Problem Chapter 17, 18, 19
17.2, 17.4, 17.12, 17.14, 17.19, 18-2, 19-3, 19-17, 19-20, 19-29, 19-34

17.2

$E = hc/\lambda$ = (6.626e-34 Js)(2.998E8 m/s)/(650e-9 m)(1 kJ/1000 J) =

17-4

microwave	rotations
infrared	vibrations
visible	metals (d-orbital electronic transitions),
	valence shell electronic transitions in heavily conjugated systems
UV	valence shell electronic transitions in organics

17-12

If it absorbs at 562 nm (the yellow region), the light that reflects back to our eyes is the "white" light minus the yellow that gets absorbed. Thus, this light appears blue. If you want to illustrate this concept …. Go into "Word", click on the "font color" tool, go to "more colors", click on "custom". Put the green and red at about 160 and the blue at 255. This is essentially removing half the green and red light from "white" light (green and red makes yellow).

17-14

a)

molar absorptivity at 325 nm = 2 (L / mol cm)

concentration = $(8*10^{18}$ molecules/$cm^3)*(1$ mol / $6.022*10^{23}$ molecules)*(1000 cm^3/1L)
= 0.0138 M

A = ebc = (2 L / mol cm)(1 cm)(0.0138 M) = 0.0276

$T = 10^{-A}$ = 0.938

molar absorptivity at 325 nm = 50 (L / mol cm)

concentration = $(8*10^{18}$ molecules/$cm^3)*(1$ mol / $6.022*10^{23}$ molecules)*(1000 cm^3/1L)
= 0.0138 M

A = ebc = (50 L / mol cm)(1 cm)(0.0138 M) = 0.69

$T = 10^{-A}$ = 0.20

b)

abs cross section (cm^2/molecule) = σ

at T= 0.14, n =$8*10^{18}$ molecules/cm^3, and b = 1 cm

$A = \sigma n b$
$T = e^{-\sigma n b}$

$-(\ln T)/nb = \sigma = -(\ln(0.14))/ (8*10^{18}$ molecules/$cm^3 \cdot 1$ cm) = $2.4_{576}*10^{-19}$ cm^2/molecule

$T = e^{-\sigma n b} = 10^{-(7.92*1018)(2.4576*10-19)(1 cm)} = 0.1428$

Percent increase = 2.0 %

c)
in winter, n = 290 Dobsons = $290(2.69*10^{16}$ molecules/$cm^3) = 7.80*10^{18}$ molecules/cm^3

$T = e^{-A} = e^{-\sigma n b} = e^{-(7.80*1018)(2.5*10-19)(1 cm)} = 0.142$

In summer, n = 350 Dobsons = $350(2.69*10^{16}$ molecules/$cm^3) = 9.42*10^{18}$ molecules/cm^3

$T = e^{-A} = e^{-\sigma n b} = e^{-(9.42*1018)(2.5*10-19)(1 cm)} = 0.095$

Transmittance is greater in the winter by about 49 %.

17-19
The absorbance due to the colored product is 0.967 – 0.622 = 0.345.
The concentration of the colored product due to the added nitrite =
$(7.50*10^{-3})*(10.0*10^{-3}$ mL) / (50.01mL + 2.00mL + 1.00mL + 1.00mL) = $1.389*10^{-6}$ M

$e = A/bc = 0.345 / ((5.00 cm)(1.389*10^{-6}$ M) = $4.97*10^4$ $cm^{-1}M^{-1}$

$A_{extract} = 0.622 – 0.153 = 0.469$

$c_{extract} = A/be = \{(0.469) / ((5.00 cm)(4.97*10^4$ $cm^{-1}M^{-1})\} = 1.887*10^{-6}$ M

moles NO_2^- = $(1.887*10^{-6}$ M)*(0.054L) = $1.020*10^{-7}$ mol or 0.1020 μmol

$\mu g\ NO_2^-$ = (0.1020 μmol)*(46.01 μg/μmol) = 4.69 $\mu g\ NO_2^-$

19-3
deuterium

19-17

$n_1 \sin\theta_1 = n_2 \sin\theta_2$

$n_1 \sin\theta_1 / n_2 = \sin\theta_2$

$1.50 \sin(30°) / 1.33 = \sin\theta_2 \rightarrow \theta_2 = 34.3°$

If $\theta_1 = 0$, there is no diffraction

19-20

Light inside the fiber strikes the wall at an angle greater than the critical angle for total reflection. Therefore, all of the light is reflected back to the center of the fiber. The fiber is plyable and can be bent as long as the angle of incidence exceeds the critical angle.

19-29

$T = P_0/P$

19-34
S/N ratio increasing in proportion to $n^{1/2}$

S + S = 2S

Squares of the absolute errors are additive
$e_S^2 + e_S^2 = e_{2S}^2$
$(1^2) + (1^2) = e_{2S}^2$
$e_{2S} = 2^{1/2} = 1.41$
2s = 200
200 ± 1.41
S/N = 200/1.41 = 141/1