General Certificate of Education
Advanced Subsidiary Examination
January 2013

General Studies (Specification A)

GENA2

Unit 2 AS Science and Society

Source Booklet

Source for use with **Questions 1.1** to **1.30**.

Greenland: some effects of climate change

(1) Buuti Pedersen, who lives in southern Greenland, first tasted locally grown broccoli two years ago. "An earlier spring and warmer weather mean people can grow vegetables that up till now had to be imported from Denmark," she says. "We have radishes, lettuces, even flowers grown here. It's a big change for us." The newspaper in Nuuk, Greenland's capital, would once have given prominence to reports of sledge races. But as the ice melts and the weather warms, the headlines are now given over to news about a glut of locally grown potatoes.

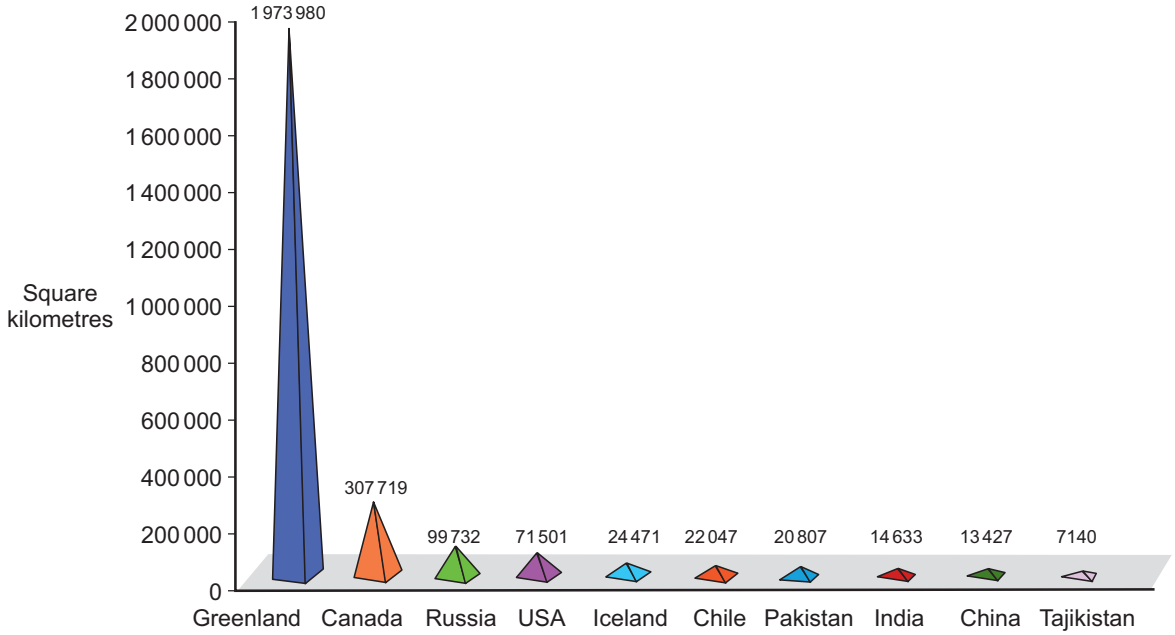
Figure 1 – Changes in mean seasonal temperatures between 1993 and 2005

Year	Mean temperatures in Greenland (°C)	
	March	September
1993	–17.5	5.1
1994	–14.6	2.4
1995	–16.1	4.8
1996	– 7.0	4.0
1997	–11.3	3.6
1998	–9.6	4.7
1999	–8.4	3.1
2000	– 9.9	5.0
2001	–6.7	5.5
2002	–10.8	5.6
2003	– 6.0	6.0
2004	–9.3	3.8
2005	–2.0	3.7

(2) Global warming is creating both problems and opportunities for Greenland, the world's biggest island with a total land area of 836 000 square miles. It is three times the size of Texas, yet the population is only 57 000. Much of the traditional way of life of the majority community, the Inuit, who have hunted and fished in the region for at least 3 000 years, is disappearing. Melting ice does not just mean less sledging and little work for the teams of huskies. Abrupt changes in the weather, with prolonged storms plus thinning ice, make hunting dangerous. Imported meats are taking the place of the traditional diet of seal and whale.

(3) The fishing industry, however, one of the mainstays of the economy, is booming. Warming waters have resulted in cod and halibut stocks migrating north into the seas around Greenland, and ports that are ice-free for more and more days each year. Tourists are flocking in: hotels in the town of Ilulissat, at the mouth of an iceberg-studded fjord 220 miles inside the Arctic Circle, are fully booked most of the year.

Figure 2 – Top 10 countries by permanent snow and ice cover



(4) Yet fishing and melting ice are nothing compared to what is considered to be the biggest opportunity of all – Greenland's hydrocarbon and mineral riches. Melting ice means that oil, gas and a treasure chest of minerals, ranging from gold and diamonds to copper and uranium, can be exploited. Meanwhile oil companies are lining up to grab a slice of the action in what some are calling the last fossil-fuel frontier. Some locals forecast a financial windfall which will enable Greenland finally to break its ties with Denmark, the old colonial master.

(5) According to the latest data from the Geophysical Survey of Denmark and Greenland, the island has one of the highest concentrations of minerals in the world, with 500 of the approximately 4000 known minerals so far found there. Substantial deposits of coal, lead, zinc and silver were mined in earlier years, though operations often fell victim to the weather, with the ground too frozen to dig, and transport and supply ships becoming trapped in ice or colliding with icebergs. At present, it is Greenland's hydrocarbon potential which is receiving most attention. The US Geological Survey says that the Arctic might contain about 13 per cent of the world's undiscovered oil reserves and up to 30 per cent of undiscovered gas. Major oil companies are rushing to sign up for concessions to explore the waters off the coast of Greenland.

(6) It is not the first time outsiders have made a grab for Greenland's energy resources: at one time the lamps of Europe were kept alight by oil from whales caught in the island's waters. The oil was shipped by Dutch traders to Rotterdam, which laid the foundations for the present-day trade in oil – of the mineral variety – in the North Sea super-port.

(7) Estimates of the hydrocarbon potential of Greenland vary widely. At one stage it was thought that Baffin Bay, on the west coast, could contain up to 50 billion barrels of oil, as much as the entire production of the North Sea, while the north east might have another 30 billion barrels. Latest indications are that the oil reserves are much smaller, though gas deposits are likely to be substantial. "The vital thing is how much ice we encounter and how many ice-free days there are," says one oil-industry figure. "In broad terms, the less ice there is, the cheaper it is for us to get the oil out." But it is early days yet, and commercial extraction of any hydrocarbon deposits found is unlikely to start until at least 2015.

(8) The exploitation of Greenland's mineral wealth began nearly 300 years ago when Dutch and Nordic explorers started working graphite deposits. For more than 100 years, up until 1987, the only cryolite mine in the world operated in the southwest of the island. Cryolite, dug out from beneath the tundra and permafrost in big white chunks, was originally sold to the rapidly expanding chemical industry, and later became a vital ingredient in the processing of aluminium. Nowadays cryolite is made chemically and the mine is derelict.

(9) The arrival of more benign weather has led to a new burst of mining activity. A Swedish project exploiting thousands of tonnes of olivine, an important ingredient in steel-making, started in 2005. Goldmines have opened in the south and west. Diamonds have been found in several locations north of Nuuk, including a sizeable specimen of 2.39 carats in 2006. Some minerals, with names such as eskimoite and vikingite, are new discoveries. Then there is greenlandite, discovered in iron deposits in the 1960s. A grass-green quartz similar in appearance to jade, it is described by gem dealers as the oldest gemstone on earth.

(10) Alcoa, the aluminium giant, is proposing to build one of the world's largest aluminium plants on the west coast. Aluminium production is highly energy-intensive, and Alcoa is attracted by Greenland's hydropower potential, which will grow as glaciers melt. But the alumina from which the plant will extract the metal will have to be shipped in from elsewhere, possibly from as far away as the Caribbean.

(11) The Greenland Minerals and Energy Company, which is actually based in Australia, plans a massive rare earths project at Kvanefjeld in the south. Rare earths are a group of 15 elements which are used in all sorts of components and devices, including missile guidance systems, iPods, low-energy light bulbs and flatscreen TVs. In most cases the elements are used as oxides. At present China has a 90% share of global rare earth resources and is rationing their sale on the international market. Mining analysts say the Kvanefjeld project creates an opportunity to break China's monopoly.

Figure 3 – Global production of rare earth oxides, 1950 to 2000

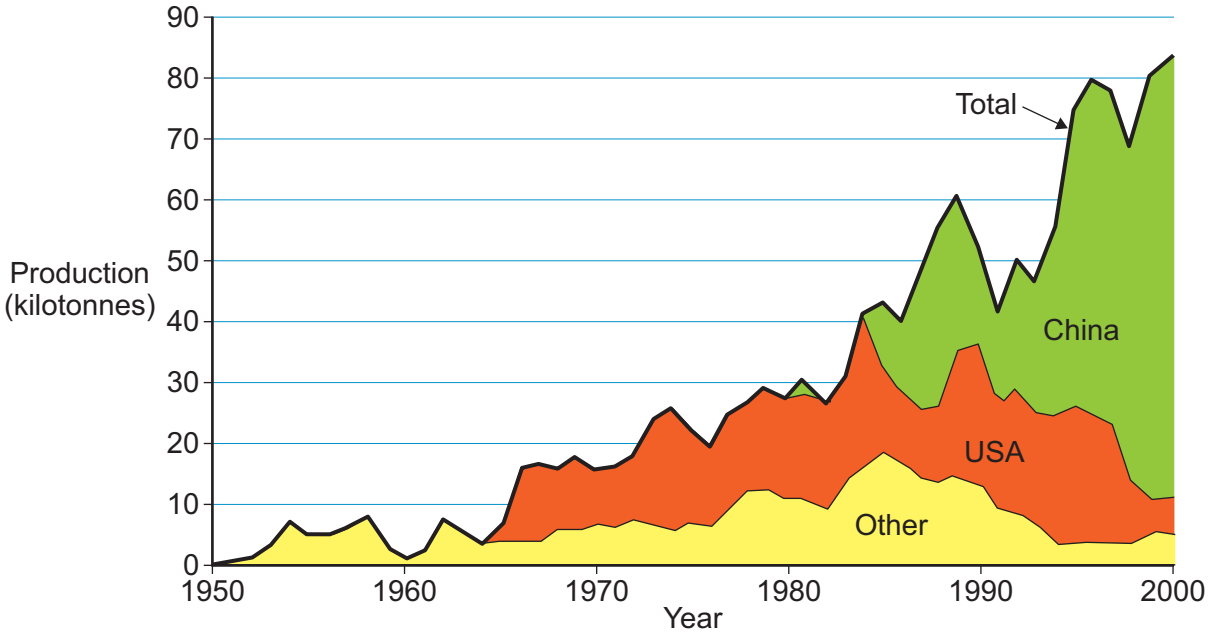
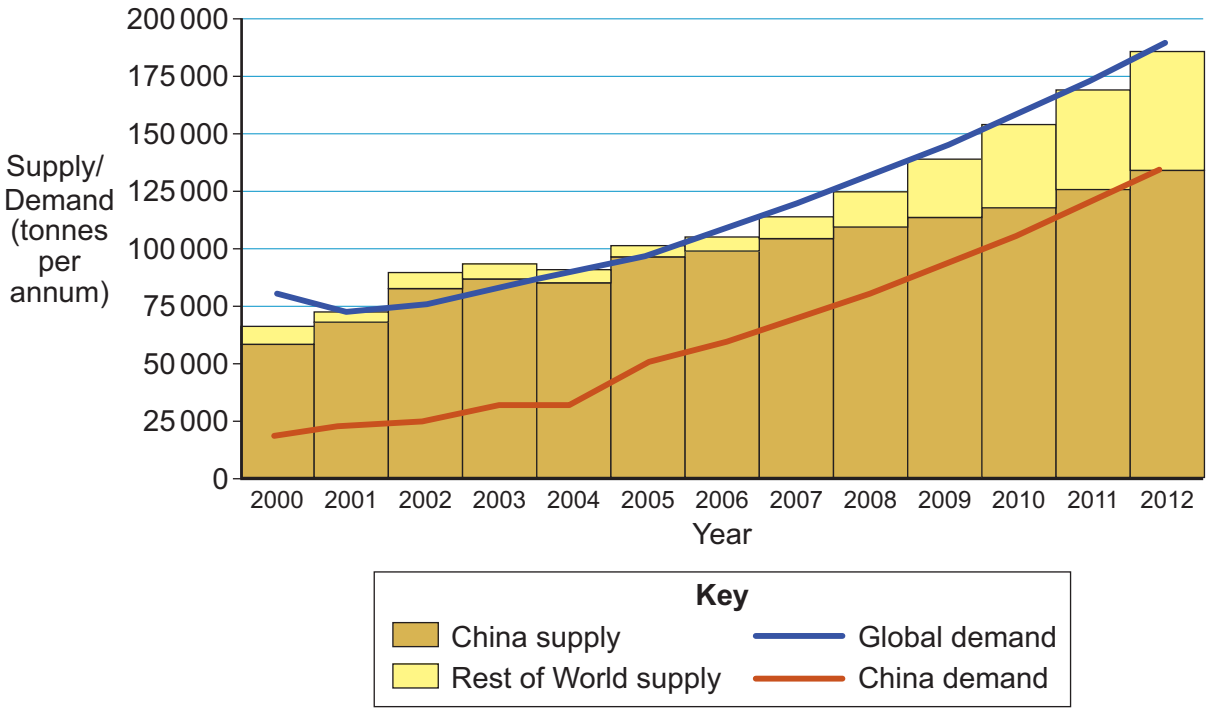


Figure 4 – Supply and demand for rare earth elements, 2000 to 2012



(12) In 2009, Greenland was formally handed self-rule by Denmark, though Copenhagen retains control over foreign policy, security and finance. Under present agreements, Greenland can grant oil and gas and mining exploration licences but Denmark has the right to receive half of any mining or hydrocarbon revenues to help to offset the financial assistance it gives to Greenland.

Source: adapted from KIERAN COOKE 'Thawing Asset', *The Times*, Eureka magazine, January 2010 © The Times Eureka

END OF SOURCES

There are no sources printed on this page

There are no sources printed on this page

There are no sources printed on this page