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Please take note of the mark allocation and time to complete the questions

Total: 30 marks Time allocation: 30 minutes

QUESTION 1 – 15 minutes

(taken from the DoE – exemplar 2008)

Alcohols are used in a variety of chemical reactions and as preservatives in certain medicines. All alcohols are toxic. Although **ethanol** is the least toxic of all alcohols, it is still a poisonous substance. It is rapidly absorbed into the blood. High blood alcohol levels can cause brain poisoning. The body can reduce high blood alcohol levels by oxidising the alcohol. Contrary to what people believe, alcohol is a depressant and not a stimulant.

The following table indicates the effects of various blood alcohol levels:

The effects of blood alcohol levels	
% per volume	Effect
0,005 – 0,15	Loss of coordination
0,15 – 0,20	Severe intoxication
0,20 – 0,40	Loss of consciousness
0,50	Death

The liver enzyme, ADH, catalyses the oxidation of ethanol to **ethanal** and then to non-toxic **ethanoic acid**. The liver is able to remove only 28 grams of pure alcohol per hour.

- 1.1 Write down the NAMES of the homologous series to which the compounds ethanal and ethanoic acid respectively belong. (2)
- 1.2 Write down the structural formula of ethanal. (2)
- 1.3 Alcohols are prepared by the **hydration** of alkenes. Use structural formulae to write down the equation which represents the formation of ethanol. (4)
- 1.4 The warning on the labels of certain medicines reads as follows:
The effect of this medicine is aggravated by the simultaneous intake of alcohol.
 Use the information in the passage above to justify this warning. (4)

[12]

QUESTION 2 – 15 minutes

The first six members of the alkanes occur as gases and liquids at normal temperatures. Alkanes are currently our most important fuels, but the use of alcohols as renewable energy source is becoming more and more important. Alcohols are liquids that might be a solution to the energy crisis.

2.1 Which chemical property of alkanes and alcohols make them suitable to be used as fuels? (2)

2.2 The table shows the boiling points of the first six alkanes and the first six alcohols.

Alkane	Boiling point (°C)	Alcohol	Boiling point (°C)
methane	- 164	methanol	65
ethane	- 89	ethanol	79
propane	- 42	1-propanol	97
butane	- 0,5	1-butanol	117
pentane	36	1-pentanol	138
hexane	69	1-hexanol	156

Draw a graph of boiling points versus number of carbon atoms for the first six ALCOHOLS. Choose 50 °C and 1 carbon atom as origin and use an appropriate scale. Plot the points and draw the best curve through the points. (6)

2.3 What trend in boiling point can be observed from the graph? (2)

2.4 Provide a reason for the trend mentioned in QUESTION 6.3 by referring to the type of intermolecular forces. (2)

2.5 Explain, referring to the type of intermolecular forces, why the boiling points of alcohols are higher than the boiling points of alkanes. (2)

2.6 People are always cautioned to keep liquids such as petrol (a mixture of alkanes) out of reach of children. Use the boiling points of alkanes and justify this precaution. (2)

2.7 Briefly explain why ethanol is a renewable energy source, while the alkanes are non-renewable. (2)
[18]

SOLUTIONS: SESSION 6

QUESTION 1

1.1

$v_i = ?$ Take downwards as the positive direction / upwards is negative ✓

$$\begin{aligned} v_f &= 0 \\ g &= 9,8 \text{ m}\cdot\text{s}^{-2} \\ \Delta y &= -15 \text{ m} \end{aligned}$$

$$\begin{aligned} v_f^2 &= v_i^2 + 2a\Delta y \quad \checkmark \\ 0^2 &= v_i^2 + 2(9,8)(-15) \quad \checkmark \quad \checkmark \\ \therefore v_i &= -17,15 \text{ m}\cdot\text{s}^{-1} = 17,15 \text{ m}\cdot\text{s}^{-1} \quad \checkmark \end{aligned} \quad (6)$$

1.2

$$\begin{aligned} \Delta x &= 95 \text{ m} \\ g &= 9,8 \text{ m}\cdot\text{s}^{-2} \\ v_i &= -17,15 \text{ m}\cdot\text{s}^{-1} \\ \Delta t &= ? \end{aligned}$$

$$\begin{aligned} \Delta y &= v_i \Delta t + \frac{1}{2} g \Delta t^2 \quad \checkmark \\ 80 \checkmark &= (-17,15) \Delta t \checkmark + \frac{1}{2} (9,8) \Delta t^2 \quad \checkmark \\ 4,9 \Delta t^2 - 17,15 \Delta t - 80 &= 0 \\ \Delta t &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\ &= \frac{17,15 + \sqrt{17,15^2 - 4 \times 4,9 \times -80}}{9,8} = 6,15 \text{ s} \quad \checkmark \end{aligned}$$

AB

$$\begin{aligned} v_f &= -17,15 \text{ s} \\ v_i &= 0 \\ a &= 9,8 \text{ m}\cdot\text{s}^{-2} \\ \Delta y &= ?? \\ \Delta t &= ?? \\ v_f &= v_i + a\Delta t \\ 0 &= (-17,15) + (9,8)\Delta t \\ \Delta t &= 1,75 \text{ s} \end{aligned}$$

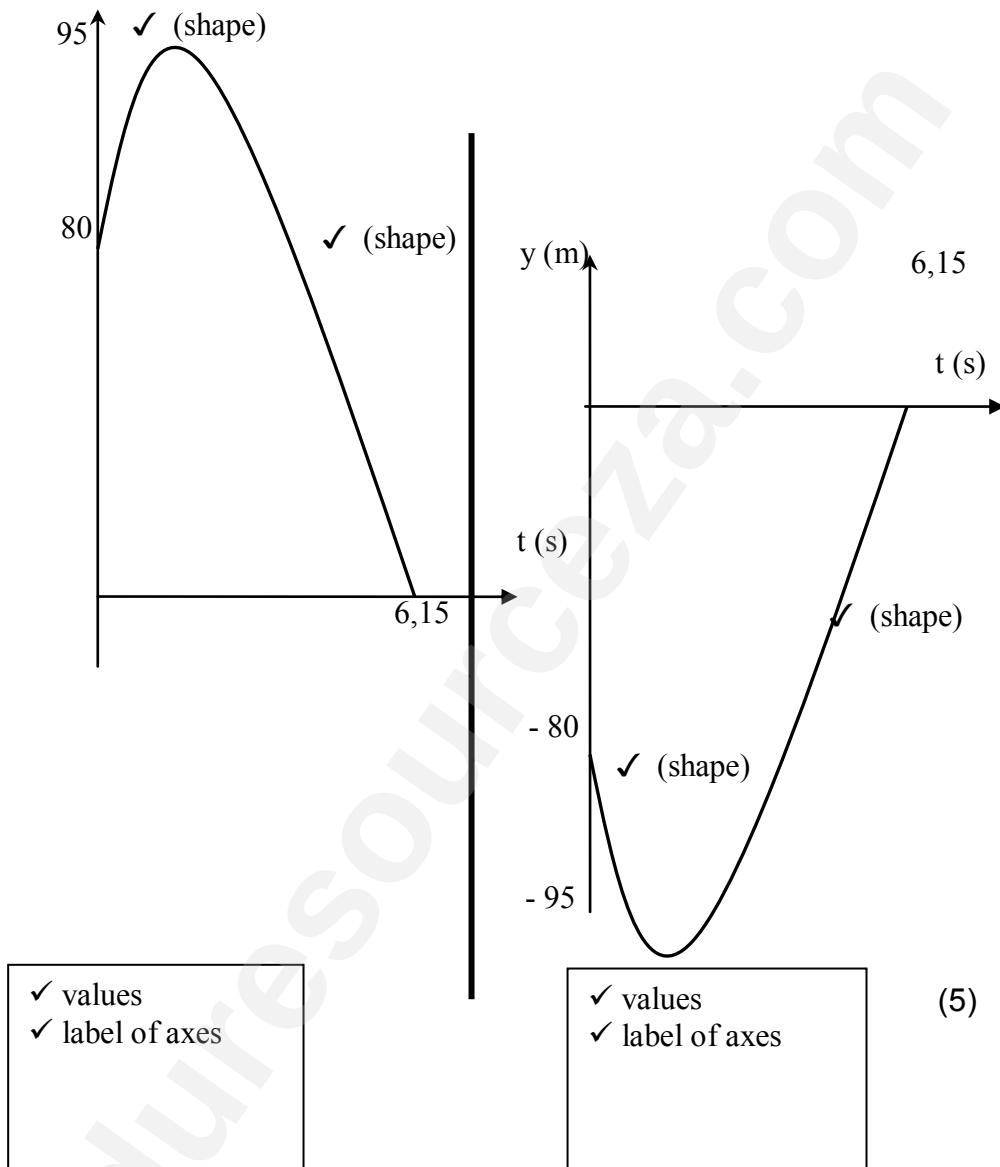
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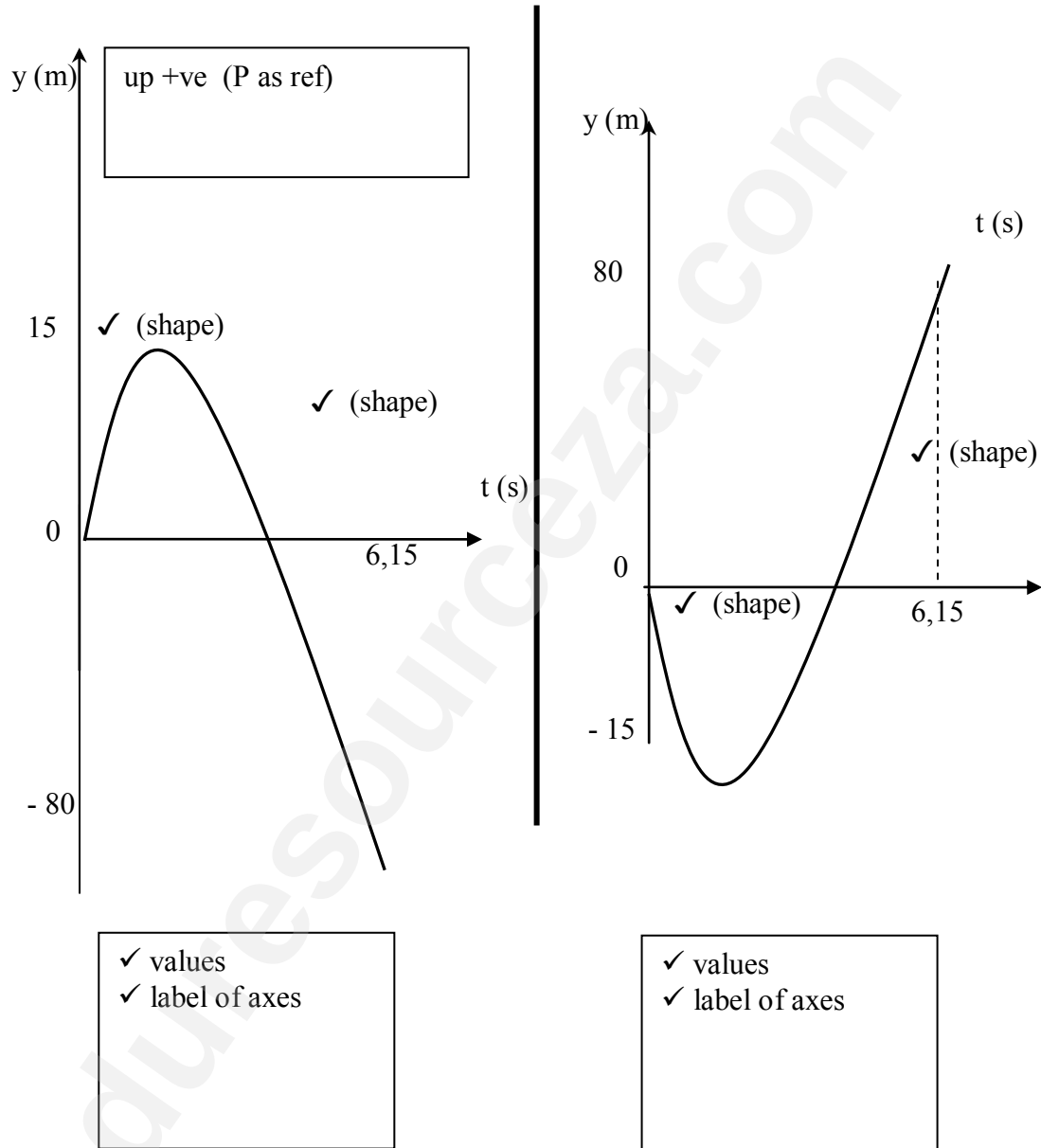
$$\begin{aligned} v_f &= 0 \\ v_i &= \\ a &= 9,8 \text{ m}\cdot\text{s}^{-1} \\ \Delta y &= 95 \text{ m} \\ \Delta t &= ?? \\ \Delta y &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \\ 95 &= 0 + \frac{1}{2} (9,8) \Delta t^2 \\ \Delta t &= 4,40 \text{ s} \\ \therefore t_{\text{total}} &= 1,75 + 4,40 = 6,15 \text{ s} \quad \checkmark \end{aligned}$$

1.3

y (m) up +ve (grd as ref)

down +ve (grd as ref)





[16]

QUESTION 2

2.1 $8 \text{ m} \cdot \text{s}^{-1}$ ✓ (1)

2.2 $v_f^2 = v_i^2 + 2a\Delta y$ ✓
 $\Delta y = \frac{0^2 + \cancel{8^2}}{2 \cdot \cancel{0.8}} = 3.27 \text{ m}$ ✓ (4)

[5]

QUESTION 3

3.1 For complete motion of stone

Upward motion negative

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark \therefore 88 \checkmark = v_i(6) \checkmark + \frac{1}{2} (9,8)(6)^2 \checkmark$$

$$v_i = -14,7 \text{ m}\cdot\text{s}^{-1} \therefore 14,7 \text{ m}\cdot\text{s}^{-1} \text{ upwards } \checkmark$$

$$v_{\text{balloon}} = v_{\text{stone}} \checkmark = 14,7 \text{ m}\cdot\text{s}^{-1}$$

OR

For complete motion of stone

Downward motion negative

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark \therefore -88 \checkmark = v_i(6) \checkmark + \frac{1}{2} (-9,8)(6)^2 \checkmark$$

$$v_i = 14,7 \text{ m}\cdot\text{s}^{-1} \therefore 14,7 \text{ m}\cdot\text{s}^{-1} \text{ upwards } \checkmark$$

$$v_{\text{balloon}} = v_{\text{stone}} \checkmark = 14,7 \text{ m}\cdot\text{s}^{-1}$$

OR

Consider upward motion only

Upward motion negative

$$v_f = v_i + g \Delta t \quad \checkmark \therefore 0 \checkmark = v_i + (9,8)(1,5) \checkmark$$

$$\therefore v_i = -14,7 \text{ m}\cdot\text{s}^{-1} \therefore 14,7 \text{ m}\cdot\text{s}^{-1} \checkmark \text{ upwards } \checkmark$$

$$v_{\text{balloon}} = v_{\text{stone}} \checkmark = 14,7 \text{ m}\cdot\text{s}^{-1}$$

OR

Consider upward motion only

Downward motion negative

$$v_f = v_i + g\Delta t \checkmark \therefore 0 \checkmark = v_i + (-9,8)(1,5) \checkmark$$

$$\therefore v_i = 14,7 \text{ m}\cdot\text{s}^{-1} \therefore 14,7 \text{ m}\cdot\text{s}^{-1} \checkmark \text{upwards} \checkmark$$

$$v_{\text{balloon}} = v_{\text{stone}} \checkmark = 14,7 \text{ m}\cdot\text{s}^{-1}$$

OR

Consider upward motion only

Upward motion negative

$$v_f^2 = v_i^2 + 2g\Delta y \checkmark \therefore 0^2 \checkmark = v_i^2 + 2(-9,8)(99 - 88) \checkmark$$

$$\therefore v_i = -14,7 \text{ m}\cdot\text{s}^{-1} \therefore 14,7 \text{ m}\cdot\text{s}^{-1} \checkmark \text{upwards} \checkmark$$

$$v_{\text{balloon}} = v_{\text{stone}} \checkmark = 14,7 \text{ m}\cdot\text{s}^{-1}$$

(6)

OR

Consider upward motion only

Downward motion negative

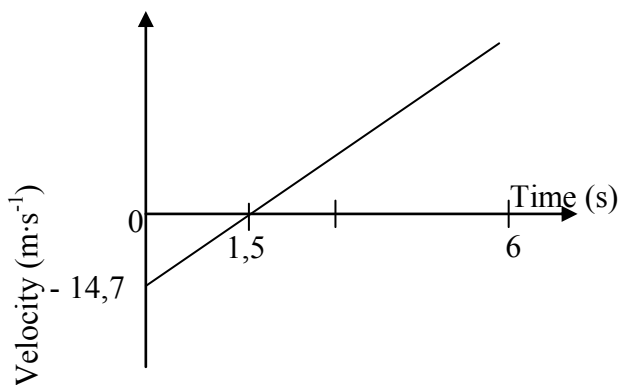
$$v_f^2 = v_i^2 + 2g\Delta y \checkmark \therefore 0^2 \checkmark = v_i^2 + 2(-9,8)(99 - 88) \checkmark$$

$$\therefore v_i = -14,7 \text{ m}\cdot\text{s}^{-1} \therefore 14,7 \text{ m}\cdot\text{s}^{-1} \checkmark \text{upwards} \checkmark$$

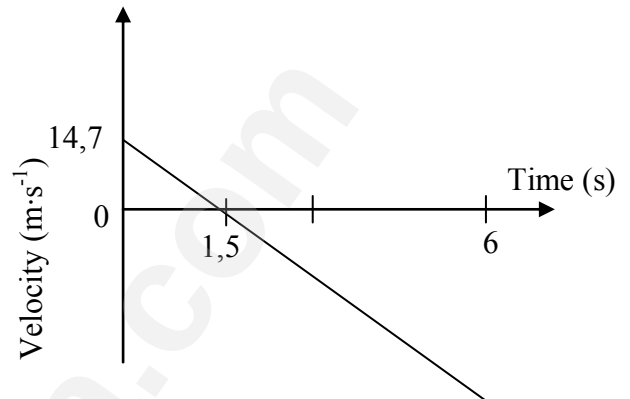
$$v_{\text{balloon}} = v_{\text{stone}} \checkmark = 14,7 \text{ m}\cdot\text{s}^{-1}$$

3.2

Upward motion as negative:



Downward motion as negative:



Checklist	Marks
Criteria for graph	
Graph is a straight line that intercepts x-axis at 1,5 s	✓
Maximum velocity after 6 s	✓
Initial velocity indicated as 14,7 m·s ⁻¹	✓

(3)
[9]