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Advanced GCE

GEOLOGY

F794 QP

Unit F794: Environmental Geology

Specimen Paper

Candidates answer on the question paper.
Additional Materials:

Scientific calculator
Ruler (cm / mm)

Time: 1 hour

Candidate Name	

Centre Number						Candidate Number				

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**	

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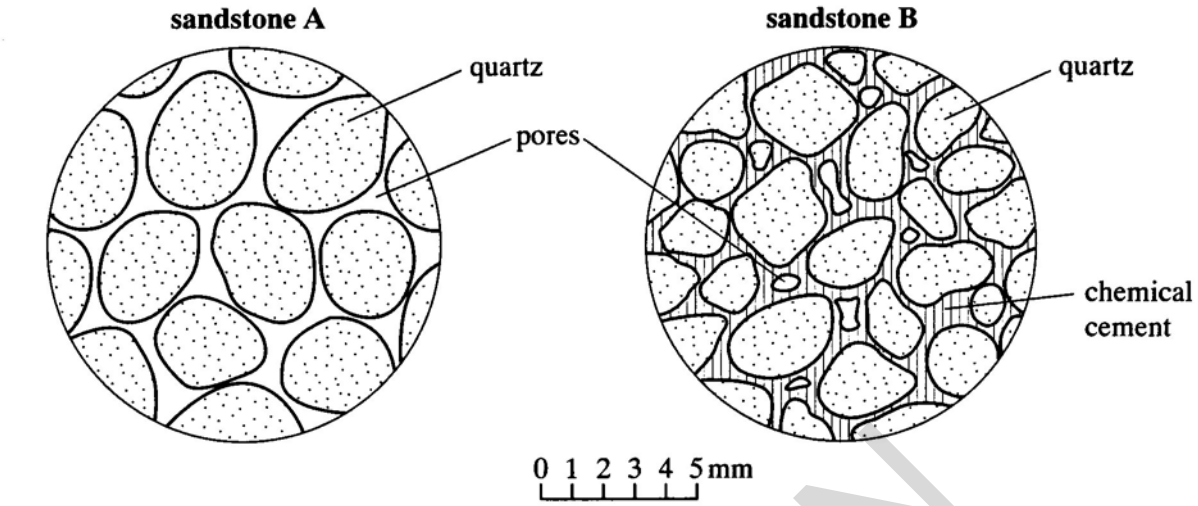
Answer **all** questions.

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]**

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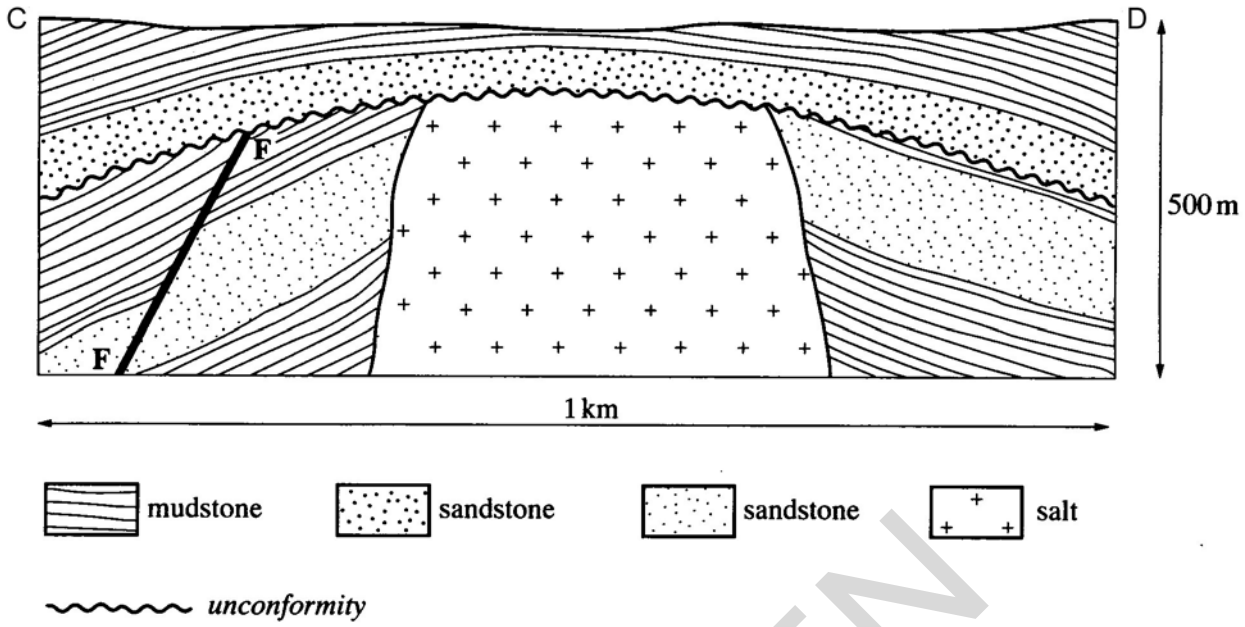
(d) Study the geological cross section below.



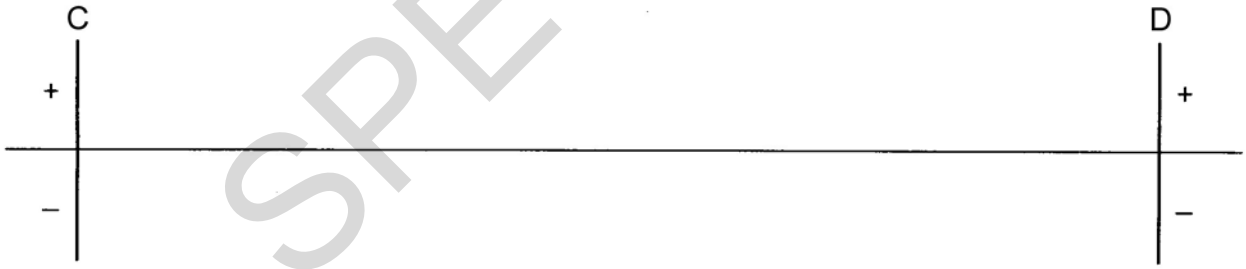
(i) On the geological cross section above, shade **two** areas where oil may be trapped. **[2]**

(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

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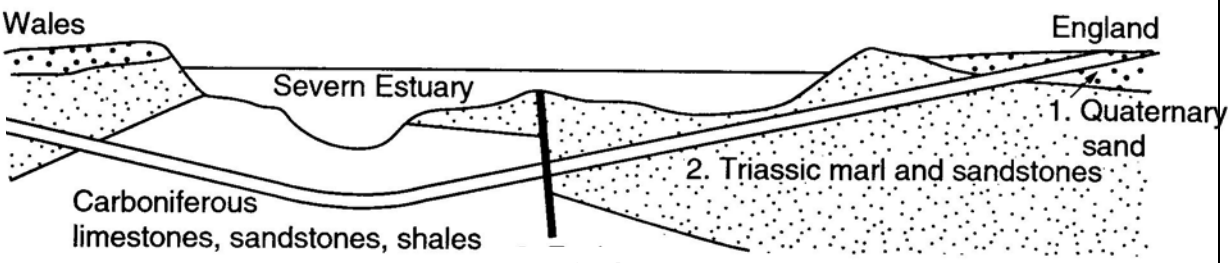
2 **(a)** A geological cross section of the Severn railway tunnel is shown below.



(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]**

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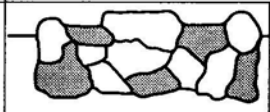
(c) The rock chippings in the top layer of a road surface must be both skid resistant and strong.

	rock E	*rock F*	*rock G*
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]

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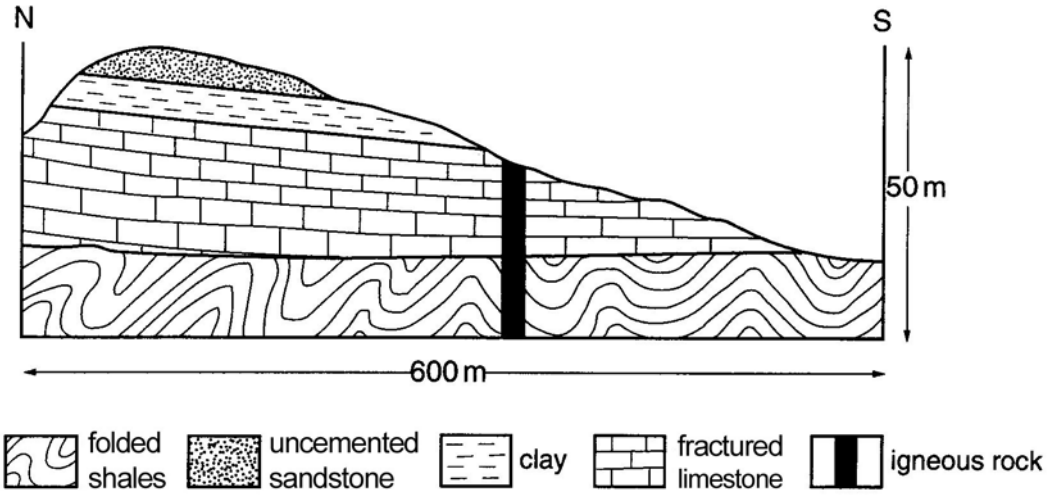
3 **(a)** A geological cross section through a hillside is shown below.



(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 mgl^{-1}
sulphate	105 mgl^{-1}
calcium	91 mgl^{-1}
magnesium	19.9 mgl^{-1}

sodium	7.3 mgl^{-1}
potassium	4.9 mgl^{-1}
nitrate	0.6 mgl^{-1}

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

.....

.....

.....

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

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(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.

.....

.....

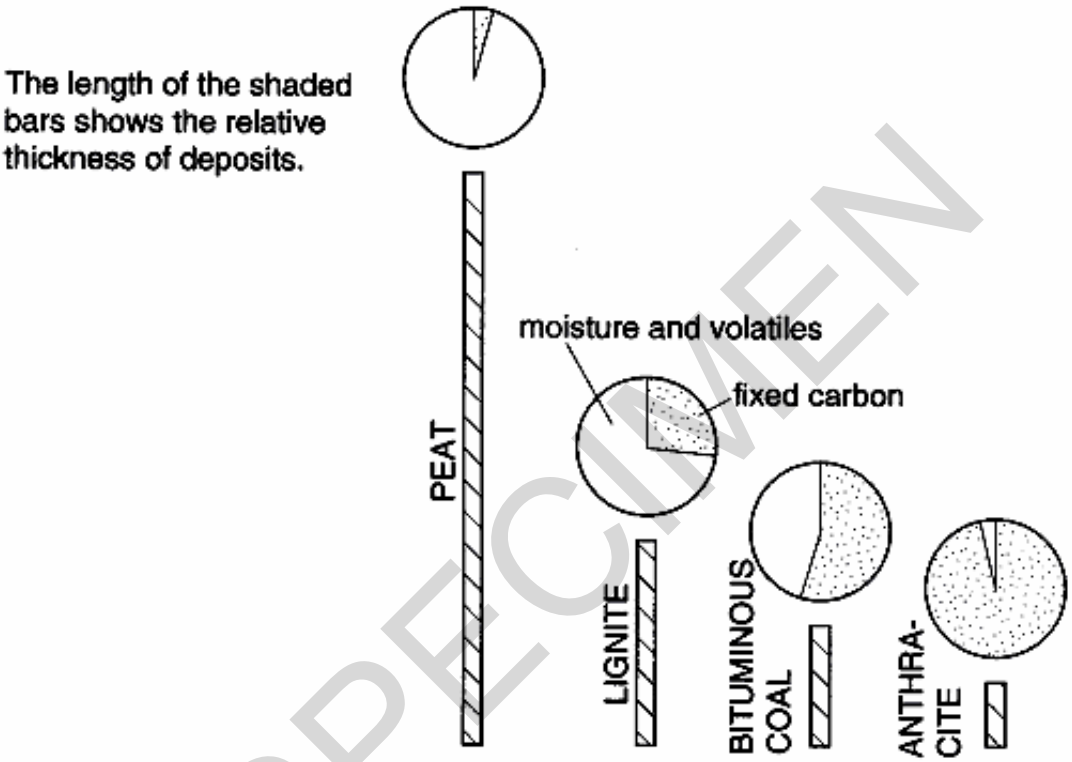
.....

.....

.....

..... **[3]**

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



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(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]**

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(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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(iii) Describe the formation of placer deposits of cassiterite, gold and diamonds. You may use diagrams to illustrate your answer.

.....

.....

.....

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OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

GEOLOGY F794 MS

Unit F794: Environmental Geology

Specimen Mark Scheme

The maximum mark for this paper is **60**.

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Question Number	Answer	Max Mark
1(a)(i)	*porosity* = 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	[any 1]
(ii)	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)	[1] [1]
(b)	danger of explosions / gushers / blow outs / fires	[any 1]
(c)	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	[any 2]
(d)(i)	at crest of anticline at top of upper sandstone bed; adjacent to left side of salt dome at top of lower sandstone bed	[1] [1]
(ii)	anticline; salt dome	[1] [1]
(e)(i)	negative over salt; positive elsewhere	[1] [1]
(ii)	salt has a low density / 2.2-2.3 g/cm^3 hence negative anomaly; other rocks / mudstone and sandstone have a higher density / 2.5-2.7 g/cm^3 hence positive anomaly; if general link to density differences = max 1	[1] [1]
2(a)(i)	Quaternary sand: unconsolidated sands are weak - tunnel may collapse / unconsolidated sands are porous and permeable – tunnel may flood; Triassic marl and sandstones: marl is weak - tunnel may collapse / sandstones are porous and permeable – tunnel may flood; 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	[1] [1] [1]
(ii)	(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	[1] [1]
(b)	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	[any 2]

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

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Question Number	Answer	Max Mark
4(a)	hot and wet topical / 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	[1]
	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;	[1]
	labelled – syncline structure	[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;	[1]
	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;	[1]
	ore mineral – mineral / naturally occurring compound containing the useful / valuable / economic metal(s) / suitable named example;	[1]
	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]

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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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