

GCSE Physics A (Gateway)

J249/04 Physics A P5-P8 and P9 (Higher Tier)

Question Set 3

1

Look at the table showing information about the electromagnetic spectrum.

| Radio | Micro-wave | Infra-red | Visible light | Ultra-violet | X-rays | Gamma-rays |
|-------|------------|-------------------|---------------|--------------|---------------|-----------------|
| 3 MHz | 30 GHz | 3 THz | | 3000 THz | 3 000 000 THz | 300 000 000 THz |
| 100 m | 1 cm | 100 μm | | | | |

(a) The speed of all electromagnetic radiation is 3×10^8 m/s.

(i) Use data in the table to show that the speed of microwaves is 3×10^8 m/s.

[2]

(ii) Ultra-violet waves typically have a frequency of 3000 THz.

Calculate the wavelength of these ultra-violet waves in nm.

Answer = nm

[3]

(b) Ultra-violet waves can damage human skin.

Describe the damage caused to human skin by ultra-violet waves.

[1]

(c) Sun cream can be used to protect skin from ultra-violet waves. Sun creams have different sun protection factors (SPF).

Look at the information about a bottle of sun cream.

This sun cream has a SPF of 10.

If used sensibly it can allow you up to $10 \times$ longer in the Sun without increasing the risk from ultra-violet waves.

- (i) A doctor says ‘adults should not sunbathe for more than 20 minutes in the midday sunshine when **not** using sun cream’.

If an adult used sun cream with SPF 6, how long could they safely sunbathe for?

Answer = minutes

[1]

- (ii) The doctor says that children should always use at least SPF 50 sun cream. Suggest reasons why.

[2]

- (d)* Ultrasound and X-rays are used to scan patients in hospital.

Look at the information about these two different waves.

| Name | Frequency | Wavelength | Type | Description |
|------------|----------------------------|-----------------------------|--------------|----------------------|
| Ultrasound | ≥ 2 MHz | $\leq 1.6 \times 10^{-4}$ m | Longitudinal | Pressure sound wave |
| X-rays | $\geq 3 \times 10^{16}$ Hz | ≤ 10 nm | Transverse | Electromagnetic wave |

Ultrasound and X-rays are used to scan different parts of the patient.

Explain how ultrasound and X-rays are used and evaluate the risks and benefits of using these two different waves to scan patients in hospital.

Use the information in the table in your answer.

[6]

Total Marks for Question Set 3: 15

Equations in physics

$$(\text{final velocity})^2 - (\text{initial velocity})^2 = 2 \times \text{acceleration} \times \text{distance}$$

$$\text{change in thermal energy} = \text{mass} \times \text{specific heat capacity} \times \text{change in temperature}$$

$$\text{thermal energy for a change in state} = \text{mass} \times \text{specific latent heat}$$

$$\text{energy transferred in stretching} = 0.5 \times \text{spring constant} \times (\text{extension})^2$$

$$\text{potential difference across primary coil} \times \text{current in primary coil} = \text{potential difference across secondary coil} \times \text{current in secondary coil}$$

Higher tier only –

$$\text{force on a conductor (at right angles to a magnetic field) carrying a current} = \text{magnetic flux density} \times \text{current} \times \text{length}$$

OCR

Oxford Cambridge and RSA

Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact The OCR Copyright Team, The Triangle Building, Shaftesbury Road, Cambridge CB2 8EA.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge