

Exercise walk-through

# 6.5

## **Black body radiation – physics only (4.6.3, RP9)**

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AQA · GCSE · Physics

## Exercises 2.1·2.3

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**2.1** State what happens to the amount of infrared a body emits as its temperature rises. [1]

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**2.2** Define a perfect black body. [2]

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**2.3** (HT) A body absorbs radiation faster than it emits it. State and explain the temperature change. [2]

## Exercises 2.1·2.3

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**2.1** State what happens to the amount of infrared a body emits as its temperature rises. [1]

**2.1** It emits more infrared in a given time.

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**2.2** Define a perfect black body. [2]

**2.2** An object that absorbs all the radiation incident on it, reflecting and transmitting none.

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**2.3** (HT) A body absorbs radiation faster than it emits it. State and explain the temperature change. [2]

**2.3** The temperature rises: the energy arriving exceeds the energy leaving, so the internal energy of the body increases.

## Exercise 3.1

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**3.1** Two identical cubes, one black and one white, sit in sunshine.

- (a) Explain which cube warms faster at the start. [2]
- (b) After a long time both temperatures are steady. Explain what this shows. [2]
- (c) The cubes are moved into shade. Explain why the black cube cools faster. [2]

## Exercise 3.1

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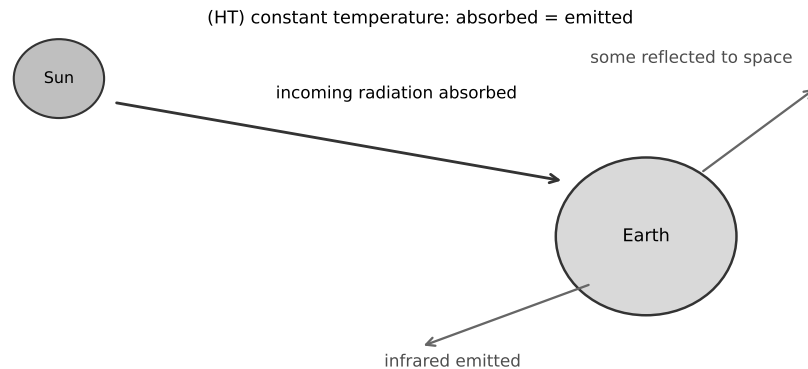
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**3.1** (a) The black cube: it absorbs the radiation better than the white surface, which reflects more. (b) Each cube now absorbs at the same rate as it emits; constant temperature means the two rates balance. (c) A good absorber is a good emitter: the black cube emits infrared faster, so it loses energy faster and cools quicker.

## Exercise 3.2

**3.2** The Earth absorbs radiation from the Sun and emits infrared into space.

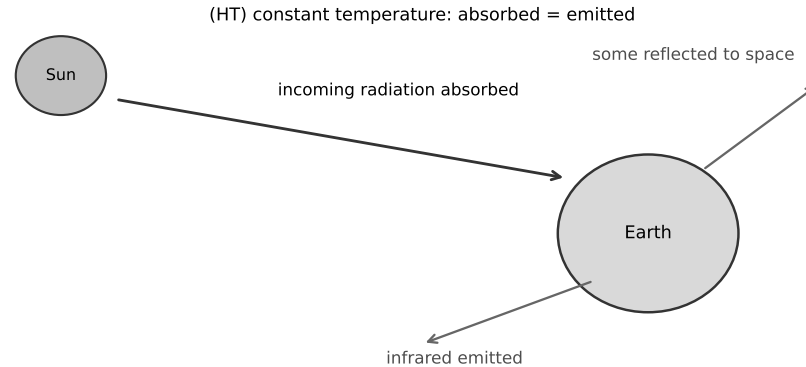
- (a) Explain why the Earth's average temperature is roughly constant. [2]
- (b) Melting sea ice exposes dark ocean. Explain the effect on the Earth's temperature. [3]
- (c) Give one factor, other than ice, that changes the reflection of radiation back to space. [1]



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**3.2** (a) The Earth absorbs radiation at (nearly) the same average rate as it emits infrared; the balance keeps the average temperature steady. (b) Ice reflects much of the incoming radiation; dark ocean absorbs it. Absorption rises, so the temperature rises until emission

## Full solution 3.2

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**3.2** (a) The Earth absorbs radiation at (nearly) the same average rate as it emits infrared; the balance keeps the average temperature steady. (b) Ice reflects much of the incoming radiation; dark ocean absorbs it. Absorption rises, so the temperature rises until emission balances again at a higher level – a feedback that amplifies warming. (c) Any one: cloud cover; atmospheric gases (aerosols/particles).

## Exercise 3.3

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**3.3** A student measures the radiation from a hot plate at two settings: the emitted intensity doubles when the plate's temperature rises, and the peak wavelength moves from  $4.0\ \mu\text{m}$  to  $2.0\ \mu\text{m}$ .

- (a) State two ways the emitted radiation changed. [2]
- (b) Explain what the shift in peak wavelength shows about the distribution of emitted wavelengths. [2]
- (c) The plate is polished to a mirror finish. Explain the change in its emission, compared with a matt black plate at the same temperature. [2]

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**3.3** (a) Intensity increased (doubled); peak wavelength halved. (b) The distribution of wavelengths shifts towards shorter wavelengths: the same total shape moves, so more of the radiation is emitted at shorter wavelength when hotter. (c) A mirror surface is a poor absorber and therefore a poor emitter; it emits much less infrared than the matt black plate, which is close to a perfect black body.