

**Advanced GCE
GEOLOGY**

F794 QP

Unit F794: Environmental Geology

Specimen Paper

Candidates answer on the question paper.

Time: 1 hour

Additional Materials:

Scientific calculator
Ruler (cm / mm)

Candidate
Name

Centre
Number

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Candidate
Number

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INSTRUCTIONS TO CANDIDATES

- Write your name, Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Do **not** write in the bar code.
- Do **not** write outside the box bordering each page.
- WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED.

INFORMATION FOR CANDIDATES

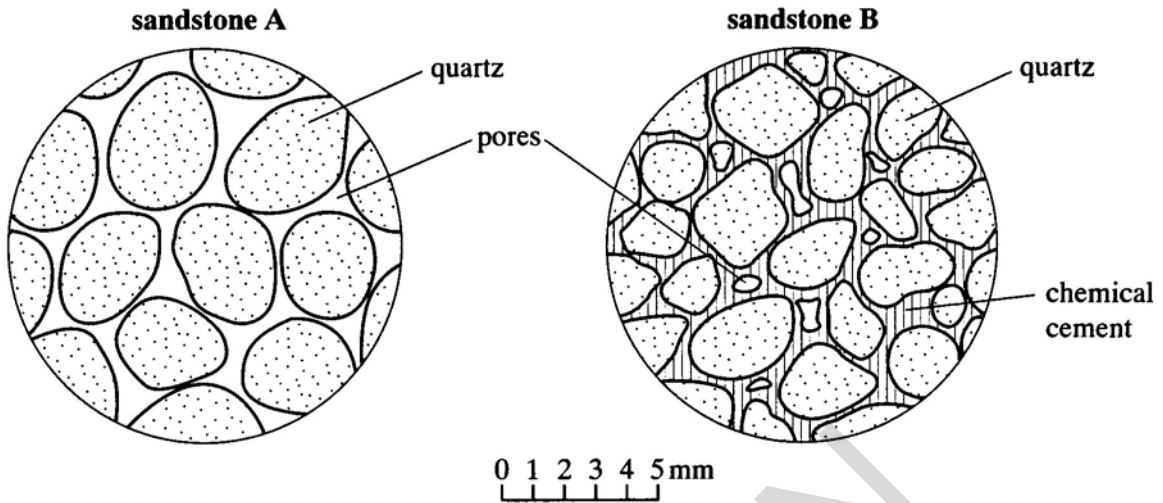
- The number of marks is given in brackets [] at the end of each question or part question.
-  Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- You may use a scientific calculator.
- You are advised to show all the steps in any calculations.
- The total number of marks for this paper is **60**.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	14	
2	12	
3	12	
4	22	
TOTAL	60	

This document consists of **11** printed pages and **1** blank page.

Answer **all** questions.

1 (a) Diagrams of thin sections of sandstones are shown below.



(i) Define the term *porosity*.

.....
 [1]

(ii) Give **two** reasons why porosity is high in sandstone **A** but low in sandstone **B**.

In your answer, you should use appropriate technical terms, spelled correctly.

.....

 [2]

(b) State **one** safety problem that could occur when drilling into an oil or natural gas reservoir.

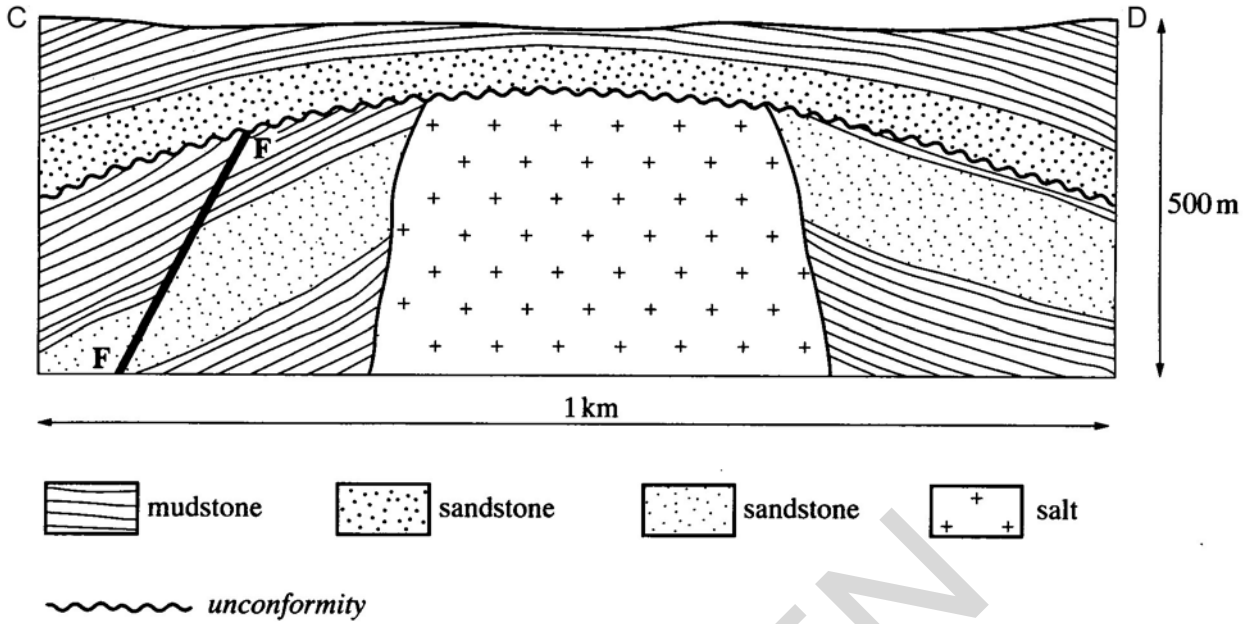
.....
 [1]

(c) Describe **two** environmental problems that might result from the offshore extraction of oil and natural gas.

.....

 [2]

(d) Study the geological cross section below.



(i) On the geological cross section above, shade **two** areas where oil may be trapped. [2]

(ii) Label and name the **two** types of traps you have shaded.

1

2 [2]

(e) (i) Using the axes below, sketch a gravity profile across the geological cross section from **C** to **D**. [2]



(ii) Describe the relationship between the gravity profile you have drawn and the geology shown on the cross section.

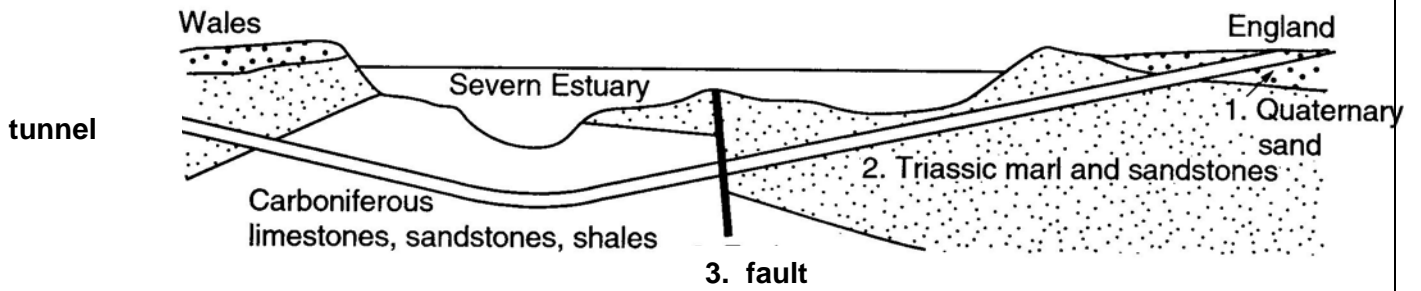
.....

 [2]

[Total: 14 marks]

[Turn over

2 (a) A geological cross section of the Severn railway tunnel is shown below.



(i) Describe the geological problems in constructing a tunnel at each of the locations numbered on the cross section.

1 Quaternary sand

2 Triassic marl and sandstones

3 Fault

[3]

(ii) In order to control leakage of water into the tunnel, grouting has been carried out. Explain the term *grouting*.

.....




[2]

(b) Describe **two** geological factors that need to be taken into consideration when constructing a road cutting across a hillside.

.....

[2]

- (c) The rock chippings in the top layer of a road surface must be both skid resistant and strong.

	<i>rock E</i>	<i>rock F</i>	<i>rock G</i>
road surface			
different minerals are shaded differently	x 1	x 1	x 1
rock crushing strength index > 80 for main roads	85	77	77
skid resistance index > 55 for main roads	57	38	54

- (i) Analyse the data shown above to identify the best and worst choice for roadstone chippings. Explain your answer.

.....
.....
.....
.....
.....
.....
.....
.....
.....

[4]

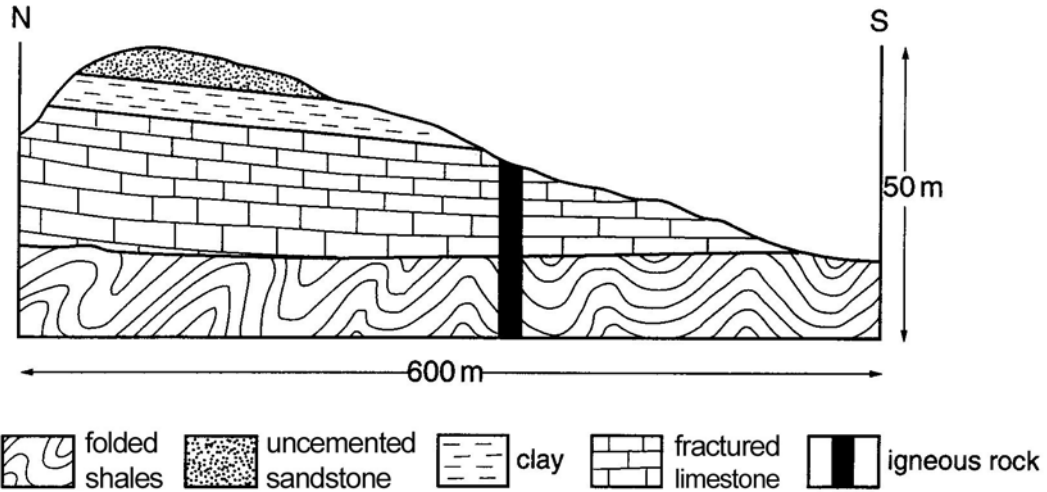
- (ii) Suggest a suitable rock type that could be used for roadstone chippings.

..... **[1]**

[Total: 12 marks]

[Turn over

3 (a) A geological cross section through a hillside is shown below.



(i) Mark on the cross section three different geological locations where springs will form. [3]

(ii) For each of the locations you have marked, explain why a spring will form at that place.

In your answer, you should use appropriate technical terms, spelled correctly.

site 1

.....

site 2

.....

site 3

..... [3]

(b) The label from a bottle of natural spring water carries the following information on the chemical content of the water. Units are milligrams per litre.

hydrogen carbonate	256 mg l ⁻¹
sulphate	105 mg l ⁻¹
calcium	91 mg l ⁻¹
magnesium	19.9 mg l ⁻¹

sodium	7.3 mg l ⁻¹
potassium	4.9 mg l ⁻¹
nitrate	0.6 mg l ⁻¹

(i) Discuss how these chemicals get into the natural spring water.

.....

.....

.....

..... [2]

(ii) Explain why spring water is often marketed as “pure water”.

.....
.....
.....
..... [2]

(c) Give **two** advantages of surface water supply (rivers and reservoirs) rather than supply from groundwater.

.....
.....
..... [2]

[Total: 12 marks]

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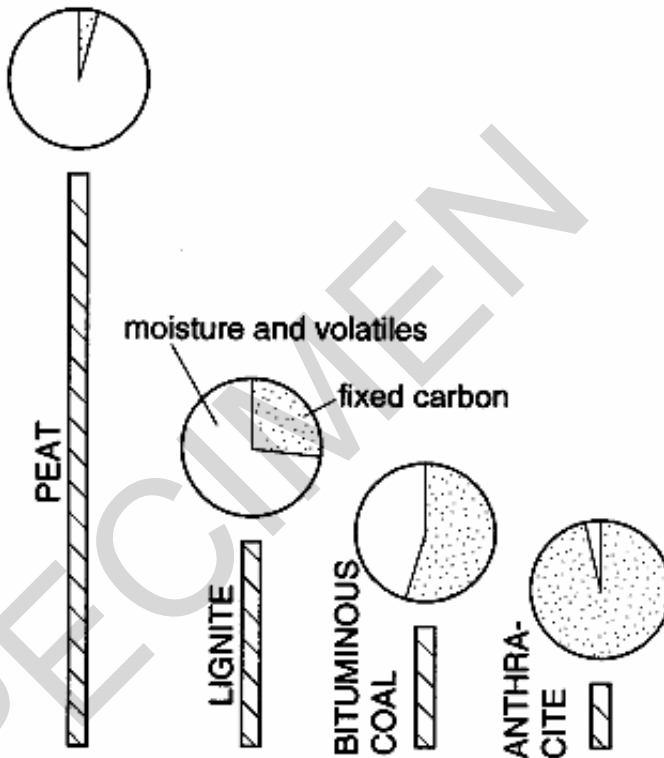
4 (a) Describe the environment in which peat and coal deposits originate.

.....
.....
.....
.....
.....

[3]

(b) The data below shows the rank of a series of peat and coal deposits.

The length of the shaded bars shows the relative thickness of deposits.



(i) Calculate the percentage reduction in volume from peat to anthracite using the data provided.

..... [1]

(ii) Name and describe the process responsible for this volume reduction.

name

description

..... [2]

(c) Draw a labelled cross section diagram to show the broad structure of the South Wales coalfield.

[2]

(d) Describe **one** geological problem that can make underground coal mining difficult and uneconomic.

.....
 [1]

(e) Metals are present in the crust in small quantities that are generally uneconomic to mine. The data below show the concentration factor necessary to produce economic deposits of tin.

% abundance of tin in continental crust	minimum % of tin for an economic deposit	concentration factor
0.002	0.4	200

(i) Explain the term *concentration factor* and how it is calculated.

.....

 [2]

(ii) ore = ore mineral + gangue.

Explain these terms.

ore

ore mineral

gangue mineral

[3]

[Turn over

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Question Number	Answer	Max Mark
<p>1(a)(i)</p> <p>(ii)</p> <p>(b)</p> <p>(c)</p> <p>(d)(i)</p> <p>(ii)</p> <p>(e)(i)</p> <p>(ii)</p>	<p><i>porosity</i> = volume of (pore) space in rock / (pore) space expressed as a percentage of total volume / percentage of (pore) space in a rock / amount of space / water / air between the grains</p> <p>sandstone A is well sorted whereas sandstone B is poorly sorted; sandstone A is uncemented / unconsolidated whereas sandstone B is cemented / lithified. QWC mark for correct use and spelling of unconsolidated / lithified or uncemented / cemented as the technical term (1)</p> <p>danger of explosions / gushers / blow outs / fires</p> <p>oil spillages / leakage from rigs / pipes / tankers; pollution of sea water / damage to marine ecosystems / marine life; pollution / environmental damage to coastlines / sea birds; oil fires / flares causing atmospheric pollution; disposal of old oil rigs; if general discussion of pollution = max 1</p> <p>at crest of anticline at top of upper sandstone bed; adjacent to left side of salt dome at top of lower sandstone bed</p> <p>anticline; salt dome</p> <p>negative over salt; positive elsewhere</p> <p>salt has a low density / 2.2-2.3 g/cm³ hence negative anomaly; other rocks / mudstone and sandstone have a higher density / 2.5-2.7 g/cm³ hence positive anomaly; if general link to density differences = max 1</p>	<p>[any 1]</p> <p>[1] [1]</p> <p>[any 1]</p> <p>[any 2]</p> <p>[1] [1]</p> <p>[1] [1]</p> <p>[1] [1]</p> <p>[1] [1]</p>
<p>2(a)(i)</p> <p>(ii)</p> <p>(b)</p>	<p>Quaternary sand: unconsolidated sands are weak - tunnel may collapse / unconsolidated sands are porous and permeable – tunnel may flood;</p> <p>Triassic marl and sandstones: marl is weak - tunnel may collapse / sandstones are porous and permeable – tunnel may flood;</p> <p>fault: plane of weakness / danger of movement causing tunnel to collapse / juxtapose different rock types on either side / leakage of water down fault causing flooding</p> <p>(holes are drilled and) <u>liquid</u> cement is pumped into ground; the cement fills the pore space and any joints / reduces permeability / makes the rock impermeable</p> <p>rock type and strength; dip of the beds / if dipping down slope will be unstable; presence of geological structures / faults / joints - weaken rock / make it unstable; porosity and permeability of rocks - water adds weight / acts as lubricant / makes landslides more likely</p>	<p>[1]</p> <p>[1]</p> <p>[1]</p> <p>[1] [1]</p> <p>[any 2]</p>

Question Number	Answer	Max Mark
(c)(i)	<p>rock A; best rock B; worst</p> <p>A is strong / rock crushing index greater than 80 / skid resistant / skid resistance greater than 55 / contains minerals of different hardness / minerals will wear down at different rates</p> <p>B has low skid resistance / skid resistance less than 55 / will polish / mono-minerallic so all same hardness / will wear down at same rate</p>	[any 3]
(ii)	dolerite / basalt / gabbro / andesite / diorite / microgranite / greywacke or other suitable named rock	[1]
3(a)(i)	<p>where base of sandstone intersects topographic surface on either side;</p> <p>where contact of dyke and limestone intersects topographic surface on either side;</p> <p>where unconformity between folded shales and limestone intersects topographic surface;</p>	<p>[1]</p> <p>[1]</p> <p>[1]</p>
(ii)	<p>impermeable clay is overlain by permeable sandstone so water table intersects surface;</p> <p>impermeable igneous rock is in contact with permeable limestone so water table intersects surface</p> <p>impermeable shales below and permeable limestone above unconformity so water table intersects surface;</p> <p>if general discussion of permeable rock meeting impermeable rock = 1 if general discussion of water table meeting topographic surface = 1 QWC mark for correct use and spelling of impermeable as the technical term (1)</p>	<p>[1]</p> <p>[1]</p> <p>[1]</p>
(b)(i)	by chemical weathering / soluble chemicals dissolved from rocks / solutes carried in solution in groundwater	[any 2]
(ii)	<p>rocks act as a natural filter / impurities are removed as water passes through rock;</p> <p>water is cleaner / water has not been treated with chemicals / water has not been chlorinated / water is less likely to be contaminated / polluted</p>	[1]
(c)	<p>readily accessible / available / easy to extract;</p> <p>cheaper to extract;</p> <p>doesn't take long to refill / recharge / replenish;</p> <p>dam and reservoir can be used for other purposes, e.g. recreation, H.E.P. generation</p>	[1]
		[any 2]

Question Number	Answer	Max Mark
4(a)	hot and wet tropical / Equatorial climate; luxuriant / high rate of tree growth; deltaic / delta top / swamp / marsh / floodplain environment; low oxygen / anoxic / anaerobic / reducing conditions (so vegetation doesn't decay); rapid sedimentation / burial / subsidence (so vegetation doesn't decay)	[any 3]
(b)(i)	88%, accept between 85 and 91%	[1]
(ii)	name – compaction / diagenesis / lithification / coalification description – peat is compressed/squeezed by weight of accumulating sediments / load pressure / causes water/volatiles to be driven off	[1]
(c)	suitable diagram of syncline; labelled – syncline structure	[1] [1]
(d)	faults offset seams disrupting production, allow water leakage, cause collapse / folds and steep dips make mechanised mining impossible / rapid alternations of cyclothem rocks have different mechanical strength make mining difficult / disrupt production permeable sandstones within deltaic sequence may allow flooding / build up of methane gas (explosive) / if water table is high flooding may occur / washouts can occur due channel switching / seam splitting can occur due to differential subsidence of delta / thin seams / lateral variations can make mining uneconomic / rank / quality / carbon content of the coal may be too low	[any 1]
(e)(i)	amount / factor / number of times by which a metal is concentrated to make an (economic) ore deposit / reach the cut off grade; cut off grade / minimum % of metal for an economic deposit divided by its average crustal abundance / abundance in continental crust (accept alternative wording)	[1]
(ii)	ore - rock which contains metal(s) of interest that can be mined at a profit / a mixture of ore minerals and gangue minerals; ore mineral – mineral / naturally occurring compound containing the useful / valuable / economic metal(s) / suitable named example;	[1]
(iii)	gangue mineral – worthless / useless / waste mineral mixed in with the ore mineral / suitable named example	[1]
(iii)	ore minerals released / separated / liberated by weathering of pre-existing mineral veins; minerals are transported into rivers; hard (or in the case of gold malleable) / physically resistant minerals can withstand erosion / abrasion / attrition; chemically inert / unreactive / stable minerals are not taken into solution; selective removal of lighter minerals increases grade / concentrates the ore minerals; ore minerals are dense / heavy; (preferential) deposition of ore minerals in lower velocity / lower energy areas	[max 4]

Question Number	Answer	Max Mark
(iii) cont'd	diagrams / descriptions of locations where placers form – 1 + 1 diagram and detailed description for each: inside of meander bends / on point bar; in waterfall plunge pools / potholes; upstream of projections in river bed; downstream of confluences and tributaries; on beaches; must describe not list; mark diagrams as text	[max 6]
Paper Total		[60]

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Assessment Objectives Grid (includes QWC)

Question	AO1	AO2	AO3	Total
1(a)(i)	1			1
1(a)(ii)		2		2
1(b)	1			1
1(c)	2			2
1(d)(i)		2		2
1(d)(ii)		2		2
1(e)(i)			2	2
1(e)(ii)			1	1
2(a)(i)		3		3
2(b)(ii)	1	1		2
2(b)	1	1		2
2(c)(i)	1	3		4
2(c)(ii)		1		1
3(a)(i)		3		3
3(a)(ii)		3		3
3(b)(i)	1	1		2
3(b)(ii)	1	1		2
3(c)	2			2
4(a)	3			3
4(b)(i)			1	1
4(b)(ii)	1	1		1
4(c)		2		2
4(d)	1			1
4(e)(i)		2		2
4(e)(ii)	1	2		3
4(e)(iii)	3	5		8
Total	20	36	4	60

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