| • Direct damage to the DNA of skin cells can be brought about by exposure to<br>ultraviolet radiation of wavelength 300 nm. What are the frequency and energy<br>(in kJ mol <sup>-1</sup> ) of this radiation?<br>The frequency, v, and the wavelength, $\lambda$ of the radiation are related by $c = v\lambda$ .<br>Hence:<br>$v = \frac{c}{\lambda} = \frac{2.998 \times 10^8 \text{ m s}^{-1}}{300 \times 10^{-9} \text{ m}} = 1 \times 10^{15} \text{ s}^{-1} = 1 \times 10^{15} \text{ Hz}$<br>The energy of the radiation is given by $E = hv = \frac{hc}{\lambda}$ . Hence:<br>$E = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34} \text{ J s})(2.998 \times 10^8 \text{ m s}^{-1})}{(300 \times 10^{-9} \text{ nm})} = 6.62 \times 10^{-19} \text{ J}$<br>This is the energy per photon. For a mole, the energy is:<br>$E = (6.62 \times 10^{-19} \text{ J}) \times (6.022 \times 10^{23} \text{ mol}^{-1}) = 400000 \text{ J mol}^{-1} = 400 \text{ kJ mol}^{-1}$<br>Frequency: $1 \times 10^{15} \text{ Hz}$ |  |  |   |            |
|--|--|--|---|------------|
| The frequency, v, and the wavelength, $\lambda$ of the radiation are related by $c = v\lambda$ .<br>Hence:<br>$v = \frac{c}{\lambda} = \frac{2.998 \times 10^8 \text{ m s}^{-1}}{300 \times 10^{-9} \text{ m}} = 1 \times 10^{15} \text{ s}^{-1} = 1 \times 10^{15} \text{ Hz}$<br>The energy of the radiation is given by $E = hv = \frac{hc}{\lambda}$ . Hence:<br>$E = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34} \text{ J s})(2.998 \times 10^8 \text{ m s}^{-1})}{(300 \times 10^{-9} \text{ nm})} = 6.62 \times 10^{-19} \text{ J}$<br>This is the energy per photon. For a mole, the energy is:<br>$E = (6.62 \times 10^{-19} \text{ J}) \times (6.022 \times 10^{23} \text{ mol}^{-1}) = 400000 \text{ J mol}^{-1} = 400 \text{ kJ mol}^{-1}$<br>Frequency: $1 \times 10^{15} \text{ Hz}$<br>Energy: 400 kJ mol <sup>-1</sup>   | • Direct damage to the DNA of skin cells can be brought about by exposure to ultraviolet radiation of wavelength 300 nm. What are the frequency and energy (in kJ mol <sup>-1</sup> ) of this radiation? |  |   | Marks<br>4 |
| $v = \frac{c}{\lambda} = \frac{2.998 \times 10^8 \text{ m s}^{-1}}{300 \times 10^{-9} \text{ m}} = 1 \times 10^{15} \text{ s}^{-1} = 1 \times 10^{15} \text{ Hz}$<br>The energy of the radiation is given by $E = hv = \frac{hc}{\lambda}$ . Hence:<br>$E = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34} \text{ J s})(2.998 \times 10^8 \text{ m s}^{-1})}{(300 \times 10^{-9} \text{ nm})} = 6.62 \times 10^{-19} \text{ J}$<br>This is the energy per photon. For a mole, the energy is:<br>$E = (6.62 \times 10^{-19} \text{ J}) \times (6.022 \times 10^{23} \text{ mol}^{-1}) = 400000 \text{ J mol}^{-1} = 400 \text{ kJ mol}^{-1}$<br>Frequency: $1 \times 10^{15} \text{ Hz}$<br>Energy: 400 kJ mol}^{-1}   | The frequency, v, and the wavelength, $\lambda$ of the radiation are related by $c = v\lambda$ .<br>Hence:   |  |   |            |
| The energy of the radiation is given by $E = hv = \frac{hc}{\lambda}$ . Hence: $E = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34} \text{ J s})(2.998 \times 10^8 \text{ m s}^{-1})}{(300 \times 10^{-9} \text{ nm})} = 6.62 \times 10^{-19} \text{ J}$ This is the energy per photon. For a mole, the energy is: $E = (6.62 \times 10^{-19} \text{ J}) \times (6.022 \times 10^{23} \text{ mol}^{-1}) = 400000 \text{ J mol}^{-1} = 400 \text{ kJ mol}^{-1}$ Frequency: $1 \times 10^{15} \text{ Hz}$ Energy: 400 kJ mol^{-1}  | $v = \frac{c}{\lambda} = \frac{2.998 \times 10^8 \text{ m s}^{-1}}{300 \times 10^{-9} \text{ m}} = 1 \times 10^{15} \text{ s}^{-1} = 1 \times 10^{15} \text{ Hz}$  |  |   |            |
| $E = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34} \text{ J s})(2.998 \times 10^8 \text{ m s}^{-1})}{(300 \times 10^{-9} \text{ nm})} = 6.62 \times 10^{-19} \text{ J}$<br>This is the energy per photon. For a mole, the energy is:<br>$E = (6.62 \times 10^{-19} \text{ J}) \times (6.022 \times 10^{23} \text{ mol}^{-1}) = 400000 \text{ J mol}^{-1} = 400 \text{ kJ mol}^{-1}$<br>Frequency: $1 \times 10^{15} \text{ Hz}$<br>Energy: 400 kJ mol^{-1}   | The energy of the radiation is given by $E = hv = \frac{hc}{\lambda}$ . Hence:   |  |   |            |
| This is the energy per photon. For a mole, the energy is: $E = (6.62 \times 10^{-19} \text{ J}) \times (6.022 \times 10^{23} \text{ mol}^{-1}) = 400000 \text{ J mol}^{-1} = 400 \text{ kJ mol}^{-1}$ Frequency: $1 \times 10^{15} \text{ Hz}$ Energy: 400 kJ mol^{-1}   | $E = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34} \text{ J s})(2.998 \times 10^8 \text{ m s}^{-1})}{(300 \times 10^{-9} \text{ nm})} = 6.62 \times 10^{-19} \text{ J}$                              |  |   |            |
| $E = (6.62 \times 10^{-19} \text{ J}) \times (6.022 \times 10^{23} \text{ mol}^{-1}) = 400000 \text{ J mol}^{-1} = 400 \text{ kJ mol}^{-1}$<br>Frequency: $1 \times 10^{15} \text{ Hz}$<br>Energy: 400 kJ mol <sup>-1</sup>  | This is the energy per photon. For a mole, the energy is:  |  |   |            |
| Frequency: $1 \times 10^{15}$ Hz Energy: 400 kJ mol <sup>-1</sup>  | $E = (6.62 \times 10^{-19} \text{ J}) \times (6.022 \times 10^{23} \text{ mol}^{-1}) = 400000 \text{ J mol}^{-1} = 400 \text{ kJ mol}^{-1}$  |  |   |            |
|  | Frequency: $1 \times 10^{15}$ Hz   |  | Energy: <b>400 kJ mol</b> <sup>-1</sup> |            |

2009-J-6

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June 2009

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