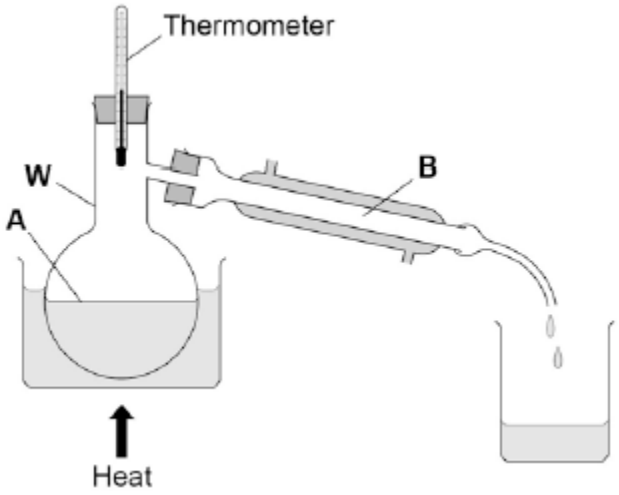
1 The apparatus in the figure below is used to separate a mixture of liquids in a fuel.



(a) What is apparatus **W** on above the figure above?

Tick **one** box.

Beaker ☐

Boiling Tube ☐

Flask ☐

Jug ☐

(1)

(b) What is the name of this method of separation?

Tick **one** box.

Crystallisation ☐

Electrolysis ☐

Filtration ☐

Distillation ☐

(1)

(c) Name the changes of state taking place at **A** and **B** in the figure above.

Use words from the box.

boiling	**condensing**	**freezing**	**melting**

Change of state at **A**: .....

Change of state at **B**: .....

(2)

(d) **Table 1** shows the boiling points of the hydrocarbons in the fuel.

Table 1

Hydrocarbon	Boiling point in °C
Pentane	36
Hexane	69
Heptane	98
Octane	125

Which hydrocarbon will be the last to collect in the beaker?

Tick **one** box.

Pentane ☐

Hexane ☐

Heptane ☐

Octane ☐

(1)

(e) The fuel is a mixture of liquids that has been designed as a useful product.

What name is given to this type of mixture?

Tick **one** box.

- Catalyst ☐
- Formulation ☐
- Polymer ☐
- Solvent ☐

(1)

(f) Describe how this fuel is different from crude oil.

.....

.....

.....

.....

(2)

(g) A student measured the melting point of a solid hydrocarbon four times.

The student's results are in **Table 2**.

Table 2

	Trial 1	Trial 2	Trial 3	Trial 4
Melting point in °C	35	48	37	37

Calculate the mean melting point of the hydrocarbon, leaving out any anomalous result.

Give your answer to two significant figures.

.....

.....

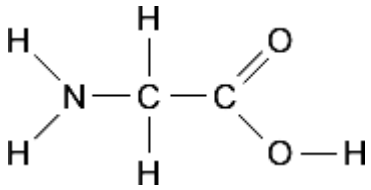
Mean melting point = ... °C

(2)

(Total 10 marks)

2 Two scientists, Miller and Urey, investigated how simple gases that may have been present in the Earth's early atmosphere led to the formation of chemicals such as glycine. Glycine is found in living organisms.

The displayed (structural) formula of glycine is:



(a) Name **three** simple gases that could have been present in the Earth's early atmosphere that might combine to form glycine.

1 .....

2 .....

3 .....

(3)

(b) Describe the main differences between the Earth's early atmosphere and the atmosphere today.

.....

.....

.....

.....

.....

.....

.....

.....

(4)

(c) Air is a source of some gases used in industrial processes.

Name the process used to separate the gases in air.

Give the reason why this process can be used to separate the gases.

.....

.....

.....

.....

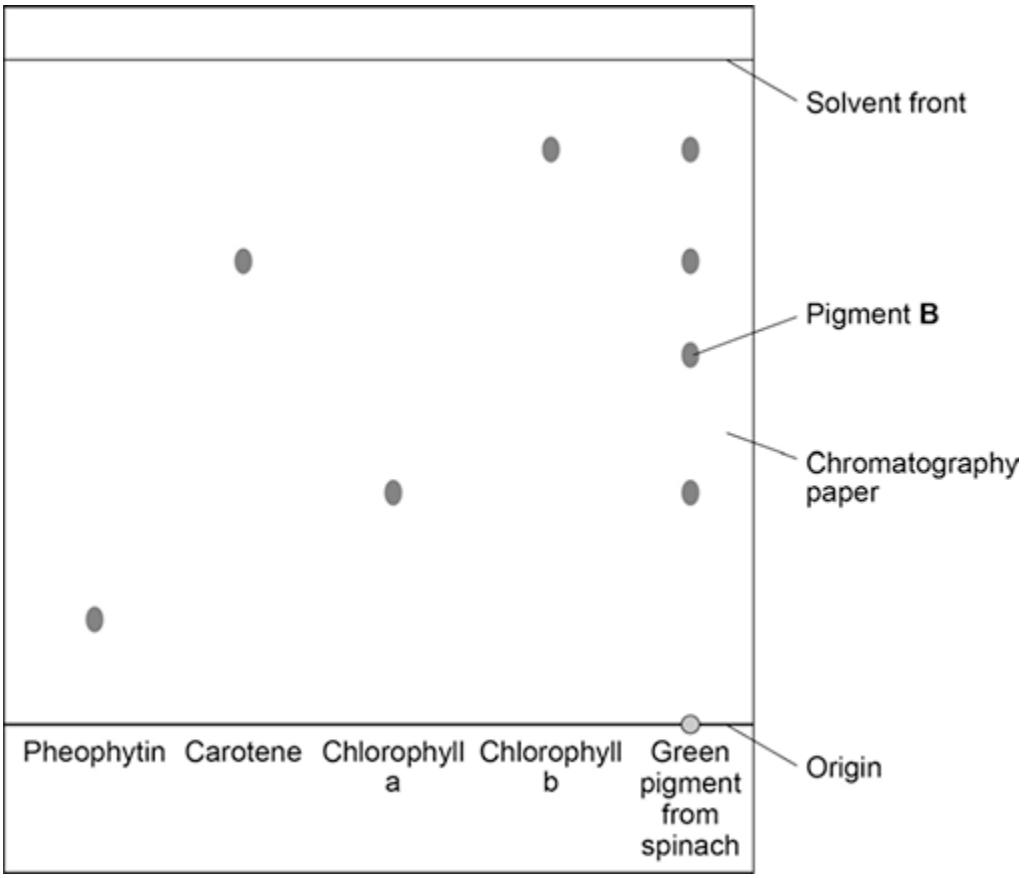
(2)
(Total 9 marks)

3 A student used paper chromatography to identify the pigments in spinach leaves.

She used propanone as a solvent.

Figure 1 shows the student's results.

Figure 1



(a) Name the mobile phase and the stationary phase in the student's experiment.

Mobile phase .....

Stationary phase .....

(2)

(b) What does **Figure 1** tell you about the green pigment from spinach?

.....

.....

.....

.....

.....

.....

(3)

(c) Write the equation that links distance moved by solvent, distance moved by solute and R_f value.

.....

(1)

(d) Use **Figure 1** to calculate the R_f value for pigment **B**.

.....

.....

.....

.....

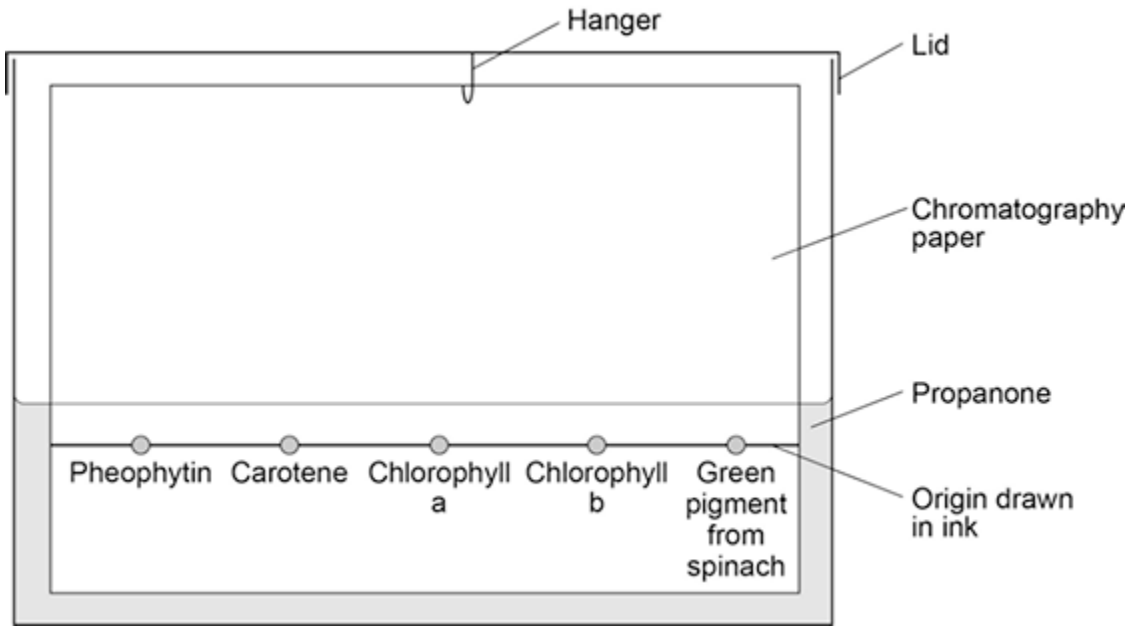
.....

R_f value = ...

(3)

(e) Another student set up the apparatus shown in **Figure 2**.

Figure 2



This student did not set up the apparatus correctly.

Identify the errors the student made.

Explain how the errors she made would affect her results.

.....

.....

.....

.....

.....

.....

.....

.....

(4)
(Total 13 marks)

1

(a) Flask

1

(b) Fractional distillation

1

(c) **A** – boiling

in this order

1

B – condensing

1

(d) Pentane

1

(e) Formulation

1

(f) the fuel is a pure compound

1

and crude oil is a mixture

or

the fuel is made up of four hydrocarbons

allow crude oil contains a large number of compounds and the fuel contains four

and crude oil could have many more

1

(g) (35 + 37 + 37 / 3) = 36.33

1

36

1

*allow (35 + 48 + 37 + 37 / 4 =) 39(.25) for **1** mark*

[10]

2 (a) *if only formula given it must be correct*

any **three** from:

- ammonia
  accept NH_3
- methane
  accept CH_4
  allow ethane / butane / propane
- hydrogen
  accept H_2
- water vapour
  accept H_2O vapour / steam
- carbon dioxide
  accept CO_2
- carbon monoxide
  accept CO
  allow oxygen / O_2
  allow nitrogen / N_2
  ignore nitrogen oxide
  ignore carbon

3

(b) (in atmosphere today)

ignore references to water vapour
allow converse

(much) less carbon dioxide / CO_2

allow carbon dioxide was the main gas (in Earth's early atmosphere)

1

more nitrogen / N_2

allow nitrogen is now the main gas (in the atmosphere today)
or
nitrogen is now 78 × 80%

1

more oxygen / O_2

1

no ammonia / NH_3 or less methane / CH_4 or more argon / Ar or more noble gases

allow less ammonia / NH_3

1

(c) (fractional) distillation

1

gases have different boiling points

allow gases condense at different temperatures

ignore condensing points / levels

ignore evaporating points / levels

1

[9]

3

(a) **mobile phase** propanone

1

stationary phase paper

1

(b) any **three** from:

- contains chlorophyll a, b and carotene
- contains Pigment B
- does not contain pheophytin
- contains (at least) one unknown substance
- contains five substances
- contains a substance that does not dissolve in the solvent

3

(c) $Rf = \frac{distance\ moved\ by\ substance}{distance\ moved\ by\ solvent}$

1

(d) both measurements correct

solvent front = 9.0 cm and pigment B distance = 5.0 cm

1

R_f = 5.0 / 9.0

1

= 0.56

allow ecf from incorrect measurements

1

(e) origin line drawn in ink

1

so it will run **or** dissolve in the solvent **or** split up

1

spots under solvent **or** solvent above spots / origin line

1

so they will mix with solvent **or** wash off paper **or** colour the solvent **or** dissolve in the solvent

1

[13]