| | λ/m | v/Hz | | AM radio |
|----------------------------|-------|---|-------------|---------------------------|
| cosmic rays | 10-14 | 1022 | Radio | Amateur radio |
| gamma räys | 10-11 | 1019 | | Aircraft |
| X-rays | 10-9 | 1017 | 9 | communication |
| far ultraviolet | [10-7 | 1015 | Microwave | Microwave oven |
| ultraviolet | 10-7 | 1015 | i G | OYCII |
| visible | 10-6 | 1014 | ≥ | TV Remote |
| infrared | 10-5 | $10^{13} \ (\tilde{v}, 10^2 \text{ cm}^{-1})$ | De la | Control |
| far infrared | 10-4 | 1012 | Infrared | Night vision goggles |
| microwave | 10-3 | 1011 | 0 | io la v |
| radar | 10-2 | 1010 | Visible | UV light from the Sun |
| television | 10° | 108 | Ultraviolet | |
| nuclear magnetic resonance | 10 | 107 | ravi | UV light from the Sun |
| radio | 102 | 106 | 5 | |
| alternating current | 106 | 102 | e ale | All port security scanner |
| eview f | | Note | a-ray | PET scan |
| 41 | 011 | 'A Of | 7 | Terrestrial |
| wieW' | -4 | 040. | . ලී | gamma-ray flashes |
| evi r | 120 | | | indico |

Electromagnetic spectrums can be presented in different ways, as seen above or on the previous page. No matter what way they are presented you will be expected to interpret them correctly.

QUANTUM THEORY OF RADIATION

The wave theory did not adequately explain all of the phenomena associated with electromagnetic radiation and in 1905 Einstein proposed that electromagnetic radiation could in some respects be regarded as small packets of energy (quanta) called photons, the energy of these photons being proportional to frequency.

Low frequency = Low energy (long wavelength)

High frequency = High energy. and (short wavelength)

The energy of any photon is given by the expression :

F = hf

where E = energy of a photon (or quantum) expressed in joules (J)

h = Planck's constant, 6.63×10^{-34} Joule seconds (Js)

v = frequency of the radiation in Hertz (Hz)

Thus for 1 mole of photons E = Lhf (data booklet p4)

where L = Avogadro's constant, $6.02 \times 10^{23} \text{ (mol}^{-1}\text{)}$ ---- but

which gives - from E 520 21 for 1 moles and 21 for

for 1 mole of photons of a given

ATING THE ENERGY ASSOCIATED WITH ONE MOLE OF PHOTONS

For example, calculate the energy associated with one mole of photons of wavenumber 2000 cm⁻¹.

since
$$\overline{v} = \underline{1}$$
 wavenumber = $\underline{1}$ wavelen

$$\lambda = 1$$
 = 5 x 10⁻⁴ cm or 5 x 10⁻⁶ m

Using the relationship -

=<u>6.02 X 10²³ X 6.63 X 10⁻³⁴ X 3 X 10⁸ x 10⁻³ (conversion factor for kJ)</u> 5 X 10⁻⁶

23.947 kJ.mol⁻¹

The lines converge because the energy levels get closer together as the quantum numbers increase



