

Easter HW 1 Combined science - Physics (Higher)

Physics Paper 1

Topic P2 Electricity

6.2.4 Energy transfers

You must complete this homework on Lined/ plain A4 paper and bring it in to school on 19/04/22

Q1.

The diagram shows the label from a new freezer.

Model Energy A	SALE See inside for details
More efficient Less efficient	
Energy consumption per year	225 kWh

- (a) An old freezer has an energy consumption per year of 350 kWh.

Use the equation in the box to calculate the extra cost of using the old freezer for one year compared with using a new 'A' rated freezer.

$\text{total cost} = \text{number of kilowatt-hours} \times \text{cost per kilowatt-hour}$
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Assume 1 kilowatt-hour (kWh) of energy costs 12 p.

Show clearly how you work out your answer.

Extra cost per year = £ _____

(2)

- (b) The price of the new freezer was reduced in a sale.

Reducing the price reduces the payback time for replacing the old freezer from 12 years to 9 years.

Calculate, in pounds, how much the new freezer was reduced in the sale.

Show clearly how you work out your answer.

Price reduced by = £ _____

(2)

- (c) An advertisement in a shop claims that:

‘Replacing an old freezer with a new ‘A’ rated freezer will benefit the environment.’

Do you agree that replacing the freezer will benefit the environment?

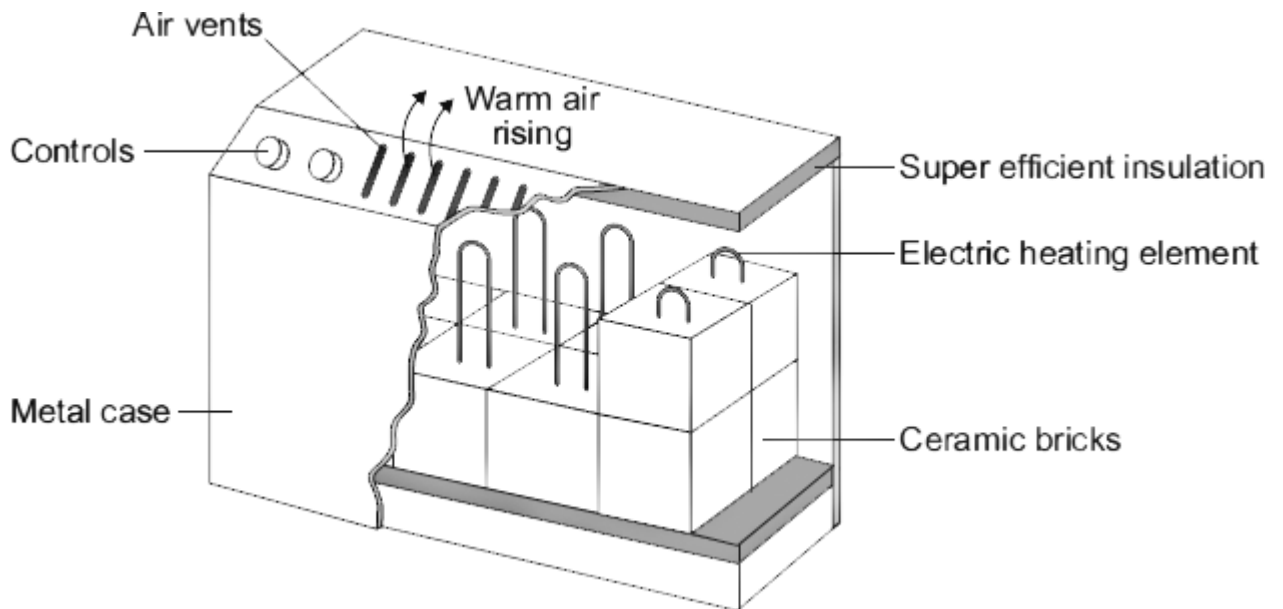
Answer yes or no. _____

Explain the reasons for your answer.

(2)
(Total 6 marks)

Q2.

The diagram shows how one type of electric storage heater is constructed. The heater has ceramic bricks inside. The electric elements heat the ceramic bricks during the night. Later, during the daytime, the ceramic bricks transfer the stored energy to the room.



- (a) In winter, the electricity supply to a 2.6 kW storage heater is switched on each day between midnight and 7 am. Between these hours, electricity costs 5 p per kilowatt-hour.

Calculate the daily cost of using the storage heater.

Show clearly how you work out your answer.

Cost = _____ p

(3)

- (b) Homes with electric storage heaters have a separate meter to measure the electricity supplied between midnight and 7 am. Another meter measures the electricity supplied at other times. This electricity supplied at other times costs 15 p per kilowatt-hour.

Electricity companies encourage people to use electricity between midnight and 7 am by selling the electricity at a lower cost.

Suggest why.

(1)

- (c) By 7 am, the temperature at the centre of the ceramic bricks is about 800 °C. The temperature of the outside metal casing is about 80 °C.

The ceramic bricks are surrounded by 'super-efficient' insulation.

Explain why.

(2)

- (d) At 7 am, the electricity supply switches off and the temperature of the ceramic bricks starts to fall. The temperature of the bricks falls by 100 °C over the next four hours. During this time, 9 000 000 J of energy are transferred from the bricks.

Calculate the total mass of ceramic bricks inside the heater.

Specific heat capacity of the ceramic bricks = 750 J/kg °C.

Show clearly how you work out your answer.

Mass = _____ kg

(2)

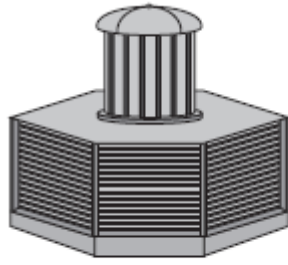
(Total 8 marks)

Q3.

A community of people living on an island are considering buying wind turbines to supply their electricity. The community have looked at two types of wind turbine.

Vertical Axis Wind Turbine

Horizontal Axis Wind Turbine



Not to scale

The community looked at information about the two different types of wind turbine.

- **Vertical axis wind turbines** start to rotate at wind speeds of 1.5 m/s.
- Vertical axis wind turbines are powered by wind coming from any direction.
- The power output at 12 m/s is 1 MW.
- The wind turbines continue to generate electricity until the wind speed reaches 40 m/s.

- **Horizontal axis wind turbines** start to rotate at wind speeds of 3.6 m/s.
- Horizontal axis wind turbines turn to point into the wind.
- The power output at 12 m/s is 1 MW.
- At very high wind speeds, above 20 m/s, the wind turbines stop working automatically to avoid damage.

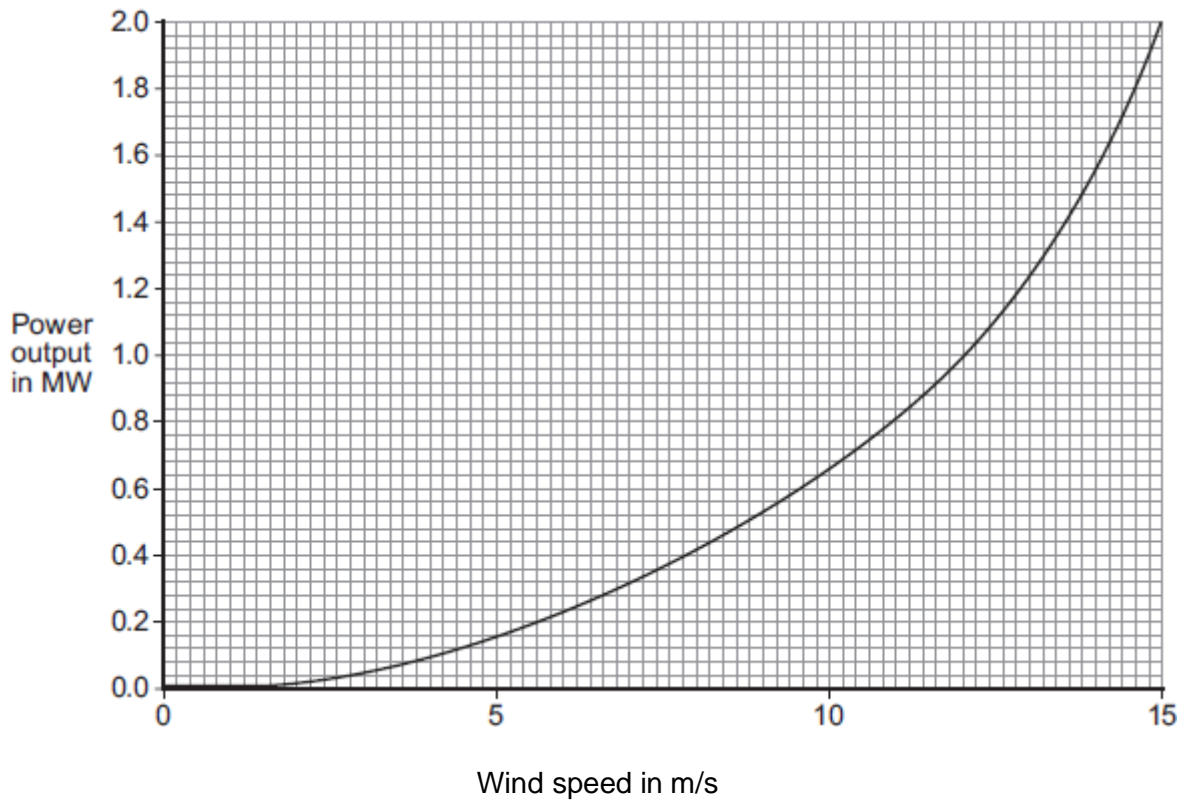
(a) The community decide that vertical axis wind turbines would be better.

Use the information given to suggest why.

(3)

(b) **Graph 1** shows how the power output varies with wind speed for a vertical axis wind turbine.

Graph 1



Describe how the power output of this wind turbine varies with wind speed for the range of wind speeds shown.

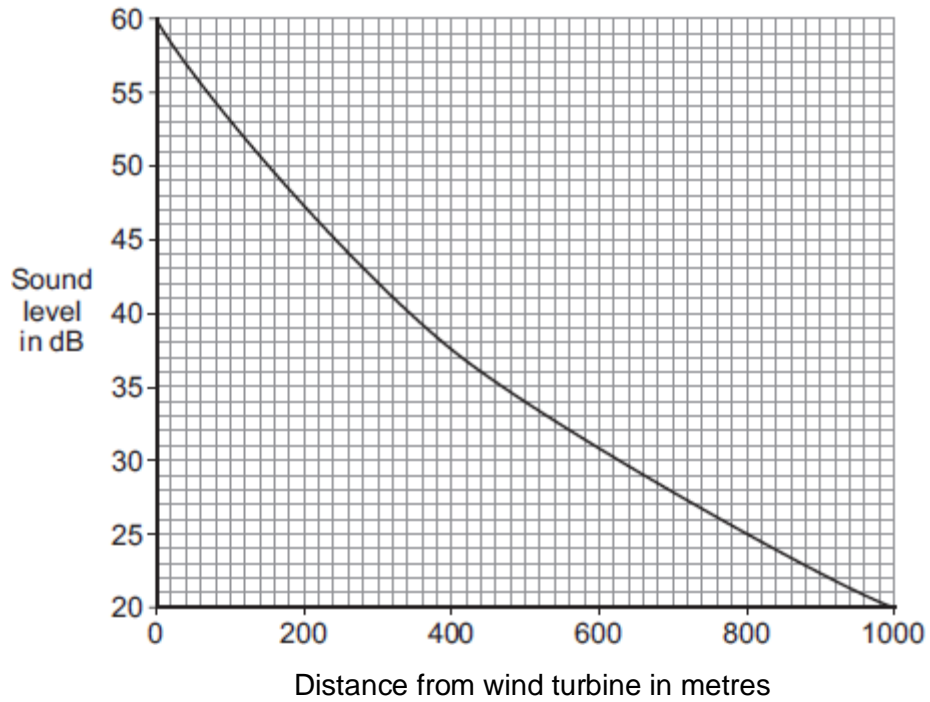
(2)

- (c) Some local people do not want the wind turbines. These people say the wind turbines are too noisy.

Graph 2 shows how the sound level detected changes with distance from a wind turbine.

Sound level is measured in decibels, dB.

Graph 2



The sound level of a normal conversation is 50 dB.

- (i) How far from the wind turbine would a person need to stand to detect a sound level of 50 dB?

Distance = _____ metres

(1)

- (ii) The graph shows that 1000 m away you can still hear the noise the wind turbines produce.

A sound level of 30 dB is the same as a person whispering in another person's ear.

The nearest house to the wind turbine is 1000 m away.

Some people do not want the wind turbines because of the noise the wind turbines produce.

Are these people justified in not wanting wind turbines?

Give reasons for your answer.

(2)

- (d) On the mainland, wind turbines are connected to the National Grid.

Electricity is transmitted through the power lines of the National Grid at very high voltages and low currents.

State why.

(1)
(Total 9 marks)