Exam Papers Practice

Thermal Energy Transfers

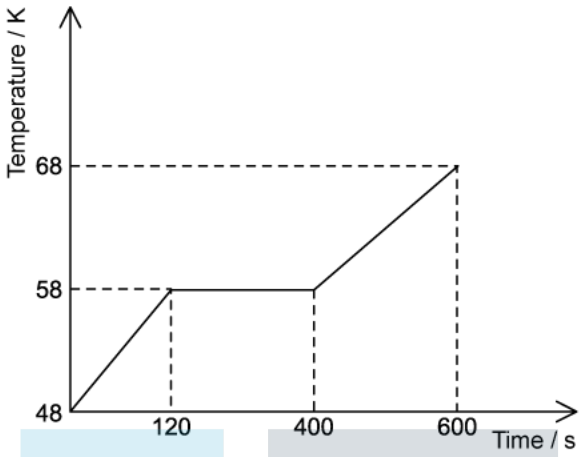
Question Paper

Course	HL IB Physics
Section	The Particulate Nature of Matter
Topic	Thermal Energy Transfers
Difficulty	Medium

To be used by all students preparing for HL IB Physics
Students of other boards may also find this useful

Question 1

A heater applies a constant power of 150m to a solid material with a specific heat capacity of 1.8×10^3 J kg^{-1} K^{-1}. The graph below shows how the temperature of the material varies with time as the solid melts and becomes a liquid.



What is the specific latent heat of fusion of the substance?

A. 4.2×10^3 J kg^{-1}

B. 6.0×10^3 J kg^{-1}

C. 4.2×10^4 J kg^{-1}

D. 6.0×10^4 J kg^{-1}

[1 mark]

Question 2

Liquid iron solidifies without a change in temperature.

Which of the following is correct for the molecules in the solid phase compared with molecules in the liquid phase?

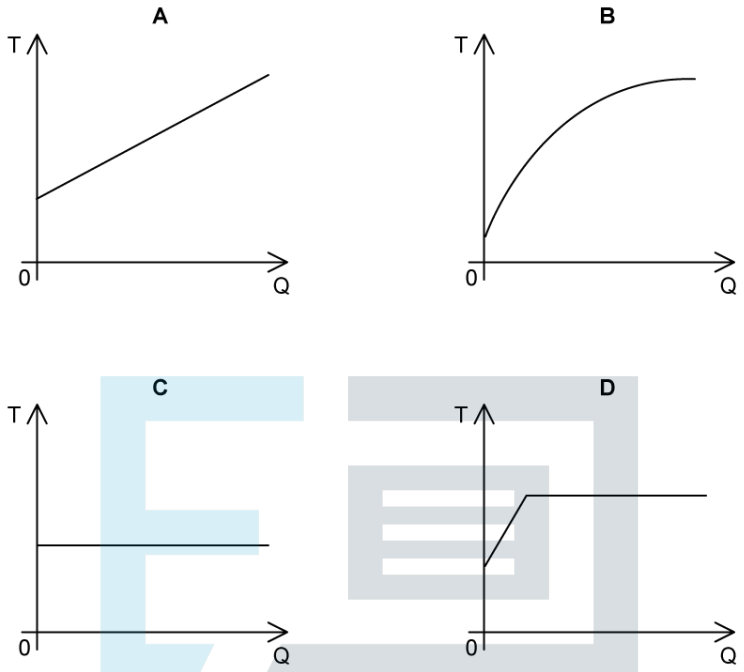
	Potential energy	Kinetic energy
A	same	same
B	same	less
C	less	less
D	less	same

[1 mark]

Question 3

A liquid is initially at its boiling point. Energy is continuously supplied to the liquid at a uniform rate until it has completely evaporated.

Which graph shows how the temperature of the liquid, *T*, varies with the energy, *Q*, supplied to the liquid?



[1 mark]

Question 4

In a refrigerator, 2 kg of water cools from 30 °C to 0 °C and then freezes to form ice also at 0 °C. The whole process takes 4000 seconds.

The specific heat capacity of water is 4200 J kg^{-1} K^{-1}.

The specific latent heat of fusion of ice is 3.4×10^5 J kg^{-1}.

What is the power required by the refrigerator during this process?

A. 233 W

B. 240 W

C. 932 W

D. 260 W

[1 mark]

Question 5

A 2 kW kettle supplies energy to a water of mass 1 kg. The initial temperature of the water is 20 °C. The specific heat capacity of water can be taken to be 4000 J kg^{-1} K^{-1}.

How long does it take for the water to start boiling?

A. 80 s

B. 120 s

C. 160 s

D. 210 s

[1 mark]

Question 6

A substance loses energy at a constant rate. The graph shows how the temperature, *T*, of the substance varies with time, *t*, as the state of the substance changes from liquid to solid.

What can be deduced about this substance from the graph shown?

A. The specific latent heat of fusion of the substance is greater than its specific latent heat of vaporization

B. The specific heat capacity of the liquid is lower than the specific heat capacity of the solid

C. The specific latent heat of fusion of the substance is less than its specific latent heat of vaporization

D. The specific heat capacity of the liquid is greater than the specific heat capacity of the solid

[1 mark]

Question 7

Aluminium melts at 660 °C. A mass *m* of solid aluminium is initially at a temperature of 645 °C. The aluminium is heated and melts into liquid aluminium and continues to be heated up to a final temperature of 720 °C.

- Specific latent heat of fusion of aluminium = L_f
- Specific heat capacity of solid aluminium = c_S
- Specific heat capacity of liquid aluminium = c_L

Which expression gives the energy needed for this change to occur?

A. $m(15c_S + L_f + 60c_L)$

B. $m(c_S + 15L_f + 75c_L)$

C. $m(15c_S + 60L_f + c_L)$

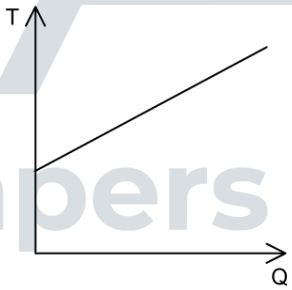
D. $m(15c_S + L_f + 75c_L)$

[1 mark]

Question 8

The graph shows how the temperature T of a liquid varies with energy Q supplied to the liquid at a constant rate *P*.

The gradient of the graph is *z* and the liquid has a specific heat capacity, *c*.



What is the mass of the liquid?

A. zc

B. $\frac{1}{zc}$

C. $\frac{p}{c}$

D. $\frac{z}{c}$

[1 mark]

Question 9

A sealed cylinder contains water at 10 °C and ice at 0 °C. The system has been thermally isolated from the surroundings. The ice and the water reach thermal equilibrium.

What happens to the total internal energy of the system in order for equilibrium to be reached?

A. It reduces

B. It increases

C. It increases until the ice has melted and then remains constant

D. It remains constant

[1 mark]

Question 10

A flask contains a mass *m* of a fluid. When 2000 J of heat is provided the temperature of the water and the flask increases by 10 K.

The mass of the fluid is doubled, and the experiment is repeated. This time 4500 J is required to increase the temperature by 10 K.

The specific heat capacity of the fluid is 5000 $J\,kg^{-1}\,K^{-1}$.

What is the value of *m*?

A. 5 g

B. 25 g

C. 40 g

D. 50 g

[1 mark]

Question 11

Objects with absolute temperature can lose energy through

I. convection
II. conduction
III. radiation

Equipment is tested on Earth for use on the surface of Mars. How will the equipment lose energy in the two locations?

	Earth	Mars
A	I and III only	II and III only
B	I, II and III	II and III only
C	I and III only	I, II and III
D	I, II and III	I, II and III

[1 mark]

Question 12

The black body temperature of Venus is 90% of the black body temperature of Earth.

Which of the following correctly shows the ratio:

$$\frac{\textit{energy radiated per second per unit area on Venus}}{\textit{energy radiated per second per unit area on Earth}}$$

A. 0.7

B. 0.9

C. 1.0

D. 1.5

[1 mark]

Question 13

A black body has absolute temperature T and surface area A. The total power radiated by the body is P. What is the value of power if the surface area is reduced to one third of A, and the temperature increased to three times T?

A. P

B. 3P

C. 27P

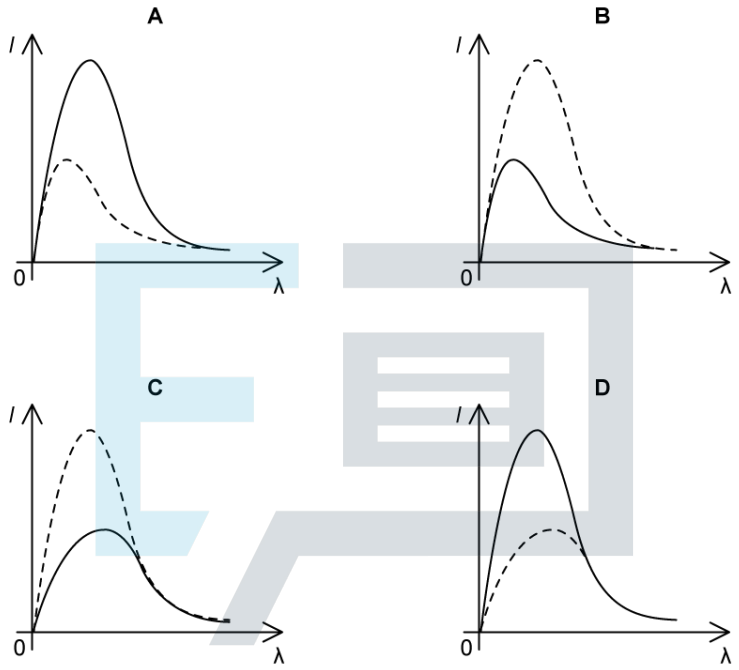
D. 81P

[1 mark]

Question 14

A graph is plotted to show the variation of intensity I and wavelength of emitted radiation λ. Cool objects are represented by a dashed line, and hotter objects are represented by a solid line.

Which graph correctly shows the relationship between I and λ?



[1 mark]