01 Matter, Mixtures and Separation

Set B Competition Practice

Name | Time **45 minutes** | Total **29 marks** | Score ____ / 29

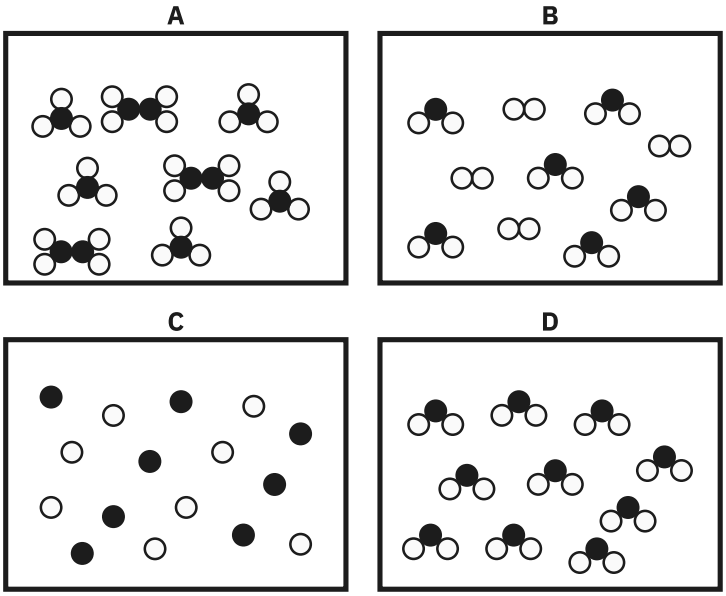
Marks by notes section For the marker: total each row. A score below the target means that section of the notes needs revising.

Notes section	Questions	Marks	Target	Score
1 Elements, Compounds and Mixtures	1, 2	2	2	
2 Particles and the States of Matter	3, 4, 5, 6, 7, 8, 9, 10	8	5	
3 Separating Mixtures	11, 12, 13, 14, 15, 16, 17, 18	8	5	
4 Chromatography	19, 20, 21, 22, 23, 24, 25, 26	8	5	
5 Judging Purity	27, 28, 29	3	2	

A Competition questions

29 MARKS

1 Which diagram represents a mixture of compounds?



A diagram A **B** diagram B **C** diagram C **D** diagram D

/1

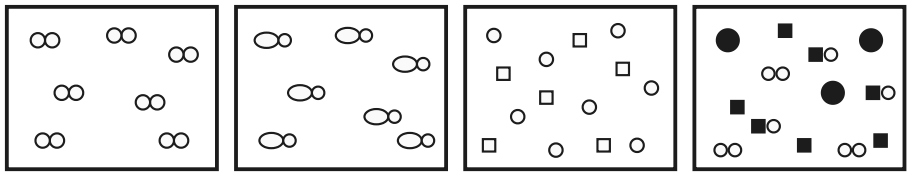
Answer ____ [1]

2024 Compassvale O Prelim P1 Q11

2 The following diagrams can be used to illustrate

1 a mixture of elements and compounds
2 a mixture of elements

3 molecules of an element
4 molecules of a compound



W X Y Z

What is the correct order of the diagrams? Each option gives the diagrams for 1, 2, 3 and 4 in that order.

A X, W, Y, Z **B** X, Z, W, Y **C** Z, Y, W, X **D** Z, Y, X, W

Answer [1]

/1

2024 Serangoon O Prelim P1 Q3

3 The melting and boiling points of five substances are tabulated.

	melting point / °C	boiling point / °C
P	50	80
Q	70	500
R	65	67
S	−15	−12
T	0	99

At which temperature would two liquids exist?

A −20 °C **B** −15 °C **C** 15 °C **D** 85 °C

Answer [1]

/1

Source: 2024 BTYSS FYE O EOY P1 Q5

4 In a change of state at constant temperature and pressure:

- energy is released as stronger forces of attraction form between the particles
- the average distance between the particles changes very little.

Which change of state is being described?

A boiling **B** condensation **C** freezing **D** melting

Answer [1]

/1

2026 Dunman O Prelim P1 Q3

5 The melting points and boiling points of four elements are shown.

element	melting point / °C	boiling point / °C
W	−183	−89
X	−78	−33
Y	−7	59
Z	44	280

In which elements are the particles far apart at 0 °C?

A W and X **B** X and Y **C** X and Z **D** Y and Z

/1

Answer [1]

2024 CHS O Prelim P1 Q6

6 Hydrogen sulfide, H_2S, is a colourless and poisonous gas. The melting point of hydrogen sulfide is −82 °C and the boiling point is −60 °C. Which statement correctly describes the particles of hydrogen sulfide at −75 °C?

A closely packed, moving freely

B closely packed, vibrating slightly

C far apart, moving freely

D far apart, vibrating slightly

/1

Answer [1]

2023 XMS O Prelim P1 Q5

7 The melting points and the boiling points of four substances are listed in the table.

substance	melting point / °C	boiling point / °C
argon	−189	−186
bromine	−7	59
chlorine	−101	−35
sulfur dioxide	−75	−10

Which substance exists as a liquid at −90 °C?

A argon **B** bromine **C** chlorine **D** sulfur dioxide

/1

Answer [1]

2021 SJI O Prelim P1 Q2

8 A sample of clean, dry air is cooled to −190 °C. The carbon dioxide forms a solid at −79 °C.

element in clean, dry air	melting point / °C	boiling point / °C
argon	−189	−186
oxygen	−218	−183
nitrogen	−210	−196

What is the state of argon, oxygen and nitrogen at −190 °C? Each option gives the state of argon, oxygen and nitrogen in that order.

A gas, gas, gas

B gas, solid, liquid

C solid, liquid, gas

D solid, liquid, liquid

/1

Answer [1]

2024 USS O Prelim P2 Q4

9 A mixture of propane, butane, hydrogen sulfide and carbon dioxide at −30 °C is allowed to cool down gradually to −200 °C.

compound	melting point / °C	boiling point / °C
propane	−188	−42
butane	−135	−1
hydrogen sulfide	−85	−51

carbon dioxide	–78	–78

Which compound can be solidified first?

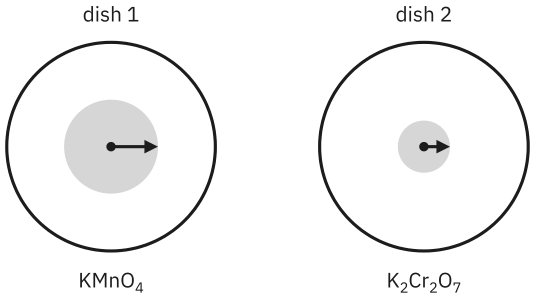
A butane **B** carbon dioxide **C** hydrogen sulfide **D** propane

Answer [1]

/1

2024 Woodlands O Prelim P1 Q3

10 Small crystals of purple $KMnO_4$ (M_r = 158) and orange $K_2Cr_2O_7$ (M_r = 294) were placed at the centres of separate petri dishes filled with agar jelly. They were left to stand under the same physical conditions. After some time, the colour of each substance had spread out as shown.



The lengths of the arrows indicate the relative distances travelled by particles of each substance.
Which statement is correct?

A Diffusion is faster in dish 1 because the mass of the particles is greater.

B Diffusion is faster in dish 2 because the mass of the particles is greater.

C Diffusion is slower in dish 1 because the mass of the particles is smaller.

D Diffusion is slower in dish 2 because the mass of the particles is greater.

Answer [1]

/1

2024 Greendale O Prelim P1 Q4

11 The table gives the densities and boiling points of five solvents.

	solvent	molecular formula	density / g cm^{-3}	boiling point / °C
I	chloroform	$CHCl_3$	1.49	61
II	ethanol	C_2H_5OH	0.79	78
III	acetone	$(CH_3)_2CO$	0.78	56
IV	hexane	C_6H_{14}	0.66	69
V	water	H_2O	1.00	100

What is the best method to separate liquids II and V?

A liquid–liquid extraction **B** thin layer chromatography

C fractional distillation **D** recrystallisation

Answer [1]

/1

Source: 2023 SJChO P1 Q29

12 Three separations are listed.

1 obtaining ethanol from a mixture of water and ethanol
2 obtaining water from a mixture of oil and water

3 obtaining water from calcium chloride solution

Which techniques would be involved in these separations? Each option gives the technique for 1, 2 and 3 in that order.

A evaporation, simple distillation, simple distillation

B fractional distillation, separating funnel, evaporation

C fractional distillation, separating funnel, simple distillation

D simple distillation, filtration, fractional distillation

/1

Answer [1]

Source: 2024 Zhonghua O Prelim P1 Q2

13 A liquid mixture of Y and Z is separated. Liquids Y and Z are immiscible. Y has a lower boiling point than Z. Y has a lower density than Z. Y and Z can be separated from each other both by fractional distillation and by using a separating funnel.

Which row correctly gives the first liquid to be collected by fractional distillation and by using a separating funnel? Each option gives the first liquid by fractional distillation, then the first liquid using the separating funnel.

A Y, then Y

B Y, then Z

C Z, then Y

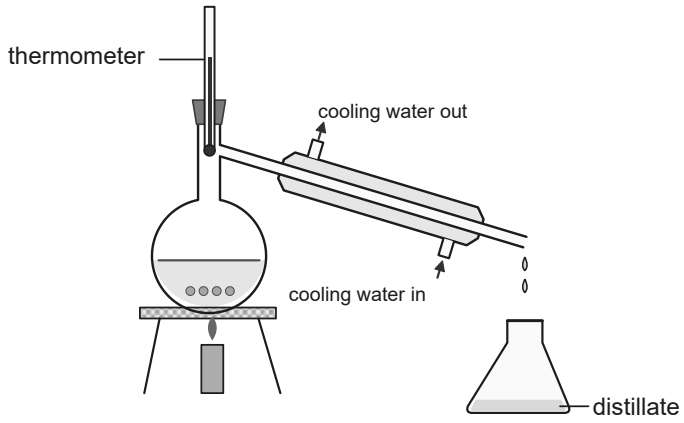
D Z, then Z

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Answer [1]

Source: 2024 BBSS O Prelim P1 Q4

14 Aqueous iron(II) sulfate, a pale green solution, is distilled using the set-up shown.



What is the temperature shown by the thermometer and the colour of the distillate in the conical flask?

A 100 °C, colourless

B 100 °C, pale green

C 106 °C, colourless

D 106 °C, pale green

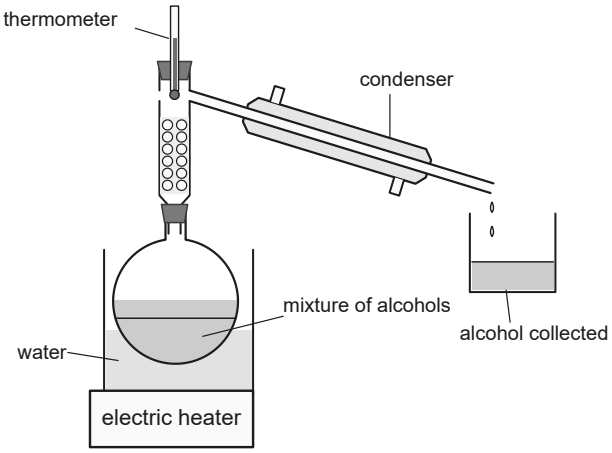
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Answer [1]

Source: 2024 SMSS O Sec3 P1 Q2

15 A student carried out an experiment using the set-up shown to separate a mixture containing four

alcohols.



The boiling points of the four alcohols used are: butanol 117 °C, ethanol 79 °C, pentanol 138 °C and propanol 97 °C.

Despite repeated attempts, the student only managed to obtain two alcohols from the mixture. Which alcohols did he fail to obtain?

A butanol and ethanol

B butanol and pentanol

C ethanol and propanol

D pentanol and propanol

/1

Answer [1]

Source: 2024 Bukit View O Prelim P1 Q5

16 Four statements about a mixture containing X, Y and Z are given.

1 X and Y are miscible liquids.
2 Z is soluble in X but not in Y.
3 Y has a lower boiling point than X or Z.
4 Z will decompose upon heating.

Which row correctly lists the steps required to separate all three substances?

A fractional distillation → crystallisation

B fractional distillation → evaporation to dryness

C simple distillation → crystallisation

D simple distillation → evaporation to dryness

/1

Answer [1]

Source: 2024 Temasek O Prelim P1 Q3

17 Salicylic acid is a substance used in skin ointments and a sample of it is found to contain impurities like iron and sodium iodide. Salicylic acid sublimes at 76 °C and is soluble in water.

What is the best method to obtain pure salicylic acid from the sample?

A Add water, filter and evaporate.

B Add water, filter and sublime.

C Use magnets, add water and filter.

D Add water, filter, crystallise and sublime.

/1

Answer [1]

Source: 2024 Punggol O Prelim P1 Q4

18 A laboratory assistant has a mixture of solid sulfur and solid carbon. Sulfur is very soluble in carbon disulfide (boiling point 46 °C) and slightly soluble in water. Carbon is insoluble in both solvents.

A sample of the mixture is shaken with water. This is P. Another sample of the mixture is shaken with carbon disulfide. This is Q. Which procedure is used to prepare a pure sample of sulfur?

A P is distilled and the distillate is evaporated to dryness to obtain sulfur.

B P is filtered and the filtrate is allowed to evaporate to dryness to obtain sulfur.

C Q is filtered and the residue is allowed to evaporate to dryness to obtain sulfur.

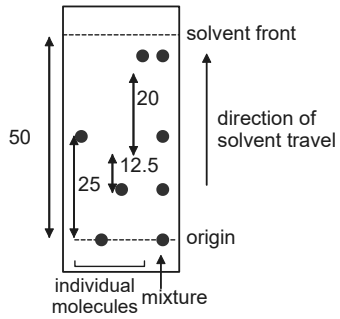
D Q is filtered and the filtrate is allowed to evaporate to dryness to obtain sulfur.

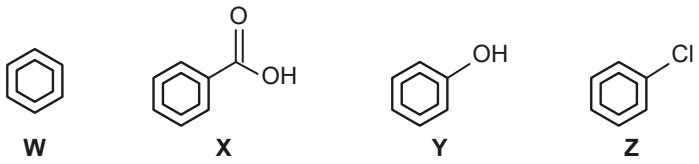
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Answer [1]

2024 CHIJ O Prelim P1 Q1

19 Thin layer chromatography (TLC) separates molecules in a mixture by their affinity for the stationary phase (the plate) and the mobile phase (the solvent). The less polar molecules move further up the plate than more polar molecules. Distances are in mm.





R_f = distance moved by molecule ÷ distance moved by solvent front, in a particular solvent. The mixture contains W, X, Y and Z, shown beside the plate.

What is the R_f of molecule Y?

A 0.50 **B** 0.25 **C** 0.30 **D** 0.90

/1

Answer [1]

Source: 2023 SJChO P1 Q27

20 The R_f values for the colours E, F, G and H in four different solvents are shown in the table.

solvent	water	ethanol	propanone	hexane
E	0.3	0.5	0.6	0.5
F	0.3	0.7	0.9	0.2
G	0.7	0.8	0.3	0.1
H	0.1	0.6	0.6	0.2

Which solvent could be used to separate a mixture of all four colours E, F, G and H?

A water **B** ethanol **C** propanone **D** hexane

/1

Answer [1]

Source: 2023 XMS O Prelim P1 Q4

21 The R_f values of some substances are shown below. The solvent used is ethanol.

substance	R_f value

X	0.20
Y	0.80
Z	0.45

Which of the following cannot be concluded from the R_f value of X?

A Substance X is less soluble in ethanol than Y and Z.

B Substance X will have the same R_f value when the solvent is changed to water.

C The distance travelled by X is one-fifth the distance travelled by ethanol.

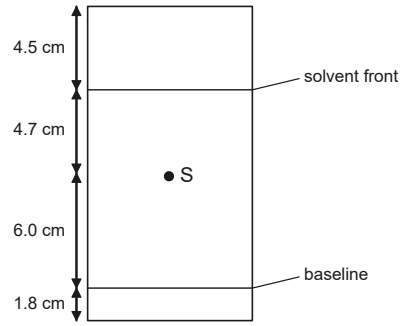
D The distance travelled by Y is four times the distance travelled by X.

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Answer [1]

Source: 2024 CCHY O Prelim P1-P2 Q6

22 The chromatogram obtained from a chromatography experiment on substance S is shown.



What is the R_f value of S?

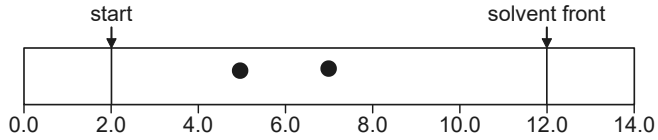
A 0.35 **B** 0.48 **C** 0.56 **D** 0.62

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Answer [1]

Source: 2024 CCHM O Prelim P1 Q3

23 A food colouring is analysed by paper chromatography.



From its chromatogram, what is the R_f value of the least soluble dye?

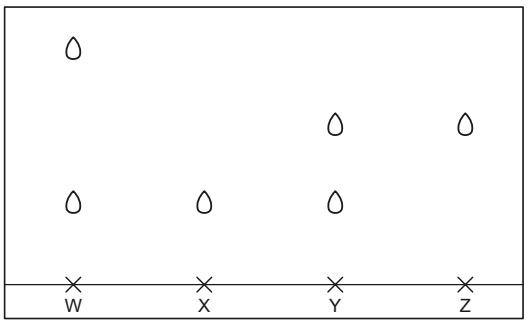
A 0.25 **B** 0.30 **C** 0.35 **D** 0.40

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Answer [1]

Source: 2024 Jurongville O Prelim P1 Q3

24 The diagram shows the chromatogram of four substances, W, X, Y and Z.



Which statement is correct?

A W contains X and Y.

B X is more soluble than Z.

C Y contains three components.

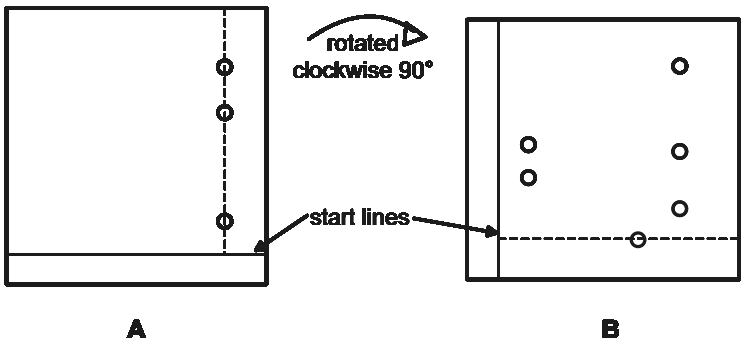
D Z has a larger R_f value than X.

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Answer [1]

Source: 2025 FHSS O Prelim P1 Q5

25 A chromatography experiment was done on a brand of food colouring to determine the number of coloured dyes present. Chromatogram A shows the separation of the dyes using water as a solvent. It is then rotated clockwise 90° and placed in ethanol as a solvent, as shown in chromatogram B.



How many different types of coloured dyes are present in the food colouring?

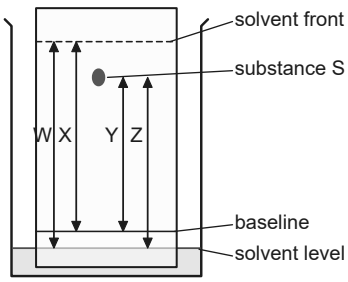
A 3 **B** 6 **C** 9 **D** 12

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Answer [1]

Source: 2024 BTYSS FYE O EOY P1 Q4

26 The chromatogram of substance S is shown. Some distances, W, X, Y and Z, are labelled on the diagram.



How is the R_f value of substance S calculated?

A X ÷ Y **B** W ÷ Z **C** Y ÷ X **D** Y ÷ W

/1

Answer [1]

Source: 2024 Greendale O Prelim P1 Q3

27 An unknown substance X starts melting at –180 °C and finishes melting at –160 °C. What is substance X likely to be?

A a compound

B a mixture

C an element

D insufficient data to determine

/1

Answer [1]

2024 VS O Prelim P1 Q4

28 An impure sample of compound X melted over a range of 162 °C to 168 °C. X was purified and its melting point was measured again. Which row correctly shows the method of purifying X and the melting point of pure X? Each option gives the method, then the melting point.

A crystallisation, 160 °C

B distillation, 160 °C

C crystallisation, 170 °C

D distillation, 170 °C

/1

Answer [1]

Source: 2024 AES O Prelim P1 Q2

29 The boiling point of liquid X is 118 °C and it is soluble in water. Which is most likely to be the boiling point of water if it contains a small quantity of X?

A 98 °C **B** 102 °C **C** 116 °C **D** 120 °C

/1

Answer [1]

Source: 2024 Compassvale O Prelim P1 Q3