1.

The wavenumber of a transition is 2000 cm^{-1}. In what part of the electromagnetic spectrum does this come?

- (•) Infrared.
- ( ) Ultraviolet-visible.
- ( ) Microwave.
- ( ) Radiowave.

2.

The frequency of a transition is 5.4×10^{15} Hz. What is the corresponding wavelength?

- ( ) 180 000 cm^{-1}
- ( ) 5.6×10^{-8} m
- ( ) 560 nm
- ( ) 5.6×10^{-6} m

3.

According to the Beer-Lambert Law, on which of the following does absorbance *not* depend?

- ( ) Solution concentration.
- ( ) Extinction coefficient of the sample.
- ( ) Distance that the light has travelled through the sample.
- ( ) Colour of the solution.

4.

What is the name of an instrument used to measure the absorbance of a coloured compound in solution?

- ( ) Colourmeter.
- ( ) Colorimeter.
- ( ) Coulometer.

- Calorimeter.

5.

A solution of X of concentration 0.010 mol dm^{-3} gives an absorbance of 0.5. What concentration is a solution of X which gives an absorbance reading of 0.25? Assume that the same optical cell is used for both readings.

- 0.020 mol dm^{-3}
- 0.0050 mol dm^{-3}
- 0.050 mol dm^{-3}
- 0.010 mol dm^{-3}

6.

Compound Z absorbs light of wavelength 320 nm. A 1.0×10^{-3} mol dm^{-3} solution of a compound Z gives an absorbance reading of 0.15 when placed in a solution cell of path length 1 cm. What is the value of the molar extinction (absorption) coefficient of Z?

- 1500 dm^3 mol^{-1} cm^{-1}
- 150 dm^3 mol^{-1} cm^{-1}
- 15 dm^3 mol^{-1} cm^{-1}
- 1.5×10^{-4} mol dm^{-3} cm^{-1}

7.

The dichromate ion absorbs light of wavelength close to 500 nm. Based on this information, what can you conclude?

- The dichromate ion absorbs outside the visible region.
- The dichromate ion absorbs within the visible region.
- The dichromate ion absorbs in the ultraviolet region.
- Solutions of the dichromate ion are colourless.

8.

A solution of a dye absorbs light of wavelength 480 nm, and for this absorption, the extinction coefficient is 18600 dm^3 mol^{-1} cm^{-1}. A sample of the dye of unknown concentration is placed in an optical cell of path length 1 cm and the absorbance reading is 0.18. What is the concentration of the solution?

- 9.7×10^{-6} mol dm^{-3}

- 0.026 mol dm^{-3}
- 2.0×10^{-8} mol dm^{-3}
- 3.0×10^{-4} mol dm^{-3}

9.

The wavelength of an absorption is 495 nm. In what part of the electromagnetic spectrum does this lie?

- Radiowave.
- Microwave.
- Ultraviolet-visible.
- Infrared.

10.

The frequency of a transition is 3.1×10^{10} Hz. What is the energy of this transition?

- 2.0×10^{-23} kJ
- 2.0×10^{-23} J
- 2.1×10^{-44} J
- 2.1×10^{-44} kJ

11.

Which of the following statements is *correct*?

- Infrared radiation has a shorter wavelength than visible light.
- Microwave radiation possesses more energy than infrared radiation.
- Infrared radiation has a lower wavenumber than visible light.
- Ultraviolet radiation has a longer wavelength than infrared radiation.

12.

A solution of compound Z absorbs light of wavelength 256 nm, and for this absorption, log ε = 3.3. What is the concentration of a solution of Z (in an optical cell of path length 1 cm) that gives the absorbance reading is 0.21?

- 2.4×10^{-3} mol dm^{-3}

- 0.064 mol dm^{-3}
- 1.1×10^{-4} mol dm^{-3}
- 5.0×10^{-4}mol dm^{-3}

13.

Which statement is *correct*?

- Wavelength is directly proportional to energy.
- Wavenumber is directly proportional to wavelength.
- Wavenumber is directly proportional to energy.
- Wavelength is directly proportional to frequency.

14.

Aqueous $KMnO_4$ solutions are purple. A plot of absorbance against concentration is:

- linear with a negative gradient.
- an exponential curve.
- linear with a positive gradient.
- non-linear.

15.

A shift to lower wavenumber for an absorption in a spectrum corresponds to:

- a shift to higher energy.
- a shift to lower wavelength.
- a loss of intensity.
- a shift to lower frequency.

16.

An absorption in an electronic spectrum is recorded at 17 000 cm^{-1}. What does this correspond to in nm?

- 590 nm
- 5900 nm

- 59 000 nm
- 59 nm

17. **A 0.100 mol dm^{-3} aqueous solution of a nickel(II) salt shows three absorbances, one of which has a value of ε = 2.95 dm^3 mol^{-1} cm^{-1}. What is the corresponding absorbance, if the path length of the solution cell used for the measurement is 1.00 cm?**

- 0.0340
- 29.5
- 0.340
- 0.295

18. **A copper(II) sulfate solution of unknown concentration is placed in a colorimeter and an absorbance reading of 0.46 is recorded. Using the same solution cell, a 0.055 M solution of copper(II) sulfate gives an absorbance reading of 0.34. What is the concentration of the first solution?**

- 0.35 mol dm^{-3}
- 8.60×10^{-3} mol dm^{-3}
- 0.074 mol dm^{-3}
- 0.041 mol dm^{-3}

19. An atom in an excited state of 4.9eV emits a photon and ends up in the ground state. The lifetime of the excited state is 1.2×10^{-13} s. What is the spectral line width (in wavelength) of the photon?

20. Assuming that the width of a spectral line is the result soley of lifetime broadening, estimate the lifetime of a state that gives rise to a line of width (a) 1.0 cm^{-1}, (b) 0.50Hz.