
SL Paper 1

A wind turbine has a power output p when the wind speed is v . The efficiency of the wind turbine does not change. What is the wind speed at which the power output is $\frac{p}{2}$?

- A. $\frac{v}{4}$
- B. $\frac{v}{\sqrt{8}}$
- C. $\frac{v}{2}$
- D. $\frac{v}{\sqrt[3]{2}}$

Markscheme

D

Examiners report

[N/A]

What is equivalent to $\frac{\text{specific energy of a fuel}}{\text{energy density of a fuel}}$?

- A. density of the fuel
- B. $\frac{1}{\text{density of the fuel}}$
- C. $\frac{\text{energy stored in the fuel}}{\text{density of the fuel}}$
- D. $\frac{\text{density of the fuel}}{\text{energy stored in the fuel}}$

Markscheme

B

Examiners report

[N/A]

Which of the following correctly shows the energy change in a photovoltaic cell and in a solar heating panel?

	Photovoltaic cell	Solar heating panel
A.	solar → electrical	solar → thermal
B.	electrical → thermal	solar → electrical
C.	solar → electrical	electrical → thermal
D.	electrical → thermal	solar → thermal

Markscheme

A

Examiners report

Some teachers argued correctly that a photovoltaic cell was a type of solar panel. In the context of this question, though, it is clear that a solar *heating* panel is meant. The response options allowed only A to be correct.

The rate of global warming might be reduced by

- A. replacing the use of coal and oil with natural gas.
- B. a reduction in the Earth's albedo.
- C. a reduction in carbon fixation.
- D. an increase in deforestation.

Markscheme

A

Examiners report

Three of the four responses were incorrect and only one option was possible. Any confusion between carbon capture and carbon fixation was not relevant here as it was clear that the option referring to carbon fixation was not correct.

The energy source that currently provides the greatest proportion of the world's total energy demand is

- A. coal.
- B. oil.
- C. natural gas.
- D. uranium.

Markscheme

B

Examiners report

[N/A]

Three gases in the atmosphere are

- I. carbon dioxide (CO_2)
- II. dinitrogen monoxide (N_2O)
- III. oxygen (O_2).

Which of these are considered to be greenhouse gases?

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

Markscheme

A

Examiners report

[N/A]

It is suggested that the solar power incident at a point on the Earth's surface depends on

- I. daily variations in the Sun's power output
- II. the location of the point
- III. the cloud cover at the point.

Which suggestion(s) is/are correct?

- A. III only
- B. I and II only
- C. II and III only
- D. I, II and III

Markscheme

D

Examiners report

The first option concerning the daily output of the Sun's power caused some confusion. The question does not ask about whether such variations occur (they do!) but rather whether they would lead to a change in power incident upon the Earth. Clearly they would, leading to D as the correct response.

A black body has kelvin temperature T and surface area A . The total power radiated by the body is P . What is the new power radiated when T is doubled and A is halved?

- A. $4P$
- B. $8P$
- C. $16P$
- D. $32P$

Markscheme

B

Examiners report

In a wind generator, the kinetic energy of the wind cannot be completely converted into mechanical kinetic energy. This is because

- A. momentum is not conserved in the collisions between air molecules and the blades.
- B. the density of the air depends on the temperature of the air.
- C. the air molecules cannot be brought completely to rest in collisions with the blades.
- D. the wind speed does not remain constant.

Markscheme

C

Examiners report

[N/A]

In the production of electric power, an advantage of using photovoltaic cells rather than fossil fuels is that the photovoltaic cells

- A. can be effective in any location.
- B. can be used continuously.
- C. have low initial set-up costs.
- D. are more environmentally friendly when in use.

Markscheme

D

Examiners report

[N/A]

The energy density of a substance can be calculated by multiplying its specific energy with which quantity?

- A. mass
- B. volume
- C. $\frac{\text{mass}}{\text{volume}}$
- D. $\frac{\text{volume}}{\text{mass}}$

Markscheme

C

Examiners report

[N/A]

A uranium nuclear fission reactor that attempts to operate without a moderator would

- A. suffer core meltdown.
- B. not require uranium enrichment.
- C. produce too much energy.
- D. produce very little energy.

Markscheme

D

Examiners report

In the production of energy from nuclear fission, fuel enrichment means increasing, in the fuel rods, the amount of

- A. uranium-238.
- B. plutonium-239.
- C. uranium-235.
- D. uranium-235 and plutonium-239.

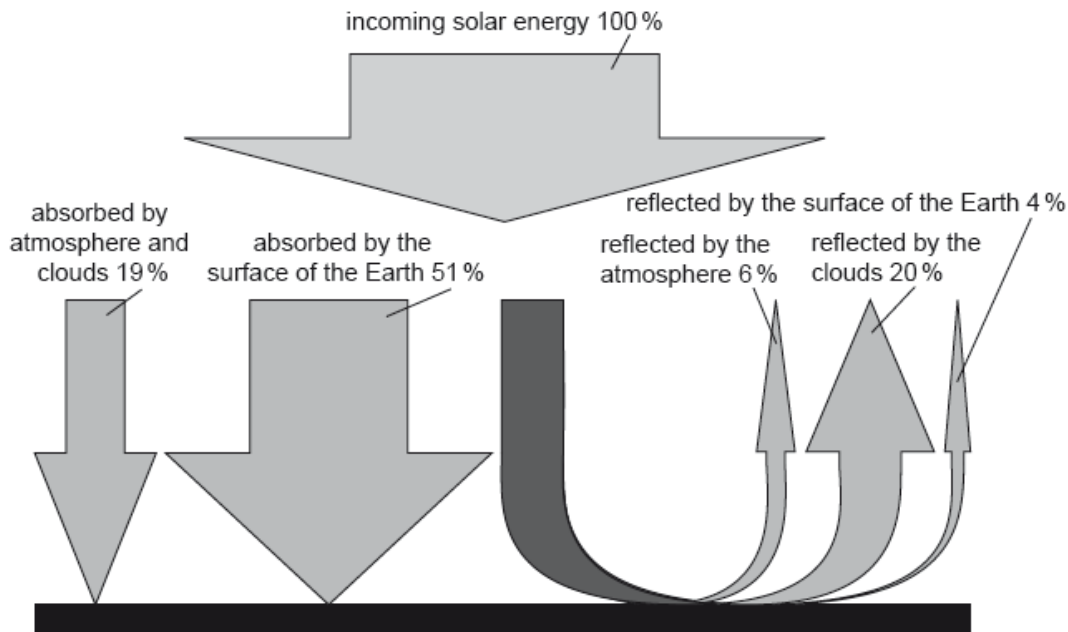
Markscheme

C

Examiners report

[N/A]

The diagram shows a simple climate model for the Earth.



What does this model predict for the average albedo of the Earth?

- A. 0.30
- B. 0.51
- C. 0.70
- D. 0.81

Markscheme

A

Examiners report

[N/A]

What is the purpose of the moderator in a nuclear power station?

- A. To absorb fast moving neutrons
- B. To slow down fast moving neutrons
- C. To initiate a chain reaction
- D. To transfer the heat generated to a heat exchanger

Markscheme

B

Examiners report

[N/A]

A natural gas power station has an output of 600 MW and an efficiency of 50%. The mass of natural gas that is burned per second is 20kg. What is the energy density of natural gas?

- A. 15 MJkg⁻¹
- B. 30 MJkg⁻¹
- C. 40 MJkg⁻¹
- D. 60 MJkg⁻¹

Markscheme

D

Examiners report

Non-renewable fuels have been produced in the past and so can be produced again, so C represents a common misconception. The key to understanding what is meant by 'non-renewable' is consideration of the time scale of production and consumption.

The average surface temperature of Mars is approximately 200 K and the average surface temperature of Earth is approximately 300 K. Mars has a radius half that of Earth. Assume that both Mars and Earth act as black bodies.

What is $\frac{\text{power radiated by Mars}}{\text{power radiated by Earth}}$?

- A. 20
- B. 5
- C. 0.2
- D. 0.05

Markscheme

D

Examiners report

[N/A]

What is the phenomenon that best explains why greenhouse gases absorb infrared radiation?

- A. Resonance
- B. Interference
- C. Refraction
- D. Diffraction

Markscheme

A

Examiners report

[N/A]

Three energy sources for power stations are

- I. fossil fuel
- II. pumped water storage
- III. nuclear fuel.

Which energy sources are primary sources?

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

Markscheme

B

Examiners report

[N/A]

Which of the following best defines non-renewable fuels?

- A. They produce a lot of degraded energy in comparison with renewable fuels.
- B. They have very high energy density but produce greenhouse gases.
- C. They cannot be produced again.
- D. Their rate of consumption is much greater than the rate at which they are being produced.

Markscheme

D

Examiners report

In nuclear power production, what is one advantage of a nuclear fusion reactor over a nuclear fission reactor?

- A. The operating temperature of the fusion reactor is lower.
- B. The nuclear reactants are more easily confined within the core of the fusion reactor.
- C. The disposal of the nuclear waste products from the fusion reactor is more straightforward.
- D. The nuclear fusion reaction is more easily sustained for long periods of time.

Markscheme

C

Examiners report

[N/A]

Methane and carbon dioxide are both greenhouse gases that are believed to cause global warming. The reason for this is that these gases

- A. absorb incoming radiation from the Sun.
- B. transmit the incoming radiation from the Sun and radiation from the Earth.
- C. reflect incoming radiation from the Sun.
- D. transmit incoming radiation from the Sun and absorb outgoing radiation from the Earth.

Markscheme

D

Examiners report

[N/A]

The average surface temperature of Mars is about 200 K. The average surface temperature of Earth is about 300 K. Both can be regarded as black bodies.

What is the ratio $\frac{\text{energy radiated per second per unit area on Mars}}{\text{energy radiated per second per unit area on Earth}}$?

- A. 0.7
- B. 0.4
- C. 0.3
- D. 0.2

Markscheme

D

Examiners report

[N/A]

Venus and Earth may be regarded as behaving as black bodies. The mean temperature at the surface of Venus is about 600 K and at the surface of Earth is about 300 K. Which of the following is the best estimate for the ratio $\frac{\text{power radiated per unit area on Earth}}{\text{power radiated per unit area on Venus}}$?

- A. $\frac{1}{2}$
- B. $\frac{1}{4}$
- C. $\frac{1}{8}$
- D. $\frac{1}{16}$

Markscheme

D

Examiners report

[N/A]

One **disadvantage** of using photovoltaic cells to power a domestic water heater is that

- A. solar energy is a renewable source of energy.
- B. the power radiated by the Sun varies significantly depending on the weather.
- C. a large area of photovoltaic cells would be needed.
- D. photovoltaic cells contain CFCs, which contribute to the greenhouse effect.

Markscheme

C

Examiners report

To heat the amount of water used in a typical household, a large area of photovoltaic cells would be required and this is a disadvantage. Some candidates were distracted by the inclusion of the variation of weather conditions for one of the options, however candidates should have realized that the power radiated by the Sun is unaffected by the weather conditions on Earth.

Mars and Earth act as black bodies. The $\frac{\text{power radiated by Mars}}{\text{power radiated by the Earth}} = p$ and $\frac{\text{absolute mean temperature of the surface of Mars}}{\text{absolute mean temperature of the surface of the Earth}} = t$.

What is the value of $\frac{\text{radius of Mars}}{\text{radius of the Earth}}$?

- A. $\frac{p}{t^4}$
- B. $\frac{\sqrt{p}}{t^2}$
- C. $\frac{t^4}{p}$
- D. $\frac{t^2}{\sqrt{p}}$

Markscheme

B

Examiners report

[N/A]

The three statements give possible reasons why an average value should be used for the solar constant.

- I. The Sun's output varies during its 11 year cycle.
- II. The Earth is in elliptical orbit around the Sun.
- III. The plane of the Earth's spin on its axis is tilted to the plane of its orbit about the Sun.

Which are the correct reasons for using an average value for the solar constant?

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

Markscheme

A

Examiners report

[N/A]

In a nuclear power station, uranium is used as the energy source and plutonium-239 is produced. Which of the following is true?

- A. Plutonium-239 is produced by nuclear fusion.
- B. A moderator is used to absorb plutonium-239.
- C. Control rods are used to slow down plutonium-239.
- D. Plutonium-239 can be used as a fuel in another type of nuclear reactor.

Markscheme

D

Examiners report

[N/A]

In a nuclear power station, a moderator is required to

- A. control the rate of fission.
- B. reduce heat losses to the surroundings.
- C. reduce the energy of high energy neutrons.

D. increase the energy of low energy neutrons.

Markscheme

C

Examiners report

[N/A]

Which of the following correctly describes both the role of the moderator and of the control rods in a nuclear reactor?

	Moderator	Control rods
A.	slows down the neutrons	maintain a constant rate of fission
B.	cools down the reactor	extract thermal energy
C.	cools down the reactor	maintain a constant rate of fission
D.	slows down the neutrons	extract thermal energy

Markscheme

A

Examiners report

Only in certain reactors does the moderator also have the role of cooling the reactor down. The best answer is therefore A.

Which of the following geographical features has the lowest albedo?

- A. Polar ice cap
- B. Desert
- C. Ocean
- D. White cliffs

Markscheme

C

Examiners report

[N/A]

World energy resources include coal, nuclear fuel and geothermal energy. Which of the following lists these resources in order of energy use in the world?

- A. nuclear, geothermal, coal
- B. nuclear, coal, geothermal
- C. coal, geothermal, nuclear
- D. coal, nuclear, geothermal

Markscheme

D

Examiners report

The design of a nuclear power station includes an electrical generator. The function of the generator is to convert

- A. nuclear energy to kinetic energy.
- B. kinetic energy to thermal energy.
- C. thermal energy to electrical energy.
- D. kinetic energy to electrical energy.

Markscheme

D

Examiners report

[N/A]

Which of the following is likely to increase greenhouse gas concentrations in the atmosphere?

- A. Using natural gas instead of coal to generate electrical energy
- B. Incineration of waste to generate electrical energy

- C. Increased use of wind turbines to generate electrical energy
- D. Carbon dioxide capture and storage at the power station

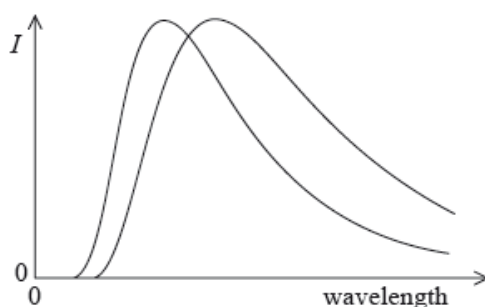
Markscheme

B

Examiners report

[N/A]

The diagram shows the variation with wavelength of the power per unit wavelength I radiated from an area of 1 m^2 of two different bodies.



Which of the following is a correct comparison of the temperature and of the emissivity of the two bodies?

	Temperature	Emissivity
A.	same	same
B.	same	different
C.	different	same
D.	different	different

Markscheme

D

Examiners report

Many candidates thought that the peaks of the curves being at the same intensity meant that the temperatures were the same (response B). It would appear that the family of curves representing bodies of different emissivities (but the same temperature) had not been widely taught.

A black body emits radiation with its greatest intensity at a wavelength of λ_{max} . The surface temperature of the black body doubles without any other change occurring. What is the wavelength at which the greatest intensity of radiation is emitted?

A. I_{\max}

B. $\frac{I_{\max}}{2}$

C. $\frac{I_{\max}}{4}$

D. $\frac{I_{\max}}{16}$

Markscheme

B

Examiners report

[N/A]

In a nuclear power station, in order to increase the chances of a chain reaction

A. kinetic energy is removed from the neutrons.

B. kinetic energy is given to the neutrons.

C. some neutrons are absorbed.

D. extra neutrons are added.

Markscheme

A

Examiners report

[N/A]

The use of which energy source enhances the greenhouse effect the most?

A. Wood

B. Coal

C. Wind

D. Tidal

Markscheme

B

Examiners report

Teachers wished to debate the answer to this question, but the candidates had no problem with it. In paper 1 candidates are required to give the best answer, which here is clearly B.

Greenhouse gases

- A. reflect infrared radiation but absorb ultraviolet radiation.
- B. reflect ultraviolet radiation but absorb infrared radiation.
- C. transmit infrared radiation but absorb ultraviolet radiation.
- D. transmit ultraviolet radiation but absorb infrared radiation.

Markscheme

D

Examiners report

Greenhouse gases allow ultraviolet to pass through them (i.e. they transmit ultraviolet light) but absorb infrared radiation.

Which of the following alternatives would be the most likely to increase the enhanced greenhouse effect?

- A. Replacement of oil and coal fired power stations with natural gas fired power stations
- B. Forests being cut down without being replanted
- C. Greater use of combined heating and power systems
- D. Use of motor vehicles powered by a combination of electricity and oil products

Markscheme

B

Examiners report

[N/A]

Surface X has a temperature T_X and emissivity ϵ_x . Surface Y has a temperature T_Y and emissivity ϵ_y . The two surfaces emit radiation at the same rate.

What is the ratio $\frac{T_X}{T_Y}$?

- A. $\left(\frac{\epsilon_y}{\epsilon_x}\right)^{\frac{1}{4}}$

B. $\left(\frac{\varepsilon_x}{\varepsilon_y}\right)^{\frac{1}{4}}$

C. $\left(\frac{\varepsilon_y}{\varepsilon_x}\right)^4$

D. $\left(\frac{\varepsilon_x}{\varepsilon_y}\right)^4$

Markscheme

A

Examiners report

Gases in the Earth's atmosphere believed to be responsible for the greenhouse effect include

- A. sulfur dioxide, nitrous oxide, water.
- B. methane, carbon monoxide, ozone.
- C. carbon dioxide, sulfur trioxide, carbon monoxide.
- D. water, methane, nitrous oxide.

Markscheme

D

Examiners report

Most candidates chose the correct response, B. Many teachers commented that various sources support response D as correct. Both B and D were therefore accepted as correct.

Which energy resource is renewable?

- A. Natural gas
- B. Uranium
- C. Biogas
- D. Coal

Markscheme

C

Examiners report

[N/A]

The property of the molecules of greenhouse gases which leads to their ability to absorb infrared radiation is their

- A. resonant frequency.
- B. speed of rotation.
- C. total electric charge.
- D. diameter.

Markscheme

A

Examiners report

For a black-body at absolute temperature T the power emitted per unit area is P . What is the power emitted per unit area when the temperature is decreased to $\frac{1}{2}T$?

- A. $\frac{P}{32}$
- B. $\frac{P}{16}$
- C. $\frac{P}{8}$
- D. $\frac{P}{4}$

Markscheme

B

Examiners report

[N/A]

A student states that the following factors may lead to global warming

- I. decreased albedo of the Earth's surface
- II. increase in volcanic activity
- III. deforestation.

Which of the above statements are correct?

- A. I and II only
- B. II and III only
- C. I and III only

Markscheme

D

Examiners report

[N/A]

The surface temperature of a black-body emitter is doubled. By what factor does the power emitted by the body increase?

- A. 32
- B. 16
- C. 4
- D. 2

Markscheme

B

Examiners report

[N/A]

The greenhouse effect can be explained by the fact that the infrared radiation emitted by the surface of Earth

- A. is absorbed by the atmosphere and then re-radiated in all directions.
- B. raises the temperature of the upper atmosphere.
- C. is trapped by the upper atmosphere.
- D. is absorbed by the atmosphere and then all of it is re-radiated back to the surface of Earth.

Markscheme

A

Examiners report

[N/A]

The original source of the electrical power produced by a wind generator is

- A. the Sun's radiated energy.
- B. the gravitational energy of the Sun and the Moon.
- C. nuclear energy stored within atoms in the Earth's atmosphere.
- D. the Earth's internal energy.

Markscheme

A

Examiners report

[N/A]

What is the correct order of energy transformations in a coal power station?

- A. thermal → chemical → kinetic → electrical
- B. chemical → thermal → kinetic → electrical
- C. chemical → kinetic → thermal → electrical
- D. kinetic → chemical → electrical → thermal

Markscheme

B

Examiners report

[N/A]

Which of the following processes leads to the production of a nucleus of plutonium-239 from a nucleus of uranium-238?

- A. Neutron capture by uranium nucleus
- B. Radioactive decay of uranium nucleus
- C. Electron capture by uranium nucleus
- D. Nuclear fission of uranium nucleus

Markscheme

A

Examiners report

The favourite response was the correct one, A. Many teachers, however, pointed out that both A and B could be construed as correct depending upon ones understanding of 'leads to' in the stem. Both responses were therefore accepted as correct.

Large areas of rainforests are cut down and burned every year. The result of these actions is

- A. reduced albedo.
- B. reduced carbon fixation.
- C. increased evaporation rate.
- D. increased mass of atmospheric methane.

Markscheme

B

Examiners report

In a nuclear fission reaction neutrons are passed through a moderator. The reason for this is to reduce the

- A. number of the neutrons.
- B. kinetic energy of the neutrons.
- C. the number of collisions between neutrons.
- D. potential energy of the neutrons.

Markscheme

B

Examiners report

[N/A]

A spherical black body has absolute temperature T_1 . The surroundings are kept at a lower absolute temperature T_2 . What is the net power per unit area lost by the body?

- A. σT_1^4
- B. σT_2^4
- C. $\sigma (T_1^4 - T_2^4)$
- D. $\sigma (T_1^4 + T_2^4)$

Markscheme

C

Examiners report

[N/A]

A room is at a constant temperature of 300 K. A hotplate in the room is at a temperature of 400 K and loses energy by radiation at a rate of P . What is the rate of loss of energy from the hotplate when its temperature is 500 K?

- A. $\frac{4^4}{5^4}P$
- B. $\frac{5^4+3^4}{4^4+3^4}P$
- C. $\frac{5^4}{4^4}P$
- D. $\frac{5^4-3^4}{4^4-3^4}P$

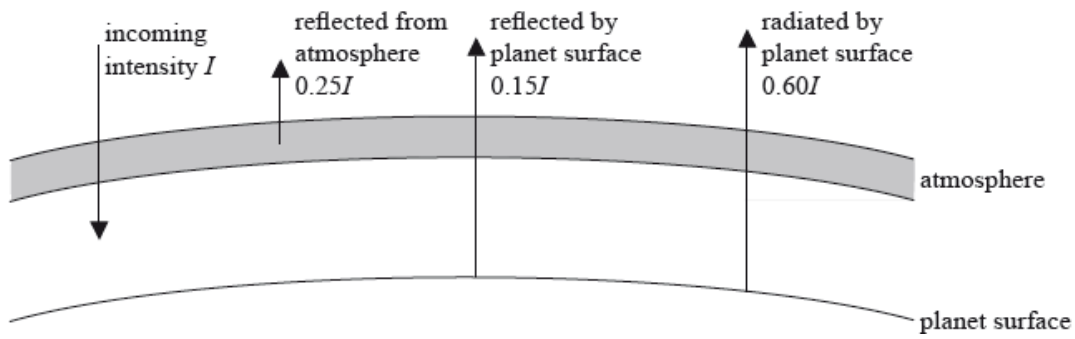
Markscheme

D

Examiners report

[N/A]

The diagram shows an energy balance climate model for a planet.



The intensities of the reflected and radiated radiation are given in terms of the incident intensity I . Which of the following is the albedo of this planet?

- A. 0.15
- B. 0.25
- C. 0.40
- D. 0.60

Markscheme

C

Examiners report

[N/A]

Which of the following is a renewable and non-renewable energy source?

	Renewable	Non-renewable
A.	uranium	coal
B.	tidal	uranium
C.	uranium	biogas
D.	natural gas	biogas

Markscheme

B

Examiners report

[N/A]

In which of the following places will the albedo be greatest?

- A. A forest
- B. A grassland
- C. An ocean
- D. A polar ice cap

Markscheme

D

Examiners report

[N/A]

Which of the following is most likely to reduce the enhanced greenhouse effect?

- A. Replace the use of gas powered stations with oil powered stations
- B. Replace coal-fired power stations with nuclear power stations
- C. Increase the use of all non-renewable energy sources
- D. Decrease the efficiency of power production

Markscheme

B

Examiners report

[N/A]

The albedo for the oceans is lower than that for glaciers. This is because, compared to ice, sea water

- A. has a greater density.
- B. has a greater specific heat capacity.
- C. has a greater coefficient of volume expansion.
- D. absorbs a greater amount of radiative power.

Markscheme

D

Examiners report

[N/A]

Which type of power-production system is most suitable for responding to a sudden high increase in demand for electrical power?

- A. A wind generator
- B. A tidal water storage hydroelectric scheme
- C. An ocean-wave energy converter
- D. A pump storage hydroelectric scheme

Markscheme

D

Examiners report

[N/A]

A solar panel has surface area 0.40m^2 and efficiency 50%. The average intensity of radiation reaching the surface of the panel is 0.25kWm^{-2} . What is the average power output from an array of 10 of these solar panels?

- A. 0.5 W
- B. 5 W
- C. 50 W
- D. 500 W

Markscheme

D

Examiners report

[N/A]

Which of the following energy sources results from the solar energy incident on Earth?

- A. Nuclear fission
- B. Wind energy
- C. Nuclear fusion
- D. Geothermal energy

Markscheme

B

Examiners report

[N/A]

A wind turbine produces a power P when the wind speed is v . Assuming that the efficiency of the turbine is constant, the best estimate for the power produced when the wind speed becomes $2v$ is

- A. $2P$.
- B. $4P$.
- C. $6P$.
- D. $8P$.

Markscheme

D

Examiners report

[N/A]

Which of the following is the primary function of the moderator in a nuclear power station?

- A. To control the rate of fission reactions
- B. To absorb neutrons
- C. To prevent the power station from becoming unsafe
- D. To slow down neutrons

Markscheme

D

Examiners report

Many candidates clearly did not understand the role of the moderator in a nuclear power station.

Wind of speed v is incident normally on a wind turbine of radius r . The maximum theoretical power output of the turbine is P . For wind of speed $2v$ incident normally on a similar turbine of radius $\frac{1}{2}r$, the maximum theoretical power will be

- A. $\frac{1}{2}P$.
- B. P .
- C. $2P$.
- D. $4P$.

Markscheme

C

Examiners report

[N/A]

A black body has absolute temperature T and surface area A . The intensity of the radiation emitted by the body is I . Another black body of surface area $2A$ has absolute temperature $2T$. What is the intensity of radiation emitted by this second black body?

- A. $4I$
- B. $8I$
- C. $16I$
- D. $32I$

Markscheme

D

Examiners report

[N/A]

The main role of a moderator in a nuclear fission reactor is to

- A. slow down neutrons.
- B. absorb neutrons.
- C. reflect neutrons back to the reactor.
- D. accelerate neutrons.

Markscheme

A

Examiners report

[N/A]

Which of the energy sources are classified as renewable and non-renewable?

	Renewable	Non-renewable
A.	Sun	wind
B.	natural gas	geothermal
C.	biomass	crude oil
D.	uranium-235	coal

Markscheme

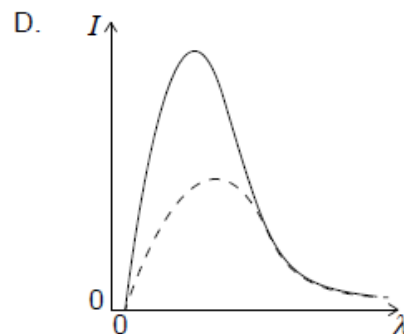
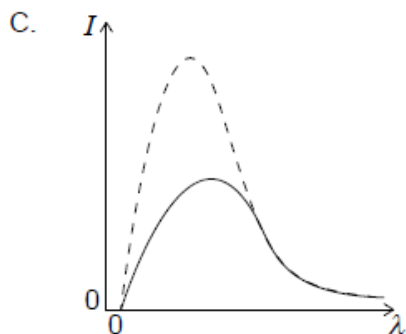
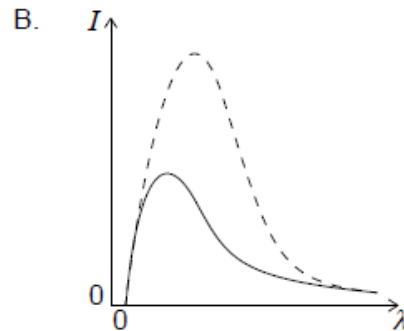
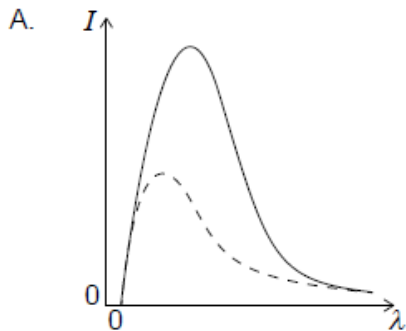
C

Examiners report

[N/A]

Planet X and planet Y both emit radiation as black bodies. Planet X has a surface temperature that is less than the surface temperature of planet Y.

What is the graph of the variation of intensity I with wavelength λ for the radiation emitted by planet Y? The graph for planet X is shown dotted.



Markscheme

Examiners report

[N/A]

Increasing the temperature of a black-body will have the following effect on its emission spectrum.

	Total power radiated	Peak wavelength of radiation
A.	increases	decreases
B.	stays the same	decreases
C.	increases	stays the same
D.	stays the same	stays the same

Markscheme

A

Examiners report

[N/A]

A black body of surface 1.0m^2 emits electromagnetic radiation of peak wavelength $2.90 \times 10^{-6}\text{m}$. Which of the following statements about the body are correct?

- I. The temperature of the body is 1000 K.
- II. The energy radiated by the body in one second is $5.7 \times 10^4\text{ J}$.
- III. The body is a perfect absorber of electromagnetic radiation.

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

Markscheme

D

Examiners report

[N/A]

The following are energy sources.

- I. a battery of rechargeable electric cells
- II. crude oil
- III. a pumped storage hydroelectric system

Which of these are secondary energy sources?

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

Markscheme

B

Examiners report

[N/A]

Which of the following is **not** a primary energy source?

- A. Wind turbine
- B. Jet Engine
- C. Coal-fired power station
- D. Nuclear power station

Markscheme

B

Examiners report

[N/A]

The blades of a certain wind turbine X have radius r . The maximum theoretical available wind power for a given wind speed is P . Another similar turbine Y has blades of radius $2r$. What is the best estimate for the maximum theoretical available wind power from turbine Y?

- A. $8P$
- B. $4P$
- C. $\frac{P}{4}$
- D. $\frac{P}{8}$

Markscheme

B

Examiners report

Which of the following correctly describes the energy transformation within photovoltaic cells and within solar heating panels?

	Photovoltaic cells	Solar heating panels
A.	solar to thermal	solar to electrical
B.	solar to thermal	solar to thermal
C.	solar to electrical	solar to electrical
D.	solar to electrical	solar to thermal

Markscheme

D

Examiners report

[N/A]

What are the principal energy changes in a photovoltaic cell and in a solar heating panel?

	Photovoltaic cell	Solar heating panel
A.	solar to electrical	solar to thermal
B.	solar to thermal	solar to thermal
C.	solar to electrical	electrical to thermal
D.	solar to thermal	electrical to thermal

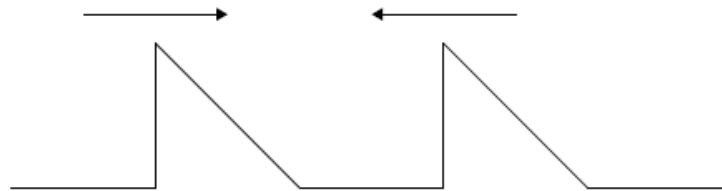
Markscheme

A

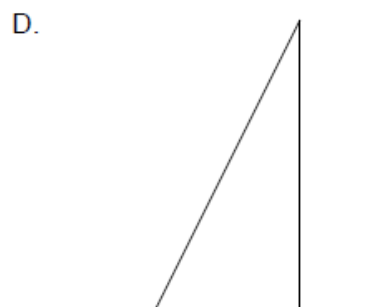
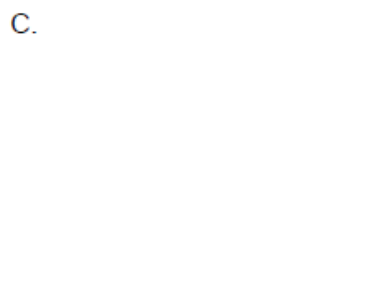
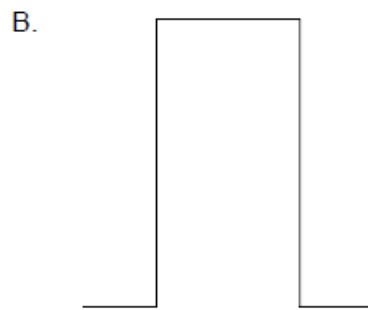
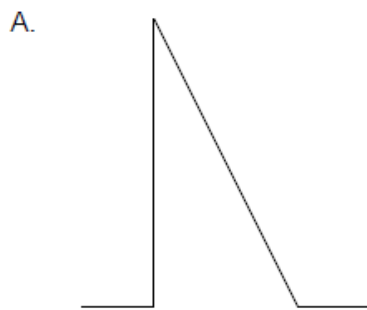
Examiners report

[N/A]

Two pulses are travelling towards each other.



What is a possible pulse shape when the pulses overlap?



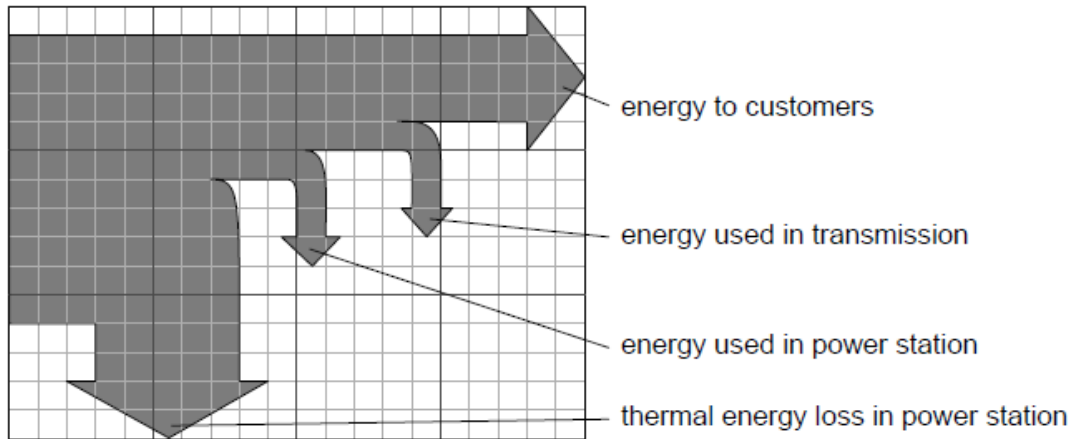
Markscheme

A

Examiners report

[N/A]

The Sankey diagram represents the energy flow for a coal-fired power station.



What is the overall efficiency of the power station?

- A. 0.3
- B. 0.4
- C. 0.6
- D. 0.7

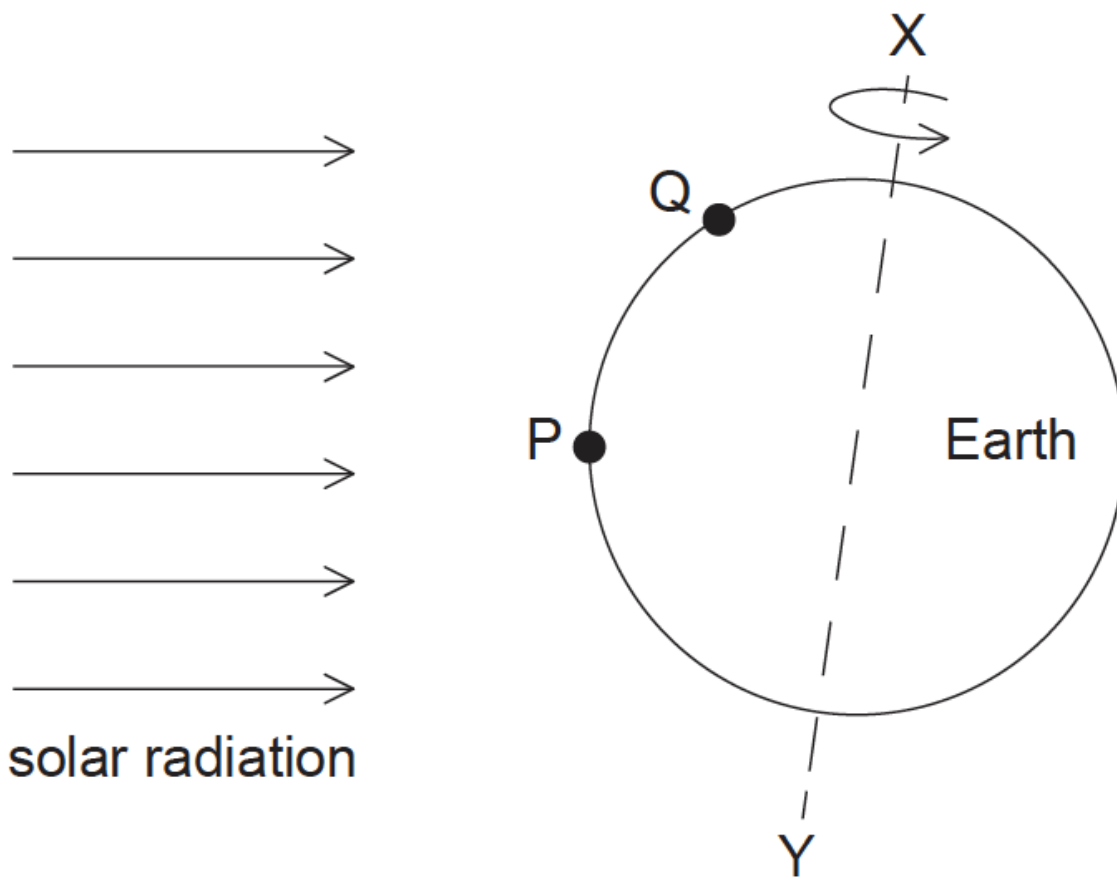
Markscheme

A

Examiners report

[N/A]

The Earth rotates about an axis XY, as shown below.



P and Q are positions on the Earth's surface that receive solar radiation from the Sun. Why is the intensity of the solar radiation incident at P significantly greater than the intensity at Q?

- A. The same amount of solar power is spread over a larger surface area at P.
- B. The path length through the Earth's atmosphere of the solar radiation is shorter for P.
- C. The distance travelled by the solar radiation to reach the top of the Earth's atmosphere is shorter for P.
- D. The periodic variations in the solar power radiated from the Sun's surface have more effect at P.

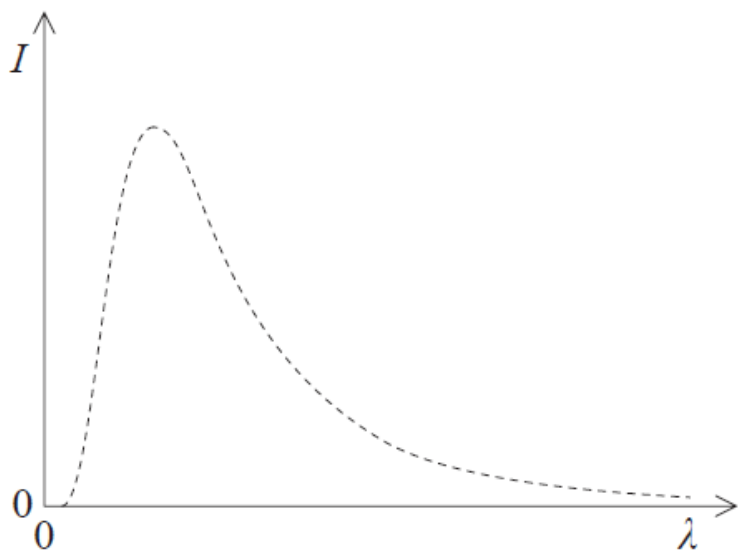
Markscheme

B

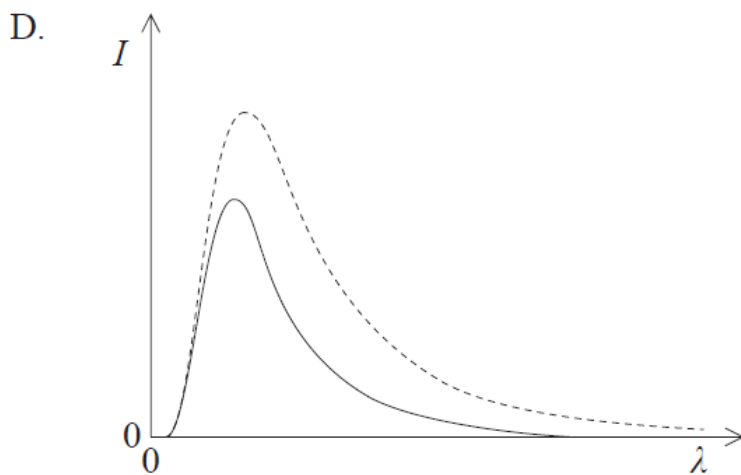
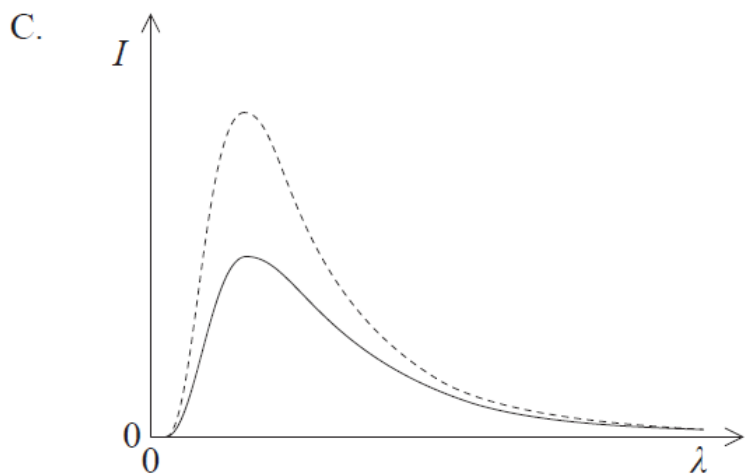
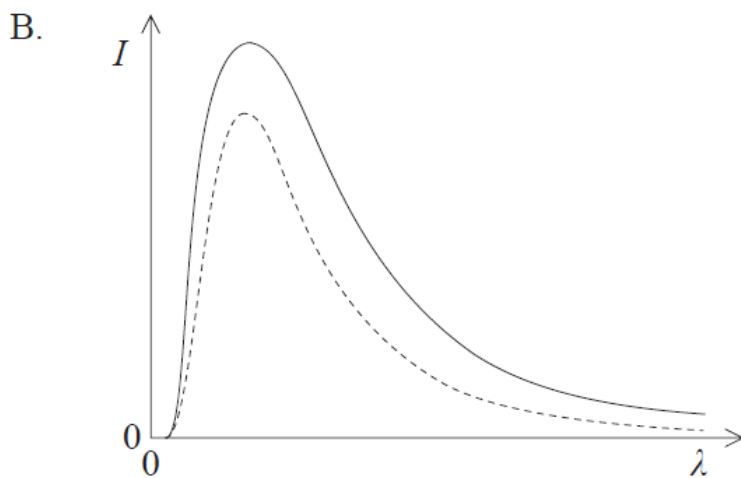
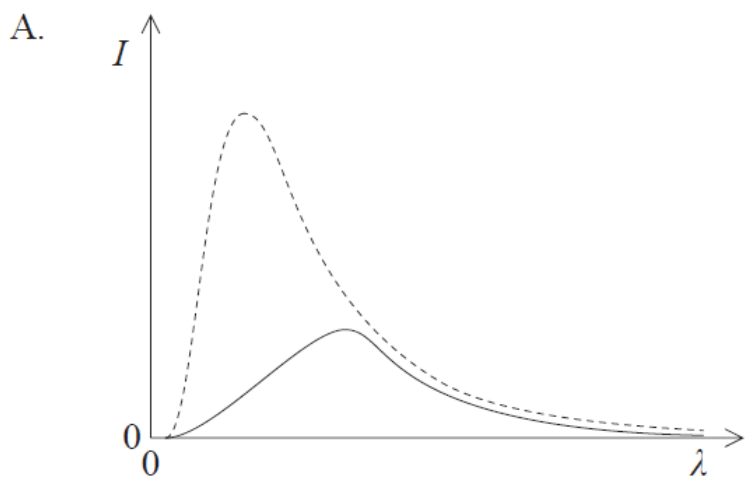
Examiners report

[N/A]

The graph shows the spectrum of a black-body.



Which graph shows the spectrum of a body of emissivity 0.5 at the same temperature as the black-body? (The original graph is shown dotted.)



Markscheme

C

Examiners report

[N/A]

What is the main role of the control rods and the main role of the moderator in a thermal fission reactor?

	Control Rods	Moderator
A.	decrease neutron speed	decrease neutron speed
B.	decrease neutron speed	absorb neutrons
C.	absorb neutrons	decrease neutron speed
D.	absorb neutrons	absorb neutrons

Markscheme

C

Examiners report

[N/A]

The average intensity of the solar radiation incident on a planet is 200 W m^{-2} . The albedo of the planet is 0.6. The average temperature of the planet is constant.

Which of the following is a correct statement about the intensity of radiation reflected and radiated by the planet?

	Intensity reflected by planet	Intensity radiated by planet
A.	120 W m^{-2}	80 W m^{-2}
B.	120 W m^{-2}	less than 80 W m^{-2}
C.	80 W m^{-2}	120 W m^{-2}
D.	80 W m^{-2}	less than 120 W m^{-2}

Markscheme

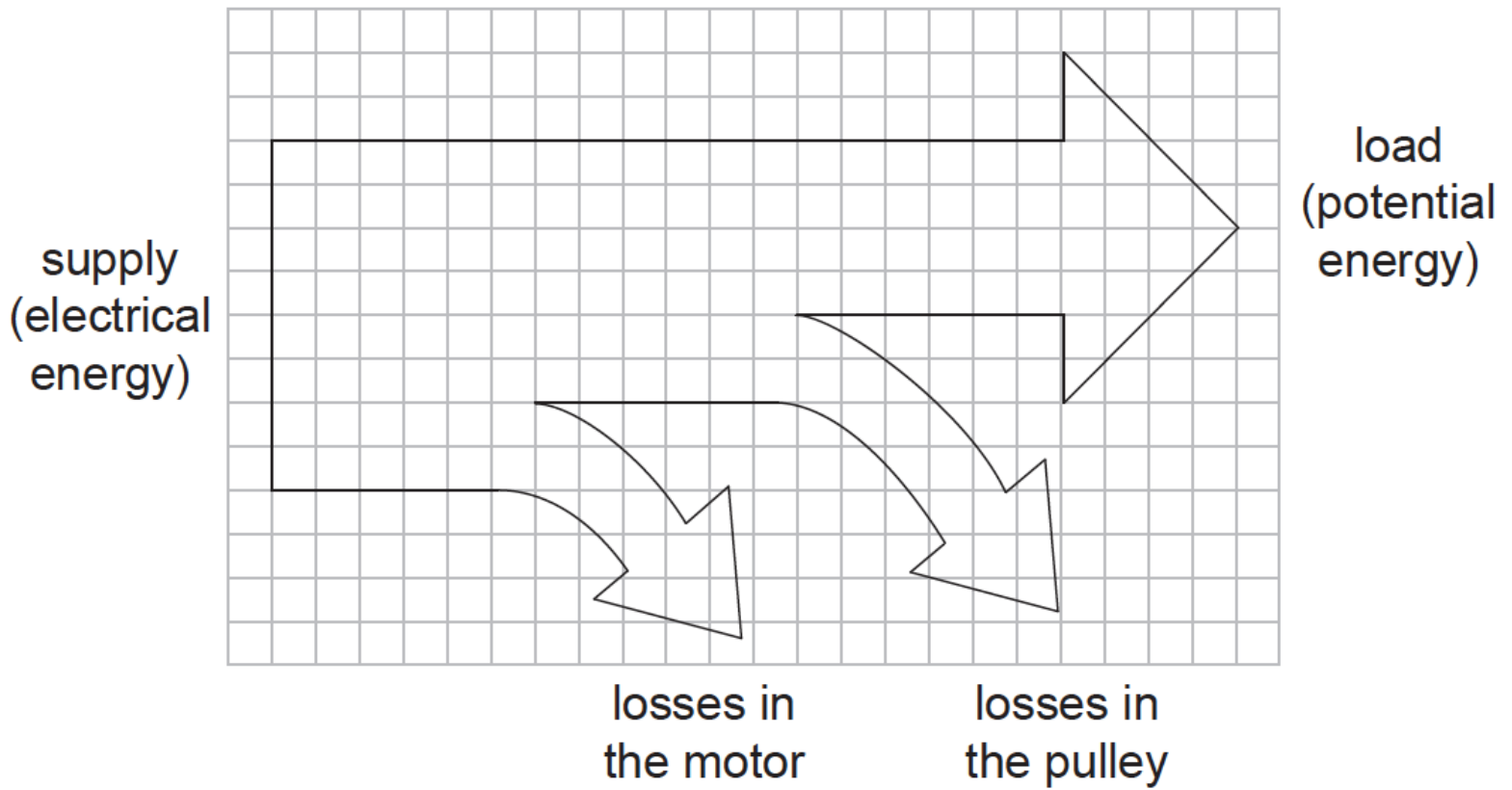
A

Examiners report

The stem clearly states that the average temperature of the planet is constant, so neither B nor D can be correct. A correct understanding of albedo leads to A.

The statistics would suggest that many candidates had not read the stem carefully.

An electric motor is used to lift a heavy load. The Sankey diagram shows the energy transformations involved in the process.



What is the efficiency of the motor?

- A. 33%
- B. 50%
- C. 67%
- D. 75%

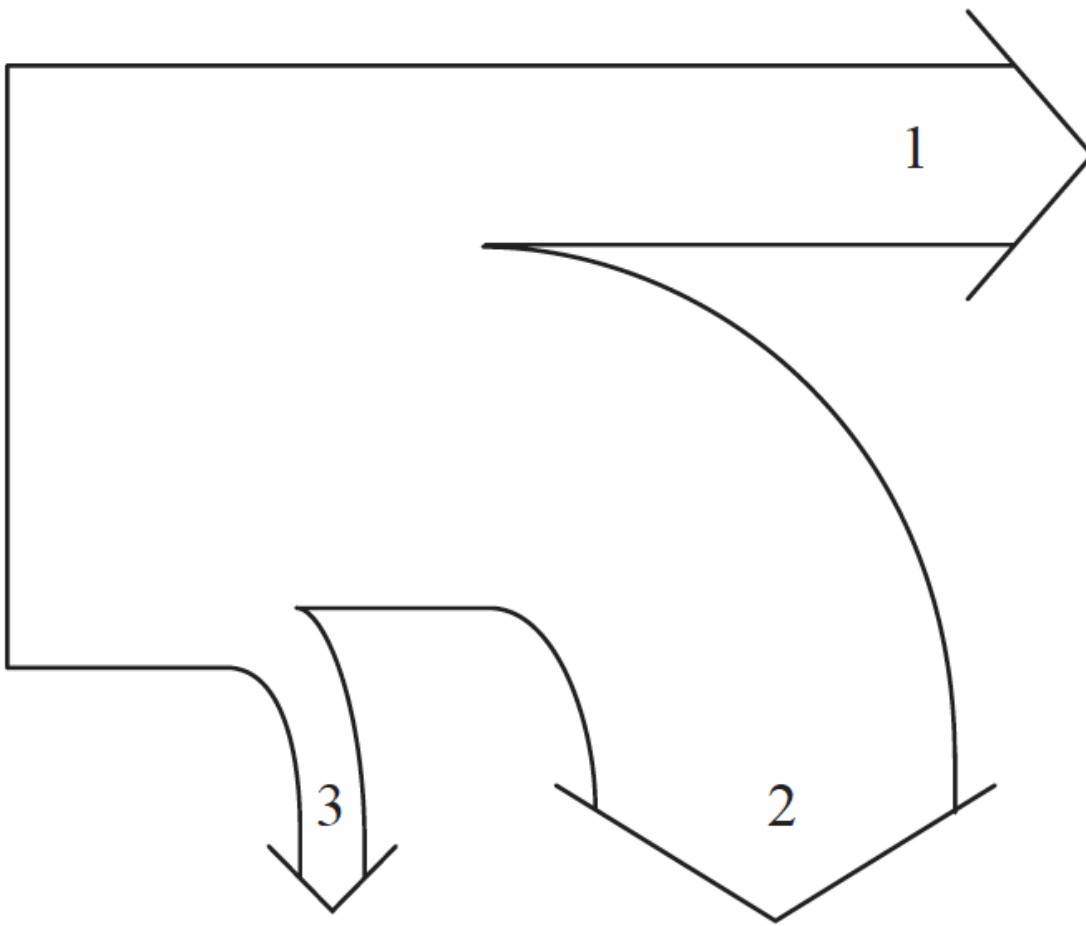
Markscheme

D

Examiners report

[N/A]

The Sankey diagram of a fossil-fuelled power station is shown below.



Which of the following best identifies the thermal energy removed by water and the useful electrical energy output of the station?

	Thermal energy removed	Useful electrical energy output
A.	2	1
B.	2	3
C.	3	1
D.	1	2

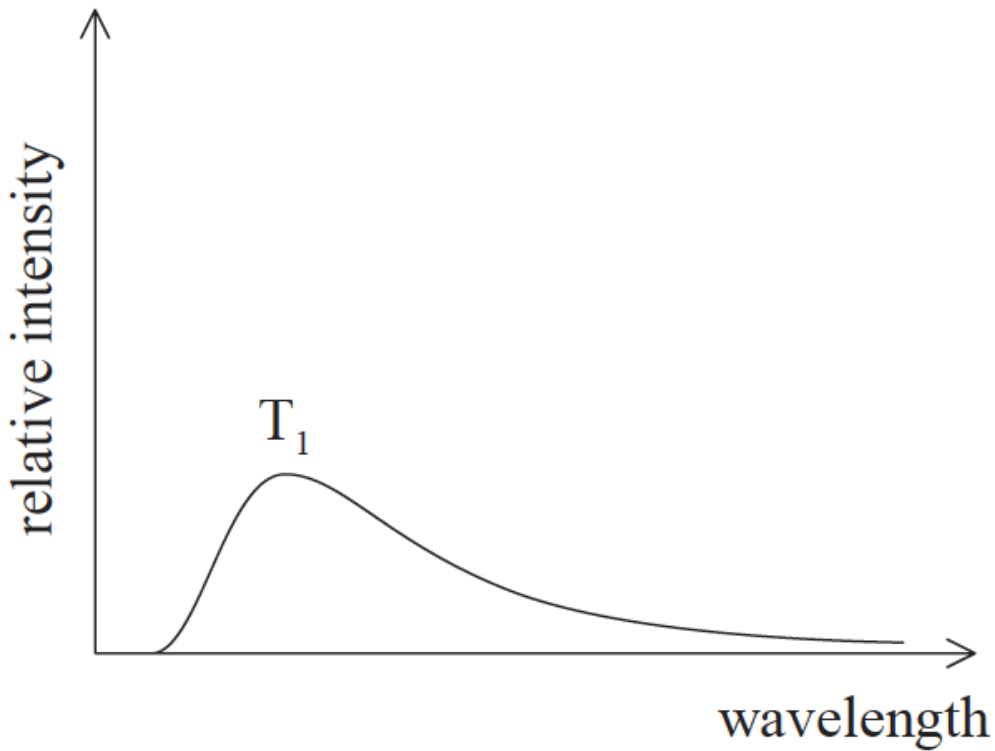
Markscheme

A

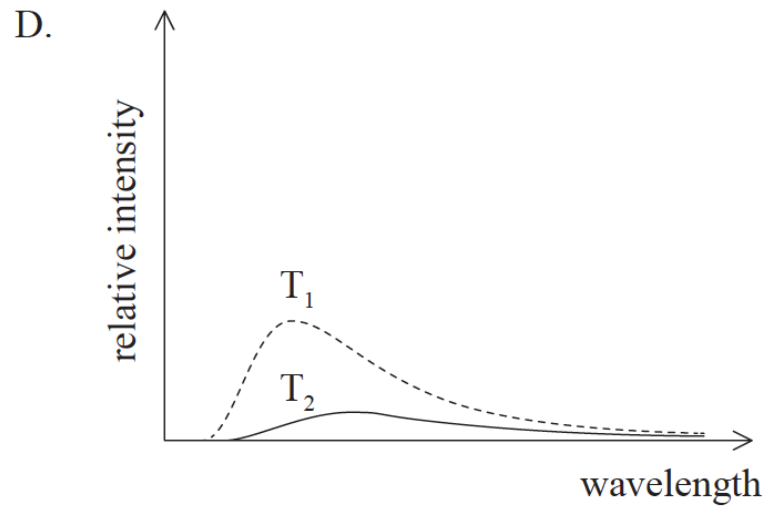
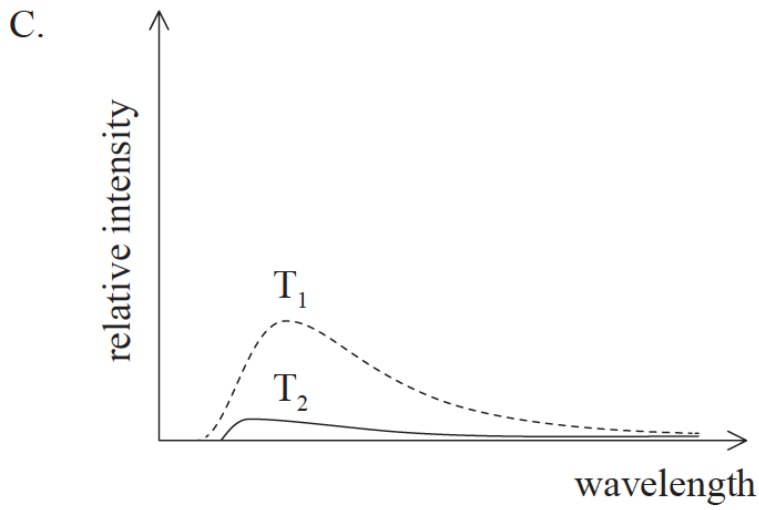
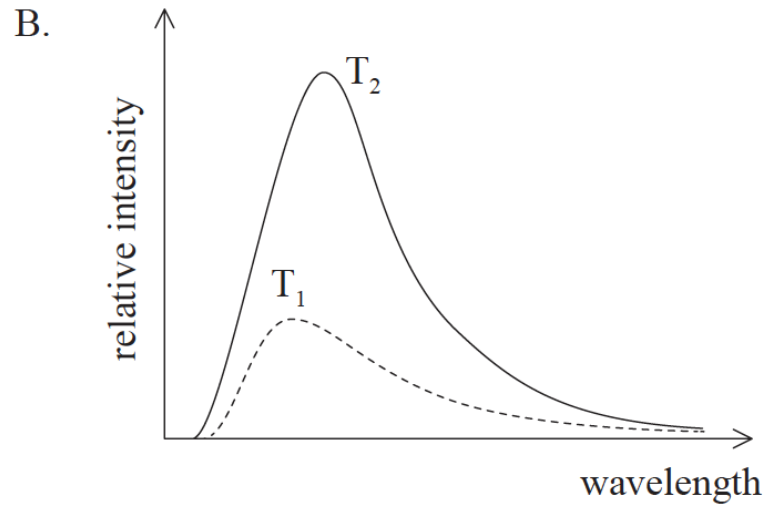
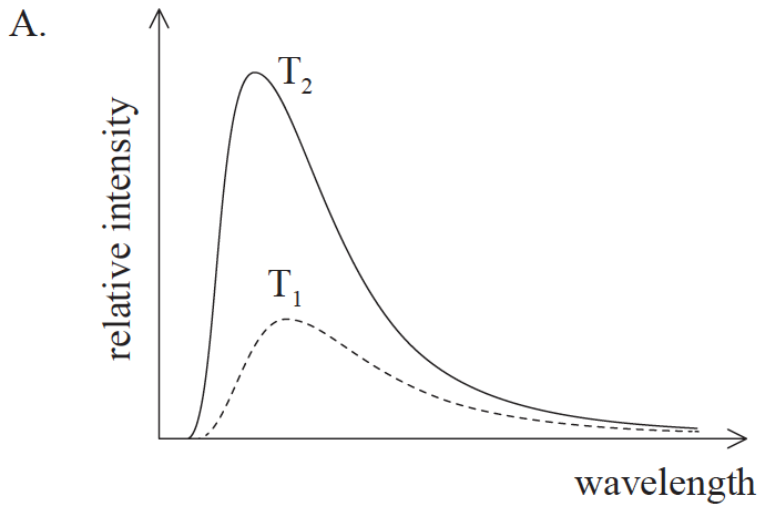
Examiners report

Sankey diagrams are quantitative and candidates should understand that the greatest proportion of the output from a fossil-fuelled power station is in the form of thermal energy.

The graph shows the emission spectrum for a black body at absolute temperature T_1 .



Which graph shows the emission spectrum for the same black body at an absolute temperature T_2 where $T_2 > T_1$? The original graph is shown as a dotted line.



Markscheme

A

Examiners report

[N/A]
