

EnergyPro-practice-1-MC [30 marks]

1. A beaker containing 1 kg of water at room temperature is heated on a 400 W hot plate. The specific heat capacity of water is $4200 \text{ J kg}^{-1} \text{ K}^{-1}$. [1 mark]

The temperature of the water increases until it reaches a constant value. It is then removed from the hot plate.

What will be the initial rate of change of temperature?

- A. 10 K s^{-1}
B. 1 K s^{-1}
C. 0.1 K s^{-1}
D. 0.01 K s^{-1}
2. Most power stations rely on a turbine and a generator to produce electrical energy. Which power station works on a different principle? [1 mark]

- A. Nuclear
B. Solar
C. Fossil fuel
D. Wind

3. A neutron collides head-on with a stationary atom in the moderator of a nuclear power station. The kinetic energy of the neutron changes as a result. There is also a change in the probability that this neutron can cause nuclear fission. [1 mark]

What are these changes?

	Change in kinetic energy of the neutron	Change in probability of causing nuclear fission
A.	increase	increase
B.	decrease	increase
C.	increase	decrease
D.	decrease	decrease

4. Three methods for the production of electrical energy are [1 mark]

- I. wind turbine
- II. photovoltaic cell
- III. fossil fuel power station.

Which methods involve the use of a primary energy source?

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

5. The orbital radius of the Earth around the Sun is 1.5 times that of Venus. [1 mark]

What is the intensity of solar radiation at the orbital radius of Venus?

- A. 0.6 kW m^{-2}
- B. 0.9 kW m^{-2}
- C. 2 kW m^{-2}
- D. 3 kW m^{-2}

6. What is the function of control rods in a nuclear power plant? [1 mark]

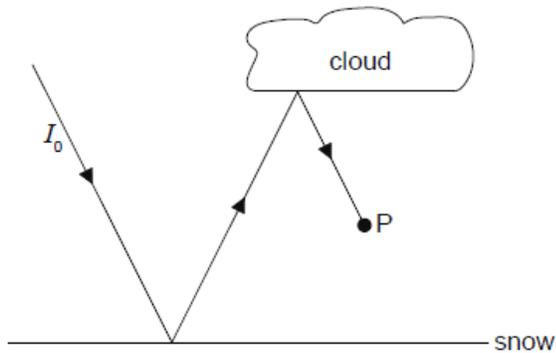
- A. To slow neutrons down
- B. To regulate fuel supply
- C. To exchange thermal energy
- D. To regulate the reaction rate

7. A photovoltaic panel of area S has an efficiency of 20%. A second [1 mark]

photovoltaic panel has an efficiency of 15%. What is the area of the second panel so that both panels produce the same power under the same conditions?

- A. $\frac{S}{3}$
- B. $\frac{3S}{4}$
- C. $\frac{5S}{4}$
- D. $\frac{4S}{3}$

8. Light of intensity I_0 is incident on a snow-covered area of Earth. In a model of this situation, the albedo of the cloud is 0.30 and the albedo for the snow surface is 0.80. What is the intensity of the light at P due to the incident ray I_0 ? [1 mark]



- A. $0.14 I_0$
B. $0.24 I_0$
C. $0.50 I_0$
D. $0.55 I_0$
9. What is equivalent to $\frac{\text{specific energy of a fuel}}{\text{energy density of a fuel}}$? [1 mark]
- 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. $\frac{\text{density of the fuel}}{\text{energy stored in the fuel}}$

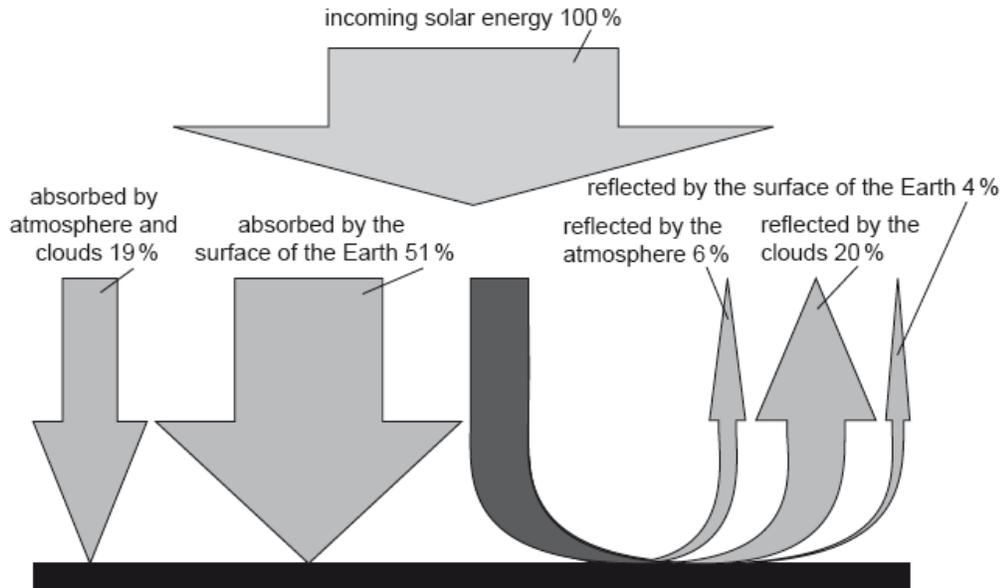
10. Three energy sources for power stations are [1 mark]
- I. fossil fuel
 - II. pumped water storage
 - III. nuclear fuel.

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

11. The diagram shows a simple climate model for the Earth.

[1 mark]



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

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

12. 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 $\frac{p}{2}$?

[1 mark]

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

13. Three gases in the atmosphere are

[1 mark]

- I. carbon dioxide (CO₂)
- II. dinitrogen monoxide (N₂O)
- III. oxygen (O₂).

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

14. Mars and Earth act as black bodies. The $\frac{\text{power radiated by Mars}}{\text{power radiated by the Earth}} = p$ and $\frac{\text{absolute mean temperature of the surface of Mars}}{\text{absolute mean temperature of the surface of the Earth}} = t$. [1 mark]

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. $\frac{t^2}{\sqrt{p}}$

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

[1 mark]

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

16. The energy density of a substance can be calculated by multiplying its specific energy with which quantity? [1 mark]

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

17. 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? [1 mark]

- A. λ_{max}
- B. $\frac{\lambda_{\text{max}}}{2}$
- C. $\frac{\lambda_{\text{max}}}{4}$
- D. $\frac{\lambda_{\text{max}}}{16}$

18. The three statements give possible reasons why an average value should be used for the solar constant. [1 mark]

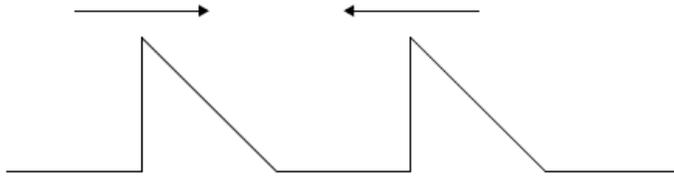
- I. The Sun's output varies during its 11 year cycle.
- II. The Earth is in elliptical orbit around the Sun.
- III. The plane of the Earth's spin on its axis is tilted to the plane of its orbit about the Sun.

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

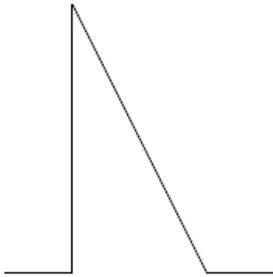
19. Two pulses are travelling towards each other.

[1 mark]

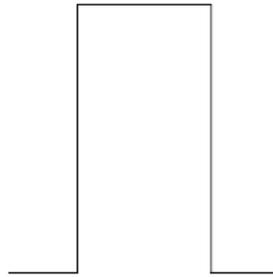


What is a possible pulse shape when the pulses overlap?

A.



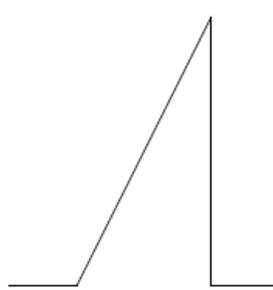
B.



C.



D.



20. The following are energy sources.

[1 mark]

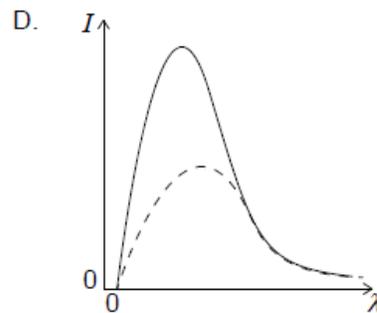
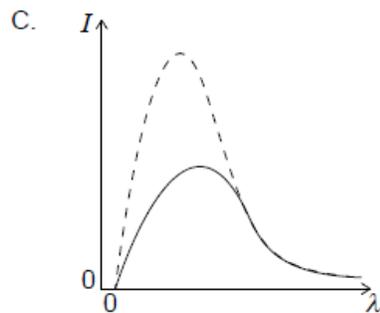
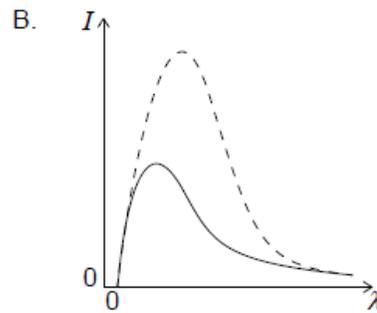
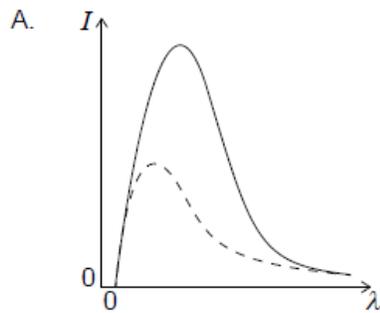
- I. a battery of rechargeable electric cells
- II. crude oil
- III. a pumped storage hydroelectric system

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

21. Planet X and planet Y both emit radiation as black bodies. Planet X has a [1 mark] 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.



22. The average surface temperature of Mars is approximately 200 K and the [1 mark] 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

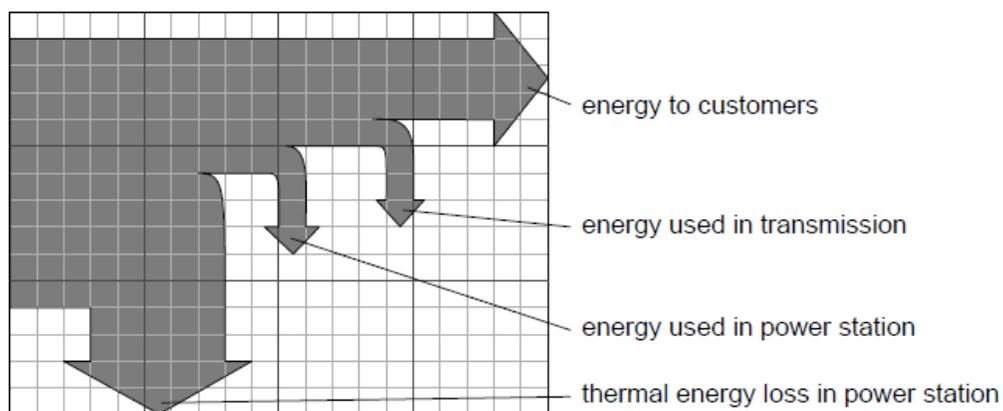
23. The main role of a moderator in a nuclear fission reactor is to [1 mark]

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

24. A room is at a constant temperature of 300 K. A hotplate in the room is at [1 mark] 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. $\frac{5^4-3^4}{4^4-3^4} P$

25. The Sankey diagram represents the energy flow for a coal-fired power station. [1 mark]



What is the overall efficiency of the power station?

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

26. Which of the following is **not** a primary energy source? [1 mark]

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

27. What are the principal energy changes in a photovoltaic cell and in a solar heating panel? [1 mark]

	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

28. 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? [1 mark]

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

29. What is the correct order of energy transformations in a coal power station? [1 mark]

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

30. 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? [1 mark]

- 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

