

2001**Question 28 — Organic Geology – A Non-renewable Resource (25 marks)**

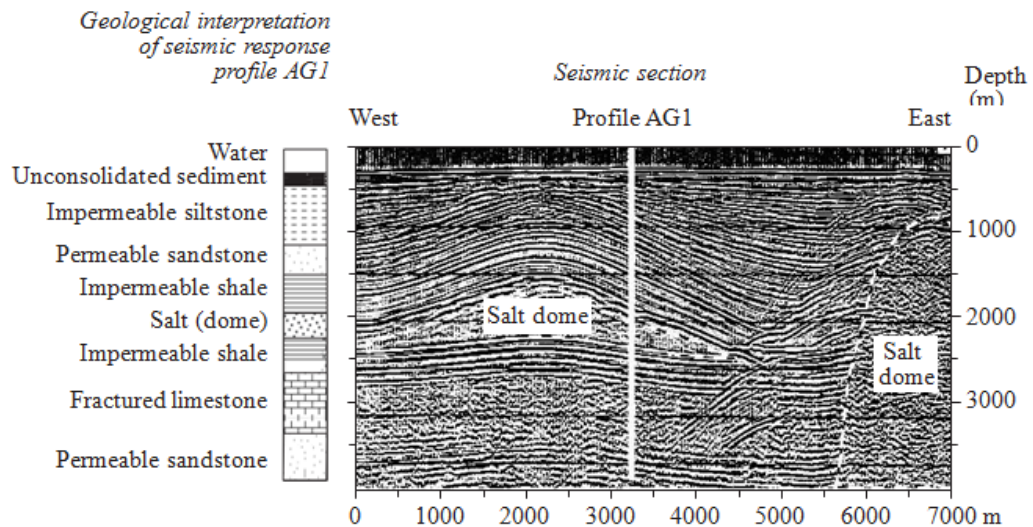
- (a) (i) Identify ONE property of coal that changes with increasing coal rank. **1**
- (ii) Coal mined from a coal seam contains mineral matter and organic material. Describe how the organic material is extracted from the coal. **2**
- (b) In your study of Organic Geology – A Non-renewable Resource, you have undertaken first-hand investigations of the combustion of fossil fuels.
- (i) Outline a procedure that could be used to distinguish between the products of complete and incomplete combustion of a fossil fuel. **2**
- (ii) Explain ONE effect on the environment resulting from the incomplete combustion of fossil fuels. **2**
- (c) The table provides data on different sources of electricity generation for a country, and the price per megawatt-hour (MWh). **4**

Amount of power commercially generated (MW)					
<i>Year</i>	<i>Solar</i>	<i>Hydroelectric</i>	<i>Nuclear</i>	<i>Coal</i>	<i>Total</i>
1970	2	183	125	1890	2200
1980	9	453	415	2223	3100
1990	24	579	709	2651	3963
2000	48	651	450	2871	4020
2010*	331	904	149	2662	4046
Price per MWh (\$) (includes capital costs)					
<i>Year</i>	<i>Solar</i>	<i>Hydroelectric</i>	<i>Nuclear</i>	<i>Coal</i>	
1970	62	32	28	24	
1980	58	32	29	20	
1990	48	32	30	17	
2000	40	31	30	20	
2010*	28	31	32	21	

* Projected values

Analyse the main trends shown in the data.

- (d) As part of an exploration program for petroleum on Australia's North West Shelf, a series of seismic sections has been collected. One of these sections and a geological interpretation of the vertical profile AG1 are shown.



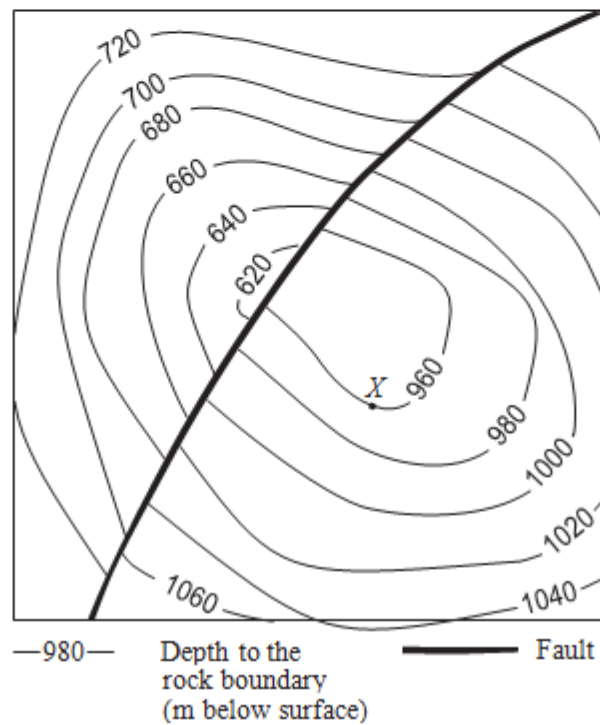
- (i) Explain why there are dark lines on the section. 2
- (ii) Propose a location for a vertical drill hole that could be used to test geological structures for potential petroleum accumulations. Justify the location of that drill hole. 4
- (e) Analyse the environmental factors that control the accumulation, preservation and maturation of organic material in coal formation. 8

2002

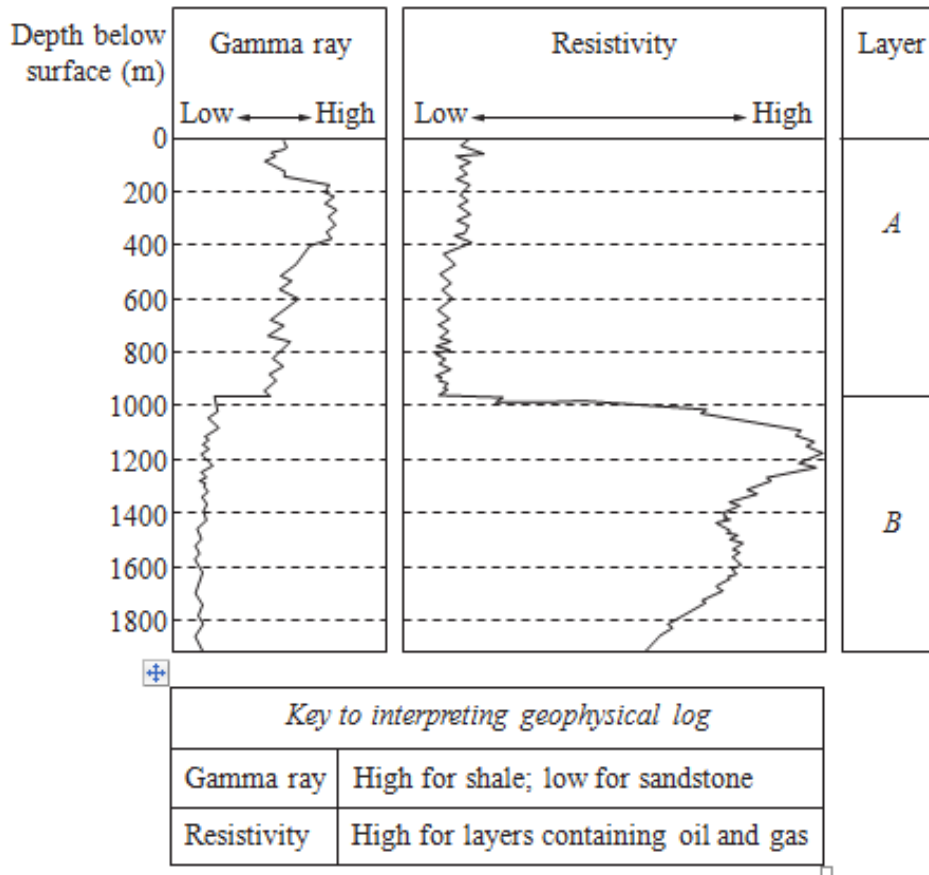
Marks

Question 28 — Organic Geology – A Non-renewable Resource (25 marks)

- (a) (i) Identify ONE alternative to fossil fuels for electricity generation. **1**
- (ii) Describe how ONE aspect of architectural design could result in a reduction in energy consumption. **2**
- (b) In your study of Organic Geology you carried out an investigation in which you compared the properties and uses of a variety of commonly used resources.
- (i) Describe the method you used in your investigation. **2**
- (ii) Justify ONE conclusion based on your results. **2**
- (c) Compare the characteristics of coal-forming environments with petroleum-forming environments. **5**
- (d) The map shows the depth from the surface of a flat-lying area to the boundary between rock layers *A* and *B*.



The graph shows a geophysical log with information about the rocks below point *X* on the map.

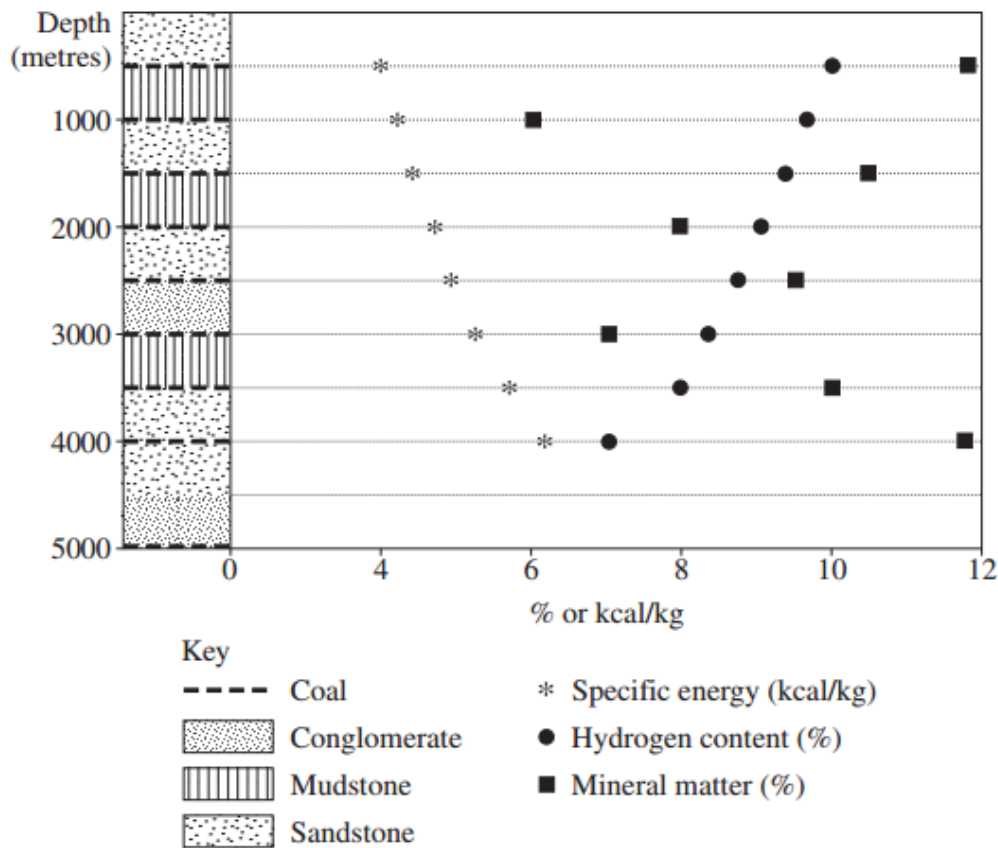


- (i) Using the geophysical log, describe the features of the layers *A* and *B* in terms of their potential as cap or reservoir rocks for petroleum. 2
 - (ii) Using information from the map and the geophysical log, analyse the potential of the area for a petroleum-producing well. 4
- (e) Assess the likely short-term and long-term effects on society of eliminating all sources of fossil fuels. 7

2003**Question 28- Organic Geology – A Non – renewable Resource (25 marks)**

- (a) (i) Identify ONE renewable and ONE non-renewable energy resource. **1**
- (ii) Choose ONE of the resources identified above and describe TWO impacts that its use would have on the Australian environment. **2**
- (b) In your study of Organic Geology you carried out a first-hand investigation to identify a variety of fossil fuels and compare their properties.
- (i) Summarise the results of your investigation for TWO of these fossil fuels. **2**
- (ii) Describe how your investigation was designed to ensure the data you collected were both valid and reliable. **2**
- (c) Assess the relative importance and potential of TWO alternative energy sources. **5**

- (d) The graph shows the geological log for a drill-hole that intersected nine coal seams. The upper eight coal seams were analysed, and the values for some of their properties are shown.



- (i) Describe TWO trends shown by the graph. 2
- (ii) Account for ONE of these trends. 2
- (iii) Predict the approximate values for specific energy and hydrogen content for coal intersected at 5000 m in this drill-hole. Account for your prediction. 2
- (e) Before locating and developing a fossil fuel resource, a detailed study should be undertaken. This study should include: 7
- 1 An exploration program
 - 2 Determining the geology of the deposit
 - 3 Determining the uses of the resource
 - 4 Consideration of the environmental issues.

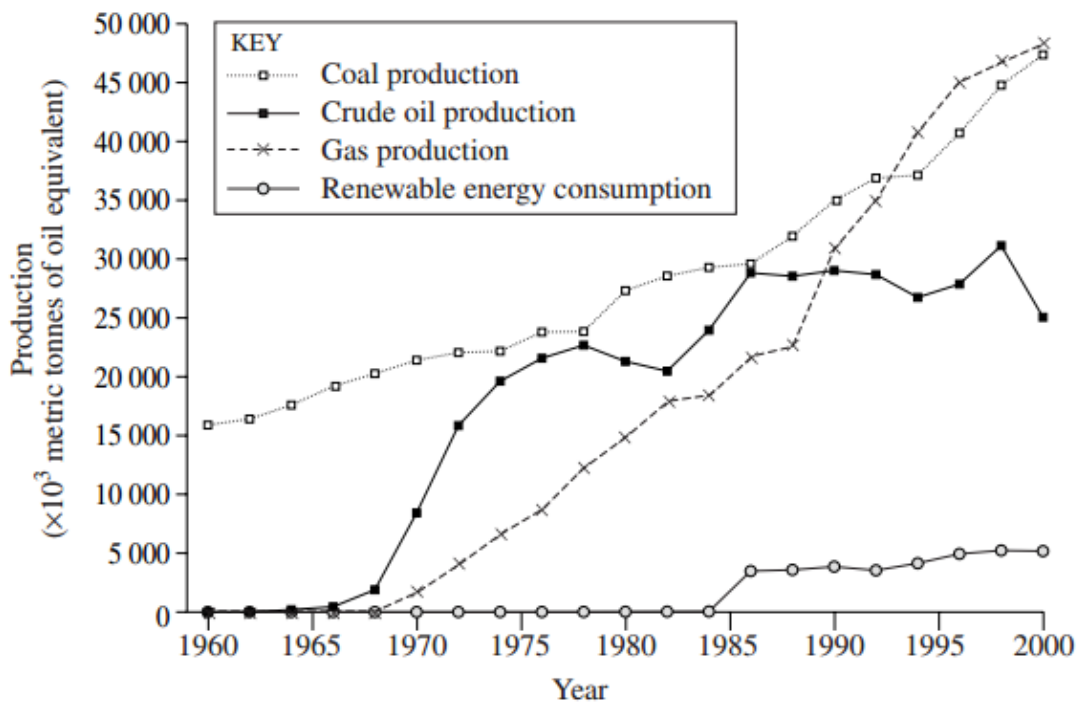
Justify why each of these factors has to be included in the study.

2004

Marks

Question 28 — Organic Geology – A Non-renewable Resource (25 marks)

- (a) (i) Identify TWO properties of coal that change with increasing rank. 2
- (ii) Describe how coal forms in a sedimentary basin. 2
- (b) The graph shows the production of coal, crude oil, gas and the consumption of renewable energy in Australia from 1960 to 2000.



- (i) Describe the trends shown for crude oil production and renewable energy consumption. 2
- (ii) Account for the trend shown for crude oil production. 2
- (iii) Outline the environmental concerns that could have contributed to the trend shown for renewable energy consumption. 2

- (c) Based on the environment of formation and geological features of EITHER coal deposits OR oil accumulations, recommend appropriate exploration methods to locate new deposits. **7**
- (d) In your study of Organic Geology – A Non-renewable Resource you performed a first-hand investigation to test the energy efficiency of various non-fossil fuel alternative energy sources.
- (i) Outline TWO methods that you used to gather data. **2**
 - (ii) Explain the steps that you took to minimise risk from potential hazards during your investigation. **2**
 - (iii) Justify how the plan that you developed for this investigation allowed you to make conclusions about the energy efficiency of various non-fossil fuel alternative energy sources. **4**

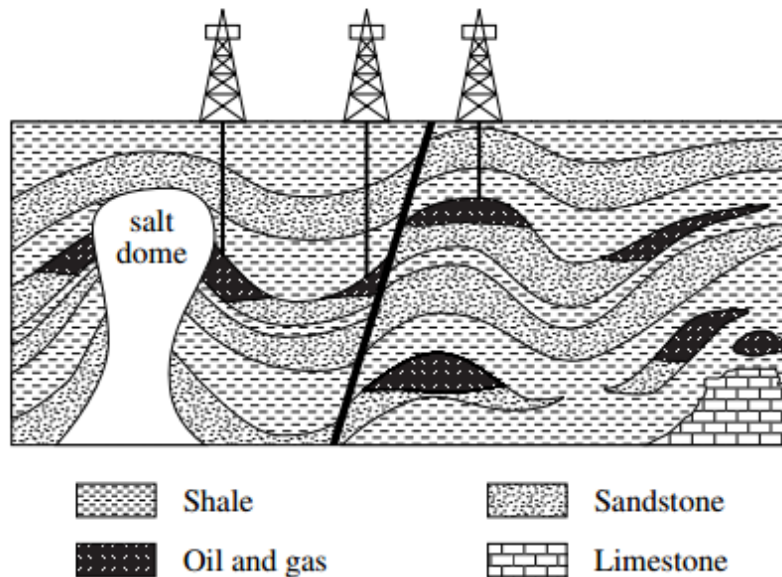
2005**Question 28- Organic Geology – a Non – renewable Resource (25 marks)**

- (a) In your study of this option you carried out an investigation to distinguish between the products of complete and incomplete combustion.
- (i) Describe ONE appropriate method you used to present the data you gathered. **2**
- (ii) Justify whether this investigation was best undertaken individually or by a team. **2**
- (b) Examine the data table of coal characteristics.

<i>Coal rank</i>	<i>Carbon (%)</i>	<i>Specific energy (MJ kg⁻¹)</i>	<i>In-situ moisture (%)</i>	<i>Volatile material (%)</i>
(Peat)	60	14.7	75	65
Brown	71	23.0	30	52
Sub-bituminous	80	33.5	5	40
High volatile bituminous	86	35.6	3	31
Medium volatile bituminous	90	36.0	1	22
Low volatile bituminous	91	36.4	<1	14
Semi-anthracite	92	36.0	<1	8
Anthracite	95	35.2	<1	2

- (i) On the graph paper provided on page 33, draw a graph to show the effect of changing coal rank on carbon content and volatile material. **4**
- (ii) Propose a reason for the trends in carbon content and volatile material with coal rank. **2**
- (c) Assess the effectiveness of strategies that are currently being used to reduce the environmental impacts of burning fossil fuels. **7**

(d)



- (i) Explain the formation of TWO major geological traps for petroleum indicated in the diagram. **3**
- (ii) Predict the ancient geological setting most likely to have generated large petroleum accumulations. **3**
- (iii) Describe the process by which petroleum is refined into fuel for use in motor vehicles. **2**

2006**Question 28- Organic geology – A non-renewable resource (25 marks)**

- (a) In this option you have gathered and analysed material from secondary sources to outline the methods and technologies used to locate fossil fuel reserves.
- (i) Outline the process by which you gathered relevant information, identifying sources that you used. **2**
- (ii) Describe how you were able to assess the reliability of the information from these sources. **3**
- (b) (i) Construct a flow-diagram to outline the refining of petroleum, including distillation and catalytic cracking. **3**

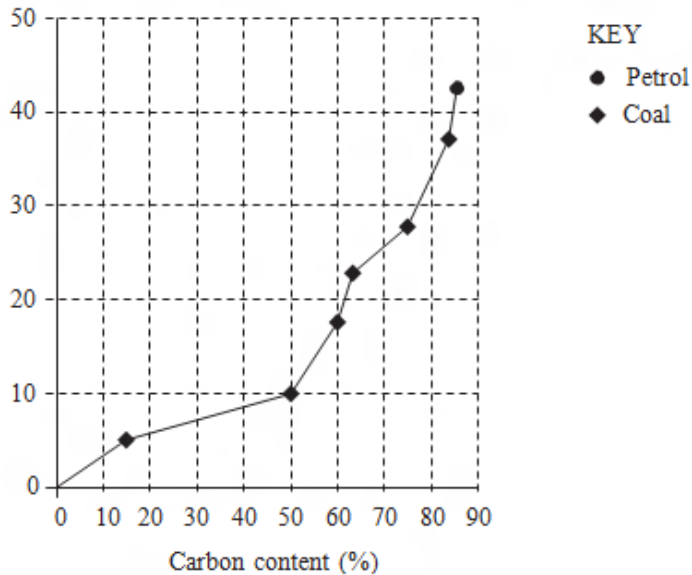
- (ii) The table shows the prices of oil and coal, and the amounts used for electricity generation in an industrial country between 1970 and 2005.

Year	Price of crude oil (\$/barrel)	Price of coal (\$/tonne)	Relative consumption of fossil fuel for electricity generation	
			Oil	Coal
1970	3	5	2.1	7
1975	10	11	3.9	8
1980	25	24	4.2	11
1985	28	33	2.5	14
1990	17	27	2.8	16
1995	17	26	2.7	18
2000	25	24	0.9	21
2005	65	22	0.4	30

- (1) What is meant by the term *fossil fuel*? 1
- (2) Using data from the table, explain the trends in the use of oil versus coal in electricity generation. 2
- (c) Evaluate the continued use of fossil fuels in Australia. 7
- (d) (i) Identify the difference between diagenesis and catagenesis in the maturation of petroleum. 1
- (ii) Explain how petroleum accumulates. 2
- (iii) Assess methods for conserving energy. 4

2007**Question 29- Organic geology – A non renewable resource (25 marks)**

- (a) (i) Identify TWO renewable resources as alternatives to fossil fuels. **1**
- (ii) Outline the future potential of ONE of these renewable resources. **2**
- (b) The graph shows the energy yield and carbon content for petrol and several types of coal.



- (i) Explain the trend in energy yield of coal relative to carbon content. **2**
- (ii) Describe TWO advantages that petrol has over coal as a transport fuel. **2**
- (c) In your study of this option, you performed a first-hand investigation to test the energy efficiency of several non-fossil fuels.
- (i) State a suitable hypothesis for your investigation. **1**
- (ii) Outline a simple procedure that tested this hypothesis. **2**
- (iii) Explain ONE safe work practice that was used during the investigation. **2**
- (d) Evaluate methods for conserving energy through architectural design for the benefit of the individual and the environment. **6**

- (e) The temperature and rock density at the bottom of twelve boreholes in an oil field were measured.

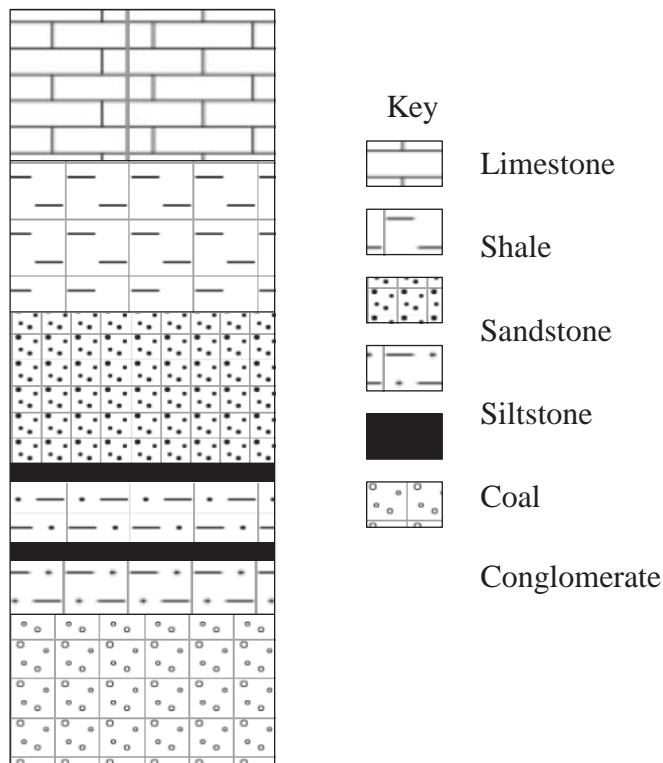
<i>Depth</i> (m)	95	600	900	1350	1776	2079	2637	2910	3389	4120	4607	4950
<i>Temperature</i> (°C)	4	18	23	32	41	47	54	73	76	100	116	120
<i>Rock density</i> (g/cm ³)	2.3	2.4	2.5	2.6	2.7	2.7	2.7	2.8	2.9	2.9	3.1	3.1

- (i) Detach the graph paper on page 33. Plot BOTH the temperature and rock density against depth. **4**
- (ii) State the relationship between temperature and depth. **1**
- (iii) Outline how temperature and rock density influence oil migration. **2**

2008

Question 28- Organic geology – A non renewable resource (25 marks)

- (a) (i) Identify ONE petroleum producing area. **1**
- (ii) Name ONE component of coal that increases as rank increases. **1**
- (iii) Define the term *fossil fuel*. **1**
- (iv) What is meant by the term *non-renewable*? **1**
- (v) Give ONE condition that is common to the formation of both coal and petroleum. **1**
- (b) Compare TWO exploration methods used to locate coal and oil. **3**
- (c) Using information in the stratigraphic column shown, construct in your writing booklet a fully labelled geological cross-section showing a structure where oil, gas and water would accumulate. **4**



- (d) (i) Identify TWO products generated by complete combustion of a fossil fuel. **1**
- (ii) Describe an appropriate procedure to distinguish between the products of incomplete and complete combustion of a fossil fuel. **3**
- (iii) How could you assess the reliability of data obtained? **2**
- (e) Analyse the effects of replacing electricity generated by fossil fuels with electricity generated from alternative sources. **7**

2009

Question 28- Organic geology – A non renewable resource (25 marks)

- (a) (i) Name ONE coal-producing locality. **1**
- (ii) What is the element that is the most abundant by mass in fossil fuels? **1**
- (iii) What property of crude oil allows it to be separated into its various fractions during distillation? **1**
- (iv) Identify ONE product of burning fossil fuels that is not a gas. **1**

- (b) The table shows world energy usage in terawatts (TW = 10^{12} watts) from 1965 to 2005, and gives projected world energy usage for 2025 and 2055.



<i>Year</i>	<i>Oil (TW)</i>	<i>Coal (TW)</i>	<i>Gas (TW)</i>	<i>Other Energy Sources (TW)</i>
1965	2.0	2.0	0.8	0.1
1975	3.5	2.2	1.5	0.2
1985	3.7	2.7	2.0	0.4
1995	4.3	3.0	2.5	0.6
2005	5.0	3.8	3.3	0.9
2025	4.0	3.8	3.8	2.1
2055	1.5	3.9	4.3	4.4

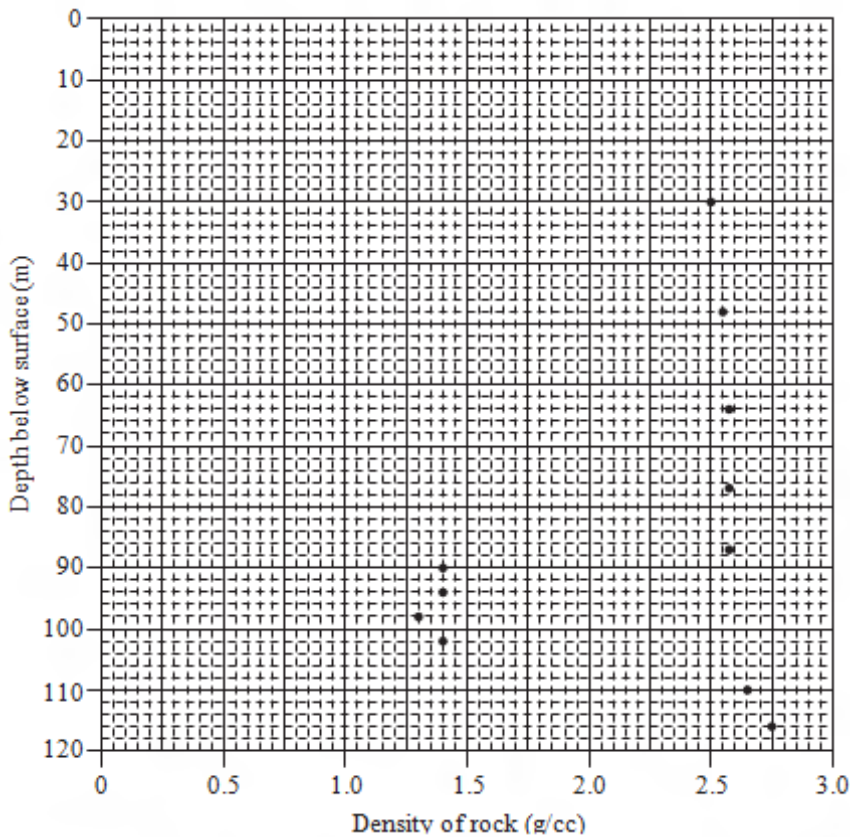
- (i) Using information in the table, predict ONE economic effect of projected world energy usage. **1**
- (ii) Justify the use of ONE other energy source in meeting future world energy demand. **3**
- (c) (i) What is catalytic cracking in petroleum refining? **1**
- (ii) Outline the maturation of petroleum including diagenesis, catagenesis and metagenesis. **3**

- (d) The table shows the percentage of carbon in some fossil fuels and the amount of carbon dioxide produced during combustion.

<i>Carbon in fuel (%)</i>	<i>Carbon dioxide production during combustion (g CO₂/100 g fuel)</i>
10	5
25	15
35	17
50	24
70	30
85	43
95	50

- (i) Identify the independent variable in the table. **1**
- (ii) Detach the graph paper on page 39. Plot the information given in the table onto the graph paper. **3**

- (e) The graph shows the relationship between depth and rock density in a coal basin.



Analyse the trend in the graph. **3**

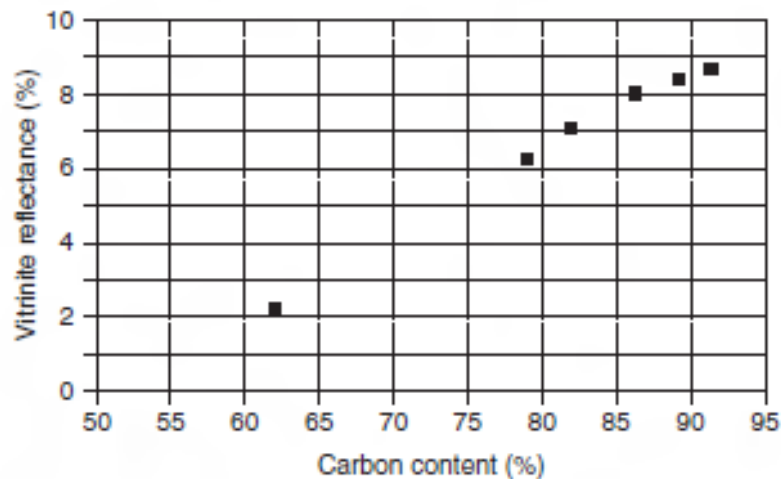
- (f) Analyse how the geology of both coal deposits and petroleum accumulations influences exploration techniques for these resources. **6**

2010

Question 32- Organic geology – A non renewable resource (25 marks)

- (a) Name ONE renewable and ONE non-renewable resource. Describe how each is used as an energy source. 4

- (b) The graph shows the relationships between vitrinite reflectance and carbon content of a coal.



- (i) Describe the trend in the graph for vitrinite reflectance. 1
- (ii) What changes, apart from vitrinite reflectance, occur during coalification? 3
- (c) (i) Identify ONE geophysical method used to locate potential hydrocarbon deposits. 1
- (ii) How does petroleum accumulate? 3

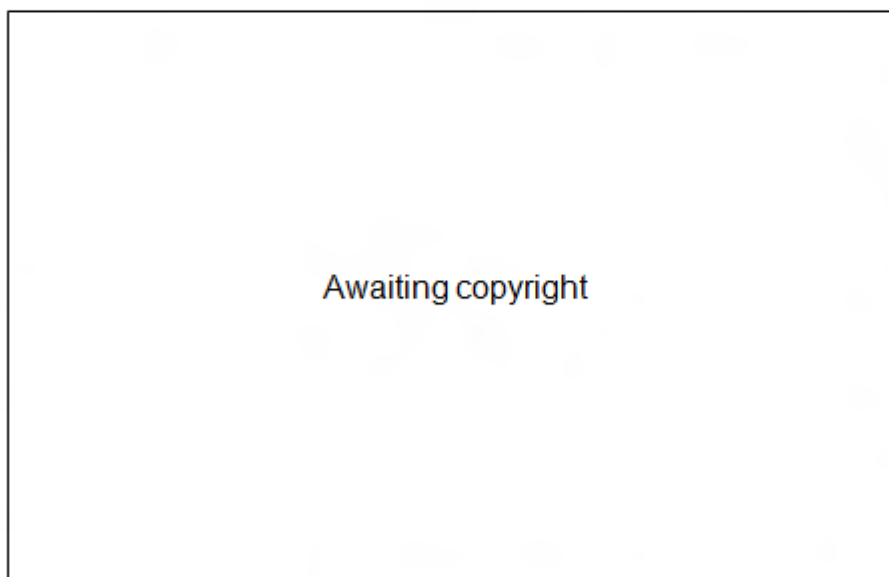
- (d) The table presents data for an investigation carried out to test the energy yield of various fuel types.

<i>Fuel type</i>	<i>Carbon content (%)</i>	<i>Energy output (MJ/kg)</i>
Wood	45	16
Black coal	68	26
LPG	82	48
Petroleum	85	49
Alcohol	88	50

- (i) Using the information in the table, give a valid hypothesis for the relationship between carbon content and energy output. **1**
- (ii) Design an experiment you could carry out to test the hypothesis you gave in part (i). **4**
- (iii) Outline TWO ways of limiting emissions from the combustion of fossil fuels. **2**
- (e) Evaluate the potential of other energy sources as alternatives to fossil fuels. Use examples in your answer. **6**

2011**Question 33- Organic geology – A non renewable resource (25 marks)**

- (a) (i) Define the term *non-renewable resource*, and give ONE example. 1
- (ii) Justify the need for catalytic cracking to produce petroleum products for industry. 3
- (b) A block diagram of an oil reservoir is shown.



- Justify the use of a combination of drilling and ONE geophysical technique to determine if oil may be located in the geological setting shown. 4
- (c) Compare the process of coalification with the process of hydrocarbon maturation. 4
- (d) To compare the products of combustion when a fuel is burned, students burned equal amounts of coal in small, medium and large containers of air. The final volumes of carbon dioxide, water vapour and carbon were measured.

The results are given below.

100 ml container: 15 units carbon dioxide, 10 units water vapour and 5 units carbon; 200 ml container: 29 units carbon dioxide, 18 units water vapour and

4 units carbon; 300 ml container: 48 units carbon dioxide, 32 units water vapour and no carbon.

- (i) Organise the results in a more scientific way. **2**
 - (ii) Comment on any trends in the results and then write a suitable conclusion for the investigation. **3**
 - (iii) Outline ONE method that could have been used to ensure the reliability of the results. **2**
- (e) Evaluate the need for a change in the use of fossil fuels as a source of energy. In your answer, refer to specific examples. **6**