**Combustion topic test solutions**

**SECTION A: Multiple-choice questions (1 mark each)**

**Question 1**

*Answer:* A

*Explanation:*

4 mol releases 130 kJ => 0.2 mol releases 130 x 0.2/4 = 6.5 kJ

**Question 2**

*Answer:* D

*Explanation:*

n(O2) = ¾ n(Al) = 3x 0.2/ 4 = 0.15 mol

V = 0.15 x 24.8 = 3.72 L

**Question 3**

*Answer:* B

*Explanation:*

n(Al required) = 4/3n(O2) = 4/3 x 0.24 = 0.32 mol => 0.36-0.32mol Al remains = 0.04 mol

**Question 4**

*Answer:* B

*Explanation:*

Exact definition of specific heat capacity

**Question 5**

*Answer:* C

*Explanation:*

4.18 x 80 x ΔT = 8000 => ΔT = 23.9 ºC. Final temp = 15 + 23.9 = 39 ºC

**Question 6**

*Answer:* D

*Explanation:*

n(ethanol) = 4.6/46 = 0.1 mol

n(CO2) = 0.2 mol

V= 0.2 x 24.8 = 4.96 L

**Question 7**

*Answer:* C

*Explanation:*

Option A = 10/24.8 x 282 = 114 kJ

Option B = 10/24.8 x 890 = 358 kJ

Option D definitely lower than option C

Option C = 15 x 47.9 = 719 kJ

**Question 8**

*Answer:* B

*Explanation:*

The Data book confirms the higher enthalpy of methane. Both fuels form the same number of mole of CO2.

**Question 9**

*Answer:* A

*Explanation:*

Energy g-1= 4.18 x 600 x 6/2.5 = 6020 kJ g-1

**Question 10**

*Answer:* C

*Explanation:*

Mass = 1 x 16/37 = 0.43 g

**SECTION B: Short-answer questions**

**Question 1**

**a. i**. 2CH3OH(l) + 3O2(g) 🡪 2CO2(g) + 2H2O(g) 1 mark

  **ii**. ∆*H* = -1450 kJ  2 marks

**b**. **i**. CH3OH(l) + O2(g) 🡪 CO(g) + 2H2O(g) 1 mark

 **ii**. *n*(methanol) =  = 7.81 mol 3 marks

  *V*(CO) = 7.81 x 24.8 = 194 L

**Question 2** (8 marks)

**a**.  **i.** energy = 80.8× 47.9 = 3870 kJ 1 mark

 **ii**. n(octane) = $\frac{80.8}{114}$ = 0.709 mol n(CO2) = 0.709 × 8 = 5.67 mol

 mass = 5.67 × 44 = 249 g 3 marks

 **iii**. V = n x 24.8 = 5.67 x 24.8 = 141 L 2 marks

**b**. mass = 1000/47.9 = 20.9 mol 2 marks

**Question 3** (6 marks)

**a**. 40 L of ethane is reacted with 84 L of oxygen gas. (Conditions are held constant)

 **i**. 48 L (O2 scarce) 1 mark

 **ii**. 72 L 1 mark

 **iii**. 40 – 24 = 16 L ethane 1 mark

**b**. n(ethane) = 0.28 ×2/7 = 0.08 mol V = 0.08× 24.8 = 1.98 L 2 marks

**c**. 2C2H6(g) + 5O2(g) 🡪 4CO(g) + 6H2O(g)

 1 mark

**Question 4**

**a**. C2H5OH(l) + 3O2(g) 🡪 2CO2(g) + 3H2O(g) 1 mark

**b**. i. mass of ethanol = 1.7 g

 *n*(ethanol) =  = 0.037 mol

 *E* = 0.037 × 1364 = 50.4 kJ

 *E* = 4.18 × 200 ×∆*T* = 50400 2 marks

 **ii**. ∆*T* = 60.3 0C

 Final temp = 65.9 0C 2 marks

 **iii**. It will be lower as there will be significant heat losses heating an open glass beaker. 1 mark

**c**. **i**. this will be unchanged as the mass of ethanol is unchanged 1 mark

 **ii**. this will be almost double the temperature increase as the specific heat capacity of oil is

 much less than water. 1 mark

**d**. *n*(methanol) =  = 0.053 mol

 *E* = 0.053 × 725 = 38500 J 2 marks

**e**. **i**. *V*(CO2) = 1 ×24.5 = 24.5 L

 **ii**. *V*(CO2) = 2 ×24.5 = 49.0 L 2 marks

**Question 5** (8 marks)

**a**. CF = energy/ΔT Energy = 5/80 = 0.0625 mol 3 marks

 = 0.0625 x 54000/4.2 = 3375/4.2 = 804 J 0C-1

**b**. Energy = CF x ΔT = 804 x 5.4 = 4340 J

 n(sodium) = 1/23 = 0.0434 mol

 Energy/mole = 4340/0.0434 = 100 kJ mol-1 2 marks

**c**. Record the temperature of the water in the can. Weigh a sample of biscuit. Burn the sample and record the temperature change. Use the heat of combustion figure for the biscuit and determine the theoretical temperature change.

The % efficiency will be = actual temp change x 100

 theoretical temperature change 3 marks