Chapter 11 Quantum theory and light. Revision Questions page 322-324 – Multiple Choice Answers

Q	Ans	Explanation
1	A	$E = hf - hf_0$ *substitute* q_eV_s *for* E $q_eV_s = hf - hf_0$ $V_s = \frac{h}{q_e}f - \frac{hf_0}{q_e}$ *then plot* $V_s(y-axis)$ *vs* $f(x-axis)$ $y = mx + c$ (linear graph) $\frac{h}{q_e} = gradient$ $h = q_e \times gradient$
2	B	A photon has no mass because if it did it wouldn't be able to travel at the speed of light. It has momentum related to its wavelength as was shown by Compton's experiment. It is also seen in the formula: $\lambda = \frac{h}{p}$ $p = \frac{h}{\lambda} = \frac{hf}{c}$
3	A	The formula $E = hf - W$ represents the maximum kinetic energy of electron when illuminated by light of frequency f.
4	D	This frequency is the threshold frequency and is the minimum needed to start photo-emission. It doesn't necessarily have to be UV or X-ray range and has to be higher than the visible range. The wavelength would have to be less than a certain maximum value, if anything.
5	B	Option B is one feature of electromagnetic radiation. Option A is true in itself but not related to the wave model. Options C and D are incorrect.
6	B	Wein's law proposes that: (i) the intensity increases as temperature increases (Option B and C). (ii) the peak wavelength shift to a shorter wavelength as temperature rises (Option B & D). The one in common is B.
7	C	Wien's displacement law proposes that the black-body radiation curve for different temperatures peaks at a wavelength inversely proportional to the temperature. As wavelength is proportional to 1/f, we can say that the black-body radiation curve for different temperatures peaks at a frequency proportional to the temperature (Option C).
8	D	$f = \frac{c}{\lambda} = \frac{3\times10^8}{550\times10^{-9}} = 5.45\times10^{14}\ Hz$

9	C	$E = \frac{hc}{\lambda} = \frac{6.626\times10^{-34}\times3\times10^{8}}{550\times10^{-9}} = 3.614\times10^{-19}\,J$ $E(eV) = \frac{3.614\times10^{-19}\,J}{1.60\times10^{-19}\,J/C} = 2.3\,eV$
10	C	The smaller the intercept on the x-axis means a lower threshold frequency (f_0). The product of $h \times f_0$ equals the work function (W). Thus: a smaller intercept means lower f_0 which means a lower work function.