Exercise walk-through

3.4
Option: Geophysical hazards

International Baccalaureate · IB Diploma · Geography · HL

How the options are examined

- In Paper 1 each option has 20 marks.
- The first part is a set of short **structured questions** (10 marks), often about a map, graph or table.
- Then you choose one of two essays (10 marks).
- SL students answer two options in 1 hour 30 minutes; HL students answer three in 2 hours 15 minutes.

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Geophysical hazards

- The Earth's surface is broken into **tectonic plates** that move a few centimetres a year.
- Most volcanoes and earthquakes happen at **plate margins** :
- **Hazard risk** grows with three things: how strong and frequent the hazard is, how many people and buildings are in its path (**exposure**), and how easily they are harmed (**vulnerability**).
- Poverty, weak buildings and poor warning systems raise **vulnerability**.

$$\text{risk} = \text{hazard} \times \text{exposure} \times \text{vulnerability}$$

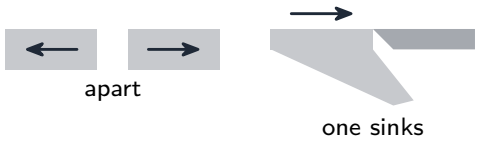
Fieldwork: geographic inquiry and sampling

- The fieldwork report is worth 25% at SL and 20% at HL.
- It is a report of up to 2,500 words, marked out of 25, on **primary data** that you collect yourself in the field.
- You cannot measure everything, so you take a sample:
- **Worked example.** Question: *Does the number of pedestrians fall with distance from the central square?* **Hypothesis**: pedestrian numbers fall as distance increases.

$$r_s = 1 - \frac{6\sum d^2}{n(n^2-1)} = 1 - \frac{6 \times 158}{8 \times 63} = 1 - \frac{948}{504} \approx -0.88$$

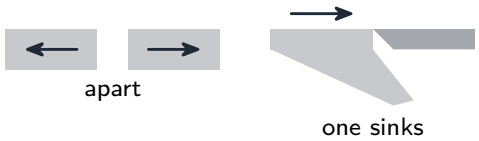
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2.1 State **two** differences between a constructive and a destructive plate margin. [2]



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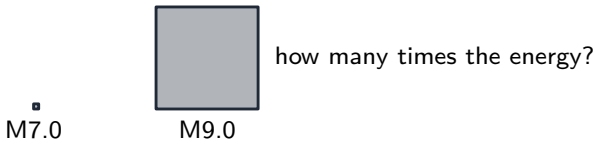


2.1

any two: constructive: plates move apart; destructive: one plate sinks under another; constructive: runny lava and gentle volcanoes; destructive: explosive volcanoes; constructive: small earthquakes; destructive: large earthquakes and tsunamis

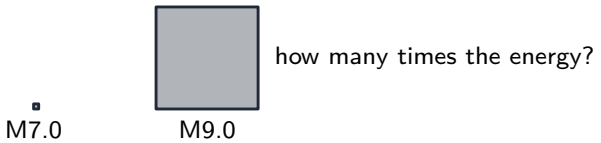
Exercise 2.2

2.2 The 2011 Tōhoku earthquake had a magnitude of 9.0, and the 2010 Haiti earthquake 7.0. Each step of 1 on the scale is about 32 times more energy. Calculate how many times more energy the Tōhoku earthquake released, and explain why Haiti still had more deaths. [3]



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2.2

$32 \times 32 \approx$ **1,000** times; Haiti's buildings were weak and the capital was close to the epicentre; Japan has strict building codes, warnings and drills, so its vulnerability is lower

Exercise 2.3

2.3 State **two** factors that increase people's vulnerability to earthquakes. [2]



reinforced



unreinforced

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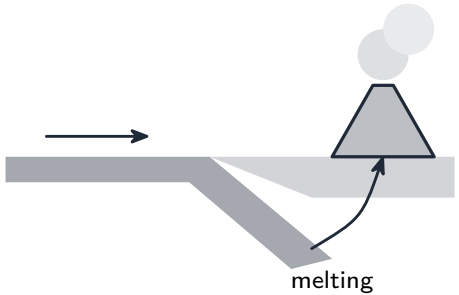
unreinforced

2.3

any two: poverty; weak buildings without building codes; no warning system or drills; a weak government or poor emergency services; living on steep slopes where landslides happen

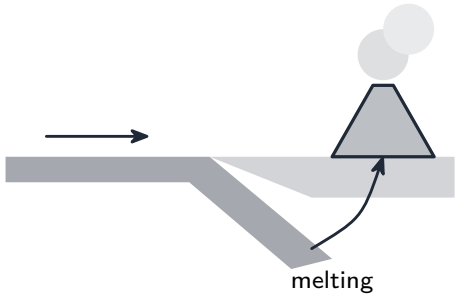
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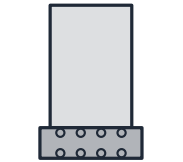


2.4

the sinking plate melts and forms magma rich in silica (andesitic); this magma is sticky (viscous), so gas cannot escape easily; pressure builds until the gas escapes violently, an explosive eruption

Exercise 2.5

2.5 Explain **two** ways in which Japan prepares for earthquakes and tsunamis. [4]



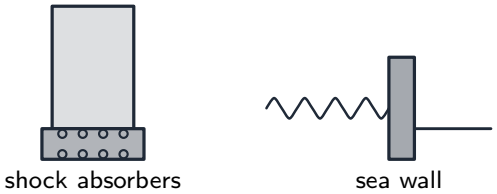
shock absorbers



sea wall

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any two, explained: strict building codes, e.g. deep foundations and shock absorbers, so buildings bend instead of collapsing; an earthquake early-warning system that stops trains and warns people seconds before strong shaking; drills in schools and workplaces every year, so people know what to do; sea walls and marked evacuation routes for tsunamis, so people can reach high ground

Exercise 3.1 (a)

3.1 *(Paper 1 style.)* The table compares two earthquakes.

(a) Using the table, identify **two** differences that help to explain the different death tolls. [2]

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(a) any two: Haiti had weak buildings and no building code enforced, Japan strict codes; Haiti's capital was close to the epicentre; Japan had warnings and drills, Haiti did not; Japan's GDP per person was far higher, so it could afford preparation

Exercise 3.1 (b)

3.1 *(Paper 1 style.)* The table compares two earthquakes.

(b) Explain why most deaths in Japan in 2011 were caused by the tsunami, not the shaking. [4]

	Haiti, 2010	Japan, 2011
magnitude	7.0	9.0
deaths (dead or missing)	more than 100,000	about 18,000
main cause of death	collapsed buildings	tsunami
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warnings and drills	few	regular

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(b) Japanese buildings are built to resist shaking, so few collapsed; the earthquake was under the sea at a destructive margin, so it pushed up the sea floor and made a tsunami; the tsunami was higher than many sea walls, so it flooded coastal towns; people had only minutes to escape, and some did not reach high ground

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Mark with the markbands: [9-10] focused on the command term, detailed and accurate knowledge, well-developed explanation, specific named examples (places, dates, numbers), balanced evaluation and a supported conclusion; [7-8] mostly focused, good knowledge and examples, some evaluation; [5-6] relevant knowledge and examples, explanation

partly developed, little evaluation; [3-4] general knowledge, few examples, mostly description; [1-2] little that is relevant. Points that may be included: development matters: Haiti 2010 killed more than 100,000; Japan 2011 far fewer from the shaking, because of building codes and drills; rich countries can afford warning systems, strong buildings and quick rescue; poor countries often have informal housing and weak governments, which raise vulnerability; but the hazard itself matters: the Tōhoku tsunami killed about 18,000 even in a very developed country; exposure matters: a quake near a big city kills more than one in an empty area; time of day and type of hazard: night-time quakes catch people in bed; tsunamis and landslides kill differently from shaking; governance and corruption: building codes only help if enforced; developing countries can lower deaths cheaply, e.g. Bangladesh's cyclone warnings show low-cost preparation works; conclusion: development is very important because it shapes vulnerability, but the size and type of hazard and the exposure also decide the impact