

9.3 Thermal Energy Transfer and Equilibrium

Name: _____ Class: _____ Date: _____

Total: 9 marks

Objective

Build the skills to answer exam questions on **thermal energy transfer and equilibrium**.

You must be able to:

- describe thermal energy transfer by **conduction** 传导, **convection** 对流, and **radiation** 辐射
- explain that objects in contact reach **thermal equilibrium** 热平衡 at a common temperature
- relate the direction of **heat** 热量 flow to the temperature difference

1 Worked examples

Study these first. Each one shows the method for a question type used later.

■ Three ways heat moves

- **Conduction** —through a solid, by particle collisions passing on energy.
- **Convection** —bulk currents in a fluid, as warm fluid rises and cool fluid sinks.
- **Radiation** —electromagnetic waves; needs **no** medium (how the Sun's energy reaches us).

■ Thermal equilibrium

Two objects in contact exchange heat until they reach a **common temperature**; then the net heat flow is zero.

■ Direction of heat flow

Heat always flows from **hotter** to **colder**.

2 Practice

2.1 Name the three methods of thermal energy transfer.

[2]

2.2 State the direction heat flows between a hot object and a cold object in contact. [1]

2.3 Two objects have reached thermal equilibrium. State what is true about their temperatures. [1]

3 Exam-style questions

3.1 The method of heat transfer that needs no medium is [1]

- **A** conduction
 - **B** convection
 - **C** radiation
 - **D** none of these
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3.2 When two objects reach thermal equilibrium, the net heat flow between them is [1]

- **A** from hot to cold
 - **B** from cold to hot
 - **C** zero
 - **D** at its maximum
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3.3 A hot metal spoon is placed in a cup of cold water.

- (a) State the direction of the heat flow. [1]
- (b) Name the main method of transfer within the metal spoon. [1]
- (c) Describe the final state of the spoon and water. [1]

4 Go further

- work through the **9.3 Thermal Energy Transfer and Equilibrium** lesson on the **Learn** page;

- read the **Thermodynamics** section of the AP Physics 2 handout on the **Know** page.

Solutions

2.1 conduction, convection, radiation.

2.2 from the hot object to the cold object.

2.3 their temperatures are equal.

3.1 C.

3.2 C.

3.3 (a) from the spoon to the water. (b) conduction. (c) both reach the same temperature (thermal equilibrium).