	Marks
• The freezing point of a sample of seawater is measured as –2.15 °C at 1 atm pressure. Assuming that the concentrations of other solutes are negligible, determine the molality (in mol kg^{-1}) of NaCl in this sample. The molal freezing point depression constant for H_2O is 1.86 °C kg mol^{-1}.	**3**
Answer:	

THE REMAINDER OF THIS PAGE IS FOR ROUGH WORKING ONLY.

• Explain the following terms or concept.	**Marks**
Osmotic pressure	**1**

	Marks
• Isooctane, an important constituent of petrol, has a boiling point of 99.3 °C and a standard enthalpy of vaporisation of 37.7 kJ mol^{-1}. What is $\Delta S°$ (in J K^{-1} mol^{-1}) for the vaporisation of isooctane?	**2**
Answer:	

	Marks
• An aqueous solution with a volume of 10.0 mL contains 0.025 g of a purified protein of unknown molecular weight. The osmotic pressure of the solution was measured in an osmometer to be 0.0036 atm at 20.0 °C. Assuming ideal behaviour and no dissociation of the protein, estimate its molar mass in g mol^{-1}.	**3**
Answer:	

• Explain the following term or concept.	**Mark**
Vapour pressure	**1**

- The concentration of NaCl used in intravenous drips is 150 mM. Explain why this particular concentration is used and what the consequences would be for a patient if pure water were used instead.

2

- At 21.0 °C, a solution of 18.26 g of a non-volatile, non-polar compound in 33.25 g of bromoethane, CH_3CH_2Br, has a vapour pressure of 4.42×10^4 Pa. The vapour pressure of pure bromoethane at this temperature is 5.26×10^4 Pa. What is the molar mass of the compound?

4

Answer:

Marks 4

- Order the following salts from lowest to highest molar solubility.

Salt	CuCl	$Cd(IO_3)_2$	$BaSO_4$	Ag_2CrO_4
K_{sp}	1.9×10^{-7}	2.3×10^{-8}	1.1×10^{-10}	2.6×10^{-12}

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2

Answer:

Page Total:

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3

Answer:

Page Total:

	Marks
• Assuming ideal behaviour, calculate the mass of $MgCl_2 \cdot 6H_2O$ that should be dissolved in 1.0 L of water at 37 ºC to obtain a solution with an osmotic pressure of 6.0 atm, the same as that of cell cytoplasm.	**4**
Answer:	

Marks 5

- The freezing point of a sample of seawater is measured as –2.15 °C at 1 atm pressure. Assuming that the concentrations of other solutes are negligible, and that the salt does not significantly change the density of the water from 1.00 kg L^{-1}, determine the concentration (in mol L^{-1}) of NaCl in this sample. (The molal freezing point depression constant for H_2O is 1.86 °C m^{-1})

Answer:

In principle, it would be possible to desalinate this water by pumping it into a cylindrical tower, and allowing gravity to push pure water through a semipermeable membrane at the bottom. At 25 °C, how high would the tower need to be for this to work? (The density of liquid Hg at 25 °C is 13.53 g cm^{-3}.)

Answer:

	Marks
• Lysozyme is an enzyme that breaks down bacterial cell walls. A solution containing 0.150 g of this enzyme in 210 mL of solution has an osmotic pressure of 0.00125 atm at 25 ^{o}C. What is the molar mass of lysozyme?	**3**
Answer:	
• What mass of ethylene glycol, $HOCH_2CH_2OH$, is required to lower the freezing point of 1.00 L of water to –10.0 °C? The freezing point depression constant of water is 1.86 °C kg mol^{-1}. Assume the density of water is 1.00 g mL^{-1} at 0 °C.	**3**
Answer:	

Marks 6

- Assume that NaCl is the only significant solute in seawater. A 1.000 L sample of seawater at 25 ºC and 1 atm has a mass of 1.0275 kg and contains 33.0 g of NaCl. At what temperature would this seawater freeze? The freezing point depression constant of water is 1.86 ºC kg mol^{-1}.

Answer:

The vapour pressure above pure H_2O is 23.76 mmHg at 25 ºC and 1 atm. Calculate the vapour pressure above this seawater under the same conditions.

Answer:

The desalination of seawater by reverse osmosis has been suggested as a way of alleviating water shortages in Sydney. What pressure (in Pa) would need to be applied to this seawater in order to force it through a semi-permeable membrane, yielding pure H_2O?

Answer:

Marks 4

- Oral rehydration therapy (ORT) is a simple low-cost treatment that replaces fluid and electrolytes lost by sufferers of diarrhoea. To make the solution for ORT, 3.5 g NaCl, 2.9 g sodium citrate (which contains 1 citrate^{3-} and 3 Na^+ ions and has a molar mass of 258 g mol^{-1}), 1.5 g KCl and 20.0 g glucose ($C_6H_{12}O_6$) are dissolved in water to make 1.0 L of solution. What is the osmotic pressure (in mmHg) of this solution at body temperature (37 °C)?

Answer:

This pressure is about the same as the osmotic pressure of blood. The calorie content of the solution can be increased by adding either more glucose or a polymer of glucose. Which would be preferable? Give a brief reason.

- Ethylene glycol antifreeze, $C_2H_6O_2$, (1.00 kg) is added to a car radiator that contains 5.00 kg of water. What is the freezing point of the solution obtained?
  Data: The molal freezing point depression constant for water $K_f = 1.86$ °C kg mol^{-1}.

3

Marks

- A specific variety of haemoglobin associated with heart disease was isolated from a blood sample. A sample of this haemoglobin (21.5 mg) is dissolved in water at 25 °C to make 1.50 mL of solution. The osmotic pressure of the solution was measured and found to be 3.61 mmHg. What is the molar mass of this particular type of haemoglobin?

4

Answer:

- Calcium oxalate (CaC_2O_4) is only slightly soluble in water (5.73 mg L^{-1} at 25 °C) and can be deposited in renal calculi (kidney stones). What is the molar solubility of calcium oxalate?

3

Answer:

Calculate the solubility product constant (K_{sp}) of calcium oxalate at 25 °C.

K_{sp} =