$$

Solution 2

C_1= 20 μg/L
V_1=x
C_2= 5 μg/L
V_2= 20 mL

$$C1 * V1 = C2 * V2 \rightarrow V1 = \frac{C2 * V2}{C1} = \frac{20 * 5}{20} = \mathbf{5}\ \boldsymbol{mL}$$

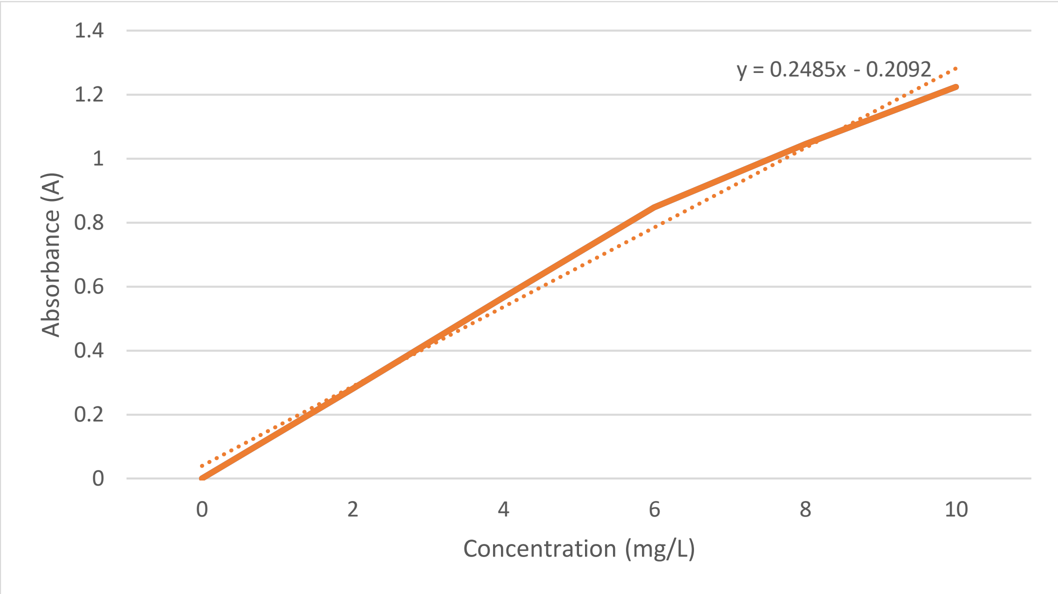
Solution 3

C_1= 20 μg/L
V_1=x
C_2= 2.5 μg/L
V_2= 20 mL

$$C1 * V1 = C2 * V2 \rightarrow V1 = \frac{C2 * V2}{C1} = \frac{20 * 2.5}{20} = \mathbf{2.5mL}$$

We should take the appropriate volume of the stock solution with the right pipette. A 5mL pipette should be used for solutions 1 and 2. For solution 3, a 2mL pipette would be more accurate.

Question 14



Line equation: y=0.2485x-0.2092

Dilution factor= 250

Amount of drug in tablet (0.386 Abs+0.2092Abs)/0.2485 L*mg-1*Abs-1= 2.395 mg/L * 250= 598.75 mg/L
There is 0.599g of drug in the tablet (1.355g), so 0.599g/1.355g= 0.4419g*100= 44.19%

There is **44.19%** of drug in the tablet.

Question 15

Va= 5mL
Vo= 10 mL
pH= 2
Ka= 3.24×10^{-4}
Kd= 5

$[H^+]$= pH 2= 10^{-2}= $1x10^{-2}$

$$D = \frac{Kd{*}[\mathrm{H+}]}{[\mathrm{H+}]+Ka} = \frac{5{*}1\mathrm{x}10{-}2}{1\mathrm{x}10{-}2{+}3.24\times 10{-}4} = 4.84$$

D can replace K_d in all our earlier formulae for F, as it is an equilibrium constant, but it includes all species

$$F = \frac{Kd}{Kd + (\frac{Va}{Vo})} = \frac{4.84}{4.84 + (\frac{5}{10})} = 0.9064 = \mathbf{90.64}\%$$