Energy Sources

Question Paper

Course	CIE IGCSE Physics
Section	1. Motion, Forces & Energy
Topic	Energy Sources
Difficulty	Hard

Time Allowed   80

Score   /59

Percentage   /100

Question 1a

Extended tier only

A solar panel receives energy from the Sun at a rate of 5.0 kW.

Thermal energy is transferred from the solar panel to water with an efficiency of 20%.

Cold water of mass 15 kg enters the solar panel every hour.

The specific heat capacity of water is 4200 J / (kg°C).

Calculate the temperature increase of the water.

temperature increase = ...°C

[4 marks]

Question 1b

State and explain one advantage and one disadvantage of heating the water in a solar panel compared with heating the water in a coal-burning boiler.

[4 marks]

Question 2a

Energy sources used to generate electricity are shown in the box.

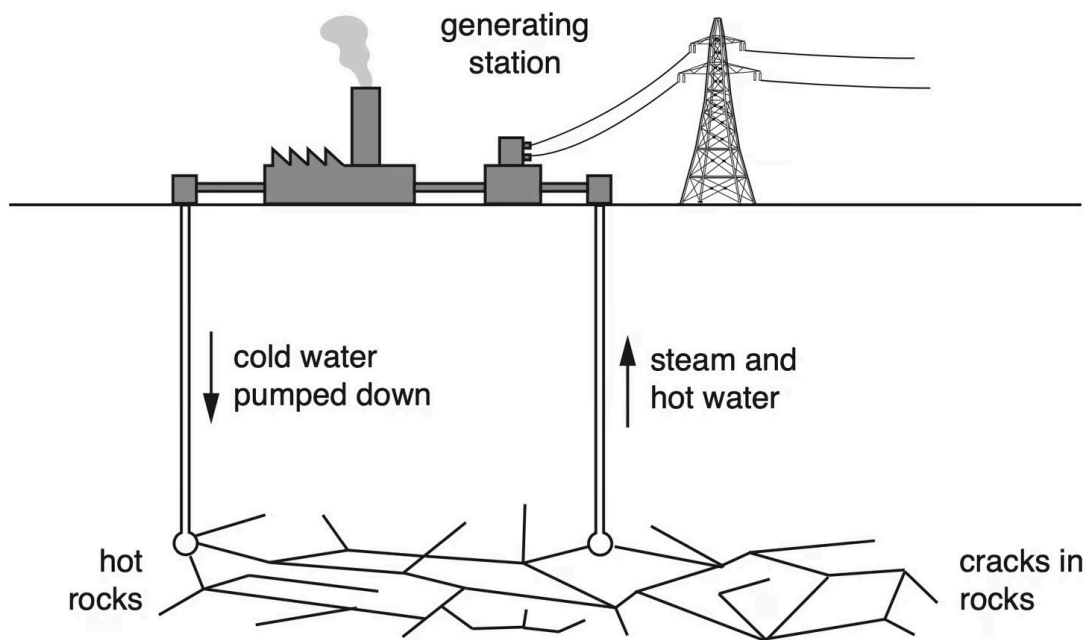| gas	oil	tides	waves	wind

Which energy sources are non-renewable?

Draw a ring around **each** energy source that is non-renewable.

[1 mark]

Question 2b

The diagram shows a geothermal power station.

Fig. 5.1

Describe how the geothermal power station generates electricity.

[4 marks]

Question 2c

In America, it is estimated that tidal power costs $150 per MWh, whereas coal costs $60 per MWh. This is partly due to construction costs of the turbines for tidal power.

Suggest why it is expensive to construct tidal turbines.

[4 marks]

Question 3a

Extended tier only

Fusion is occurring in the centre of a star. The region in which a certain type of fusion is occurring has a diameter of 150 000 km.

Calculate the surface area of this sphere.

[3 marks]

Question 3b

The weight of the star around the core exerts a large force on the core.

The core experiences a pressure of 26.5×10^{15} Pa.

(i)   Calculate the size of the force due to gravity experienced by the core.

[3]

(ii)   The volume of the core is approximately constant, so pressure and temperature (in degrees Kelvin) can be approximated as directly proportional. They are related in the following equation:

$$P = cT$$

c is a constant equal to 2.2×10^9 Pa/K

Calculate the temperature of the core of the star.

[2]
[5 marks]

Question 3c

Extended tier only

Compare the advantages and disadvantages of nuclear fusion and nuclear fission.

[4 marks]

Question 4a

Calculate the number of joules in 1 GWh.

[2 marks]

Question 4b

Extended tier only

Tidal power electrically transfers energy in the kinetic store of moving water.

When the tide is moving, a portion of sea water passes through the turbine. The turbine has a cylindrical shape as the turbine spins in a circular path. A turbine is shown in Fig. 1.1.

The cylinder is 24 m long and has a radius of 5.0 m. The tide is travelling at 6.0 m/s.
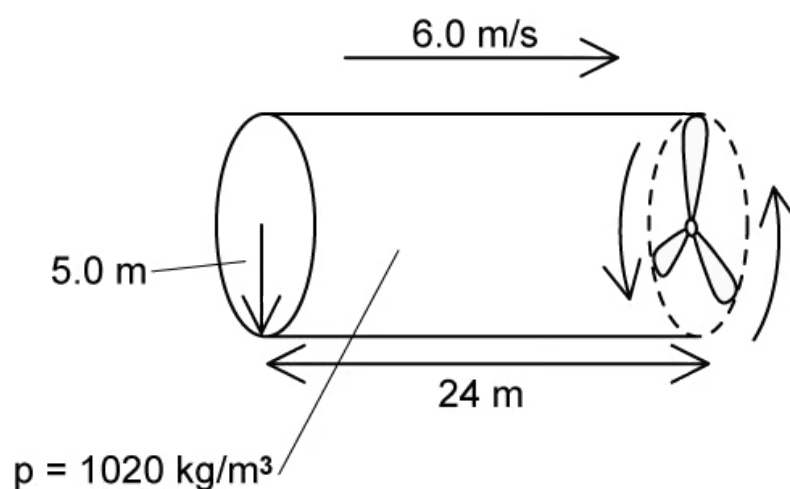
Fig. 1.1

(i) Calculate the kinetic energy of this cylinder of sea water.

Density of sea water = 1020 kg/m^3

[4]

(ii) Calculate the time taken for 24 m of water to pass through the turbine at 6.0 m/s.

[1]

(iii) Calculate the power transferred to the turbine.

[1]

(iv) The turbine's electrical power output is 7.0 MW. Calculate its efficiency.

[1]
[7 marks]

Question 4c

In America, it is estimated that tidal power would cost $150 per MWh produced, whereas coal only costs $60 per MWh produced.

Suggest why tidal power is more expensive than power from fossil fuels.

[2 marks]

Question 4d

Some ocean environmental groups oppose the use of tidal power, stating that it can physically harm aquatic life, as well as impacting their ability to communicate.

Suggest why these statements could be correct.

[2 marks]

Question 5a

A coal power station has an average output of 400 MW. Explain how, in a power station, burning a fuel causes a generator to produce an alternating current.

[4 marks]

Question 5b

Extended tier only

The Sun has a total power output of 3.8×10^{26} W across its whole surface. The surface of the Earth receives 5.0×10^{-8} % of this power.

Calculate the total power the surface of the Earth receives from the Sun.

[2 marks]

Question 5c

Extended tier only

The power that the Earth receives from the Sun is actually twice the percentage given in part (b).

(i)   Suggest why the power at the Earth's surface is less than this value.

[1]

(ii)   The Earth's radius is 6 370 000 m. Calculate the surface area of the Earth which is in sunlight at any one time.

[3]

[4 marks]

Question 5d

Extended tier only

(i)   Under the assumption that there are no clouds obscuring the Sun, calculate the power that each square metre of the Earth receives from the Sun.

[2]

(ii)   A solar cell absorbs sunlight over a surface area of 2.5 m². It has an efficiency of 0.6. Calculate its power output.

[3]

(iii)   Determine the number of solar cells required to match the power output of the coal power station.

[2]

[7 marks]