

8.1 Energy Sources

Question Paper

Course	DPIB Physics
Section	8. Energy Production
Topic	8.1 Energy Sources
Difficulty	Easy

Time allowed: 90
Score: /67
Percentage: /100

Question 1a

A manufacturing company is looking to revolutionise the way water can be heated in the home. Fuels can be compared using energy density and specific energy.

(a)
Match, by drawing a line, energy density and specific energy to the quantity they compare and their units.

Specific Energy	Mass	J m^{-3}
Energy Density	Volume	J kg^{-1}

[4]

[4 marks]

Question 1b

Kerosene is a clean and cost-effective energy source for heating water. The specific energy of Kerosene is $48 \times 10^6 \text{ J kg}^{-1}$ and the energy density is $3.3 \times 10^{10} \text{ J m}^{-3}$.

$$\text{Density} = \frac{\text{Energy density}}{\text{Specific energy}}$$

(b)
Calculate the density of Kerosene.

[3]

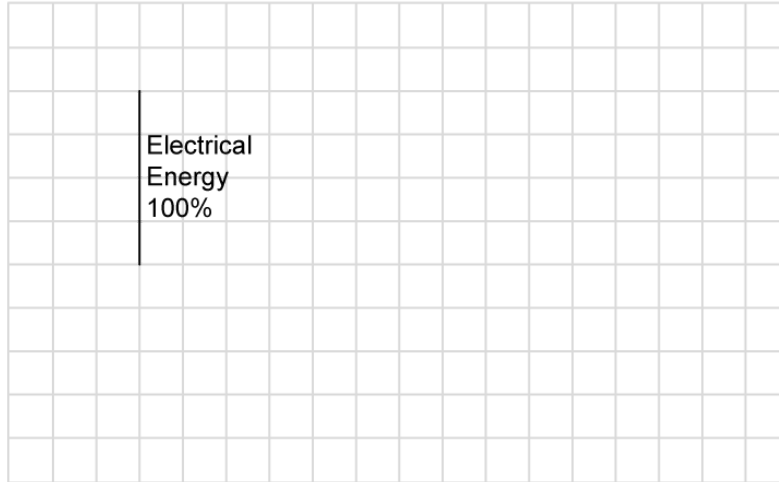
[3 marks]

Question 1c

A new kettle is being developed that claims to be 75% efficient.

(c)

Sketch a Sankey diagram on the squares below to represent this situation.



[3]

[3 marks]

Question 1d

In a new prototype kettle, claimed to be 95% efficient, 300 000 J of energy is required to raise the temperature of the full kettle of water from room temperature to boiling point.

(d)

Calculate the amount of energy wasted by the kettle.

[2]

[2 marks]

Question 2a

An energy company is analysing their energy sources to provide cheaper and greener energy to its customers.

(a)

Define a primary energy source.

[3]

[3 marks]

Question 2b

The energy company are considering using more nuclear power to generate their electricity.

(b)

State whether nuclear fission is a renewable or non-renewable energy source and give a reason for your answer.

[2]

[2 marks]

Question 2c

The energy company is trying to improve its understanding of nuclear energy.

(c)
Identify four advantages of using nuclear power by placing a tick (✓) next to the correct statements in the table below.

	There are extensive reserves of fissionable materials
	Nuclear power is always sustainable and will never run out
	The technology to extract the fissionable material from the rocks is improving
	No greenhouse gases are produced from a nuclear reactor
	Nuclear waste is easy to dispose
	A large amount of power can be produced from a small amount of fissionable material

[4]

[4 marks]

Question 2d

The energy company is investigating the purpose of the control rods, the moderator and the shielding within a nuclear reactor.

(d)
Place a tick (✓) in the correct box to show the purpose of each part of the nuclear reactor.

	Control Rods	Moderator	Shielding
Absorb hazardous radiation			
Slow down neutrons			
Absorb neutrons			

[3]

[3 marks]

Question 3a

A developer looking to create a new residential complex is analysing the energy required for the construction of the project. She is investigating the differences between primary and secondary energy sources.

(a)
The following statements are about secondary energy sources. Place a tick (✓) next to the correct statement(s).

	Statement is correct
Wind power is an example of a secondary energy source	
Secondary energy sources come from the use or processing of primary energy sources	
Examples of secondary energy sources are geothermal, hydroelectric and solar power	
An example of a secondary energy source includes converting the gravitational potential energy from falling water into electricity	

[2]

[2 marks]

Question 3b

The developer is also trying to identify which energy resources are renewable and which are non-renewable.

(b)
Identify whether the energy resources below are renewable or non-renewable. Place a tick (✓) in the correct for each resource.

	Renewable Resources	Non-Renewable Resources
Petrol		
Solar Energy		
Wind		
Coal		
Nuclear Fission		
Tidal		
Natural Gas		
Bio-Fuel		

[4]

[4 marks]

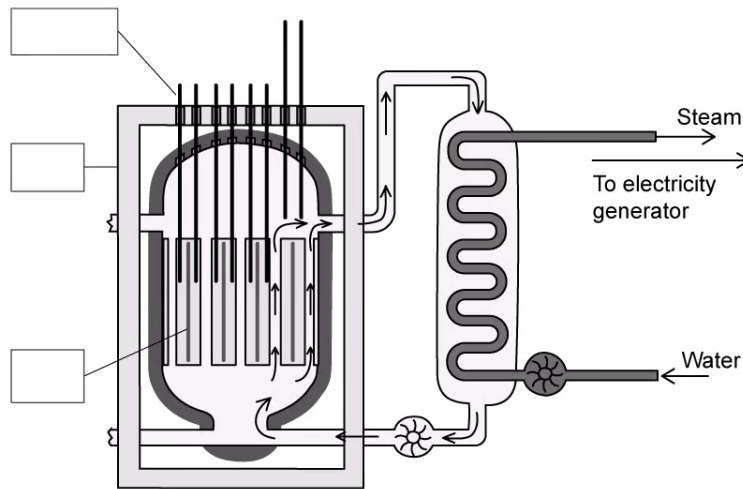
Question 3c

The developer is investigating the set-up of a nuclear power plant.

(c)

Identify the key components of the nuclear reactor by adding the following labels to the diagram:

- Control Rods
- Graphite Moderator
- Radiation Shielding



[3]

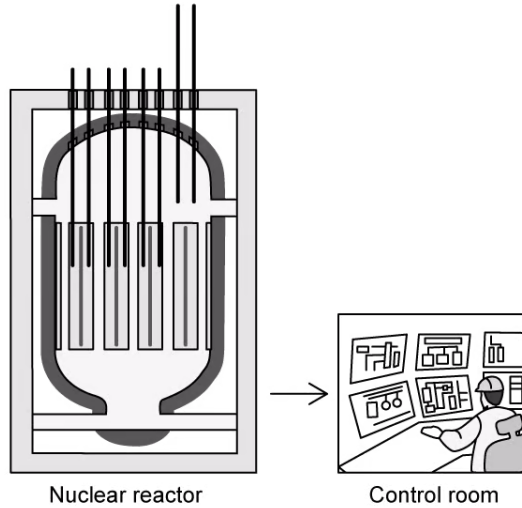
[3 marks]

Question 3d

The developer is impressed by the amount of electricity that can be generated in a nuclear reactor with a small amount of uranium. They are concerned, however, with the safety of workers within a nuclear power plant.

(d)

With the aid of the diagram supplied below, identify three safety features designed to reduce workers' exposure to radiation.



[3]

[3 marks]

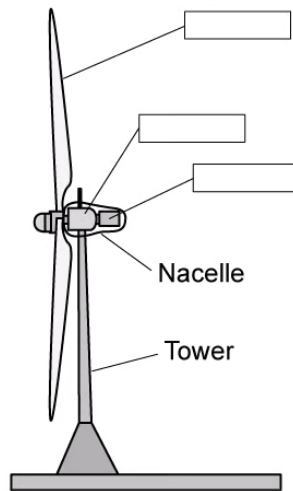
Question 4a

A farmer has been approached by the National Grid asking if they can install wind turbines on part of his land.

(a)

Identify the following components of the wind turbine by labelling the diagram below:

- Rotor blade
- Generator
- Gear Box



[3]

[3 marks]

Question 4b

The National Grid are really keen to use the farmer's land for wind turbines because of the consistently high wind speed available. The density of the surrounding air is 1.32 kg m^{-3} and its velocity is 12 m s^{-1} . The cross-sectional area of the column of air that would be incident on one wind turbine is $125\,000 \text{ m}^2$.

(b)

Calculate the maximum power possible in this situation and put your answer in standard form.

[3]

[3 marks]

Question 4c

The farmer would prefer not to have wind turbines on his land. He is keen to support the motion for an extension to be made to the local coal-fired power station instead.

(c)

The following statements are advantages or disadvantages of using a coal-fired power station to generate electricity. Place a tick (✓) next to the correct statement(s) to say whether they are advantages or disadvantages.

	Advantage	Disadvantage
Produces greenhouse gases		
High energy density of fuel		
Available at any time		
Non-renewable		
Produces pollution		
Long established method for generating electricity		
Extensive infrastructure already in place		

[4]

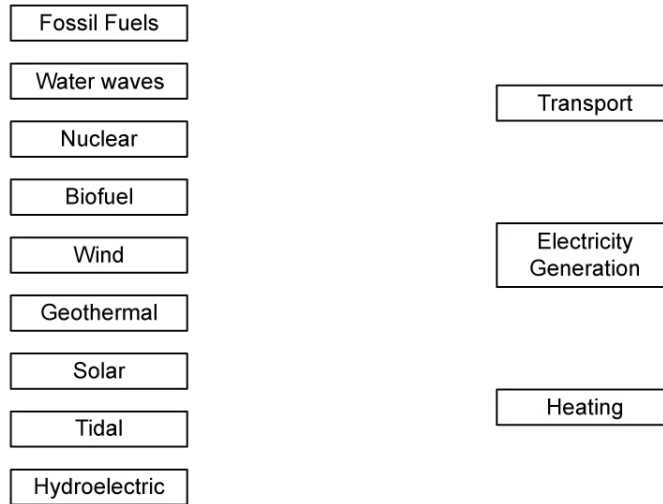
[4 marks]

Question 4d

The National Grid are continually assessing the main uses of energy and the types of energy resources used to generate them.

(d)

Identify the types of energy resources used for transport, electricity generation and heating by drawing lines between them. Each energy resource may be used up to a maximum of two times.



[3]

[3 marks]

Question 5a

Nepal is a mountainous country, making it ideal for using hydroelectric power to generate electricity.

(a)
Use the text in the box to complete the sentences below, identifying the conditions needed for hydroelectric power.

gravitational potential energy
Kinetic energy

depth
height

dropped
pumped

(i)
Water needs to be stored at _____.

[1]

(ii)
_____ energy is released.

[1]

(iii)
Water is _____ from a height to turn the turbines of a generator.

[1]

[3 marks]

Question 5b

A location in the Annapurna region of Nepal is being analysed for its suitability as a new hydroelectric power station. The plan is to have water of density 1000 kg m^{-3} flowing at a rate of $150 \times 10^{-3} \text{ m}^3 \text{ s}^{-1}$ through a turbine that then descends a distance of 380 m.

(b)
Calculate the maximum power obtained from this system.

[4]

[4 marks]

Question 5c

Most people in cities in Nepal have solar panels on their roof to generate electricity for their household.

(c)

Identify an advantage of using solar panels in countries like Nepal where there is bright sunlight for a large portion of the day. [3]

[3 marks]

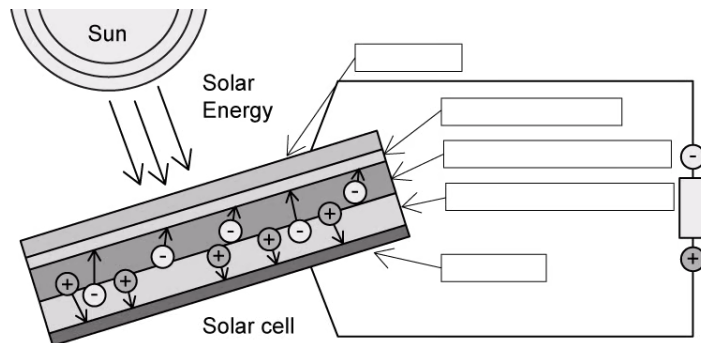
Question 5d

The Nepali government are putting together a flyer to explain to people how solar panels work.

(d)

On the diagram below label the following:

- Electrode
- Reflect-proof film
- N-type semiconductor
- P-type semiconductor



[4]

[4 marks]

Question 5e

On the second page of the flyer, the Nepali government wants to have a clear description of the function of each part of the solar panel.

(e)

Draw a line between the correct component of the solar panel and its function.

Electrode	Stops the incident light being reflected away from the solar panel
Reflect-Proof Film	Negative electrons move from one side of the semiconductor
N-Type Semiconductor	Incident light causes electrons to be emitted
P-Type Semiconductor	The movement of the electrons through the semiconductor generates an electrical current

[4]

[4 marks]

