LEARNING OUTCOMES!

Candidates should be able to:

- describe, with the help of a simple diagram for each method, how non-renewable fuels (coal, crude oil and natural gas) are extracted: – coal as obtained by open cast, adit and shaft mining methods – natural gas and crude oil obtained by exploration and drilling
- understand the difference between renewable and non-renewable sources of electricity
- explain (briefly) how electricity can be generated from renewable resources (hydel, wind, solar, and other possibilities such as wave, tidal, biofuels, geothermal)
- understand the importance of power sources for development.
- describe the quality and the amount of coal available from within Pakistan and how long reserves are likely to last, and also describe the types of coal which have to be imported for industrial purposes
- describe how coal both produced in Pakistan and imported is transported to the end users
- state how much natural gas is produced by Pakistan, and how long reserves are likely to last
- describe the extent of the natural gas pipeline network in Pakistan and explain how natural gas can be taken to those parts of Pakistan away from the pipelines, and the limitations of doing this
- state how much oil is produced by Pakistan, how long reserves will last and how much oil is imported, and explain why it is necessary to import large amounts of oil
- describe the extent of the oil pipeline network in Pakistan and describe the other methods that are used to transport both imported oil and oil produced in Pakistan
- understand that electricity can be generated in a variety of ways. In thermal power stations by burning coal, oil, gas and waste, or with nuclear energy; or with renewable sources e.g. water (including hydel), the wind and the sun
- understand that non-renewable power sources are running out, and are increasing in price.

- explain and evaluate the advantages and disadvantages of the different methods of producing electricity from renewable resources (generated by water, wind, wave and sun)
- understand the physical and human conditions that favour the development of multi-purpose hydel schemes
- state and explain the factors, both physical and human, which promote or hinder the availability of electricity and other power resources listed, including the feasibility of small-scale, renewable power generation
- explain why the supply of electricity is not sufficient or reliable to develop many parts of Pakistan.

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COAL

- ✓ Coal is basically formed by the decomposition of plants.
- ✓ Plants are buried in the subsurface and when they decompose they form coal.
- ✓ Coal is always found in layers.
- ✓ Hence forms of coal are:
- ✓ Peat → Lignite → Sub-Bituminous → Bituminous → Anthracite

DETERMING QUALITY OF COAL

- ✓ It is determined by at what depth it is found.
- ✓ Quality of coal depends upon its color.
- ✓ It also depends upon its carbon content. The more carbon the better the coal is.
- ✓ Depends upon its heating value. The more heating value the better the coal is.
- ✓ If there will be more sulphur, Coal is of inferior quality.
- ✓ If there will be less sulphur, Coal is of superior quality.
- ✓ More moisture, Coal is of inferior quality.
- ✓ Less moisture, Coal is of superior quality.

TYPES OF COAL

Anthracite

- ✓ Blackest coal of all and found in thin layers, deep underground.
- ✓ It is the best quality of coal, hardest, with highest carbon content and burns with great heat.

Bituminous

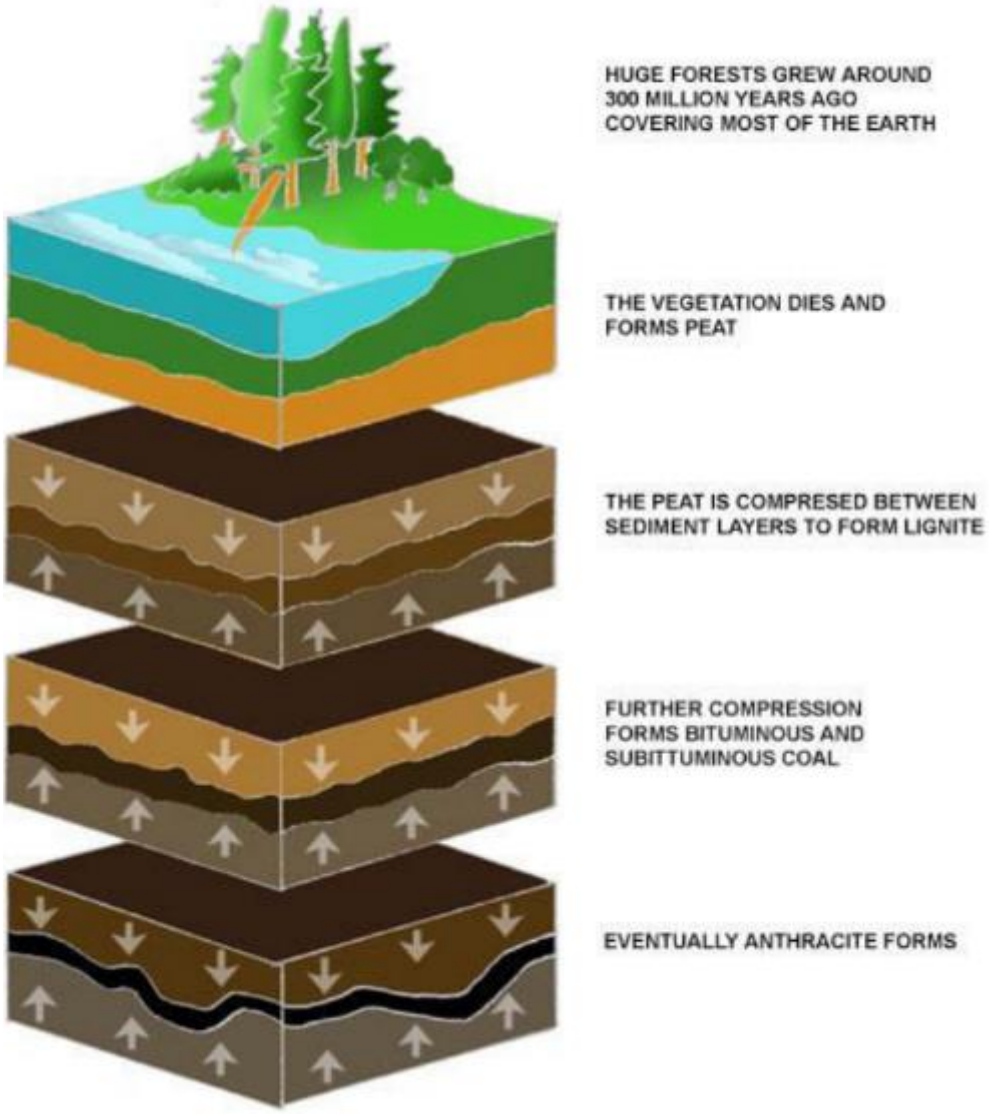
- ✓ It is darker in color and found further" deep underground and has two types; Steam Coal and Coking Coal

Lignite

- ✓ It is found near the surface and easier to mine. It is a low quality coal with a high moisture and ash content. It has a low heating value.

Peat

- ✓ It is exclusively vegetative matter and represent the initial stage of coal formation.



COAL IN PAKISTAN

- ✓ In Pakistan, lignite and sub bituminous quality of coal is found.
- ✓ Having: Low heating value, Low carbon content, High moisture and High sulphur content
- ✓ Coal region is the same as coal fields.
- ✓ Mines is the same as mining centers.
- ✓ So many mines combine to form a coal region.
- ✓ If coal is located near the surface then it is mined by Open-cast mining.

- ✓ If coal is located in the greater depth then it is extracted by Shaft mining.
- ✓ If coal is located on hill slopes then Adit mining is used to extract coal.

COAL EXTRACTION

The extraction of coal occurs by 3 main methods, which are Adit, Shaft and Opencast.

Adit Mining

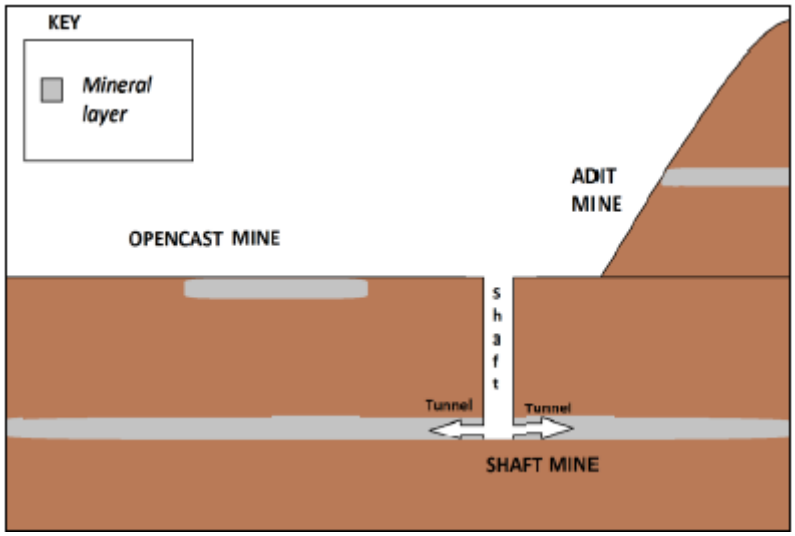
- ✓ Adit method of mining is used when a mineral layer is exposed near the surface of a hill.
- ✓ In this technique a single near horizontal or multiple layers are dug into the mineral layer.
- ✓ Explosives are used to blast and loosen the rock.
- ✓ Once this has been carried out, pillars and steel nets are installed.
- ✓ This prevents the roof of mine from caving in and steel nets prevent rocks from falling down and killing the miners.
- ✓ Then diggers are used to remove the mineral bearing rock and which is then transported by rail or donkeys to the mine entrance after which is loaded into trucks

Shaft Mining

- ✓ Shaft mining is used when the mineral layer is found deep in the soil.
- ✓ First a vertical layer is dug to reach the mineral layer.
- ✓ Once the mineral layer is reached then a horizontal layer is dug in both sides into the mineral layer.
- ✓ Explosives are used to blast and loosen the rock.
- ✓ Once this has been carried out then pillars and steel nets are installed.
- ✓ This prevents the roof of mine from caving in and steel nets prevent rocks from falling down and killing the miners.
- ✓ Then diggers are used to remove the mineral containing rock after it has been blasted apart by dynamites.
- ✓ This is then transported by rail to the lift, whereas then it is lifted to the surface to be transported by trucks.
- ✓ It must be noted that ventilation shafts are also dug along the length of mine along with main shaft to prevent the build-up of explosive odourless gases like methane.

Open Cast Mining

- ✓ Opencast mining is used when the mineral layer is exposed near the surface of the earth.
- ✓ Firstly the vegetation is cut, topsoil and subsoil removed.
- ✓ Then explosives are used to blast and loosen the rock.
- ✓ Then diggers are used to remove the mineral containing rock which is then transported by huge trucks carrying 500 tonnes in one go onto the surface.
- ✓ Opencast mine is a big hole in the ground with pathways for trucks running on the diameter of the mine



THREE MAJOR COALFIELDS

- ✓ SALT RANGE (PUNJAB) and MAKARWAL-GULLAKHEL COALFIELDS (KPK) (LIGNITE TO SUB-BITUMINOUS)
- ✓ QUETTA COALFIELDS (BALOCHISTAN) (BITUMINOUS/SUB-BITUMINOUS)
- ✓ LOWER SINDH COALFIELDS (SINDH) (LIGNITE)

MINING CENTERS

Dandot

- ✓ Salt Range Coalfield.

Pidh

- ✓ Salt Range Coalfield.

Khost-Sharig-Harnai

- ✓ Quetta coalfield.
- ✓ Largest and highest output in Pakistan.

Sor Range-Degari

- ✓ Quetta coalfield.
- ✓ 16 km east of Quetta.

Mach

- ✓ Quetta coalfield.
- ✓ 55 km north of Quetta.

Lakhra

- ✓ Lower Sindh coalfield.
- ✓ North of Hyderabad.

Jhimpir-Meting

- ✓ Lower Sindh coalfield.
- ✓ South of Hyderabad

Sonda-Thatta

- ✓ Lower Sindh coalfield.
- ✓ South of Jhimpir-Meting

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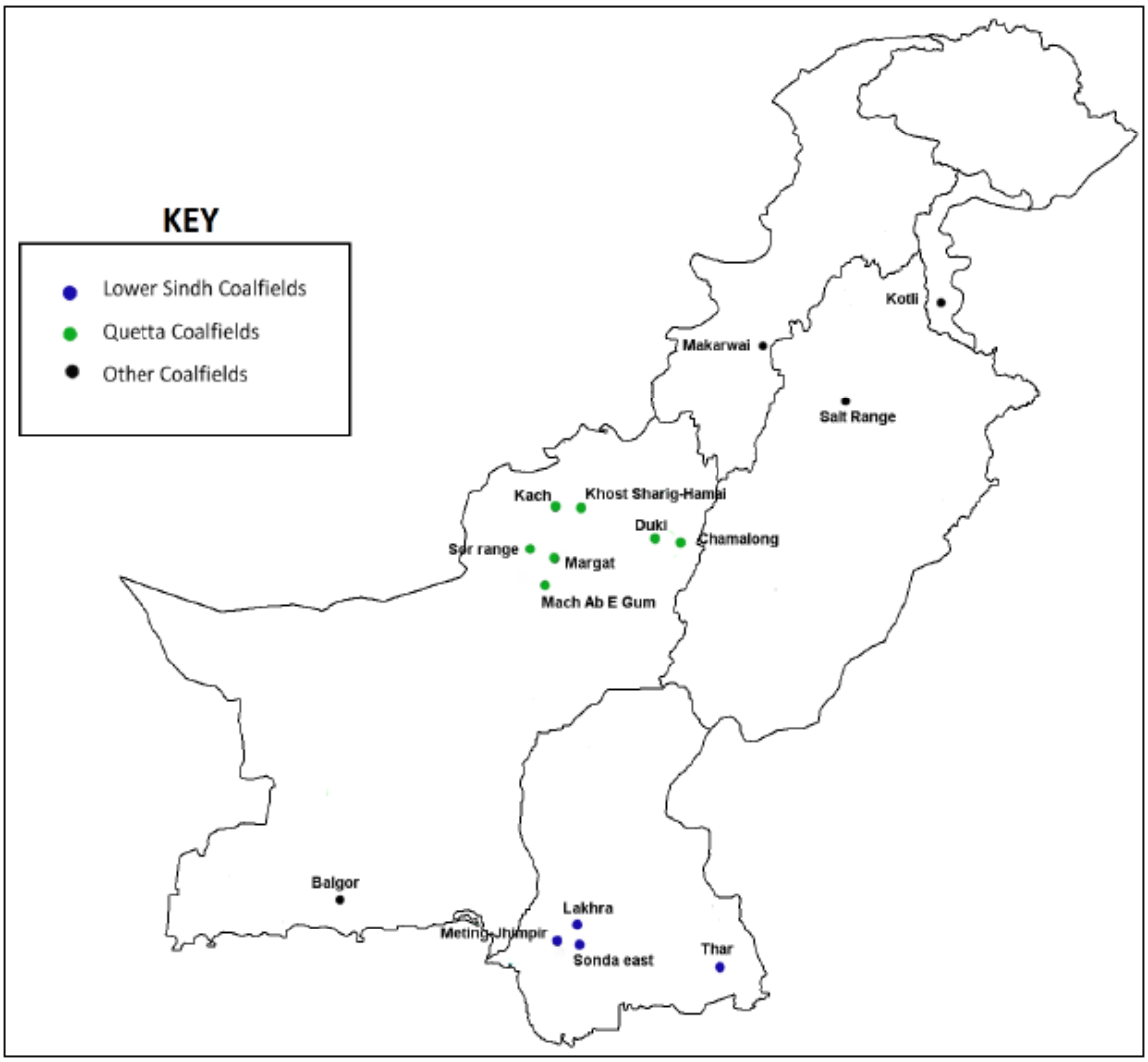
LOCATION OF COALFIELDS



WHY PAKISTAN HAVE LOW QUALITY COAL?

- ✓ Lignite Coal.
- ✓ Low burning temperature.
- ✓ Low carbon content.
- ✓ High Ash content.
- ✓ High Sulphur content.
- ✓ Reserves not developed.
- ✓ Difficult to mine.
- ✓ Few industries use coal as a fuel.
- ✓ Mining for good quality is risky.

WHY COAL HAS TO BE IMPORTED?

- ✓ Poor quality coal.
- ✓ Lack of technology.
- ✓ Lack of capital.
- ✓ Lack of government interest.
- ✓ Lack of skilled labor.
- ✓ Mainly imported from India, Australia and Brazil.

USES OF COAL

- ✓ Brick Kiln
- ✓ Power Generation
- ✓ Steel Making
- ✓ Industrial Uses
- ✓ Cooking

TRANSPORTATION OF COAL

- ✓ After the extraction of coal from the coal face, it is loaded onto trolleys, which run on a track, which leads from the coalmine to the outside surface.
- ✓ In some small coalmines donkeys are used as an underground transport.
- ✓ Once the coal comes out of the mine , the qualities of coal are separated and sold to the middleman who further loads it into trucks and supplies it to the brick kilns and cement factories where it used as a fuel.
- ✓ When the coal is supplied to thermal power stations, rail transport is also used if it is economically feasible.
- ✓ Brick kilns use 83 % of Pakistan's coal production.

PRACTICE QUESTIONS 1.1

Question 1 J2017/P2/Q3/B

(b) Study Fig. 4, which shows the amount of coal produced in Pakistan over the period 1980–2012.

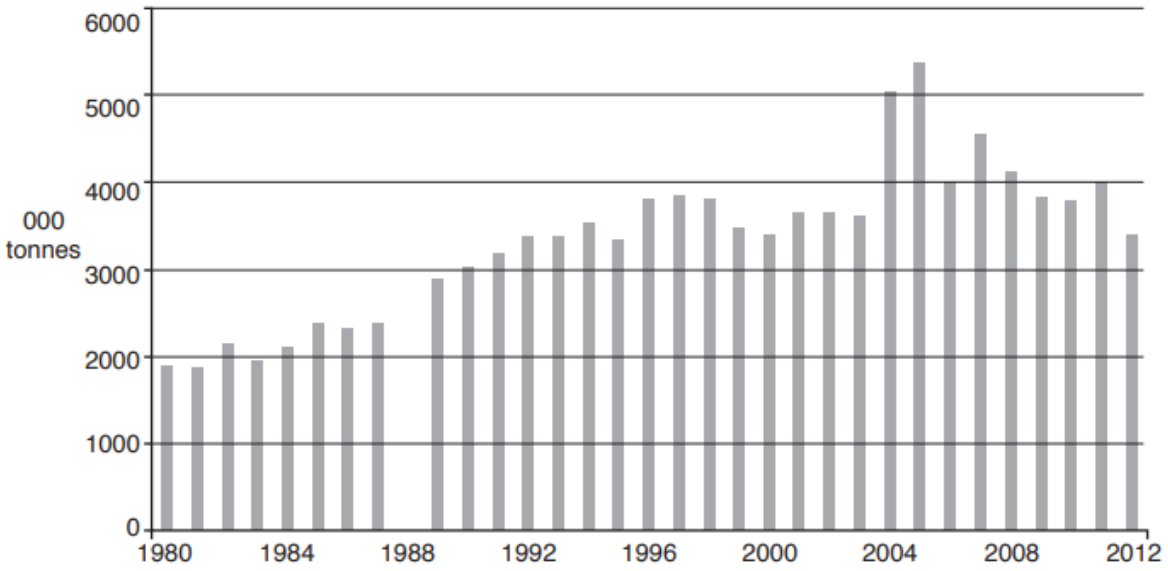


Fig. 4

(i) Name **two** coal producing areas in Pakistan.

1 .....

2 .....[2]

(ii) A Complete Fig. 4, by drawing the bar for 1988. The amount of coal produced in 1988 was 3 million tonnes.

B In which year did coal production peak?

.....

C How has coal production changed since its peak? (Circle) the correct answer.

increased decreased stayed the same [3]

(iii) Explain why the amount of coal being extracted in Pakistan has changed since its peak. You should develop your answer.

.....

.....

.....

.....

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.....

.....[4]

Question 2 N2016/P2/Q3/A

(a) Study Fig. 4 which is a diagram of a coal mine.

Type of mine .....

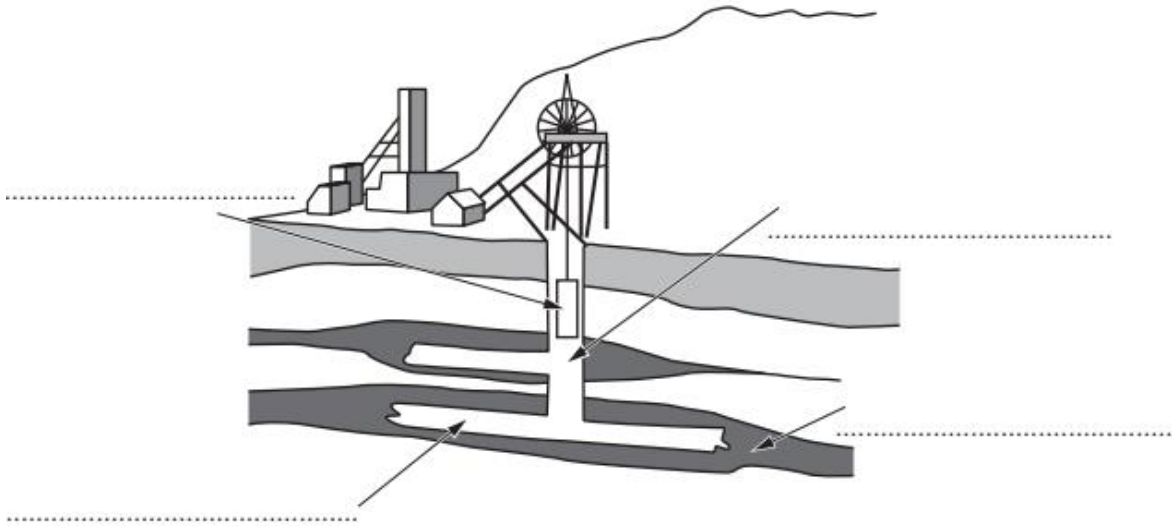

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Fig. 4

(i) Choose **two** terms from the list below and use them to label the diagram in any **two** of the spaces provided.

adit cage shaft open-cast seam tunnel [2]

(ii) Suggest **two** reasons for using this type of mine and **one** disadvantage of using it.

Reason .....

.....

Reason .....

.....

Disadvantage .....

.....[3]

(iii) What type of coal is imported by Pakistan and how is it used?

Type .....

Use .....

.....[2]

Question 3 J2014/P2/Q2/D

(d) (i) Name an area where coal is mined in Pakistan, and state **one** type of coal found there.

Name ..... Type of coal .....[2]

(ii) Give **two** reasons why most of the coal mined in Pakistan is called 'low quality'.

1 .....

2 .....[2]

Question 4 J2005/P2/Q4/A-C

(a) Study Fig. 4, a cross section showing two types of coal mine.

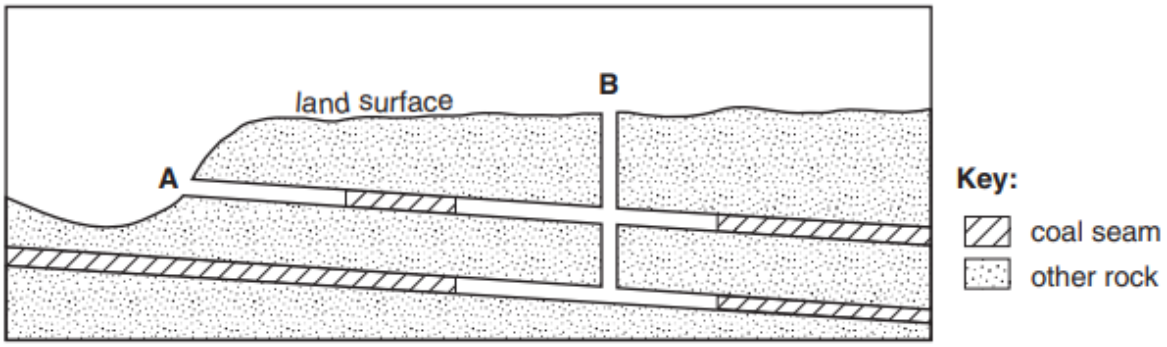

Fig. 4

For each of the mines **A** and **B**,

(i) name the type of mine, [2]

(ii) explain why that is the type of mine there, [2]

(iii) describe the method of mining. [5]

(b) Study the map Fig. 5 showing coalfields and coal mining centres in Pakistan.

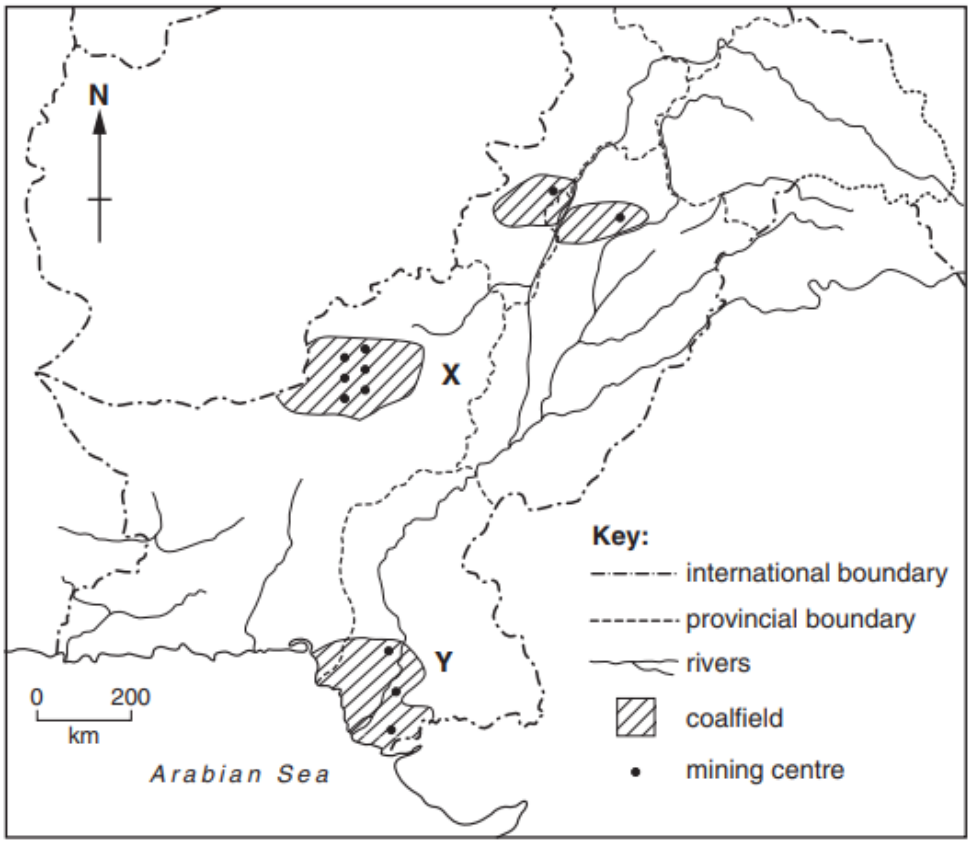

Fig. 5

(i) Name the coalfield **X** and **one** of the mining centres there. [2]

(ii) Name the coalfield **Y** and **one** of the mining centres there. [2]

(iii) State the **two** main uses of the coal mined in coalfield **X**. [2]

(c) Explain why coal has to be imported. [3]

CRUDE OIL

- ✓ Viscous and impure oil.

OIL DRILLING

- ✓ Oil occurs in porous spaces of sedimentary rock and is derived mainly from decomposition of marine animals.
- ✓ Once drilling site has been selected, a derrick is setup.
- ✓ Once the depth is found, pipes are setup.
- ✓ Physical surveys are conducted to find out oil and gas reservoirs. Different facilities are installed on the surface such as vibratory trucks. Wire lines are laid down and Geophones are placed.
- ✓ An explosion takes place and sound waves are produced. These sound waves when reaches reservoirs, reflect back to the surface and are detected by geophones. The graphical reading helps to locate the location of oil and gas.
- ✓ Then the facilities are removed from the surface and an oil rig or gas rig is installed. They help in drilling out oil. It is also known as derrick.
- ✓ In a derrick, different instrument are installed. There is a cable, and a travelling block is installed on it. At the end of travelling block is a swivel. At its end is a drill pipe, which is fixed on a rotator table.
- ✓ At the end of drill string is another pipe called drill bit. Diamond or steel is stuck on it. Another pipe is attached to swivel is called mud pipe. Mud pipe is fixed in mud pump. When the rotator table will rotate, drill string will rotate with drill bit. This will make a hole (well). If this process keeps on going, the drill bit and the whole pipe will go in the subsurface. Again they will install a new pipe on the top of the first one. We will keep on adding pipes until we reach the reservoirs.
- ✓ During the process of drilling, there is a friction between drill and well and this can make the drill blunt.
- ✓ Sand is also to be brought out as you are digging so well so they keep adding on mud with the drilling and sand cuttings inside came out automatically from the sides.
- ✓ Once oil rig is ready for production, the Derrick is removed. Another facility is installed called a Christmas tree which controls the well pressure and indicates the well pressure.

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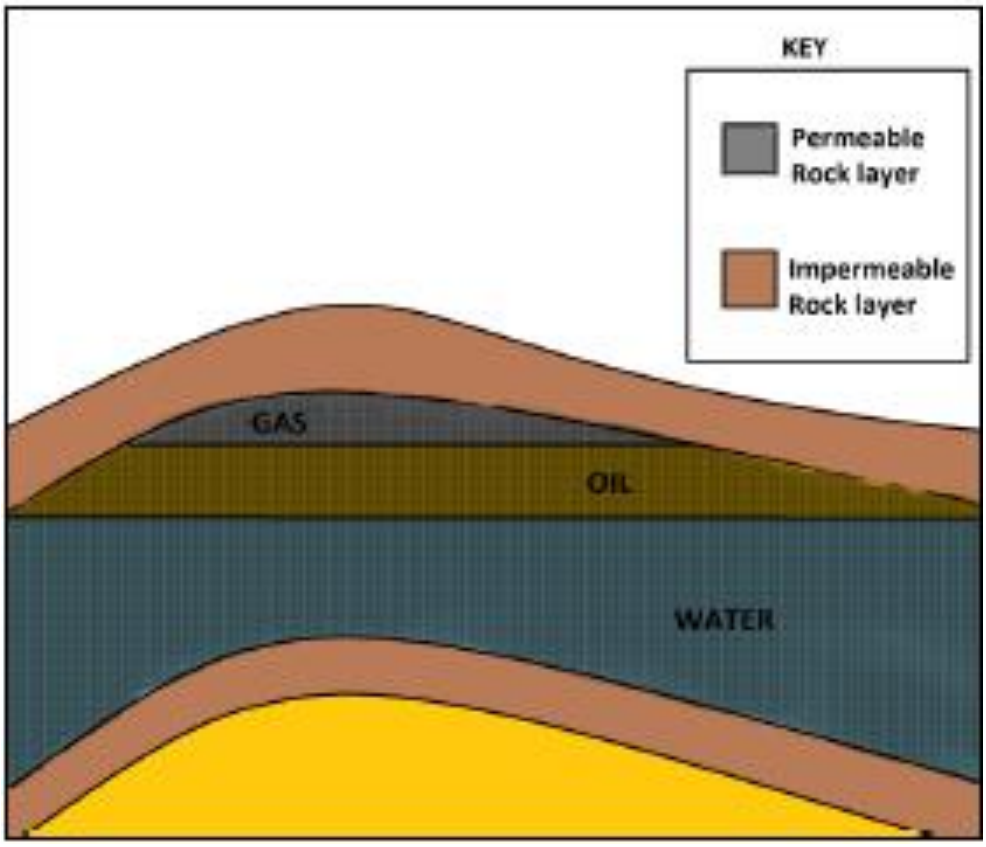
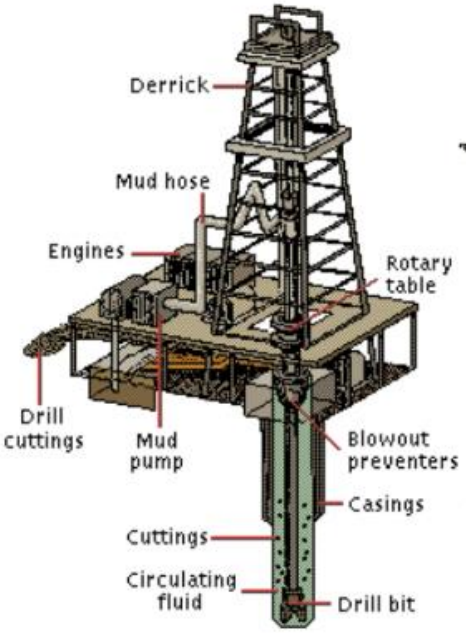
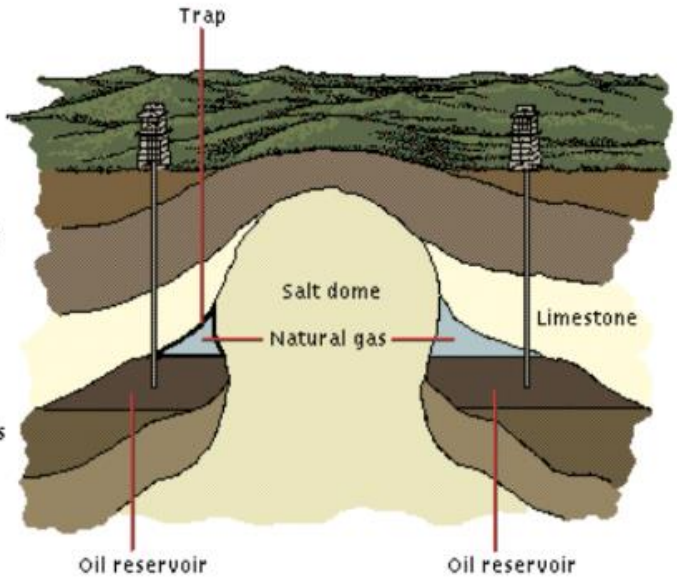
OIL TRAP



OIL DRILLING



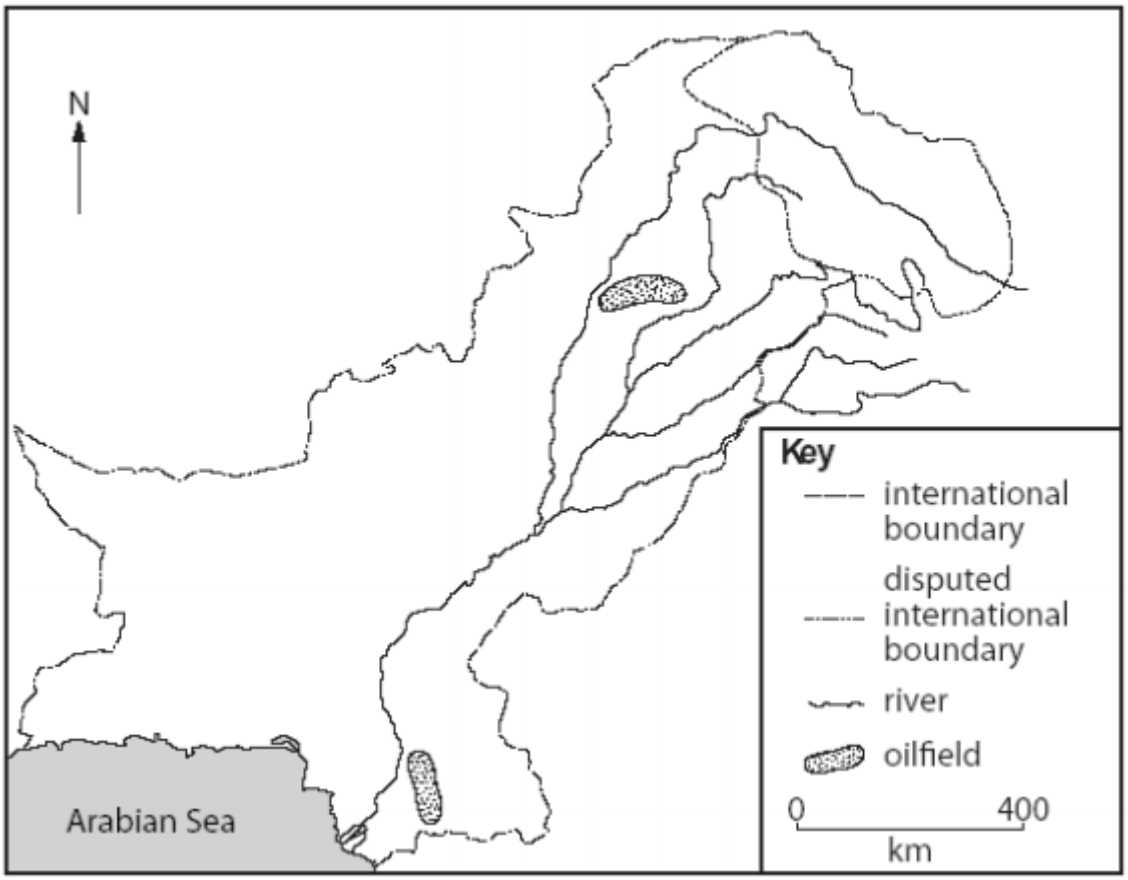


OILFIELDS

- ✓ UPPER PUNJAB (Between River Indus & Jhelum)
- ✓ LOWER SINDH (Southern side) (Hyderabad)

OIL REFINERIES

- ✓ Crude Oil cannot be used in raw state.
- ✓ It has to be refined into useful products like Kerosene, Petroleum, Diesel and other Lubricant oil.
- ✓ These refineries process crude oil → through fractional distillation → after which different products are obtained e.g. wax.
- ✓ Attock Refinery – (Morga, Potwar Plateau)
- ✓ NRL – National Refinery Limited (Korangi, Karachi)
- ✓ PRL – Pakistan Refinery Limited (Korangi, Karachi)
- ✓ Parco Refinery – Pak Arab Cooperation (Multan, Mehmood Kot)
- ✓ Hub Refinery – (Hub, Baluchistan)



WHY DO WE IMPORT OIL?

- ✓ Pakistan produces 55,000 barrels per day.
- ✓ Requirement is 400, 000 barrels per day.
- ✓ Oil production is small
- ✓ Pakistan cannot satisfy its needs
- ✓ Resources not exploited
- ✓ Growing demand for population
- ✓ More industries
- ✓ Mechanization of agriculture
- ✓ Most thermal stations use oil

PROBLEMS OF IMPORTING OIL

- ✓ Negative trade balance
- ✓ Economy go down
- ✓ Uses for exchange
- ✓ Creditors increase influence over Pakistan's affairs
- ✓ Less money for investment and to spend in education, agriculture and health
- ✓ More tax is composed
- ✓ Cannot afford to exploit new oil fields.

TRANSPORTATION OF OIL

Imported Oil

- ✓ Imported Oil (from K.S.A, U.A.E., Kuwait)
- ✓ Sea imports by oil tankers at Kemari Port and Port Qasim
- ✓ Oil Pier (Platform with oil handling system)
- ✓ Oil products pumped from oil tankers
- ✓ Storage Tanks
- ✓ Pumped through Pipeline and Tankers
- ✓ Oil Refinery

Local Oil

- ✓ Transported by tankers from oil field → Refinery

Transportation of Oil on Land

- ✓ Tankers
- ✓ Rail
- ✓ Pipeline

Transportation of Oil from Kemari Port

- ✓ Pipeline
- ✓ Transported from Tanker
- ✓ From Oil Terminal at Kemari
- ✓ To NRL, PRL and Hub

Transportation of Refined Oil

- ✓ Road → Petrol Station
- ✓ Rail Tankers → Furnace oil → Thermal Power Station.

USES OF OIL

Transport

- ✓ Cars, trucks, railways etc.

Power

- ✓ Thermal power stations to produce electricity.

Industry

- ✓ Chemical, wax, rubber, plastic etc.

Domestic

- ✓ Detergents, heating, cooking.

Government

- ✓ Transport, public utilities.

Agriculture

- ✓ Tube wells, insecticides, tractors, pesticides, for road making to practice agriculture.

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WHITE OIL PIPELINE PROJECT

- ✓ In 2002 PARCO launched a white oil pipeline project (WOPP) which will carry refined oil from Karachi to the north.
- ✓ After conversions of PARCO's existing pipeline network for crude oil transportation, the white oil pipeline will be used for the transport of refined petroleum products to the central and northern regions of Pakistan.
- ✓ These areas account for almost 60 % of the total petroleum consumption in the country.
- ✓ Bin Qasim Port will be the initial point of the white Oil Pipeline project.
- ✓ The new underground pipeline costing $480 million will also carry refined oil from the Pakistan oil refinery at port Qasim to Mahmood Kot in district Muzaffargarh covering a distance of 817 KM.
- ✓ The demand for petroleum products is rising at a rate of 10 % per annum.

PRACTICE QUESTIONS 1.2

Question 1 J2017/P2/Q5/A

(a) Study Fig. 7, which shows the amount of oil produced in Pakistan and the amount of oil imported, for selected years.

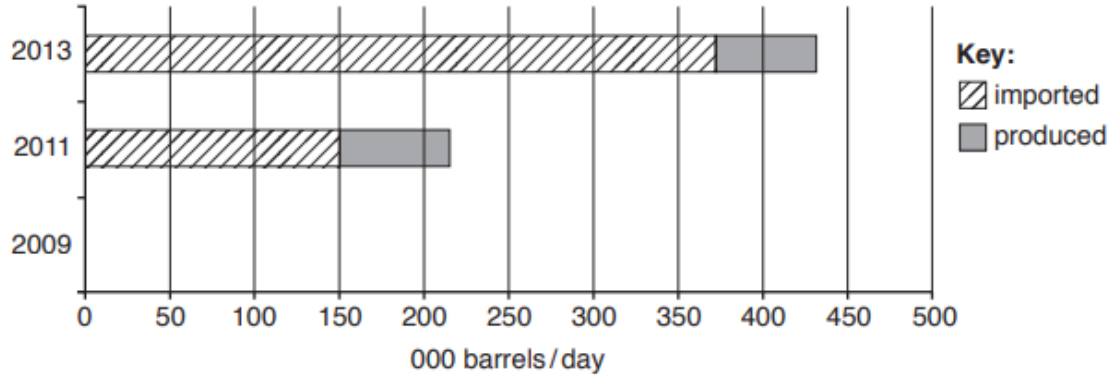


Fig. 7

(i) Name the location of **one** oil refinery in Pakistan. Give **one** reason to suggest why it is located there.

Location .....

Reason .....

.....[2]

(ii) Complete Fig. 7 by drawing the bar for 2009, using the information below:

2009	Barrels/day
Imported	185 000
Produced	60 000

[1]

(iii) Compare the amount of oil produced and the amount of oil imported in Pakistan in the years 2011 and 2013.

.....

.....

.....

.....[2]

(iv) Give **two** reasons why Pakistan imports large amounts of oil.

1 .....

.....

2 .....

.....[2]

Question 2 J2014/P2/Q2/A-C

(a) Study Fig. 2, a cross section showing an oil trap.

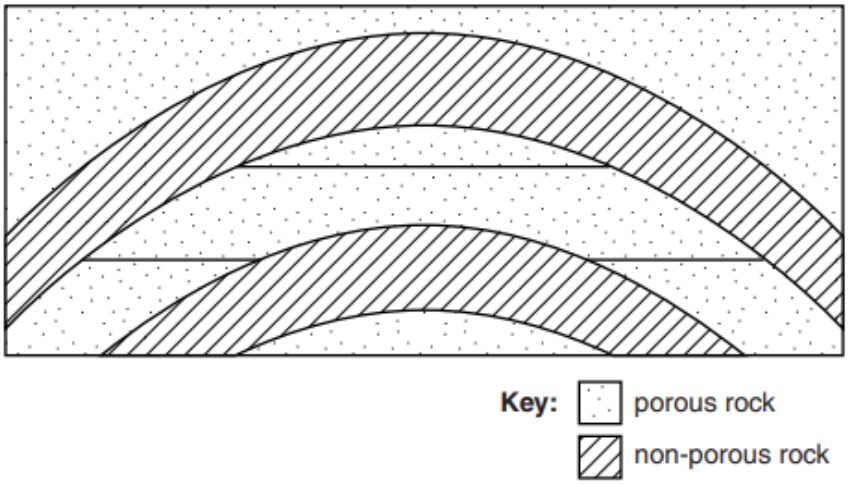


Fig. 2

(i) Label on the diagram

A the layer of rock containing oil.
B the layer of rock containing gas. [2]

(ii) What is meant by the term 'porous rock'?

.....

.....[1]

(iii) Why is the feature in Fig. 2 called 'an oil trap'?

.....

.....

.....

.....[2]

(b) Study Fig. 3 which shows the uses of oil.

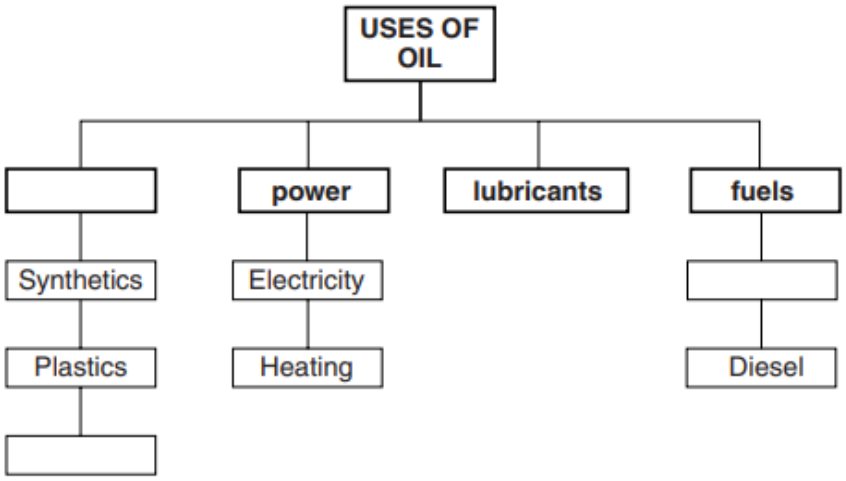


Fig. 3

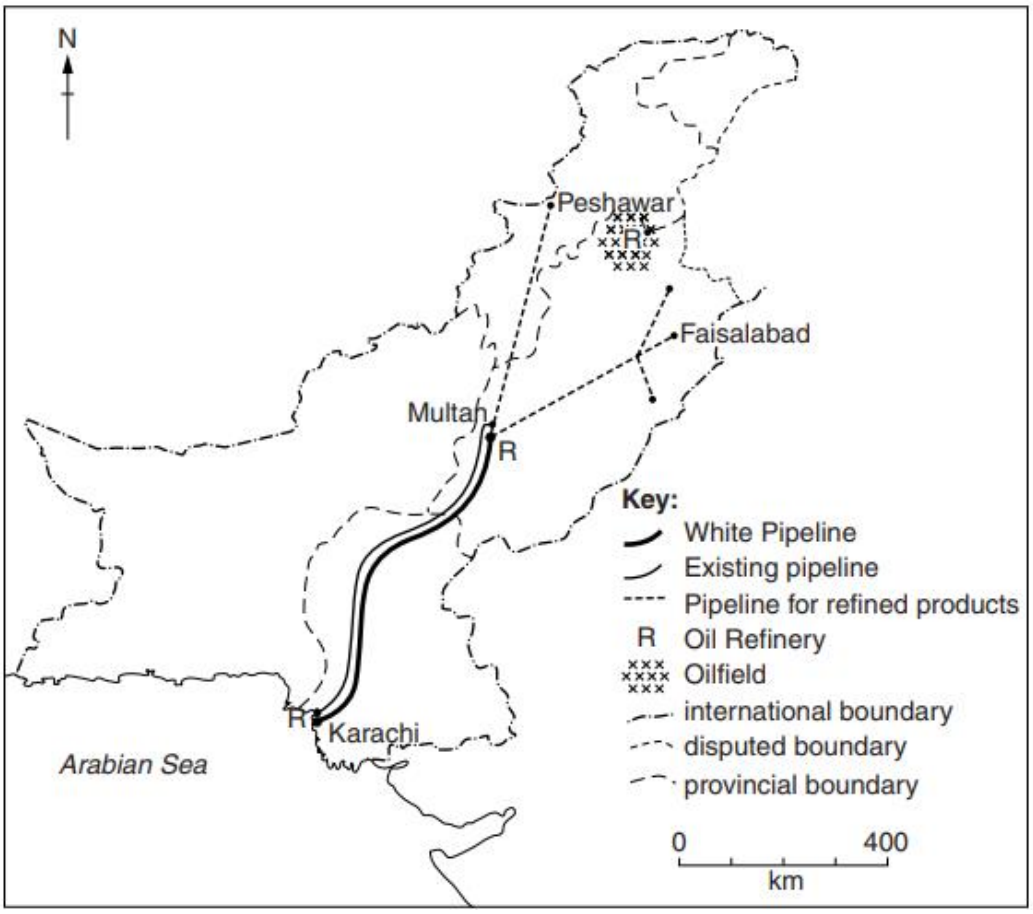
Choose **three** of the following terms below to complete Fig. 3.

by-products raw materials pesticide

petrol biogas bagasse

[3]

(c) Study Fig. 4, a map showing oil refineries and pipelines in Pakistan.



(i) Name and locate the oil refinery marked on the oilfield in Fig. 4.

Name ..... Location .....[2]

(ii) Name **one** refinery where imported oil is processed.

.....[1]

(iii) Explain the importance of the White Pipeline, and other pipelines to the development of Pakistan.

.....

.....

.....

.....

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.....[4]

Question 3 N2009/P2/Q4/B

(b) Study Fig. 8, a map of Pakistan.

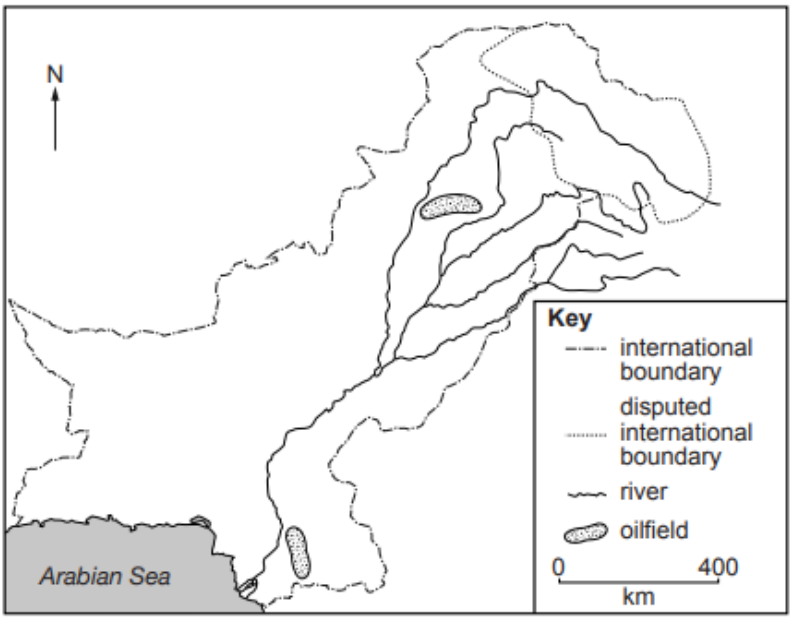

Fig. 8

(i) Describe the location of the **two** main oil fields shown on the map. [2]

(ii) What is crude oil? [1]

(iii) Why does Pakistan import most of its oil? [2]

Question 4 N2006/P2/Q3/A-C

(a) **(i)** Locate an oil refinery near the coast, and give **one** reason why it is there. [2]

(ii) Locate an oil refinery in the province of Punjab, and give **one** reason why it is there. [2]

(b) State **two** ways in which refined oil can be transported in Pakistan, and give an advantage and disadvantage of each. [6]

(c) Study Fig. 3 which shows some examples of the four main uses of oil.

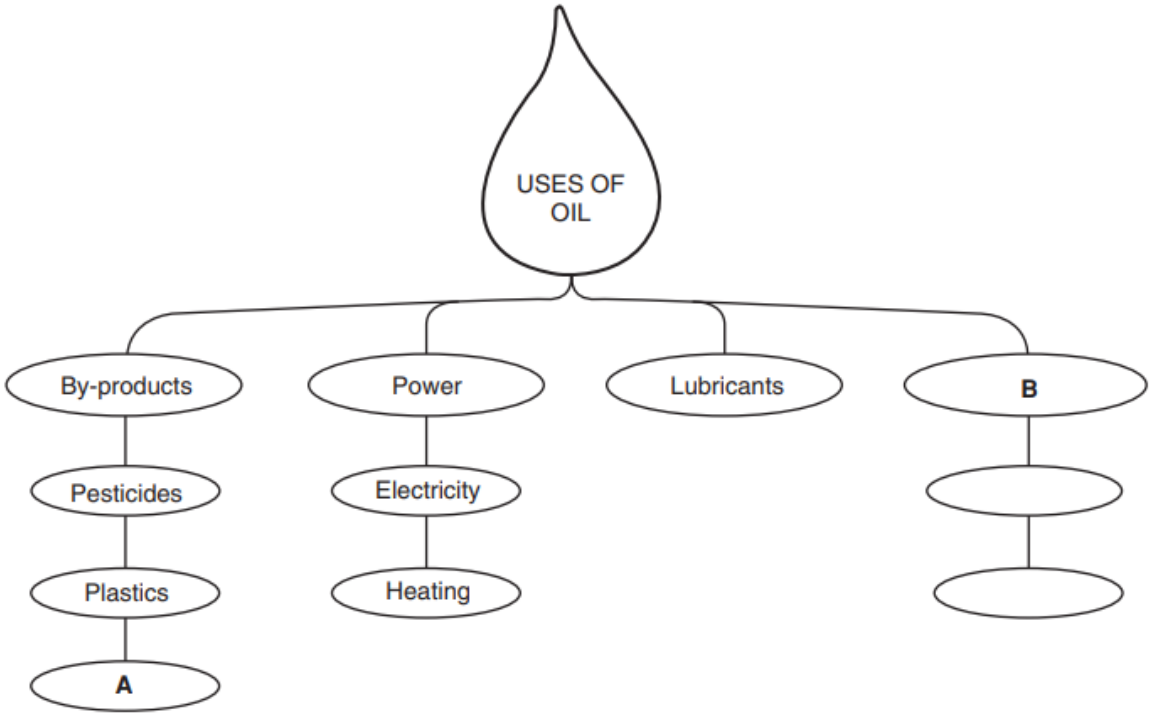

Fig. 3

(i) Name another by-product **A**. [1]

(ii) Name the fourth main use of oil **B**. [1]

(iii) With reference to Fig. 3 and using your own knowledge, explain how oil products are important to **either** farming **or** manufacturing. [6]

Question 5 N2005/P2/Q3/A-B

Study Fig. 5 a cross section showing an anticline oil trap.

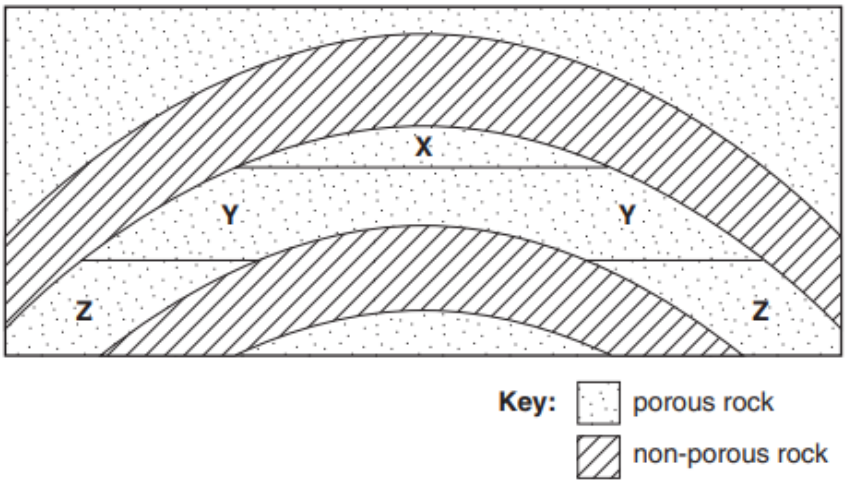

Fig. 5

(a) On your answer paper state the letter for the following,

(i) the area of rock containing oil, [1]

(ii) the area of rock containing natural gas. [1]

(b) (i) What is meant by the term 'porous rock'? [1]

(ii) Why is the feature in Fig. 5 called an oil 'trap'? [3]

(iii) How is oil extracted from this 'trap'? [5]

NATURAL GAS

- ✓ Made up of many gases methane, ethane, propane and butanes.
- ✓ When it is cooled to very low temperature it turns into a liquid (LPG).
- ✓ Colorless and Odourless

WHY SMELL ADDED TO NATURAL GAS?

- ✓ Colorless and Odourless.
- ✓ People will not be able to detect it until it becomes explosive.
- ✓ A chemical called Mercaptan is added to the gas.
- ✓ Mercaptan is harmless, non-toxic and has a strong "rotten egg" smell.

MAIN GAS FIELDS

- ✓ SUI (Balochistan) (7,423 million cubic metres)
- ✓ PIRKOH (Balochistan) (410 million cubic metres)
- ✓ MARI (Lower Sindh) (1876 million cubic metres)
- ✓ MEYAL (Potwar) (268 million cubic metres)
- ✓ DHURNAL (Potwar) (116 million cubic metres)

USES OF NATURAL GAS

- ✓ Power generation.
- ✓ Cooking and heating.
- ✓ For cement.
- ✓ For Fertilizers.
- ✓ For Vehicles.

SECTORAL CONSUMPTION OF GAS

- ✓ Power 29.44 %
- ✓ Fertilizer Industry 24.36 %
- ✓ Household 21.60 %
- ✓ Industry 19.40 %
- ✓ Commercial 03.27 %
- ✓ Cement Industry 01.89 %
- ✓ Transport 00.66 %

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TRANSPORTATION OF GAS

- ✓ Natural gas is transported on land by two means; pipelines and cylinders.
- ✓ The use of cylinders means that only little amount of gas can be carried at once.
- ✓ Refilling takes time, risk of explosion due to faulty cylinders is an added concern.
- ✓ The cylinders are heavy and difficult to move.

GAS PIPELINE

PRACTICE QUESTIONS 1.3

Question 1 N2016/P2/Q3/B

(b) Explain what the fuel CNG is and state the main reasons for using this fuel.

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.....[4]

Question 2 N2015/P2/Q2/A

(a) **(i)** Study Fig. 2, which shows the usage of natural gas in Pakistan in the year 2010–11.

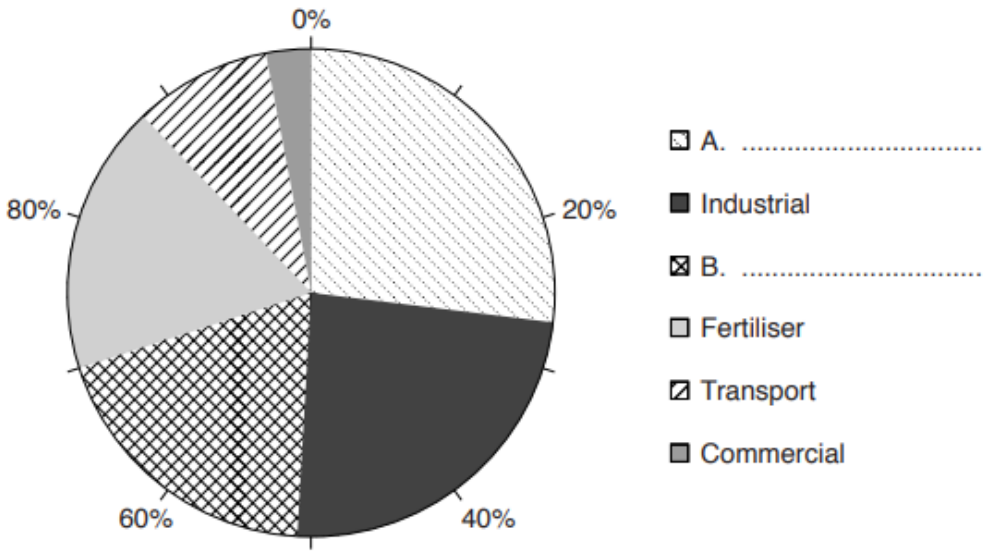


Fig. 2

In the key, name the activities A and B which are two of the main users of natural gas in Pakistan. [2]

(ii) State **two** ways in which gas is transported to homes in Pakistan.

1 .....

2 .....[2]

Question 3 N2009/P2/Q4/C

(c) Study Photograph B (Insert), a gas extraction unit at Nautheh in the Potwar Plateau.

(i) With reference to Photograph B, explain why natural gas is an easy fuel to extract. [3]

(ii) Study Fig. 9, an advertisement for natural gas.

Fig. 9

Suggest why this advertisement states that natural gas is 'A cheap fuel. Easy to use.' [4]

Question 4 J2007/P2/Q4/A-B

(a) Study Fig. 4, which shows the gas pipelines in Pakistan.

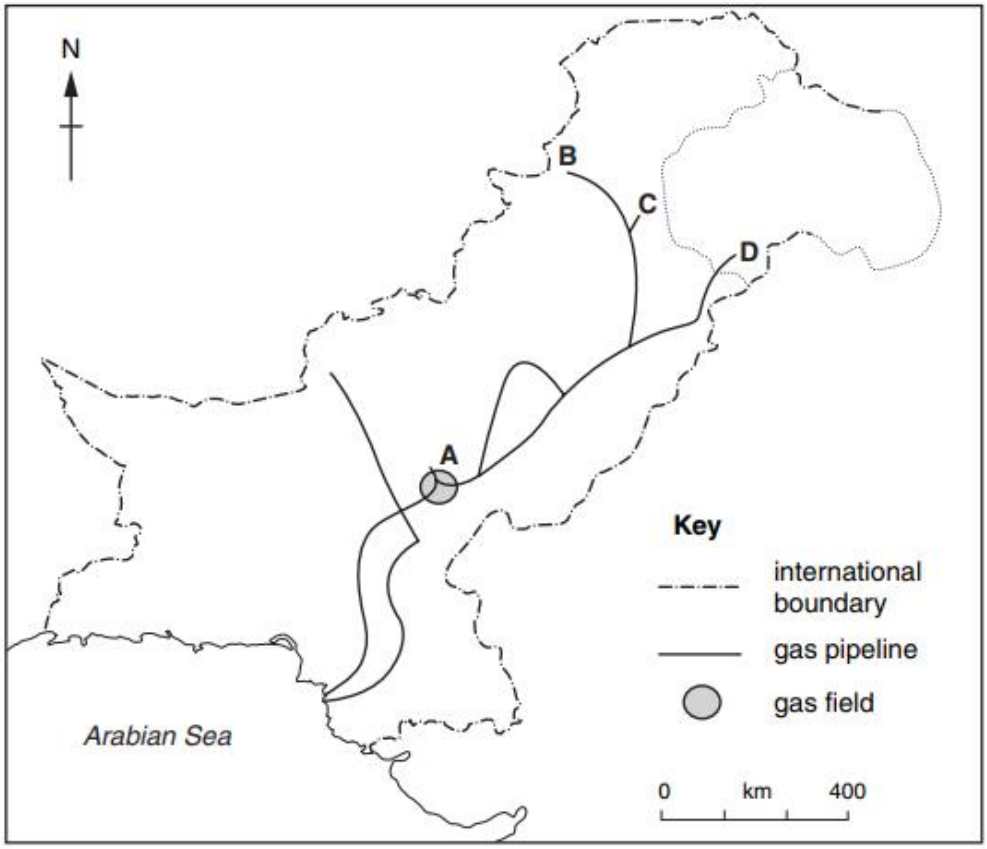


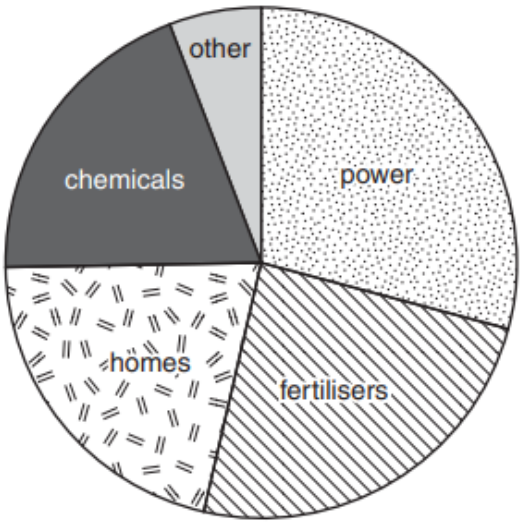
Fig. 4

(i) Name the gas field **A**. [1]

(ii) Name the cities **B**, **C** and **D** at the ends of the gas pipelines. [3]

(iii) State **two** ways in which gas can be supplied to areas away from pipelines. [2]

(b) Study Fig. 5, which shows the uses of natural gas in Pakistan.



(i) State the largest use of natural gas. [1]

(ii) Name a use in the 'other' sector. [1]

(iii) What is natural gas used for in homes and why is this fuel chosen? [3]

(iv) Why is natural gas called 'non-renewable'? [1]

Question 5 N2006/P2/Q3/D

(d) (i) Which gas field produces most natural gas in Pakistan? [1]

(ii) Name **two** industries in Pakistan that use natural gas as a raw material. [2]

(iii) Why is natural gas an important fuel in Pakistan? [4]

PRACTICE QUESTIONS 1.4

Question 1 N2016/P2/Q3/C

(c) Study Fig. 5 which is a graph giving information about different non-renewable fuels used for electricity production in Pakistan over the period 2006–11.

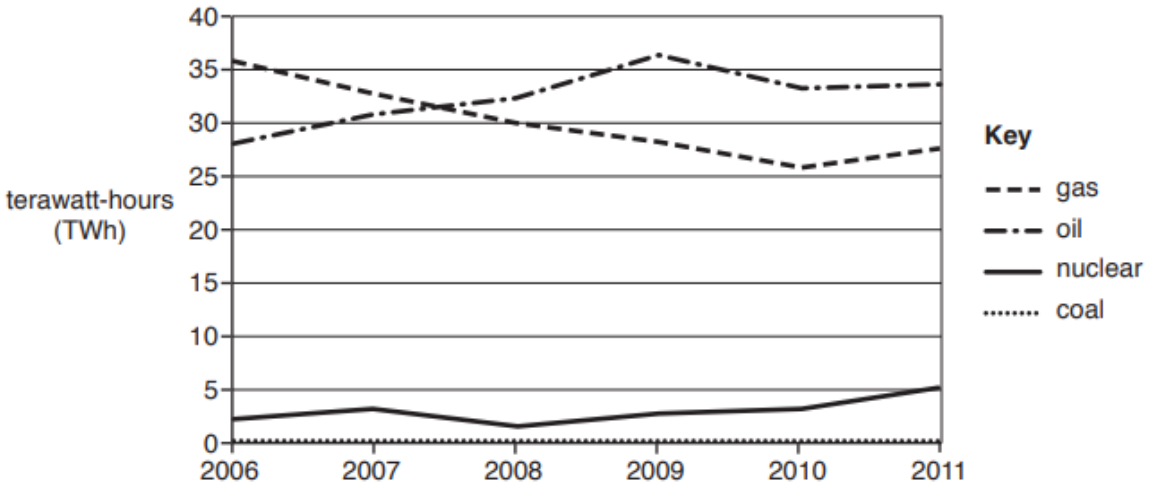


Fig. 5

(i) What is meant by the term 'non-renewable fuel'?

.....

.....

.....

.....[2]

(ii) Which fuel use has increased by the largest amount between 2006 and 2011?

.....[1]

(iii) Use information from the graph to describe **one** main difference between the change in gas used for electricity production and the change in oil used for electricity production.

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.....[2]

(iv) Explain why so little coal is used for electricity production in Pakistan.

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.....[3]

Question 2 J2013/P2/Q4/C

(c) Study Fig. 6, which shows the percentages of fuels used for electricity supply.

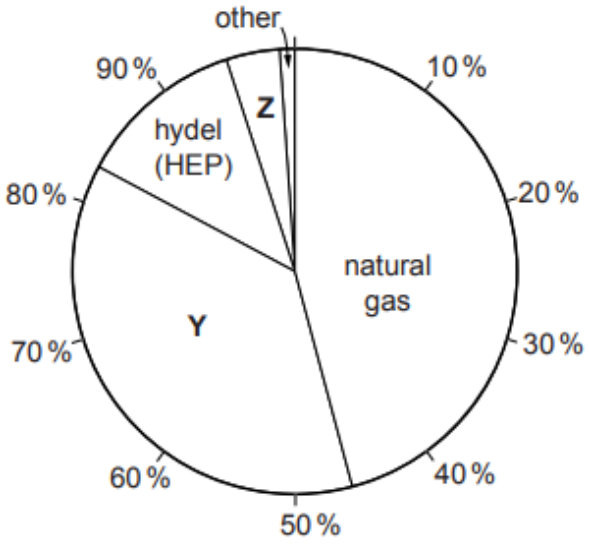

Fig. 6

(i) Use Fig. 6 to state the percentage of electricity generated from natural gas.

.....[1]

(ii) Name the **two** other fossil fuels **Y** and **Z**, and explain why each is used less than natural gas.

Y ..... **Z** .....

explanation .....

.....

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.....[3]

Question 3 N2009/P2/Q4/A

(a) Study Fig. 7, a pie chart showing the sources of energy supply.

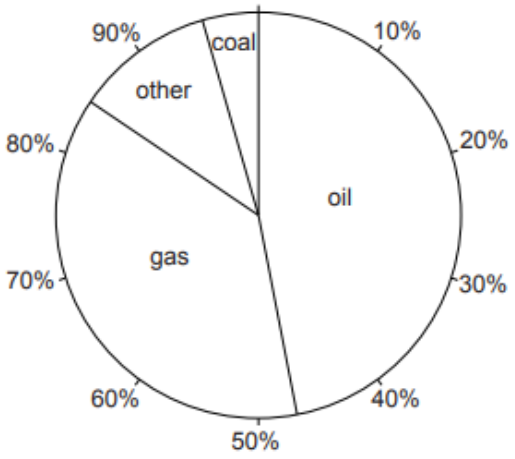

Fig. 7

(i) Name the **two** largest sources of energy. [1]

(ii) What percentage of energy comes from oil? [1]

(iii) Name **two** other sources not named on the pie chart. [2]

(iv) Why does coal only supply 4% of the energy supply in Pakistan? [3]

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LOAD SHEDDING

Planned powercuts by the supplier of electricity is known as Load Shedding.

EFFECTS OF LOAD SHEDDING

- ✓ Interrupts production
- ✓ Damages machinery
- ✓ Cannot meet deadlines
- ✓ Loss of quality
- ✓ Loss of orders
- ✓ Loss of money/profit
- ✓ Cost of generators
- ✓ Lights/computers/freezers/air conditioning/heating etc. stops
- ✓ Transport/traffic problems

WHY ELECTRICITY CAN'T MEET THE DEMANDS?

- ✓ Population increasing so greater demand.
- ✓ Little new investment in new power stations (foreign investors less willing to invest due to political instability) (other government priorities such as healthcare/ education/housing/transport/alleviating poverty);
- ✓ Pakistan has small/inaccessible/depleting fossil fuel reserves (fossil fuels expensive to extract/poor quality/ have to import);
- ✓ Renewable energy plants expensive to construct;
- ✓ Power losses due to old/long transmission lines;
- ✓ Power theft (people diverting existing power sources for their own use);
- ✓ Most people live in rural areas (electricity does not reach there/lack of infrastructure/power lines);
- ✓ Many power plants are not working to full capacity (as a result of siltation in dams and reservoirs)/(they are still under construction);
- ✓ Power breaks down (lack of expertise to handle it)/(due to old machinery);
- ✓ More rural to urban migration (means demand cannot be fulfilled);
- ✓ Seasonal variations (less HEP generation in winter as less rainfall/snowmelt at times of peak demand).

SUPPLYING ELECTRICITY TO RURAL AREAS

Possibilities

- ✓ Extend national grid
- ✓ Increase (national) power generation/nuclear power

- ✓ More/good potential for renewable schemes, wind, solar, HEP
- ✓ More small-scale power generation schemes E.g. biogas using animal/plant waste/molasses

Difficulties

- ✓ High cost of technology/fuel/maintenance
- ✓ Theft
- ✓ Damage/energy loss… …Due to long transmission lines/siltation in reservoirs for HEP
- ✓ Distance from grid stations/remoteness of some rural areas
- ✓ Tribal opposition
- ✓ Insufficient power generation… …So urban needs met first
- ✓ Lack of government support/loans/investment/policies
- ✓ Difficult construction in rugged/mountainous terrain
- ✓ Lack of skilled personnel, e.g. engineers

PRACTICE QUESTIONS 1.5

Question 1 J2017/P2/Q5/B

(b) Study Fig. 8, which shows population and electricity production in Pakistan over the period 2000–2014.

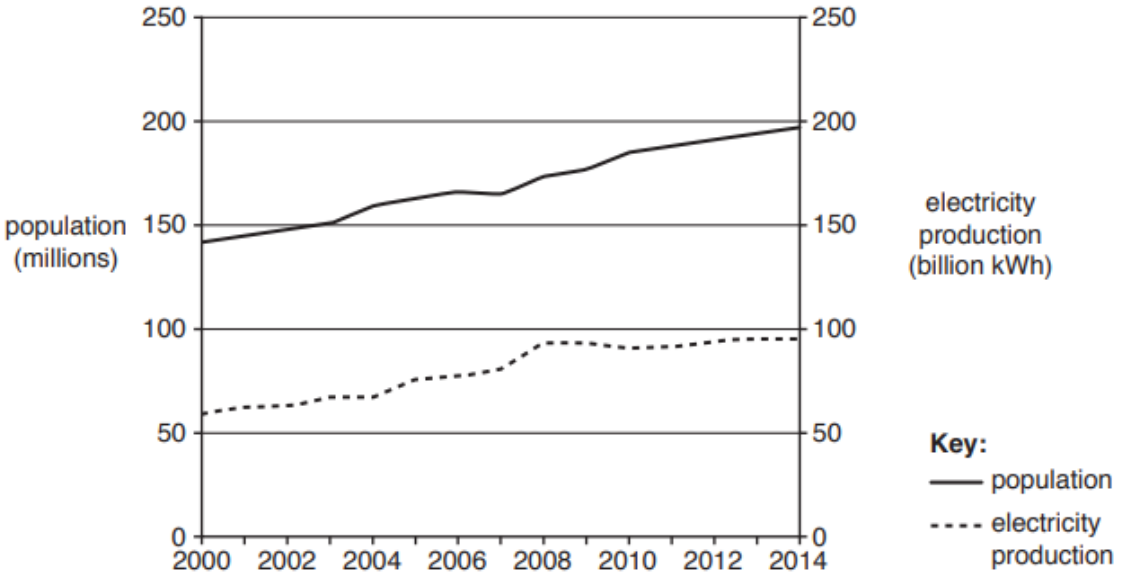

Fig. 8

(i) A Describe the relationship between population and electricity production from 2000 to 2008.

.....

.....

B Describe the changes in population and electricity production since 2008.

.....

.....[2]

(ii) Explain why electricity production does not meet the demand for electricity in many parts of Pakistan. You should develop your answer.

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.....[4]

Question 2 N2016/P2/Q3/D

(d) Read the following article:

> Energy crisis
>
> Industrial growth in Pakistan relies on the availability of energy. Pakistan does not produce enough energy for its needs and therefore spends a lot of its earnings on expensive imports of fuels.

Describe briefly different measures that can be taken to solve the country's energy crisis. To what extent can these measures be successful?

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.....[6]

Question 3 N2013/P2/Q4/D

(d) To what extent is it possible to increase the electricity supply to rural areas?

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.....[6]

Question 4 J2013/P2/Q4/B

(b) Explain why the supply of electricity is not reliable in many parts of Pakistan.

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.....[4]

Question 5 J2008/P2/Q5/C

(c) Study Fig. 5, a pie chart showing the different users of electricity in Pakistan.

(i) Which sector uses the largest percentage of electricity? [1]

(ii) State **two** more large users of electricity shown on the chart and explain what they use it for. [4]

(iii) What problems are caused when the electricity supply to factories breaks down? [4]

Question 6 N2005/P2/Q3/E

(e) What is 'load shedding' and how does it affect industry and business in Pakistan? [4]

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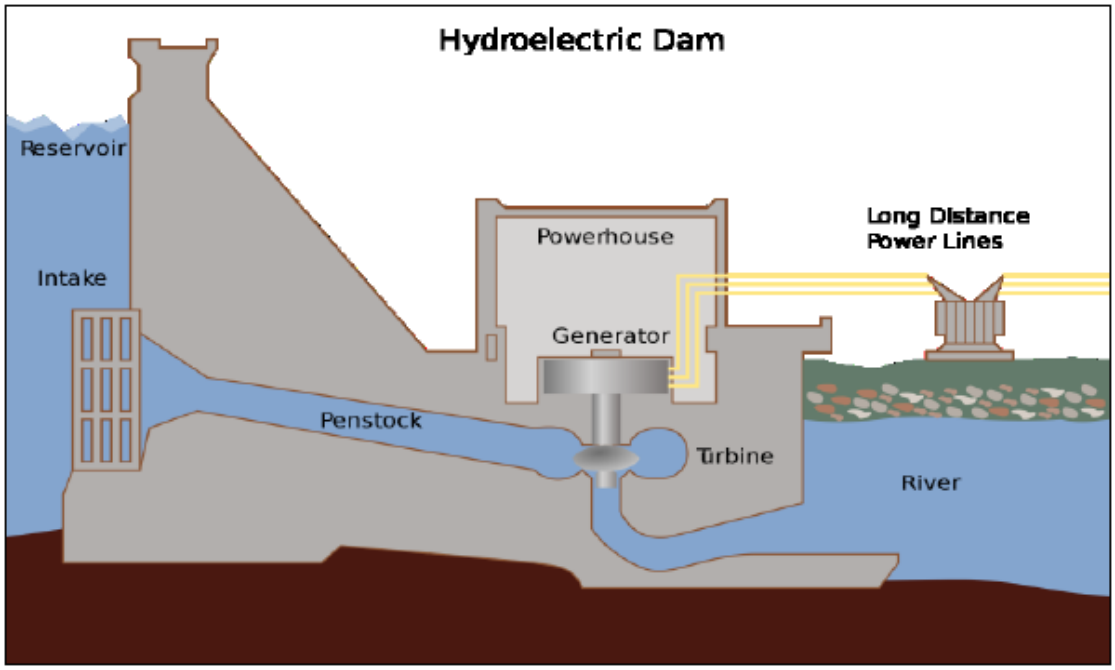
HYDROELECTRIC POWER

- ✓ This is the most important source of renewable energy in the world today.
- ✓ Hydroelectric power stations use the force of running water to turn turbines, which turn the generator in a magnetic field, thus generating electricity.



CONDITIONS THE LOCATION OF HEP SETUP

- ✓ A deep valley thus which can carry more water leading to more force at which turbines are turned. Also, a deep valley means that the water has more time to speed up and gather momentum before it hits the turbines.
- ✓ A narrow valley to make sure that construction cost of dam for concrete etc remain low and project is feasible due to the technical difficulties in building a wider dam wall.
- ✓ A large reservoir so to store any un-required surge of water which might have been wasted during rainy seasons. If this water is stored in the reservoir then it can be used in future months to generate electricity.
- ✓ The dam must not be located at or near a fault line. These areas are prone to earthquakes, which can fatally lead to dam failures, sudden flash floods and tragic loss of life.
- ✓ Impermeable layers of soil to prevent seepage and making sure that the reservoir of dam doesn't lose water too quickly.
- ✓ River basin that is fed by glaciers. The glaciers melt and provide water. Also, the drainage basin must be large and be under influence of the monsoons etc.

- ✓ River must pass through forested areas so that river carries low amount of silt. Trees roots bind the soil together and prevent flash floods (which erode more land) as they slow down the descent of rainfall. If this silt starts accumulating behind a dam wall it can cause some serious problems and reduce life of dams either by reducing their capacity or blocking spillways etc.
- ✓ The average temperatures of the surrounding areas should be low, to keep the rate of evapo-transpiration to a minimum.
- ✓ The dam must be located in a lowly populated area so the rehabilitation cost of citizens who are displaced is low.

PRACTICE QUESTIONS 1.6

Question 1 J2016/P2/Q4/A

(a) (i) Study Fig. 7 which is a diagram of an HEP (Hydel) power station.

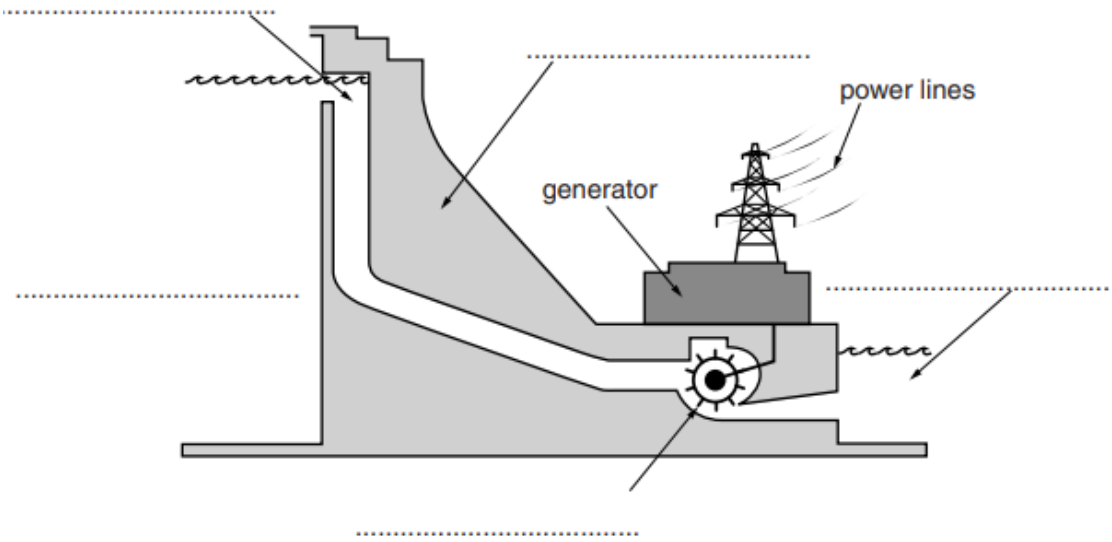


Fig. 7

A. **On the diagram** place an arrow or arrows to indicate the direction of movement of water through the power station.

B. Choose **two** terms from the list below and use them to label the diagram in **two** of the spaces provided.

outflow turbine reservoir dam [3]

(ii) Name **one** multi-purpose dam in Pakistan.

.....[1]

(iii) Give **two** uses for a dam such as the one you named in **(ii)**.

1 .....

2 .....[2]

Question 2 N2013/P2/Q4/C

(c) (i) With reference to water supply and relief (topography) explain why it might be possible to build more HEP (hydel) power stations in areas such as that shown in Photograph C (Insert).

Water supply .....

.....

.....

.....

Relief (topography).....

.....

.....

.....[4]

(ii) Give **three** reasons why it is difficult to develop more HEP (hydel) power stations in Pakistan.

1 .....

2 .....

3 .....[3]

Question 3 N2010/P2/Q4/B

(b) (i) Name an HEP (hydel) power station and state the name of the river on which it is built.

Name ..... River ..... [2]

(ii) Why is HEP(hydel) an important source of electricity in northern Pakistan?

.....

.....

.....

.....

.....[3]

(iii) Why can the supply of power from these stations be unreliable?

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.....[3]

Question 4 J2009/P2/Q1/D

(d) (i) Why is HEP (hydel) a cheap source of electricity? [2]

(ii) What problems occur when supplying electricity from reservoirs to areas of high population? [3]

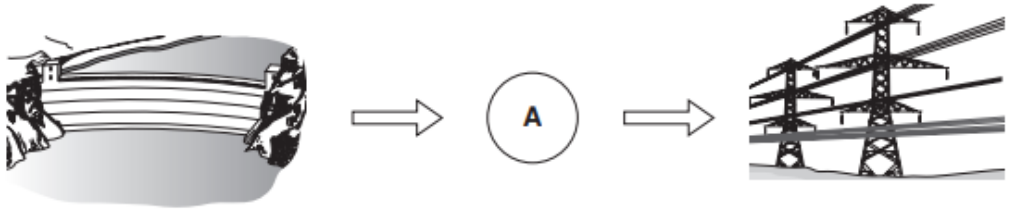
Question 5 J2008/P2/Q5/A-B

(a) Most hydro-electric power (hydel) schemes are in Northern Pakistan.

(i) Name **two** large dams **and** the river on which each is built.

(ii) Why do the reservoirs of these dams hold very large quantities of water?

(b) Study Fig. 4, a diagram showing how hydro-electric power is made.



dam and reservoir transmission grid

Name the machine **A**, and explain how it uses the flow of water to make electricity. [2]

Question 6 J2005/P2/Q4/D

(d) Hydro-electric power (HEP/hydel) is called a 'renewable' source of power.

(i) State three physical conditions necessary for the development of an HEP scheme. [3]

(ii) Why is it important for Pakistan to develop renewable power sources? [4]

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SOLAR

- ✓ Energy from the Sun can be utilized in the form of solar panels, which can generate electricity or heat water in homes.
- ✓ For generating electricity, these panels are installed in either deserts or large places of open and barren land.
- ✓ The panels absorb sunlight and use it to produce electricity free of cost except for the maintenance cost.
- ✓ On the other hand, these black panels absorb radiation from the sun and transfer it to the water to heat it.
- ✓ Another way of generating electricity is to use mirrors in desert, which reflect sunlight on to a very concentrated place on a tower (which contains water).
- ✓ The concentrated rays of sun heat the water and convert it into steam thus rotating the turbines and generating electricity.

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PRACTICE QUESTIONS 1.7

Question 1 J2017/P2/Q5/C(i)

(c) (i) Electricity can be generated using solar power. Complete the passage below by choosing the correct words from the list and placing them in the spaces provided.

Rectangular, solar ..... are made up of many solar ..... which convert the ..... energy from the sun into electrical energy. They can be placed on the ..... of houses and other buildings. Large arrays of solar panels can be sited on the ground, for example in deserts. Solar panels should face ..... in order to collect as much of the sun's energy as possible. Other solar power systems use the sun to heat water and the ..... is then used to turn a turbine.

roofs panels wind steam east

heat light south cells [3]

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WIND

- ✓ Wind energy is based on simple principles.
- ✓ A turbine is attached to a blade.
- ✓ This blade is mounted on a tower which is placed in a windy area such as on hillsides, near cost or off-shore.
- ✓ The force of wind, turns blade and thus turns the turbine; producing electricity.

WAVES

- ✓ There is much need for research and development before we see any large scale use of this form of energy.
- ✓ Tidal power uses same principles as wind except being installed on seabed and using force of tides to turn the blades.
- ✓ Currently it is very expensive to mount these turbines on seabed and the electricity produced is low.

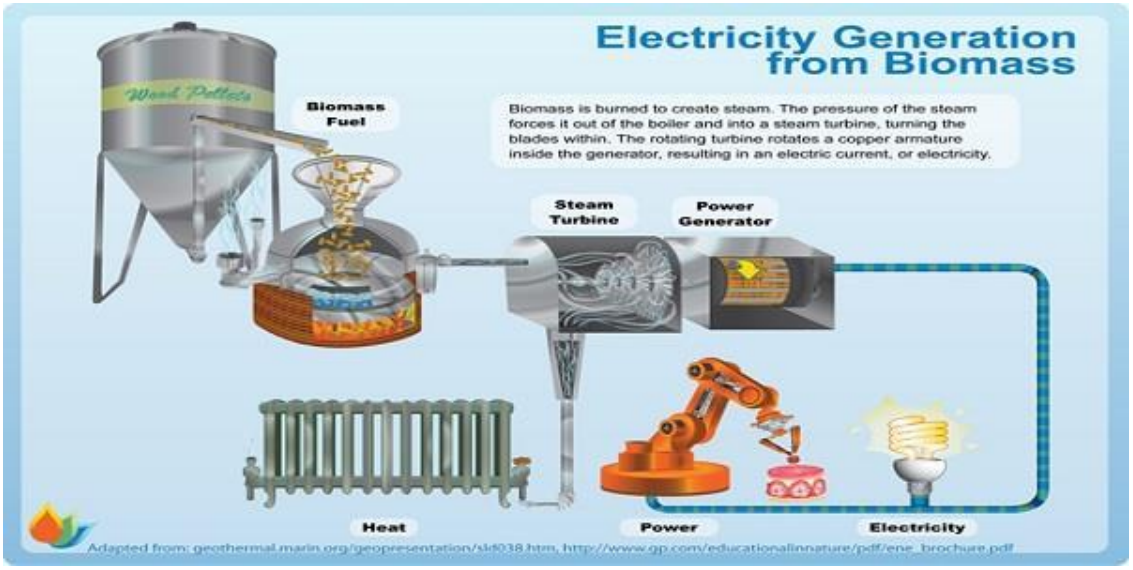
GEOTHERMAL

- ✓ Geothermal power is used in countries where favourable topographical conditions exist like in New Zealand and Iceland such as geysers etc.

- ✓ Conditions like these exist in some places in Azad Kashmir like near Kotli etc
- ✓ Two big pipes are dug into the surface.
- ✓ These pipes reach hot rocks in the earth's crust.
- ✓ These rocks are heated up by the magma beneath them.
- ✓ From one pipe cold water is sent below and from other pipe hot steam or water is received.
- ✓ Through a heat exchanger system this heat is transferred to water in another pipe network.
- ✓ Here the water absorbs heat and becomes steam which is fed into turbines to generate electricity

BIOMASS

- ✓ It is the energy generated in form of electricity or heat from plants/organic matter etc
- ✓ Dead leaves, branches, stumps etc are burnt directly to produce heat.
- ✓ In some countries garbage burning plants have been set up, which burn garbage and use the heat produced to turn water into steam.
- ✓ This steam then turns turbines, which produce electricity
- ✓ One good use of biomass is in production of biogas.
- ✓ In a biogas plant, animal dung is fed into a closed container deprived of oxygen.
- ✓ Bacteria and other micro-organisms then digest it and produce methane as a result.
- ✓ This methane is used either for cooking or for producing electricity



RENEWABLE RESOURCES

Definition

- ✓ Energy from a source that is not depleted when used, such as wind or solar power.

Advantages

- ✓ As their name suggests, they are renewable meaning that unlike non-renewable energy they will never run out.
- ✓ Renewable are mostly clean and have little lasting impact on environment.
- ✓ They require investment once only and maintenance thereafter, no need to buy fuel like fossil fuels etc. So they are cheaper in the long run.
- ✓ They can be used in remote areas (wind power in mountainous areas), where other power resources can't be used due to difficulty of transporting furnace oil etc. Also, these areas may be far away from the national grid (It is uneconomical to extend the grid to small population centres as the wires and pylons are expensive)
- ✓ The supply of fossil fuels is very unstable due to conflicts in the Middle East, thus to have secure energy supplies in the future, Pakistan should develop renewable energy.

Disadvantages

- ✓ Solar energy is not much efficient, about 20%, when converting light energy from the sun into electricity; also it requires regular maintenance to remove dust which can cut efficiency by 3/4th. Also the panels must tilt with time of day and location of sun to maintain maximum efficiency
- ✓ Some dangerous substances like cadmium are used to make solar panels and raise questions about how they will be dealt in future when their lifetime has expired
- ✓ Wind turbines produce an audible sound which locals hate and it also spoils the scenery. Also not many places have many windy days
- ✓ Geo-thermal isn't available at all places in the world and few favourable places exist. Also it leads to Carbon Dioxide emissions which lead to global warming; melting of polar ice caps and floods of low lying areas
- ✓ Less water is available downstream due to dams, thus affecting fisheries as mangroves don't get enough fresh water. Agriculture may also be affected due to lack of water for plant growth
- ✓ Biomass produces limited amount of energy and is unfeasible to sustain current power demands
- ✓ Wind and solar power aren't available at all times like during windless days or cloudy days or nights

- ✓ All of the renewable sources require large amounts of capital to produce single megawatt of electricity as compared to fossil fuels
- ✓ In hydel projects immense costs are incurred due to; Large scale planning and research costs, which involves dam design etc, Evacuation procedures along with resettlement of people affected by the reservoir of the dam, Building roads (for access to site) and tunnels (to channel water into the turbines), Laying down power lines and connecting them to the grid system, hiring professionals (engineers etc) and workers and accommodating them on site, Buying expensive heavy machinery and maintaining it and Buying raw materials like cement and steel in exceptionally large quantities
- ✓ Hydro-electric causes massive displacement of people and loss of livelihood. Forests are flooded and killed; the trees then decay and produce methane, leading to global warming

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PRACTICE QUESTIONS 1.8

Question 1 — J2017/P2/Q5/C(ii)

(ii) What are the disadvantages of generating electricity by wave and tidal power?

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.....

.....[3]

Question 2 — N2013/P2/Q4/A

(a) Study Photographs D and E (Insert).

(i) Name the type of renewable energy being generated.

D ..... E .....
[2]

(ii) Give **three** advantages of renewable energy.

1 .....

2 .....

3 .....[3]

(iii) Give **three** disadvantages of generating energy by **either** D **or** E.

Choice.....

Disadvantages

1 .....

2 .....

3 .....[3]

Question 3 N2010/P2/Q5/D

(d) The development of wind power generators off the coast of Pakistan could reduce the country's dependence on imported fuels.

Explain the advantages and disadvantages of developing alternative power sources.

Advantages .....

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Disadvantages .....

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.....[5]

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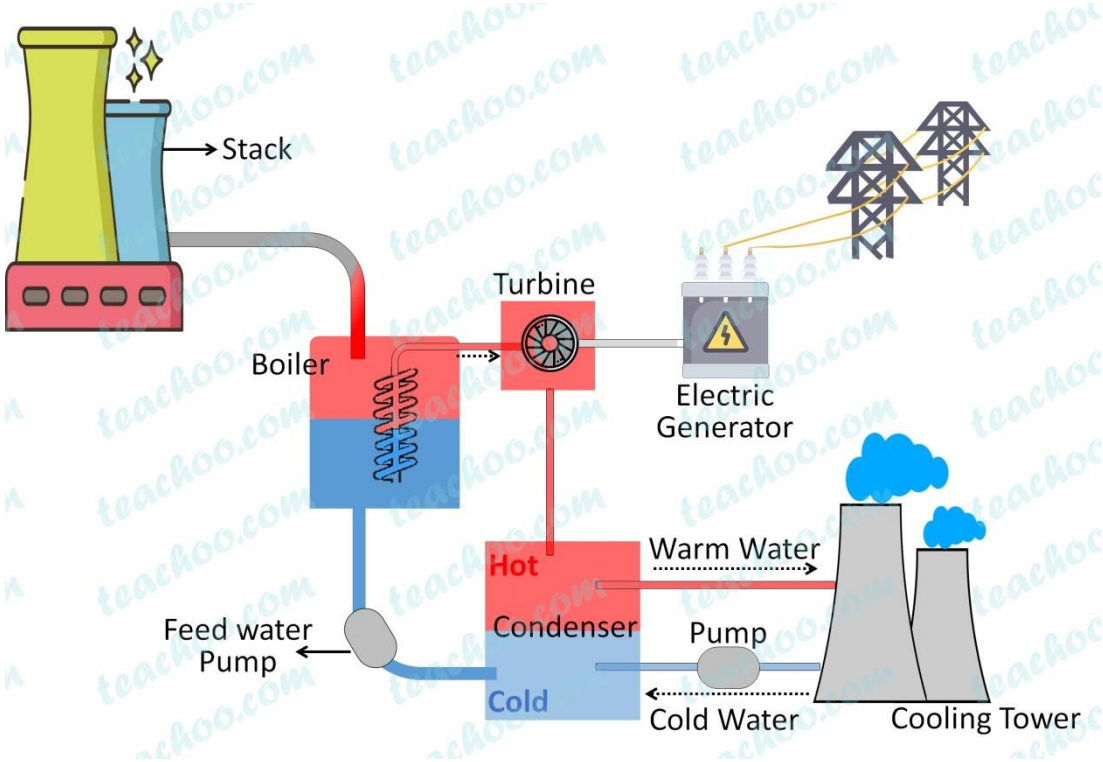
THERMAL POWER

- ✓ Electricity that is generated by non renewable resources such as coal, oil and gas.
- ✓ Fossil fuels produce heat energy which is used to run water into steam which is then used to run turbines.



NUCLEAR POWER

- ✓ Nuclear energy is power that is released from atoms and the most powerful source of energy.
- ✓ Fission: In atomic fission energy is released when atoms splits up into small substances.
- ✓ Fusion: In atomic fusion, energy is released when atoms are joined together to form a bigger atom that releases energy.
- ✓ Both process used heat energy to generate the electricity.
- ✓ Pakistan is also utilizing nuclear energy for electricity generation.
- ✓ Two nuclear power plants have been established in Pakistan; Karachi Nuclear Power Plant and Chashma Nuclear Power Plant.

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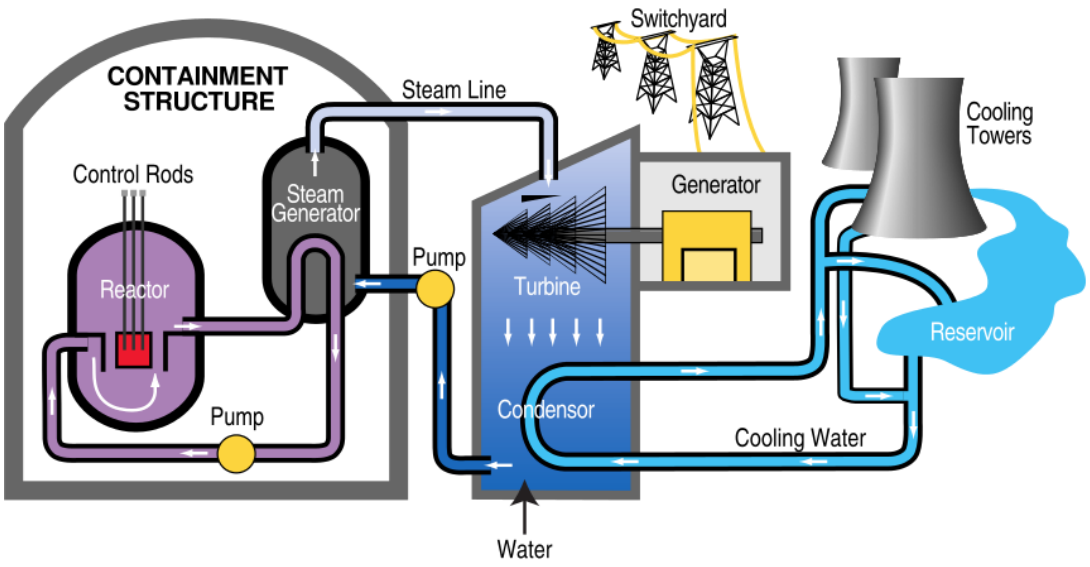

NON RENEWABLE RESOURCES

Definition

- ✓ Non-renewable energy comes from sources that will run out or will not be replenished for thousands or even millions of years.

Advantages

- ✓ They require low initial investment as compared to renewable sources, and are perfect for urgently meeting demands as they require less time to build
- ✓ Electricity can be produced on large scale as no know how of advanced engineering like those involved in big dams etc is required
- ✓ The technology exists and therefore there are no research costs

Disadvantages

- ✓ These energy sources are non-renewable meaning that they will eventually run out and can't be depended upon in the long run
- ✓ They pollute the environment leading to acid rain or global warming. Acid rain kills trees and aquatic life. Also nuclear power produces wastes which remain radioactive for thousands of years and need to be stored underground safely for that period of time
- ✓ Due to conflicts in fossil fuel rich Middle East, the price of these fossils fuels looks set to rise, so Pakistan won't be able to import much oil to produce electricity in the future

- ✓ These projects however do require a lot of expensive maintenance and fuel, so are expensive in the long run. Also, **Independent Power Producers** charge a higher rate for electricity generation than state owned thermal stations
- ✓ Due to gas cuts in both industrial and power sector, it seems that relying heavily upon gas thermal stations isn't a reliable option in the long run

PRACTICE QUESTIONS 1.9

Question 1 J2015/P2/Q2/C

(c) (i) Fig. 5 is a diagram of a thermal power station.

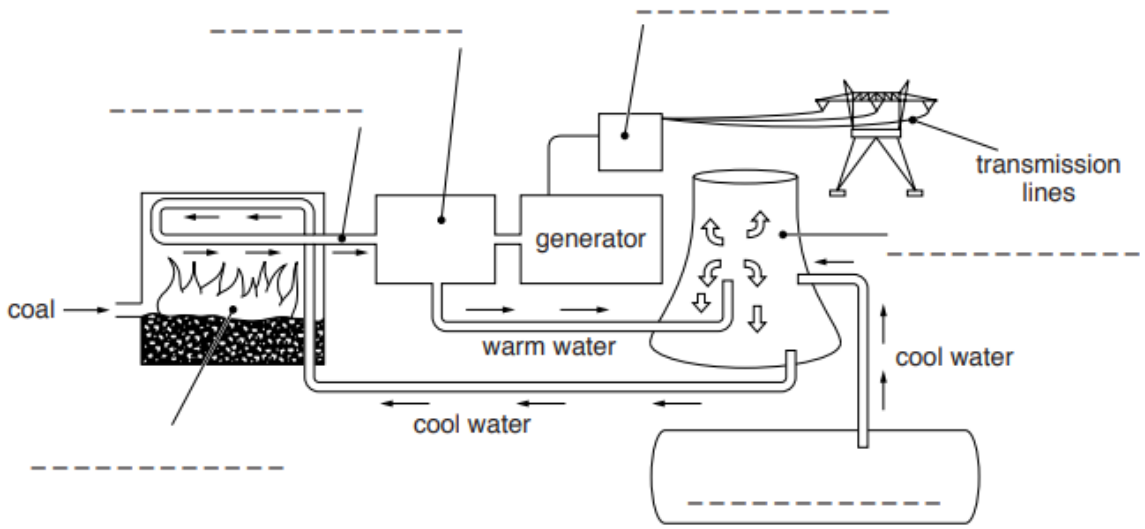

Fig. 5

Choose **three** terms from the list below and use them to label the diagram in **three** of the spaces provided.

reservoir transformer boiler turbine cooling tower steam [3]

(ii) Explain why burning fossil fuels in power stations is unsustainable.

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.....[4]

Question 2 N2009/P2/Q4/D

(d) Explain the advantages and disadvantages of developing nuclear power. [6]

Question 3 N2005/P2/Q3/D

(d) In a recent study it was stated that over 46% of thermal power in Pakistan is generated in the area around Karachi.

(i) Why is so much thermal power generated in this area? [3]

(ii) What problems are created when there are many large thermal power stations in one area? [4]

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NATIONAL GRID SYSTEM

- ✓ The National Grid connects hydel generation in the north and thermal generation in mid country and the south managed by WAPDA and KESC.
- ✓ It consists of a large network of transmission lines and grid stations to transmit power to load centers and then to commercial and domestic consumers throughout the country.
- ✓ The purpose of forming a National Grid System is to supply electricity to different areas according to their requirements and not on the basis of their own power generation.
- ✓ For example some areas of Pakistan where heavy industries are located require more electricity than they are capable of generation supplying electricity through the National Grid System solves this problem.
- ✓ On the other hand, there are some areas where more electricity is generated than their actual requirements.
- ✓ This surplus electricity can then easily be transferred to other areas through this system.
- ✓ However, there is lot of wastage of electricity through the transmission lines and grid stations if they are not properly maintained, also due to the long distances involved.

SUSTAINIBILITY OF POWER

- ✓ Mismanagement of these resources can lead to energy crises for the future generation.
- ✓ In order to have sustainable development of power resources the following measures must be taken.
- ✓ The development of renewable resources of energy by using advanced technology.
- ✓ The preservation and conservation of the non-renewable resources of the earth to guard against the danger of their future exhaustion.
- ✓ The protection of the environment by enforcing the strict laws through environment protection.
- ✓ Faulty and damaged transmission lines should be replaced on an emergency basis to avoid losses in electricity.
- ✓ Strict measures to avoid the chances of theft.

REVIEW EXERCISE

Question 1 J2017/P2/Q5/D

(d) Read the following two views about solutions to Pakistan's shortage of energy:

A

To produce more energy, large-scale power generation schemes such as nuclear, gas-fired, oil-fired, and multi-purpose HEP (Hydel) power stations should be built.

B

To produce more energy, small-scale power generation schemes should be set up, such as biogas, wind, and solar power plants.

Which view do you agree with more? Give reasons to support your answer and refer to examples you have studied. You should consider **both** View A and View B in your answer.

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Question 2 J2014/P2/Q2/E

(e) To what extent can Pakistan rely on fossil fuels to increase fuel and power supplies?

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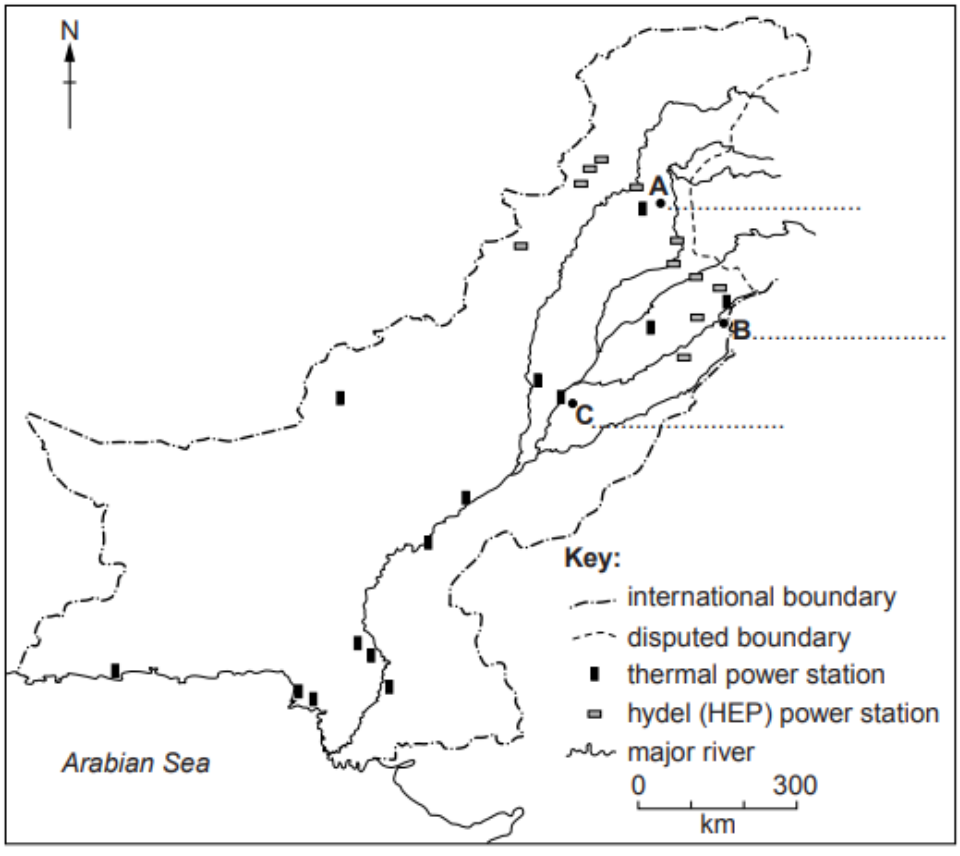
Question 3 J2013/P2/Q4/A,D

(a) Study Fig. 5, which shows thermal and hydel (HEP) power stations in Pakistan.



(i) Name the cities **A**, **B** and **C**.

A .....

B .....

C ..... [3]

(ii) Compare the distribution of thermal and hydel (HEP) power stations.

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.....[4]

(iii) Explain why **these two** different types of power station are built in different areas in Pakistan.

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RECENT PAST PAPER QUESTIONS

Question 1 N2018/P2/Q2

(a) (i) Which **one** of the following definitions correctly describes hydel power? Tick **one** box below.

	Tick (✓)
Hydel power is electricity generated by using fossil fuels.	
Hydel power is electricity generated by using heat from the sun to heat water.	
Hydel power is electricity generated by using the fast flow of water to move turbines which drive generators.	

[1]

(ii) Explain how the climate causes problems in developing hydel power in Pakistan. You should develop your answer.

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(b) (i) Study Fig. 2.1, pie charts showing the percentage share of energy produced in Pakistan and the world.

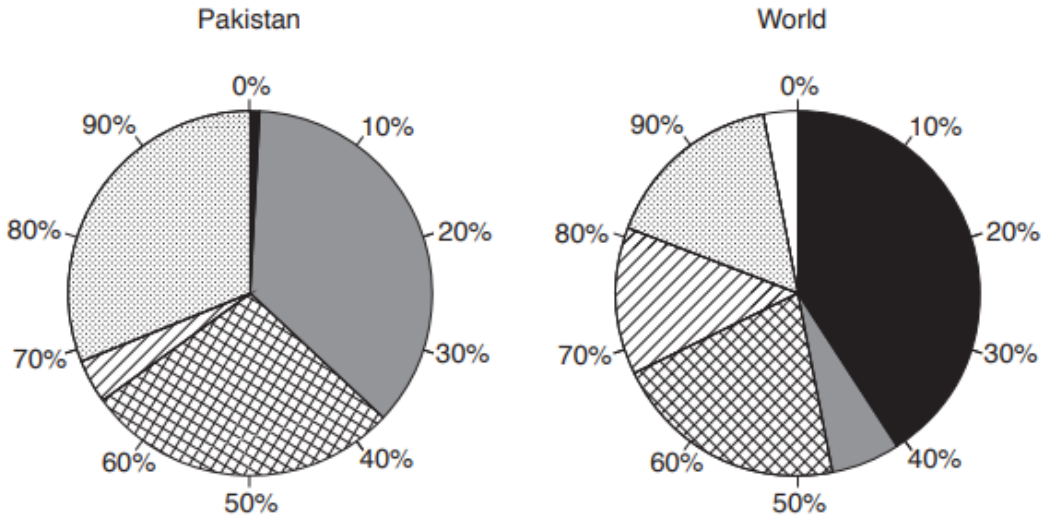

Fig. 2.1

Compare the proportion of energy produced from any **two** non-renewables in Pakistan with the rest of the world.

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.....[2]

(ii) State **three** reasons why the contribution of renewable energy sources, other than hydel power, is smaller in Pakistan compared to the rest of the world.

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.....[3]

(iii) Suggest **two** ways solar energy can help solve the problems of producing and distributing energy in the rural areas of Pakistan.

1 .....

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2 .....

.....[2]

(c) (i) **Draw** and **label** a diagram of a wind turbine.

[3]

(ii) Give **two** advantages and **two** disadvantages of using wind energy.

Advantages	Disadvantages
1	1 .....
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.....	.....
2	2 .....
.....	.....
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[4]

(d) Pakistan is planning to expand its nuclear energy capacity from 1300 to 8800 megawatts between 2018 and 2030.

To what extent is further developing nuclear energy a sustainable way of generating more electricity in Pakistan? Give reasons to support your **judgement** and refer to examples you have studied. You should consider **different** points of view in your answer.

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Question 2 J2019/P2/Q3

(a) (i) Study Fig. 3.1, a map showing gas producing regions and the natural gas pipeline network in Pakistan.

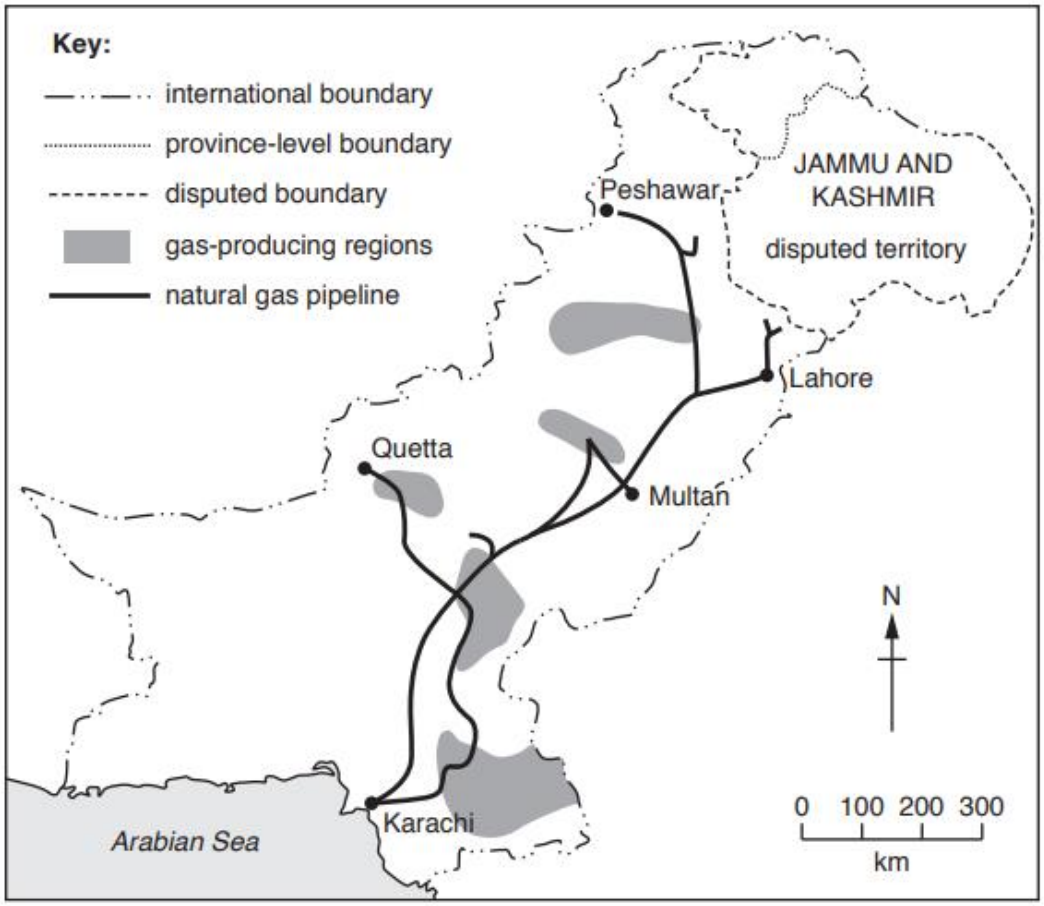

Fig. 3.1

Name **three** gas producing regions in Pakistan.

1 .....

2 .....

3 ..... [3]

(ii) Using Fig. 3.1 and your own knowledge, describe the distribution of the natural gas pipeline network in Pakistan.

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(iii) Explain **one** way of transporting natural gas to parts of Pakistan not served by the pipelines and **one** limitation of this method. You should develop your answer.

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..... [4]

(b) (i) Study Fig. 3.2, which shows the percentage share of natural gas used by selected sectors in Pakistan.

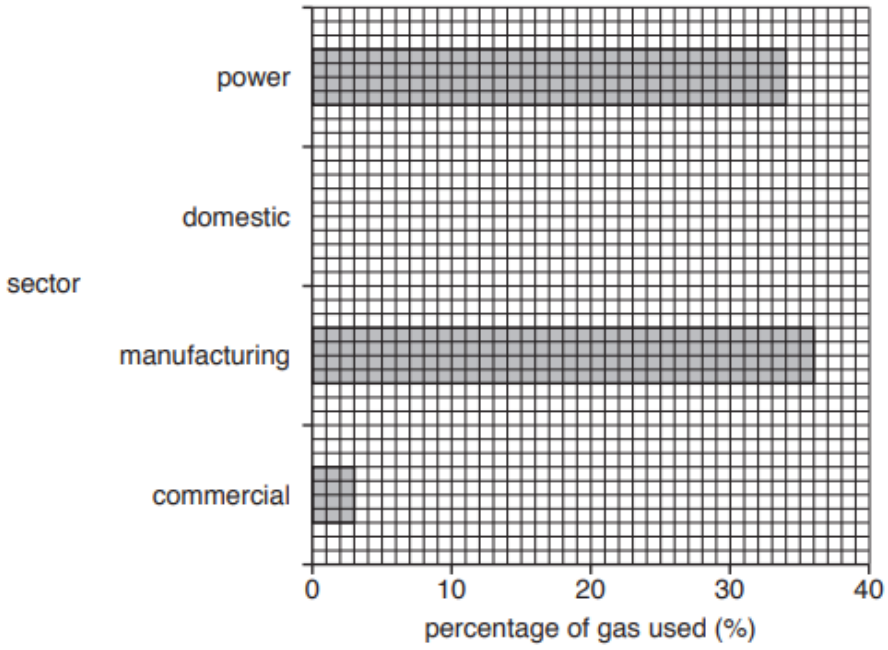

Fig. 3.2

Complete Fig. 3.2 by drawing the bar for domestic use using the information below.

gas use	percentage (%)
domestic	18

[1]

(ii) Name **two** other sectors that use natural gas which are not shown on Fig. 3.2.

1 .....

2 ..... [2]

(c) **Complete** the passage about generating electricity using natural gas. Choose the correct words from the list and place them in the spaces provided.

To produce electricity in a ..... power station, ... such as coal, oil or gas are burned to make ..... that moves the ..... to generate electricity. Transformers control the voltage and transfer electricity to pylons through ..... lines.

biofuels conductor fossil fuels heat hydel light nuclear power steam thermal transmission turbines

[5]

(d) The natural gas field discovered at Sui is considered to be one of the largest in the world. Additional smaller gas fields have since been discovered and developed in Pakistan.

To what extent is further development of the natural gas industry possible in Pakistan? Give reasons to support your **judgement**. You should consider **different** points of view in your answer.

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..... [6]

ANSWER KEY

Practice Questions 1.1

Question 1 — J2017/P2/Q3/B

- Lower/S Sindh/Lakhra/Jhimpir/Sonda/Thar/Thar desert;
- N/NW Balochistan/Quetta/Sor/Mach/Degari/Khost/ Shahrig/Harnal/Duki/Chamalang;
- Salt Range/Dandot Pidh/Potwar plateau;
- Makerwal.

2 @ 1 mark

A Bar accurately drawn on Fig. 4

B 2005

C Decreased

Note: Width within demarcations and height must touch the 3m line.

3 @ 1 mark

- Existing coalfields becoming exhausted/existing coal measures becoming harder to access (therefore increasing cost of extraction);
- High cost of extraction/exploration/equipment/ technology (leads to indebtedness);
- Lack of government funding (which a developing country with high population growth cannot afford);
- Lack of/poor transport links to/from coal producing areas/potential coal producing areas (which discourages further investment);
- Lack of skilled/highly trained labour (therefore requiring expensive foreign expertise);
- Insurgency/lack of security (which discourages foreign mining companies from operating/investing);
- Decreased demand for fossil fuels/change to cleaner fuels/renewables (due to world agreements/targets);
- Coal from Pakistan is low grade (so has to be imported from other countries);
- Domestically replacing coal with gas (as Pakistan has many gas fields, e.g. at Sui/one of largest in world);
- Change from coal to oil/diesel for trains (due to partition).

ETC.

Note: One mark for identification of appropriate idea and a further mark for development (in parentheses).

Note: Max 2 marks if no development.

2 @ 2 marks

Question 2 N2016/P2/Q3/A

(a) Study Fig. 4 which is a diagram of a coal mine.

(i) Choose <u>two</u> terms from the list below and use them to label the diagram in any <u>two</u> of the spaces provided.

adit cage shaft open-cast seam tunnel [2]

<u>Any two</u> of (left to right): cage, tunnel, shaft, seam, shaft, (type of mine)

(ii) Suggest <u>two</u> reasons for using this type of mine and <u>one</u> disadvantage of using it. [3]

<u>Reasons</u> – *2 marks*

To access seams deep below surface
To access seams of different depths
Can exploit further along the seams
Where seam does not appear at / near surface / hillside

<u>Disadvantage</u> – *1 mark*
<u>More</u> expensive
Greater risk of accident / flooding / gas build-up – credit all reasonable ways that accidents can happen
Dependent on [power for] lift to the surface

(iii) What type of coal is imported by Pakistan and how is it used? [2]

<u>Type</u>: Anthracite / bituminous – *1 mark*
<u>Use</u>: Steel industry / heavy engineering / smelting – *1 mark*

Question 3 J2014/P2/Q2/D

(d) (i) Name an area where coal is mined in Pakistan, and state one type of coal found there. [2]

Quetta – coking coal / Sharig coal / sub-bituminous
Lower Sindh / Thar (desert) – lignite
Salt Range / Dandot Pidh – sub-bituminous / lignite
Makerwal – sub-bituminous
If no or incorrect named area, 0 marks *[2 × 1 mark]*

(ii) Give two reasons why most of the coal mined in Pakistan is called 'low quality'. [2]

High ash content
High moisture content
High sulphur content
Low (hydro)carbon content
Gives off less heat / low heating value / low burning temperature
Crumbles easily / soft / not compressed

Question 4 J2005/P2/Q4/A-C

(a) For each of the mines A and B

(i) Name the type of mine,
A – adit/drift **[1]**
B – shaft **[1]**

(ii) Explain why that is the type of mine there,
A – coal (seam) exposed on a slope/can dig tunnels along the seam **[1]**
B – coal (seam) underground / does not outcrop **[1]**

(iii) Describe the method of mining coal in the mine.

Adit mine
Horizontal shaft into hillside
Possibly several shafts at different levels
Pick and shovel/trepanner (only credit once)
Dynamite on seam (only credit once)
Buckets/trucks/trolleys/conveyor belt/donkeys to surface

Shaft mining
Main shaft (vertical or sloping)
Tunnels/side shafts along seams
Pick and shovel/trepanner *(only credit once)*
Dynamite on seam *(only credit once)*
Buckets/trucks /trolleys to main shaft
Lifted to surface/elevator [Res 2 for each type of mine, float of 1] **[5]**

Study the map Fig. 5 showing coalfields and coal mining centres in Pakistan.

(b) (i) Name the coalfield X and one of the mining centres there.
Quetta (coalfield) **[1]**
Sor Range, Degan, Mach, Khost, Shahrig, Harnai **[1]**

(ii) Name the coalfield Y and one of the mining centres there.
Lower Sindh (coalfield) **[1]**
Blakhra, Jhimpir, Sonda **[1]**

State the two main uses of coal mined in coalfield X
Brick making/brick kilns
(mixed with imported coal) For steel making/in the blast furnace

Briquetting **[2]**

(c) Explain why coal has to be imported.
Not good enough for iron smelting/no metallurgical coal/needed for Pakistan Steel
Need for coal to mix with poorer grade
Difficult to mine/seams thin/seams contorted

Not enough mined in Pakistan/lack of technology/lack of finance
[Credit any line up to 2]
[3]

Practice Questions 1.2

Question 1 J2017/P2/Q5/A

- Morgah/Rawalpind – close to oilfields (in Potwar Plateau);
- Central Punjab – close to oilfield;
- Karachi/Korangi – near oil terminals/close to oilfield/port;
- Mahmood Kot/Muzaffargarh – terminus of crude oil pipeline from Karachi.

Note: No credit for reason only

2 @ 1 mark

Bar correctly drawn on Fig. 4

Note: Tolerance: imported 180–190, produced 55–65.

1 @ 1 mark

The amount of oil imported increased/higher/rose/figures from 150 to 370–380;
The amount of oil produced decreased/fallen/figures from 60–70 to 55–65/almost constant/stayed the same;
The total amount of oil increased/overall it went from 210–220 to 430–440.

Note: a tolerance of ± 5% allowed except at 150 value.

2 @ 1 mark

- Small reserves/potential oilfields not explored/small amount produced;
- Lack of government investment/funding for further exploration/lack of money for developing oil fields/ exploration/expensive equipment;
- Lack of technology/expertise for extraction/exploration/ lack of skilled labour;
- (Large/increasing demand for) oil for vehicles/transport;
- Heating/domestic use/cooking;
- Electricity generation/electricity;
- Manufacturing/manufactured products;
- Cannot exploit/explore reserves due to tribal opposition/ insurgency;
- Due to population growth.

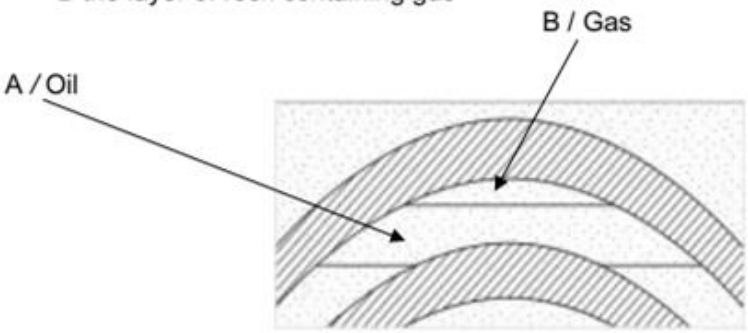
2 @ 1 mark

Question 2 J2014/P2/Q2/A-C

(a) Study Fig 2, a cross section showing an oil trap.

(i) Label on the diagram **[2]**

A the layer of rock containing oil
B the layer of rock containing gas



(ii) What is meant by the term 'porous rock' [1]

Rock with pores / holes / spaces / that lets liquids or gases pass through

(iii) Why is the feature in Fig. 2 called 'an oil trap'? [2]

Oil cannot get through the rocks around it
Oil lies / trapped between layers of non-porous / impervious / impermeable rock
Oil rises to the top of the anticline / top of bend in rocks

(b) Study Fig. 3 which shows the uses of oil.
Choose <u>three</u> of the following terms to complete Fig. 3. [3]

by products – in the LHS heading box
pesticide – below plastics
petrol – below fuels

(c) Study Fig. 4, a map showing oil refineries and pipelines in Pakistan.

(i) Name and locate the oil refinery marked on the oilfield in Fig. 4. [2]

Attock (oil refinery)
Morga(h) / Rawalpindi / Potwar Plateau / SE of Peshawar / NW of Faisalabad

(ii) Name <u>one</u> refinery where imported oil is processed. [1]

National Refinery / Pakistan Refinery / Pak-Arab Refinery / Korangi / Mahmood Kot

Question 3 N2009/P2/Q4/B

(b) Study Fig. 8, a map of Pakistan.

(i) Describe the location of the two main oil fields shown on the map. [2]

Potwar plateau/Northern Punjab
Lower Sindh/Southern Sindh

(ii) What is crude oil? [1]

unrefined/raw/as it comes out of the ground

(iii) Why does Pakistan import most of its oil? [2]

no enough for demands/not self-sufficient/mall reserves
running out
lack of investment/development of new fields
high cost/lack of money
lack of skilled/educated labour

Question 4 N2006/P2/Q3/A-C

(a) (i) Locate an oil refinery near the coast, and give one reason why it is there.
Refinery:
Karachi / Keamari / Bin Qasim

Reason:
Imported oil
Demand from named area
Oilfields in Southern Sindh (1+1) **[2]**

(ii) Locate an oil refinery in the province of Punjab, and give one reason why it is there.
Either:
Mahmood Kot / PARCO
Pipeline from Karachi / port
Demand from named area / Multan

or:
Attock / Morga
Local oilfield in Potwar plateau
Demand from named area / Islamabad / Rawalpindi **[2]**

b) State <u>two</u> ways in which refined oil can be transported in Pakistan, and give an advantage and disadvantage of each.
<u>Pipeline</u>
Bulk transfer / large quantities
Cheap (after cost of building)

But – only to a few big centres
Costly to build and maintain
Problem of leakage
Only a single product (e.g. Diesel)

<u>Railway</u>
Can go to more places than pipeline
More products can be carried

But – smaller quantities
Expensive
Chance of accidents (NOT explosion)

<u>Tanker / Lorry</u>
Can go anywhere by road
More products can be carried

But – expensive
Heavy / can only carry small amounts
Chance of accidents
Theft 1 + 1 + 1 for each of 2 ways **[6]**

Study Fig. 3 which shows some examples of the four main uses of oil.

(c) (i) Name another by-product A.
wax / synthetic rubber / detergent / pharmaceutical products / furnace oil / etc. **[1]**

(ii) Name the fourth main use of oil B.
fuel **[1]**

(iii) With reference to Fig. 3 and using your own knowledge, explain how oil products are important to <u>either</u> farming <u>or</u> manufacturing.
<u>farming</u>
fuel for machines
fuel for transport
electricity generation – for power
fertiliser – for growth }
pesticides – for healthy growth } raw material
tarmac for better roads / metalled roads

lubricants for machines
etc.

manufacturing
fuel for machines
fuel for transport vehicles
electricity generation – for power / heat / light
fuel for heating
raw material for named product
tarmac for better roads / metalled roads
etc. *(the candidate may choose to link this answer to Fig. 3)*
(credit ONLY farming OR manufacturing, general answer max. 2) **[6]**

Question 5 N2005/P2/Q3/A-B

On your answer paper state the letter for the following.

(a) (i) The area of rock containing oil.

Y **[1]**

(ii) The area of rock containing natural gas.

X **[1]**

(b) (i) What is meant by the term 'porous rock'?

Has pores/holes/spaces (to hold liquids/gases)
(to let liquids/gases pass through) **[1]**

(ii) Why is the feature in Fig. 5 called an oil 'trap'?

Cannot get through rocks around it
Between layers of non-porous/impervious/impermeable rock
Rises to top of anticline/top of bend **[3]**

(iii) How is oil extracted from this 'trap'?

Derrick/drilling rig built
Drilling (oil well)/oil well constructed/pipes inserted
Diamond/tough metal drills into rock
Cooled with mud mixture/water
Oil rises when pressure released/pumped up/sucked up
Valves to control flow into pipeline

Derrick removed/dismantled after oil is flowing [5]

Practice Questions 1.3

Question 1 N2016/P2/Q3/B

(b) Explain what the fuel CNG is and state the main reasons for using this fuel. [4]

Definition – *Reserve 1 mark*
Compressed natural gas
Gas compressed to 1% volume it has at normal pressure
Methane under high pressure

Reasons – *Reserve 1 mark*
Used (instead of petrol / diesel) in transport / vehicles
Especially buses / rickshaws
(Compared to petrol / diesel) cheaper, cleaner / reduces air pollution, safer
Can be stored / transported in cylinders

Question 2 N2015/P2/Q2/A

(a) (i) Study Fig. 2, which shows the usage of natural gas in Pakistan in the year 2010–11. In the key, name the activities A and B which are two of the main users of natural gas in Pakistan. [2]

A Power [stations]/electricity [generation] 1 mark
B Household/domestic/residential 1 mark
USE LIST RULE

(ii) State two ways in which gas is transported to homes in Pakistan. [2]

By pipeline [to major cities]
In cylinders / as LPG / by tanker

Question 3 N2009/P2/Q4/C

(c) Study Photograph B, a gas extraction unit at Nautheh, in the Potwar Plateau.

(i) With reference to Photograph B explain why natural gas is an easy fuel to extract. [3]

small size of land
little impact on the environment
simple machinery/small machinery
pipes go into ground
works automatically/no/little manpower needed
controlled by valves/valves control pressure
near road for easy access

(ii) Study Fig. 9, an advertisement for natural gas.
Suggest why this advertisement states that natural gas is 'A cheap fuel. Easy to use'. [4]

produced in Pakistan/in Balochistan/at Sui/not imported
large reserves
lightweight
available in pipelines
portable in cylinders
cleaner than burning wood/coal
easy to extract

Question 4 — J2007/P2/Q4/A-B

(a) Study Fig. 4, which shows the gas pipelines in Pakistan.

(i) Name the gasfield A.
Sui [1]

(ii) Name the cities B, C and D at the ends of the pipelines.
B *Peshawar,* C *Islamabad,* D *Sialkot/Jammu* [3]

(iii) State two ways in which gas can be supplied to areas away from pipelines.
Changed to a liquid/LPG/CNG
Cylinders
(Pressurised) tankers [2]

(b) Study Fig. 5, which shows the uses of natural gas in Pakistan.

(i) State the largest use of natural gas.
power [1]

(ii) Name a use in the 'other' sector.
commercial/office
cement
transport/cars/lorries/motor vehicles
named industry (not on pie chart) [1]

(iii) What is natural gas used for in homes and why is this fuel chosen?
Use (res. 1)
Heating
Cooking
Why (res. 1)
Available in cities/towns
Cheaper than oil or coal
Easier than collecting firewood
Less bulky/easier to transport than coal/wood
Cleaner than coal/wood/oil

(Reserve 1 for each of use and why) [3]

(iv) Why is natural gas called 'non-renewable'?
it will run out/is not being replaced/etc. [1]

Question 5 — N2006/P2/Q3/D

(d) (i) Which gas field produces most natural gas in Pakistan?
Sui **[1]**

(ii) Name two industries in Pakistan that use natural gas as a raw material.
fertiliser
cement
chemical
(not power) **[2]**

(iii) Why is natural gas an important fuel in Pakistan?
Can reach remote areas in cylinders
Easier to transport than coal
Alternative to oil in vehicles
Used in power stations
Cleaner than oil or coal
Reduces dependence on imported fuels

Shortage of coal and / or oil in Pakistan
Cheaper compared to another named fuel [4]

Practice Questions 1.4

Question 1 N2016/P2/Q3/C

(c) Study Fig. 5 which is a graph giving information about different non-renewable fuels used for electricity production in Pakistan over the period 2006–11.

(i) What is meant by the term 'non-renewable fuel'? [2]

An energy source that depletes / runs out / is not being replaced / has fixed reserves / is finite – *1 mark*
With any one example e.g. fossil fuels, wood, coal, oil – *1 mark*

(ii) Which fuel use has increased by the largest amount between 2006 and 2011? [1]

Oil

(iii) Use information from the graph to describe one main difference between the change in gas used for electricity production and the change in oil used for electricity production. [2]

Gas overall decrease: oil overall (throughout / 2006–2011 / over the years) increase
Gas from 36 to 27–28 TWh / by 8–9 TWh: oil from 27–28 to 33–34 TWh / by 6–7 TWh

Reserve 1 mark for use of data with unit (TWh)

(iv) Explain why so little coal is used for electricity production in Pakistan. [3]

Coal mined in Pakistan is unsuitable
Lignite, sub-bituminous to peat
Contains impurities / sulfur
Low heat producing, low carbon content, large amount of ash, does not give out much energy
Coal reserves not exploited due to shortage of funds / technical skills
Not imported (because expensive)
Difficult / expensive to transport around country because bulky
International agreements / pressure to use less coal since is a dirty fuel / causes high emissions of smoke / CO_2

Question 2 J2013/P2/Q4/C

(c) Study Fig. 6 which shows the percentages of fuels used for electricity supply.

(i) Use Fig. 6 to state the percentage of electricity generated from natural gas.

46–47 [1]

(ii) Name the two other fossil fuels Y and Z, and explain why each is used less than natural gas.

coal – poor quality, small reserves, remote/in Balochistan, heavy to carry
oil/petroleum/diesel – small reserves, unexplored, expensive. [3]

Question 3 N2009/P2/Q4/A

(a) Study Fig. 7, a pie chart showing the sources of energy supply.

(i) Name the two largest suppliers of energy. [1]

oil and gas (2 for 1 mark)

(ii) What percentage of energy comes from oil? [1]

47–48

(iii) Name two other sources not named on the chart. [2]

HEP, nuclear, bagasse, solar, wind, geothermal, waves, tidal

(iv) Why does coal only supply 4% of the energy supply in Pakistan? [3]

low quality/lignite
reserves not developed/not mined
bulky/heavy to transport
used for other things e.g. coke, bricks, cement
coal seams difficult to mine because – thin, contorted, faulted

Practice Questions 1.5

Question 1 J2017/P2/Q5/B

A Positive correlation/as population increases, electricity production increases/both increasing/population is always higher/more than electricity production (or vice versa);

B Population increases: electricity production remains same/very slightly increases/population kept increasing/ electricity did not have much change.

2 @ 1 mark

- Population increasing (greater need/greater use of electricity in homes/businesses) (named example of new technology in home/business)/(new towns have to be built because growing population puts a burden on electricity);
- Increased affluence for some (enables more electrical appliances in the home or named examples/items are becoming more affordable);
- Little new investment in new power stations (foreign investors less willing to invest due to political instability) (other government priorities such as healthcare/ education/housing/transport/alleviating poverty);
- Pakistan has small/inaccessible/depleting fossil fuel reserves (fossil fuels expensive to extract/poor quality/ have to import);
- Renewable energy plants expensive to construct;
- Power losses due to old/long transmission lines;
- Power theft (people diverting existing power sources for their own use);

- Most people live in rural areas (electricity does not reach there/lack of infrastructure/power lines);
- Many power plants are not working to full capacity (as a result of siltation in dams and reservoirs)/(they are still under construction);
- Power breaks down (lack of expertise to handle it)/(due to old machinery);
- More rural to urban migration (means demand cannot be fulfilled);
- Seasonal variations (less HEP generation in winter as less rainfall/snowmelt at times of peak demand).

ETC.

Note: One mark for identification of appropriate idea and a further mark for development (in parentheses).

Note: Max 2 marks if no development.

2 @ 2 marks

Question 2 N2016/P2/Q3/D

(d) Read the following article:

Energy crisis

Industrial growth in Pakistan relies on the availability of energy. Pakistan does not produce enough energy for its needs and therefore spends a lot of its earnings on expensive imports of fuels.

Describe briefly different measures that can be taken to solve the country's energy crisis. To what extent can these measures be successful? [6]

L3	5–6 marks	6 – ***Developed points addressing measures taken and the extent of their success with evaluation*** 5 – ***Developed points addressing measures taken and the extent of their success***
L2	3–4 marks	4 – ***Two developed point(s) addressing any measure*** 3 – ***Developed point addressing any measure***
L1	1–2 marks	2 – ***Two simple point(s) addressing any measure*** 1 – ***Simple point addressing any measure*** 0 – ***No valid response***

Indicative content (development of points in parentheses)

Measures
Moving away from non-renewable / large-scale schemes to renewable / small-scale schemes
E.g. wind, solar, biogas (details / examples)
Investment in large-scale power stations
E.g. nuclear, wind, solar, HEP, gas, coal gas (details / examples)
Energy saving in workplaces / homes
Public / media awareness about not wasting energy resources

Evaluation *(depends on measures)*
Successful
Small-scale schemes can be maintained locally / in rural areas
Given sufficient government / private / foreign investment
Wind – large empty areas of uplands / Makran coast
Solar – lack of cloud (250–300 sunny days per year)
Biogas – large agricultural sector producing manure / plant waste

Unsuccessful
Opposition to new technology / power stations
High cost (leading to domestic / foreign debt)
Changes of government priorities (large projects may be delayed / cancelled)
Limited skills / expertise (in using advanced technology)
Other issues considered higher priority than saving energy (e.g. escaping poverty / increasing levels of education / health)
Hydro in north – far from the major centres of population, transport costs
Green energy is less reliable

Question 3 N2013/P2/Q4/D

(d) To what extent is it possible to increase the electricity supply to rural areas? [6]

Possibilities
Extend national grid
Increase (national) power generation/nuclear power
More/good potential for renewable schemes, wind, solar, HEP (max 2)
(allow dev to further max 2 for details)
More small-scale power generation schemes
E.g. biogas using animal/plant waste/molasses (dev)

Problems
High cost of technology/fuel/maintenance
Theft
Damage/energy loss…
…Due to long transmission lines/siltation in reservoirs for HEP
Distance from grid stations/remoteness of some rural areas
Tribal opposition
Insufficient power generation…
…So urban needs met first
Lack of government support/loans/investment/policies
Difficult construction in rugged/mountainous terrain
Lack of named skilled personnel, e.g. engineers

Question 4 J2013/P2/Q4/B

(b) Explain why the supply of electricity is not reliable in many parts of Pakistan.

shortage due to lack of oil, gas, coal
less water in reservoirs due to silting, less melting of glaciers
damage to grid/transmission
long transmission lines
theft
poor maintenance/old machinery/breakdowns
demand exceeds supply/increasing demands/load shedding
lack of investment in new power stations/alternative energy **[4]**

Question 5 J2008/P2/Q5/C

(c) Study Fig. 5, a pie chart showing the percentage use of electricity.

(i) Which sector uses the largest percentage of electricity?
Domestic/homes [1]

(ii) State two other large users of electricity shown on the chart and explain what they use it for.
Industry – for machinery, computers, lighting, air conditioning etc
Farming – for much of above, tubewells, drying crops, etc.
Offices – computers, lighting, communication, air conditioning etc.
One mark for two large users
Three marks for how the electricity is used (2+1) [1+3] [4]

(iii) What problems are caused when the electricity supply to factories breaks
Stops production/slows production/output reduced
Damages machinery short circuit/explosion
Damages goods/affects the quality e.g. food, cloth
Delays contracts/orders
Loss of money/profit/orders
Workers laid off/sit idle [4]

Question 6 N2005/P2/Q3/E

(e) What is 'load shedding', and how does it affect industry and business in Pakistan?

Definition (res. 1) Planned power cuts

Effects
Interrupts production
Damages machinery
Cannot meet deadlines
Loss of quality
Loss of orders
Loss of money/profit
Cost of generators
Lights/computers/freezers/air

conditioning/heating etc. stops (max 2)

Transport/traffic problems [4]

Practice Questions 1.6

Question 1 J2016/P2/Q4/A

(a) (i) Study Fig. 7 which is a diagram of an HEP (Hydel) power station.

A: On the diagram place an arrow or arrows to indicate the direction of movement of water through the power station.

B: Choose two terms from the list below and use them to label the diagram in two of the spaces provided. [3]

A: Arrow(s) drawn downwards through channel
B: From L to R: reservoir dam turbine outflow
NB: 'water intake' top left space not used

(ii) Name one multi-purpose dam in Pakistan. [1]

Tarbela/Mangla/Warsak

(iii) Give two uses for a dam such as the one you named in (ii). [2]

HEP/electricity [generation]
Irrigation
Water supply / stores water [for industrial/domestic use]
Controlling floods
Recreation/named recreational use/tourist attraction
Fishing

Question 2 N2013/P2/Q4/C

(c) (i) With reference to water supply and relief (topography) explain why it might be possible to build more HEP (hydel) power stations in areas such as that shown in Photograph C (Insert). [4]

Water supply
High rainfall, melting glaciers, melting snow, low temperatures/evaporation, continuous supply from rivers/rain *(max 2)*

Relief (topography)
Deep valleys, narrow valleys, steep slopes/steep-sided valleys, waterfalls, high altitude *(max 2)*

(ii) Give three reasons why it is difficult to develop more HEP (hydel) power stations in Pakistan. [3]

(Climate change so) less rainfall
(Climate change so) higher temperatures and more evaporation/glaciers smaller
Liable to siltation in reservoirs
High cost
No investment/government support/changing government policies
Opposition from tribal areas (in mountains)/security issues
Lack of skilled labour/expertise
Opposition to loss of land (for reservoir)
Dispute over share of water (between provinces)

Question 3 N2010/P2/Q4/B

(b) (i) Name an HEP (hydel) power station and state the name of the river on which it is built. [2]

Tarbela on the River Indus
Mangla on the River Jehlum
Warsak on the River Kabul
(see atlas or textbook for others)

Credit correct dam for 1 mark even if not on correct river

(ii) Why is HEP (hydel) an important source of electricity in northern Pakistan ? [3]

Cheap to generate
Renewable
Available / no fossil fuels / no thermal power stations
Rivers / water from glaciers
High rainfall
Lack of evaporation / lower temperatures
Deep / steep sided valleys for dams
No air pollution / CO_2

(iii) Why can the supply of power from these stations be unreliable? [3]

Shortage / not enough for every user/ load shedding
Silting in reservoir (reduces capacity)
Silt in turbines (causes damage)
Seasonal shortages e.g. winter / frozen / monsoon etc.
Lack of rainfall / changing climate
Theft
Damage to power lines
Old / worn machinery

Question 4 J2009/P2/Q1/D

(d) (i) Why is HEP (hydel) a cheap source of electricity?
Free raw material/rain in mountains
Will never run out/renewable
Not imported/mined/drilled
Efficient/high power output [2]

(ii) What problems occur when supplying electricity from reservoirs to areas of high population?
Long distance to areas of use/high population
Cost of wires and poles/difficult terrain/Pakistan cannot afford this/shortage of money
Loss by damage
Loss by theft
Loss of power by resistance/transmission [3]

Question 5 J2008/P2/Q5/A-B

(a) Most hydro electric power (hydol) schemes are in Northern Pakistan.

(i) Name two large dams and the rivers on which they are built.
Tarbela on river Indus
Mangla on river Jhelum

Warsak on river Kabul
Must name both dam and river for one mark [2]

(ii) Why do the reservoirs of these dams hold large quantities of water?
Deep valley/large valley/high dam
Steep sides
Large river/permanent flow/water from snowfields/glaciers
Low evaporation/cool climate,
High rainfall [3]

(b) Study Fig. 4, a diagram showing how hydro electric power is made.
Name the machine A, and explain how it uses the flow of water to make electricity.
A – turbine/generator/power station
Turbine spins/rotates/moves [2]

Question 6 J2005/P2/Q4/D

(d) Hydro-electric power (HEP) is called a 'renewable' source of power.

(i) State three physical conditions necessary for the development of an HEP scheme.
Wet climate/moderate/high rainfall/over 750 mms
Water from glaciers/snowfields
Deep valley
Steep sided valley
Narrow valley
Impervious/impermeable rock
Large drainage basin/large river/large catchment area
Cool climate/low evaporation
Strong/hard rock
Reliable water supply **[3]**

(ii) Why is it important for Pakistan to develop renewable power sources?
Reserves of fossil fuels running out
Named pollution/not environmentally friendly/causes global warming/greenhouse gasses
More readily available
Schemes in remote areas/can be built away from fuel resources
Low running costs of HEP, solar power, wave energy etc./cheaper in the long term
Fossil fuels expensive
Fossil fuels are imported
Nuclear power dangerous **[4]**

Practice Questions 1.7

Question 1 J2017/P2/Q5/C(i)

Rectangular, solar **panels** are made up of many solar **cells** which convert the **light** energy from the sun into electrical energy. They can be placed on the **roofs** of houses and other buildings. Large arrays of solar panels can be sited on the ground, for example, in deserts. Solar panels should face **south** in order to collect as much of the sun's energy as possible. Other solar power systems use the sun to heat water and the **steam** is then used to turn a turbine.

5 or 6 @ 3 marks
3 or 4 @ 2 marks
1 or 2 @1 mark

Practice Questions 1.8

Question 1 J2017/P2/Q5/C(ii)

- Expensive technology/expensive investment for government;
- Small scale/only generates small amounts of electricity;
- Only at coastal sites;
- Hazardous to marine life/damages habitats;
- Disruption to shipping/fishing areas;
- Difficult to set up/inadequate technology;
- Not enough output to meet demand;
- Can be damaged or disrupted by cyclones or tsunamis;
- Shortage of expertise/knowledge/skills to set up.

3 @ 1 mark

Question 2 N2013/P2/Q4/A

(a) Study Photographs D and E (Insert).

(i) Name the type of renewable energy being generated. **[2]**

D wind
E solar

(ii) Give <u>three</u> advantages of renewable energy. **[3]**

Will not run out/does not deplete natural resources
Clean/do not pollute (environment)
Free at source
Can be small scale

(iii) Give three disadvantages of generating energy by either D or E. **[3]**

<u>Wind</u>
Not constant, ineffective if wind speed too low/too high, unsightly, noisy, expensive to build, small output, can harm wildlife e.g. birds

<u>Solar</u>
Not constant, needs clear skies, not at night, less in winter, expensive to build, small output

Question 3 N2010/P2/Q5/D

(d) The development of wind power generators off the coast of Pakistan could reduce the country's dependence on imported fuels.

Explain the advantages and disadvantages of developing alternative power sources. **[5]**

NB The introduction refers to wind, but the question is about **any** alternative power supply.

<u>Advantages</u> (of **any** alternative power supply) (res. 2)
Cheap power (after construction)
Renewable / do not run out.
Reduces CO_2 emissions / air pollution / harmful gases
Free resource / readily available
E.g. sunny climate, coast, mountains for HEP
Increases supply of electricity / less loadshedding / power cuts

Can be used in remote areas / mountains / deserts / etc.
Lower cost of oil / coal imports / improves balance of trade / can pay off debt

Disadvantages (of **any** alternative power supply) (res. 2)
Expensive to build / cost of import
Expensive / foreign technology
Unreliable (referring to weather etc.)
Lack of skills / expertise
Low output from generators
May not be in areas where power is needed / much of country a long way from coast

Practice Questions 1.9

Question 1 — J2015/P2/Q2/C

(c) (i) Fig. 5 is a diagram of a thermal power station.
Choose three terms from the list below and use them to label the diagram in three of the spaces provided. **[3]**

Credit any three correct of (L to R): boiler, steam, turbine, transformer, reservoir, cooling tower

(ii) Explain why burning fossil fuels in power stations is unsustainable. **[4]**

Releases carbon dioxide/contributes to global warming/climate change
Will exhaust/run out eventually/non-renewable/cannot be replaced
Having to be extracted from increasingly inaccessible/inhospitable places, e.g. Arctic/ deep sea
Named environmental damage other than air pollution, e.g. oil spills from tankers/ pipelines
Becoming expensive
Production/prices controlled by cartels, e.g. OPEC
Many countries, e.g. Pakistan, have few deposits and have to import

Question 2 — N2009/P2/Q4/D

(d) Explain the advantages and disadvantages of developing nuclear power. **[6]**

Advantages (res. 2)

large output
reliable
small input of raw material/efficient
long lasting fuel
fossil fuels running out/reduce burden on other fuels
less pollution/environmentally friendly
will be less need for load-shedding/power cuts

Disadvantages (res.2)

expensive to buy fuel
expensive to build
lack of technology/skills/difficulties of maintainance
dangerous/risk of radioactivity
unpopular/local opposition
disposal of waste is a problem
risk of terrorism
use for bombs

Question 3 N2005/P2/Q3/D

(d) (i) Why is so much thermal power generated in this area?

Gas/Oilfields in Lower Sindh
Named oilfield (max. 1)
Coal mines in Lower Sindh
Named mining centre/Lakrha/Jhimper/Sonda
Gas pipeline from Sui
Imports of oil at Karachi
Demand from industry
Demand from large population
Other demands e.g. railway (max. 2)
Oil refineries at Karach **[3]**

(ii) What problems are created when there are many thermal power stations in one area?

Air pollution and details (max. 2)
Shortage of oil/gas/coal supply
Depletion of oil/coal reserves in the area
Lack of investment in renewable energy generation
Hot water flows out into rivers

(Answers must refer to the close environment of Karachi only) **[4]**

Review Exercise

Question 1 J2017/P2/Q5/D

Levels marking

Level 1 (1–2 marks)
Simple point addressing any view (1).
Simple points addressing any view (2).

Level 2 (3–4 marks)
Developed point(s) explaining one view (3).
Developed point(s) explaining both views (4).
No evaluation.

Level 3 (5–6 marks)
Developed points explaining both views. Evaluation giving clear support to one view or a named example (5).

Developed points explaining both views. Evaluation giving clear support to one view and a named example (6).

Content Guide:

Answers are likely to refer to:

For large-scale
- Funding available from China
- Provide very large amounts of power from small amount of uranium
- Large coal reserves

Against large-scale
- Large sums of money/loans needed
- Problems with disposing of/reprocessing/storing waste
- Danger of insurgency threat/accident
- Danger of flooding
- Coal extracted in Pakistan is poor quality for power generation
- Oil expensive to import
- Large coal reserves not exploited
- Fossil fuel reserves are depleting
- Political issues between provinces with the construction of multi-purpose dams over division of water

For small-scale
- Lower cost to maintain
- Renewable resources do not deplete
- Renewable resources do not pollute the environment
- Biogas – cheap source of energy
- Wind – available land in Balochistan highlands
- Solar – many parts of Pakistan experience 250–300 sunny days per year

Against small-scale
- Do not contribute/only small amount to national grid
- Renewables only generate small amount of energy
- Wind/solar have high construction cost
- Wind is considered unsightly/harms wildlife
- Not constantly producing energy
- Biogas decreases availability of manure for organic fertiliser

ETC.

Question 2 J2014/P2/Q2/E

(e) To what extent can Pakistan rely on fossil fuels to increase fuel and power supplies? [6]

Possibilities – Res 2
Large reserves of gas
Sui / Pirkoh / Mari / Potwar Plateau area
Large / new reserves of coal
Of a type suitable for use in power stations / power generation
Coal a cheap fuel
Potential of coal gas
Port at Karachi for imports

Problems – *Res 2*
Small oil reserves / oil has to be imported
Will run out / not renewable
Coal is heavy / bulky to transport
Gas is difficult to transport / explosive
Fossil fuels expensive to import
Because becoming inaccessible / higher cost of production / exploration / extraction / rising world prices

Question 3 J2013/P2/Q4/A,D

(a) Study Fig. 5 which shows thermal and hydel (HEP) power stations in Pakistan.

(i) Name the cities A, B and C.

A Islamabad or Rawalpindi
B Lahore
C Multan **[3]**

(ii) Compare the distribution of thermal and hydel (HEP) power stations.

Both near rivers
Credit any relevant comparison from the list below

Thermal (res. 1)
in cities/towns/urban areas
along River Indus in Sindh
more widespread

Hydel (res. 1)
away from cities/towns/urban areas
on River Indus in Punjab, KPK (accept NWFP)
in Northern part of the country
none in Sindh/Baluchistan **[4]**

(iii) Explain why these two different types of power station are built in different areas in Pakistan.

Thermal
built where fuel is locally available,
e.g. coal at Quetta, Potwar plateau
oil/gas at Sui, N Punjab
oil/coal imported at Karachi
near demand in cities/towns

Hydel
needs large volume of water in river
high rainfall
deep/steep-sided valley
only available in North/in mountains **[4]**

(d) To what extent can the development of renewable energy resources improve the reliability of electricity supply in Pakistan?

Reliability (res. 2)
available everywhere
free after installation
possibilities, e.g. sunshine for solar, exposure for wind, coast for tidal or wave (max. 3)

Problems (res. 2)
costly to install
lack of technology
lack of skills
low output
variable output, e.g. wind, sun **[6]**

Recent Past Paper Questions

Question 1 N2018/P2/Q2

Hydel power is electricity generated by using the fast flow of water to move turbines which drive generators.

1 @ 1 mark

- Some areas have less rainfall e.g. Gilgit and Chitral (e.g. cannot generate electricity if not enough water);
- Rain shadow areas;
- More precipitation in highland areas (e.g. where most dams are located);
- Less rainfall in winter / more snow / stored as snow and / or ice in mountains;
- Less rainfall means less water in rivers (e.g. so more difficult to generate electricity);
- Rainfall not evenly spread throughout Pakistan (e.g. rainfall is unpredictable);
- Very high temperatures – lead to evapotranspiration, less water available;
- Very low temperatures – lead to freezing, less water available.

Note: One mark for identification of appropriate idea and a further mark for development (in parentheses).

Note: Max. 2 marks if no development.

2 + 2 marks

- World uses more (41%) coal than Pakistan (1%);
- Pakistan (37%) uses more oil than the world (5%);
- Pakistan (28%) uses more (20%) gas than the world;
- World (13%) uses more nuclear than Pakistan (3%).

2 @ 1 mark

- Expensive to build or develop own renewable energy / limited funding available;
- Limited education / skills / know how to develop these technologies;
- Want to use up coal / gas reserves first / cheaper to use coal / gas;
- Reliant on other countries to help develop renewable sources;
- Demand of growing population difficult to meet / not enough electricity can be produced;
- Areas suitable for large scale production are distant from centres of population;

Etc.

3 @ 1 mark

- Solar panels can be located anywhere / portable;
- Do not need to be connected to the national power gird;
- Energy can be produced on site / in-situ / does not have to be transported through cables;
- Easy to set up small scale scheme / independent schemes / every house will have their own solar panel;
- Limitless / will not run out;

Etc.

2 @ 1 mark

Sketch of a wind turbine, labels can include:

- Generator
- Rotor Blades / fans
- Tower / pole
- Gear box
- Transformer
- Cables

Etc.

3 @ 1 mark

Advantages:

- Wind is renewable / does not run out;
- Does not pollute the atmosphere or water or environmentally friendly (clean or green);
- Plenty of wind available in Pakistan;
- Wind is free / cheap to run;
- Can be deployed locally / remotely;
- Wind turbines improve electricity supply in rural areas;
- Wind farms attract tourists;
- Wind turbines vary in size depending on requirements;
- Wind energy can be generated at night unlike solar;

Etc.

Disadvantages:

- Expensive to build;
- Wind is not constantly blowing / variable wind speed;
- Stop working during storms;
- Many turbines are needed to generate enough power for a town or city / low output individually;
- Need a large area to construct wind farm / can take land which could be used for agriculture;
- Can kill birds;
- Perceived as an eyesore;
- Noise pollution;
- Interfere with radio / TV signals;
- Limited sites where wind is reliable;

Etc.

4 @ 1 mark

Levels marking

No valid response	0
Level 1 Simple point addressing any view (1) Simple points addressing any view (2)	1–2
Level 2 Developed point(s) explaining one view (3) Developed point(s) explaining both views (4) No evaluation	3–4
Level 3 Developed points explaining both views Evaluation giving clear support to one view or appropriate example (5) Evaluation giving clear support to one view and appropriate example (6)	5–6

Content Guide
Answers are likely to refer to:

More sustainable because:
- Boosts economy;
- Can bridge the gap with energy shortages / deficiencies in oil and gas;
- Can be used near the coast to provide energy to nearby industries;
- Assists development;
- Provides jobs;
- A small quantity of uranium can generate a large amount of energy;
- Less than half kg of uranium contains 3 million more times energy than the same weight of coal;
- The chances of accidents in nuclear power stations is low / there have been fewer accidents in nuclear power stations than any other kind of power station;
- Nuclear power can help speed up the process of industrialisation;
- Nuclear power contributes less to the greenhouse effect and acid rain compared to fossil fuels;

Etc.

Less sustainable because:
- Expensive to build so may have to borrow money or seek investment from other countries / economic burden;
- Will take up valuable land space needed for more important development projects / or example;
- Renewable energy schemes such as solar energy / wind power are more appropriate;
- Have many coal reserves that can still be exploited;
- Only provides jobs in the short term whilst building them;
- Probably built in other countries so negative multiplier effect;
- Fuel rods in reactors produce dangerous rays which are cancer causing;
- Nuclear waste remains radioactive for many years;
- Finding suitable locations for storing radioactive waste is a problem;

Etc.

Question 2 J2019/P2/Q3

- Sui / Eastern Balochistan / Pirkoh / Uch / Zin / Loti;
- Lower Sindh / Tharparker / Thora / Tando Adam / Nazari / South Mzari Deep / Pasakhi;
- Northern Sindh / Mari;
- Northern gas region / Potwar Plateau / Meyal / Dhurnal / Adhi / Pindori / Balkassar / Fimkassar.

3 @ 1 mark

- Named provinces: Sindh / Punjab / KPK / Northern Balochistan;
- From / to named cities;
- Large areas are not served by natural gas via the pipeline / or named examples;
- Distance from any specified place or feature;
- Direction from any specified place or feature;
- Runs from the coast in the south to the tip of the Northern Regions;
- Forms a line down the centre of Pakistan / central Pakistan;
- Only a few branch lines / two branch lines to the west / east;
- Connects to / from all the gas producing regions.

4 @ 1 mark

Method of transport:

- Road / rail / cylinders; can be cooled to a very low temperature where it turns into a liquid (dev); LPG can be placed into (special) cylinders; the cylinders can then be transported to all parts of Pakistan / named example where pipelines cannot be found (dev);

Etc.

Limitation:

- It is dangerous / hazardous to transport gas cylinders by road; accidents can happen causing an explosion or leakage (dev);
- It is more expensive to transport gas by road rather than by pipeline; less income will be earnt (dev);
- It takes longer to transport gas by road than through the pipeline; there could be delays on the roads leading to a gas shortage in remote areas (dev);
- Only small amounts can be transported; therefore may lead to a shortage of gas in remote areas (dev);
- Supply is not continuous; roads blocked in winter / theft (dev);
- Needs safety precautions in place; may increase cost of transport (dev);

Etc.

Note: One mark for identification of appropriate idea and a further mark for development (in parentheses).

Note: Max. 2 marks if no development.

2 @ 2 marks

Accurate completion of bar chart for household 18%.

1 @ 1 mark

- Fertiliser industry / animal feed;
- Cement industry;
- Transport / CNG.

2 @ 1 mark

To produce electricity in a thermal power station, fossil fuels such as coal, oil or gas are burned to make steam that moves the turbines to generate electricity. Transformers control the voltage and transfer electricity to pylons through transmission lines.

5 @ 5 marks
4 @ 4 marks
3 @ 3 marks
2 @ 2 marks
1 @ 1 mark

Levels marking

No valid response 0

Level 1 1–2
Simple point referring to any view (1)
Simple points referring to any view (2)

Level 2 3–4
Developed point referring to one view only (3)
Developed points referring to both views (4)

Level 3 5–6
Developed points referring to both views with evaluation or relevant example (5)
Developed points referring to both views with evaluation and relevant example (6)

Content Guide
Answers are likely to refer to:

Possibilities
- More pipelines and gas fired thermal power stations could be set up;
- Potential for more gas fields to be found;
- Pipeline could be extended further to areas currently not served;
- Pipeline could be over-ground, doesn't have to be underground;
- If more gas fired thermal power stations are built, Pakistan could reduce imports of oil and coal;
- Finding more gas reserves would increase the domestic supply and increase the number of potential years use;
- Improve the lives of people in remote rural areas / provide employment opportunities;

Etc.

Difficulties
- Financial constraints / loans may have to be taken out;
- Topography and / or climate may hinder or make difficult the building of more pipelines or further exploration;

- Cost of exploration and / or building thermal power stations will not be value for money / cost effective;
- Industries would not be built in these areas anyway as remote / not ideal locations for building further industry;

Etc.