

## GLY261 Practical 5: Gabbroic rocks Memo

Name: \_\_\_\_\_

Student Number: \_\_\_\_\_

### Part 2: Trace element calculations

A rock is made of 20% olivine, 40% clinopyroxene and 40% plagioclase. The olivine contains 100 ppm Ni and 20 ppm Sr. The clinopyroxene contains 20 ppm Ni and 20 ppm Sr. The plagioclase contains 10 ppm Ni and 50 ppm Sr. The batch melting equation  $Cl/Co = 1/(D(1-F)+F)$  applies. The following partition coefficients apply:

	D for Ni	D for Sr
Olivine	10	0.1
Clinopyroxene	0.2	0.1
Plagioclase	0.01	0.8

1. What would this type of rock be called? Gabbro
2. What is the total concentration of Sr in the rock? 32 ppm  
( $0.2*20+0.4*20+0.4*50$ )
3. What is the total concentration of Ni in the rock? 32 ppm  
( $0.2*100+0.4*20+0.4*10$ )
4. If 40% of only the olivine melts, then what will be the concentration of Ni and Sr in the liquid produced? Ni 15.6 ppm Sr 43.5 ppm
5. If 50 % of only the plagioclase melts, then what will be the concentration of Ni and Sr in the liquid produced? Ni 20 ppm Sr 55.6 ppm
6. Calculate a Bulk Partition Coefficient for Ni and Sr, to apply if all the minerals melt in the same percentages as in the original rock.  
BULK D for Ni 2.084 BULK D for Sr 0.38
7. Using the Bulk D, what will be the concentrations of Ni and Sr in the liquids produced by the melting of 10% and 20% of the rock?  
Ni (10%) 16.9 Ni (20%) 17.1 Sr (10%) 72.4 Sr (20%) 63.5
8. What will be the concentration of Ni and Sr left in the residual rock after 10 and 20% of the rock has melted? Ni (10%) 33.7 Ni (20%) 35.7 Sr (10%) 27.5 Sr (20%) 24.1

### Part 3: Geochronology

$\lambda$  for  $^{87}\text{Rb}$  to  $^{87}\text{Sr} = 1.42 \times 10^{-11}$ . We have a rock with the following isotopic ratios:

	$^{87}\text{Rb}/^{86}\text{Sr}$	$^{87}\text{Sr}/^{86}\text{Sr}$
Biotite	289.7	1.969
K-feldspar	5.60	0.8010
Plagioclase	0.528	0.7767

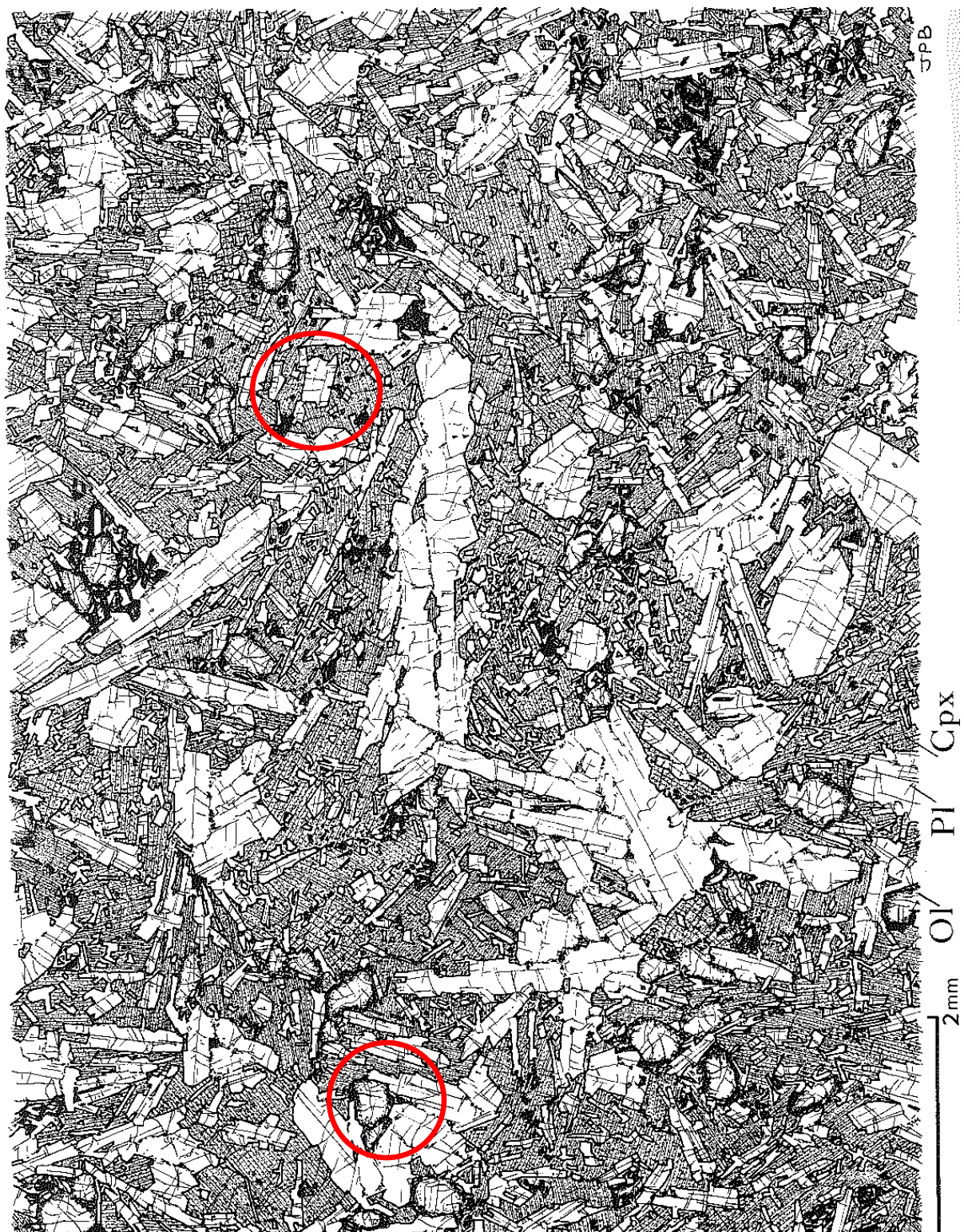
Plot these rocks on an isochron diagram with suitable scales on the axes. Answer the following questions:

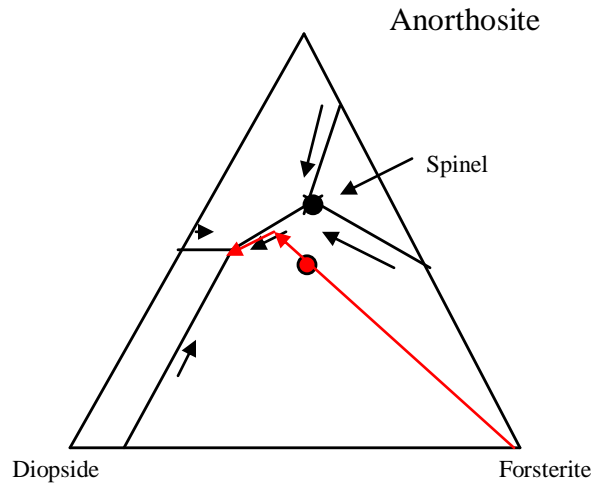
- 1) What is the original  $^{87}\text{Sr}/^{86}\text{Sr}$  ratio for the rock at time of formation?  
\_\_\_\_ **0.776** \_\_\_\_\_
- 2) What is the slope of the regression line drawn? \_\_\_\_ **0.0041** \_\_\_\_\_
- 3) What is the age of the rock? \_\_\_\_ **288 Ma** \_\_\_\_\_

#### **Part 4: Textures and phase diagrams**

1. Consider the picture below. Answer the questions:

- a) What is the name for this type of rock? \_\_\_\_\_ **Gabbro** \_\_\_\_\_
- b) What crystallised first, and why do you say that? \_\_\_\_\_ **Olivine- in places, plagioclase has grown around the olivine** \_\_\_\_\_  
\_\_\_\_\_
- c) What crystallised second? Why? \_\_\_\_ **Plagioclase-it definitely grows around olivine, and clinopyroxene in turn grows around it** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- d) What crystallised last? Why? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- e) Plot the likely evolution path for this rock on the phase diagram below:



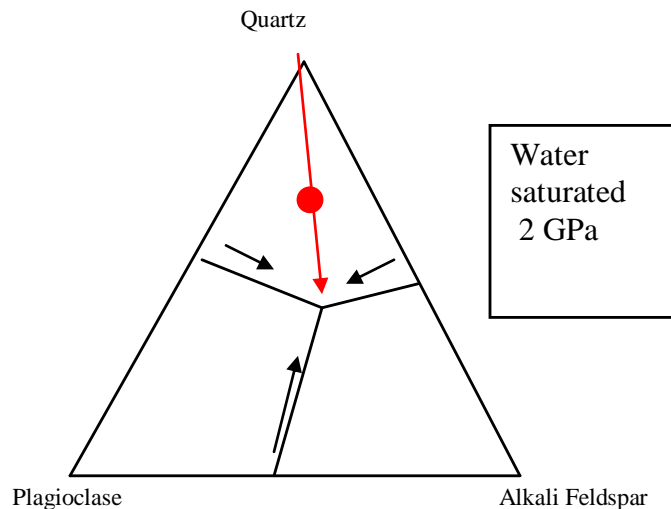


2. Consider the rock below. Answer the following questions:

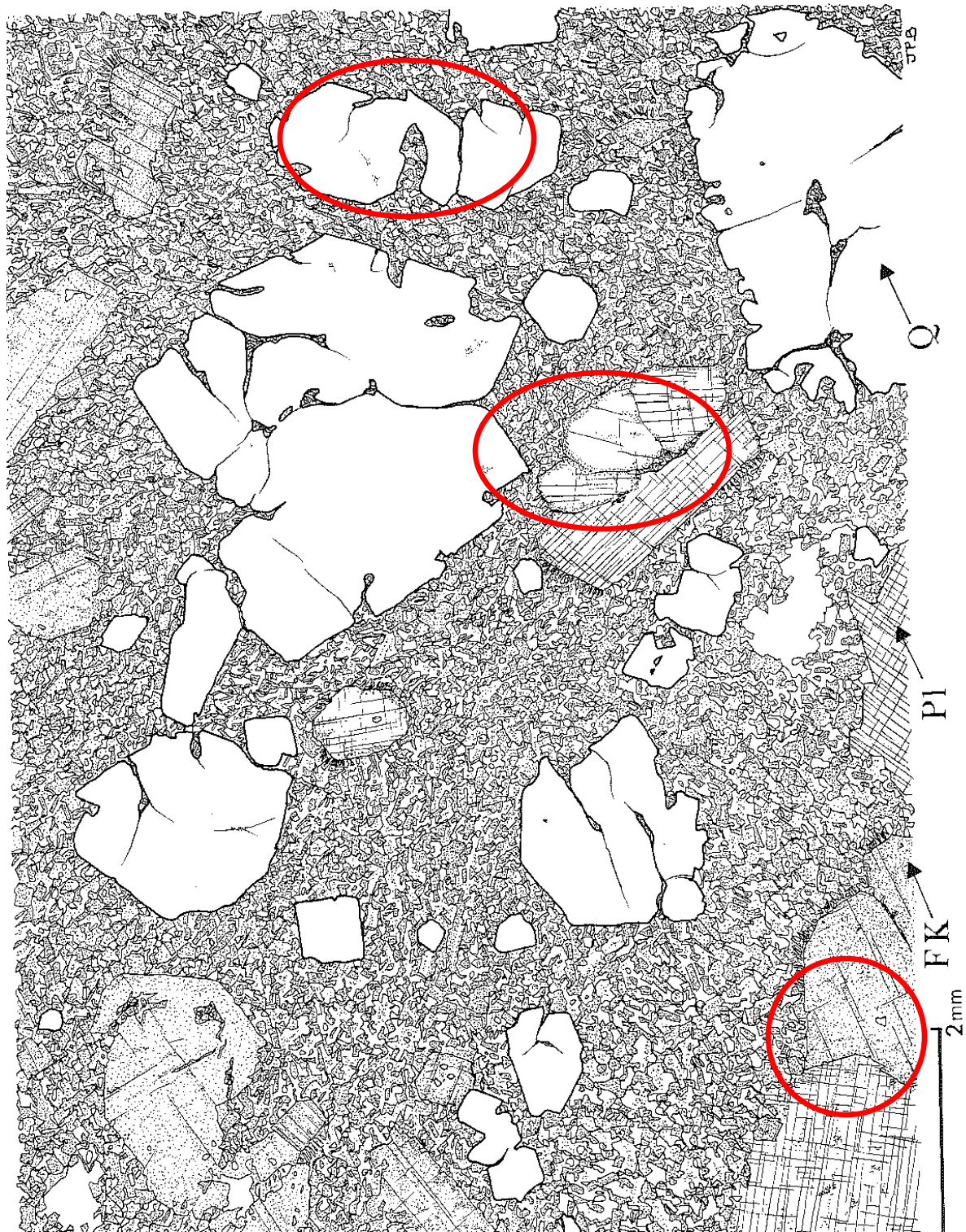
- a) What is the name for this type of rock? \_\_\_\_\_ **Granite** \_\_\_\_\_
- b) What crystallised first, and why do you say that? \_\_\_\_ **Quartz- it is euhedral and embayed. However, no large grains of k-fsp or plagioclase are in contact with the quartz, so there is some ambiguity** \_\_\_\_\_

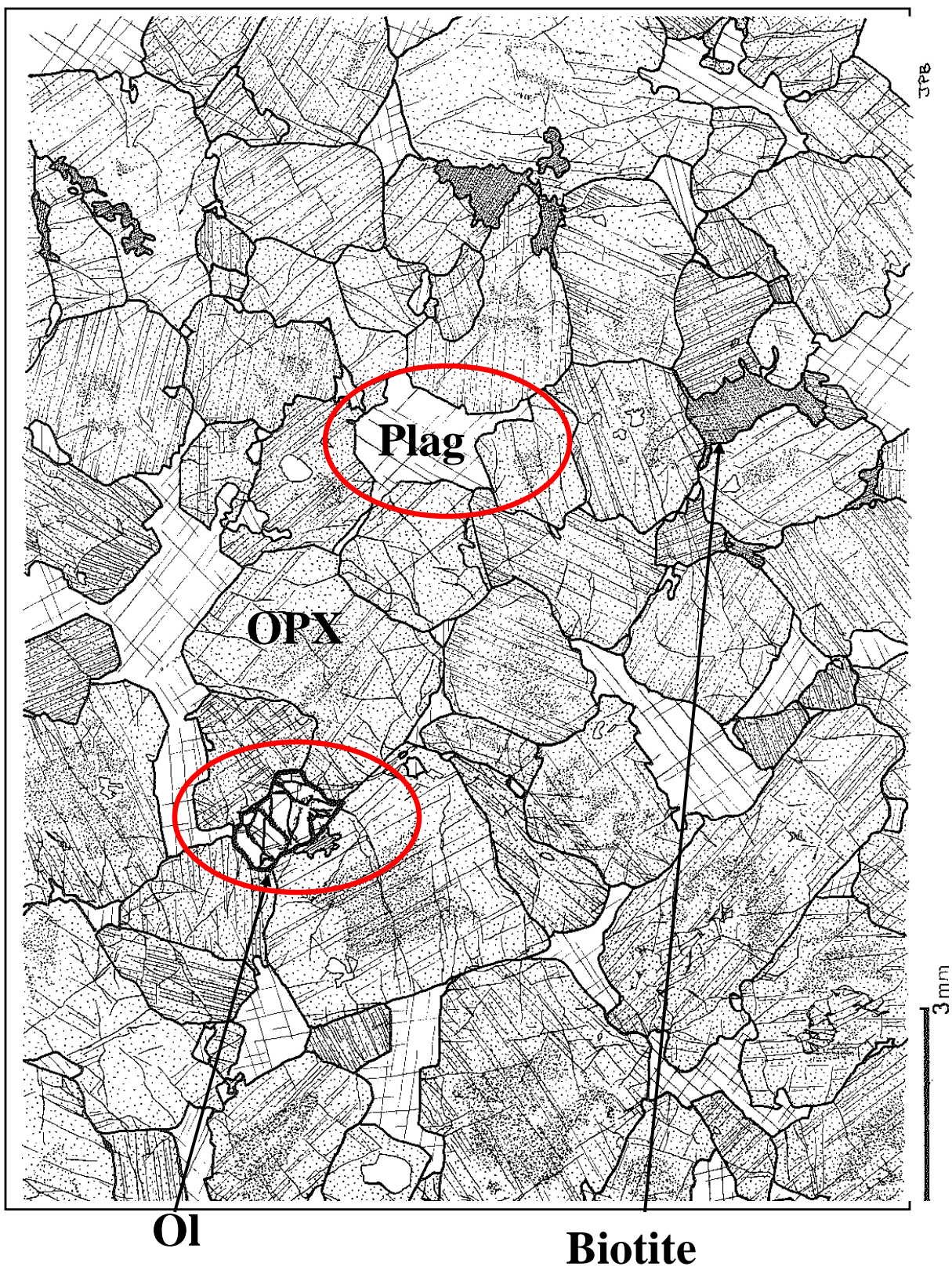
- c) What crystallised second? Why? **Plagioclase and K-feldspar appear to have crystallised together, considering the conflicting textural evidence**
- d) What crystallised last? Why?

- e) Plot the likely evolution path for this rock on the phase diagram below:











3. Consider the rock above. Answer the following questions:

- f) What is the name for this type of rock? Gabbro (norite)
- g) What crystallised first, and why do you say that? Olivine crystallised first.  
Though there is only one grain of olivine in view, it is clearly surrounded by the other minerals, and appears to overgrow most of them
- h) What crystallised second? Why? Orthopyroxene crystallised next, as plagioclase and biotite are clearly interstitial
- i) What crystallised last? Why? Plagioclase crystallised last, though biotite is an alteration product and forms after crystallisation. Plagioclase is clearly anhedral and interstitial
- j) Plot the likely evolution path for this rock on the phase diagram below:

