**ANSWERS: Fractional Distillation**

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| **2017** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| (a) (i)  (ii) | Crude oil consists of a mixture of hydrocarbon molecules of different sizes, which must be distilled to separate into useful fractions, since the fractions have different uses.  Hydrocarbons of different molecular masses have different boiling points. Smaller molecules have a smaller mass and therefore weaker intermolecular forces between molecules and hence lower boiling points. When the heated crude oil vapour enters the tower, the smaller hydrocarbons with the lower boiling points condense into liquids higher up in the tower where it is cooler, or remain as gases, and exit from the top of the tower. | • Describes crude oil as a mixture of different hydrocarbons.  • Recognises the separation of the (lighter and heavier) fractions depends on differences in the boiling points  **OR**  smaller hydrocarbons have a low boiling point  **OR**  top of the tower is cooler / bottom of tower is hotter. | • Explains that the crude oil must be separated into its fractions (different  hydrocarbons) to allow the  fractions to be useful.  • Links the small size of the hydrocarbon to its boiling point and where the fraction collects in the tower | • Links the small size of the hydrocarbon to the size of the intermolecular forces, the boiling point and where the fraction is collected in the tower. |

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| **2016** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| (a)  (b)(i)  (ii) | LPG / propane / butane / methane / petroleum gas / CNG – heating / cooking / fuel / transport  Octane / petrol – fuel / transport  Paraffin – heat / light  Naphtha – chemicals  Diesel – fuel / transport  Jet fuel / kerosene – camp fuels / cooking / solvent / aeroplanes / transport  Lubricating oils – engines / waxes / polishing  Heavy oils – fuels / ships / transport  Bitumen / tar – roads / roofs.  Crude oil consists of a mixture of hydrocarbon molecules of different sizes, which need to be distilled in order to separate into useful fractions, since the fractions have different uses.  A tower is used because the crude oil is heated and the hot particles rise.  Hydrocarbons of different molecular masses have different boiling points. Larger molecules have higher boiling points. When the heated crude oil vapour enters the tower, the larger, heavier hydrocarbons with the higher boiling points condense into liquids lower down in the tower, while the smaller, lighter hydrocarbons with the lower boiling points rise up the tower and condense back into a liquid at the lower temperatures near the top of the tower. The smallest hydrocarbons (C1 – C4) remain gases at room temperature, and exit from the top of the tower. This allows the fractions to be separated.  The temperature at which a specific hydrocarbon condenses is related to its molecular mass, particularly the number of carbon atoms. The lower / higher its molecular mass is, the lower / higher the temperature at which it will condense. This determines whereabouts on the tower the particular fraction is collected. | * Lists TWO fractions and describes a use. * Describes crude oil as a mixture of different hydrocarbons or alkanes / needing to be separated into parts. * The separation of the (lighter and heavier) fractions depends on differences in the boiling points. | * Explains that the crude oil needs to be separated into fractions of different length / sized hydrocarbons / alkanes for the fractions to be useful. * Links the size of the hydrocarbon to where the fraction collects in the tower OR to its boiling point. | * Links the process of fractional distillation (heating, condensing, separating) to the size of the molecules, the temperature at which they change state, and their position of collection in the tower. |

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