DEVIL PHYSICS

BADDEST CLASS ON CAMPUS

CHAPTER 12 TEST REVIEW -- MARKSCHEME

1.	D	**6.**	C	**11.**	C	**16.**	A
2.	A	**7.**	A	**12.**	B	**17.**	B
3.	A	**8.**	C	**13.**	D		
4.	D	**9.**	A	**14.**	C		
5.	A	**10.**	B	**15.**	C		

18. using conservation of energy, Initial $E_K = E_P$;

$E_K = 5.0$ MeV $= 5.0 \times 1.6 \times 10^{-13} = 8.0 \times 10^{-13}$ J;

$E_P = \dfrac{k.2e.79e}{d}$;

$d\left(=\dfrac{9.0\times10^9\times2\times79\times[1.6\times10^{-19}]^2}{8.0\times10^{-13}}\right) = 4.6 \times 10^{-14}$ m; 4

Accept answers that combine any of the above steps.

19. (a) (i) light consists of photons/quanta;
a certain minimum amount of energy (the work function)
is required to remove an electron from the metal;
if the photon energy is below this energy/work function
no electrons will be emitted;
the energy of the photons is proportional to the frequency /
$E = hf$ (with terms defined); 4
If work function is mentioned it must be defined to award ***[4]***.

(ii) different metals need a different amount of minimum energy
for electrons to be removed; 1
Accept answers in terms of work function if defined either here or in (a)(i).

(b) (i) $KE_{max} = hf - \phi$;
$= 6.6 \times 10^{-34} \times 1.0 \times 10^{15} - 3.2 \times 10^{-19}$;
$= 3.4 \times 10^{-19}$ J 2

(ii) use of $E = \dfrac{p^2}{2m}$ and $p = \dfrac{h}{\lambda}$ ***or*** use of $v = \sqrt{\dfrac{2E}{m}}$ and $p = mv = \dfrac{h}{\lambda}$;

to give $\lambda = \dfrac{h}{\sqrt{2mE}}$;

$\lambda = 8.4 \times 10^{-10}$ m; 3

20. (a) ejection of electron from metal surface following absorption of
em radiation/photon; 1

(b) (i) energy of one photon $= 6.67 \times 10^{-34} \times 8.7 \times 10^{14} (= 5.8 \times 10^{19}$ J);

number of electrons released from surface per second $= \dfrac{9.0\times10^{-6}\times1.1\times10^{-3}}{5.8\times10^{-19}} = 1.7 \times 10^{10}$;

current $= 1.7 \times 10^{10} \times 1.6 \times 10^{-19}$;

$= 2.7$ nA 3

(ii) 2.4 eV ***or*** 3.9×10^{-19} J; 1

21. (a) particles have an associated wavelength;

wavelength = $\frac{h}{mv}$ ***or*** $\frac{h}{p}$; (*symbols must be defined)* 2

(b) $\lambda = \frac{h}{\sqrt{2meV}}$

8.3×10^{-13} m; 2

(c) (Heisenberg suggests that) $\Delta p \Delta x$ is a constant ***or*** $\geq \frac{h}{4\pi}$;

if λ is known then Δp is zero therefore uncertainty in position Δx is infinite/very large; 2

*Award **[1 max]** if Δp and Δx not defined.*

or

(the Uncertainty Principle states that) it is impossible to know the position and momentum of a particle at the same time;

if λ is precise then momentum is precise so position is not known;

22. (a) *Look for these main points.*

light consists of photons whose energy depends on the frequency/*hf*;

hence the energy available to the (photo)electrons will depend on *f*;

the potentials V_A and V_B correspond to/are a measure of the maximum kinetic of the emitted electrons;

the work function (of metal)/energy to emit electron is same for both light sources;

as electrons in A have more kinetic energy available, this frequency must be higher;

(so A) 4 max

(b) (i) 1.6 eV; (*answer must be expressed in eV*)

work function = (3.6 – 1.6 =) 2.0 eV; 1

*Allow answer in J if (b)(i) expressed in joule (ECF), otherwise award **[1 max]**.*

(ii) energy of photons = $\left(\frac{6.6\times10^{-34}\times8.8\times10^{14}}{1.6\times10^{-19}}=\right)$3.6 (eV);

work function = (3.6 –1.6 =) 2.0 eV; 2

*Allow answer in J if (b)(i) expressed in joule (ECF), otherwise award **[1 max]**.*

(c) photon energy increases (because frequency increases);

so for same intensity fewer photons per second;

so current reduced / fewer electrons emitted per second; 3

(d) all particles/electrons exhibit wave properties/have an associated wavelength (called the de Broglie wavelength);

the wavelength is equal to the Planck constant divided by the *h* momentum of the particle/electron/ $\lambda = \frac{h}{p}$ with terms defined; *(terms **must** be defined for mark)* 2

23. (a) a function whose (absolute squared) value may be used to calculate the probability of finding a particle near a given position / quantity related to the probability of finding an electron near a given position/at a given position; 1

(b) middle of the box / (near) 0.5×10^{-10} m; 1

(c) the de Broglie wavelength is 2.0×10^{-10} m;

$p = \frac{h}{\lambda} = \frac{6.63 \times 10^{-34}}{2.2 \times 10^{-10}} = 3.3 \times 10^{-24}$ Ns; 2

(d) difference in energy is

$\Delta E \left(= -\frac{2.18 \times 10^{-18}}{2^2} + \frac{2.18 \times 10^{-18}}{1^2} \right) = 1.635 \times 10^{-18}$ J;

$\lambda = \frac{hc}{\Delta E}$;

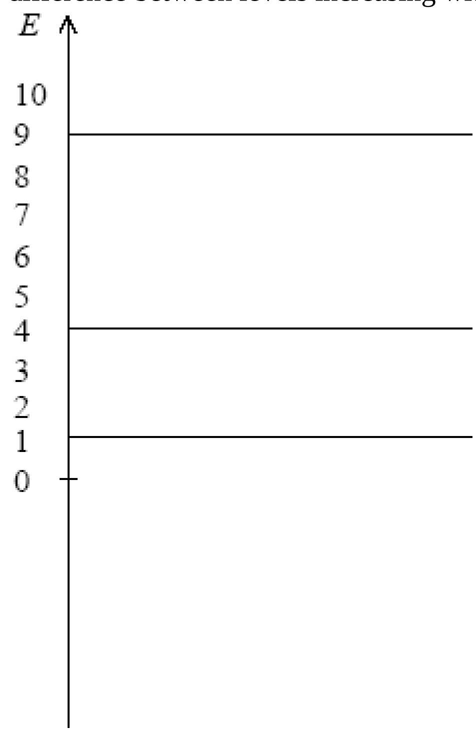
$\lambda = \left(\frac{6.63 \times 10^{-34} \times 3.0 \times 10^{8}}{1.635 \times 10^{-18}} \right) = 1.22 \times 10^{-7}$ m; 3

(e) (i) attempt at using the energy – time uncertainty relation;

$\Delta E \left(= \frac{h}{4\pi \Delta t} = \frac{6.63 \times 10^{-34}}{4\pi \times 1.0 \times 10^{-10}} \right) = 5.3 \times 10^{-25}$ J; 2

(ii) the wavelength of the photons is determined by the difference in energy between the two levels;
and that energy difference is not well defined/definite/not always the same (because of the uncertainty principle); 2

(f) energy levels all with strictly positive energy;
difference between levels increasing with increasing *n*; 2



Judge separation of levels by eye – there will not be numbers on the candidates' graphs.

24. (a) (i) probability that a nucleus decays in unit time; 1

(ii) $150 = 800e^{-1.2 \times 10^{-3} t}$;
1400 s; 2

(b) (i) 580 s; 1

(ii) activity/count rate measured at <u>regular</u> time intervals/for at least three half-lives;
plot graph activity/count rate versus time;
detail of determination of half-life from graph; 3

(c) beta energy spectrum is continuous and associated gamma spectrum is discrete;
difference in energies accounted for by existence of another particle; 2

or

if another particle not present;
then momentum not conserved in beta decay;