Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Mark Schemes

Q1.

(a) Photons of light incident on the metal surface cause the emission of electrons ✔

The electrons emitted are those near the surface of the metal✔

2

(b) Use of = hc / λ condone errors in powers of 10✔

5.2×10^{-19}J✔

Converts their energy in J to eV or work function to J

photon energy = 3.3 eV or work function = 3.7×10^{-19}J✔

Compares the two values and draws conclusion✔

4

(c) Diffraction effects (spreading of light) when light passes through a single slit

OR

interference patterns (light and dark fringes) using two slits or diffraction grating✔

Only waves diffract and interfere✔

2

[8]

Q2.

(a) The process involves the ejection of electrons which are negatively charged. ✓

1

Any electrons ejected will only make the positive charge greater. ✓

1

(b) **The mark scheme gives some guidance as to what statements are expected to be seen in a 1 or 2 mark (L1), 3 or 4 mark (L2) and 5 or 6 mark (L3) answer. Guidance provided in section 3.10 of the '*Mark Scheme Instructions*' document should be used to assist in marking this question.**

Mark	Criteria	QoWC

6	Both ideas fully analysed, with full discussion of alternatives.	The student presents relevant information coherently, employing structure, style and sp&g to render meaning clear. The text is legible.
5	Both ideas analysed with supporting discussion but without alternatives	
4	Both ideas analysed, with one dealt with satisfactorily and the other with some supporting discussion	The student presents relevant information and in a way which assists the communication of meaning. The text is legible. Sp&g are sufficiently accurate not to obscure meaning.
3	Both ideas analysed, with only one dealt with satisfactorily	
2	One idea analysed with some supporting discussion	The student presents some relevant information in a simple form. The text is usually legible. Sp&g allow meaning to be derived although errors are sometimes obstructive.
1	One idea analysed, with little supporting discussion	
0	Unsupported combination or no relevant analysis	The student's presentation, spelling, punctuation and grammar seriously obstruct understanding.

The following statements are likely to be present.
To demonstrate threshold frequency:
The metal should be kept the same, and the light source varied.
Using any metal, and light sources 1 and 3,
no charge will be lost with light source 1
but charge will be lost with light source 3
because light source three has a greater photon energy
and therefore frequency (from E=hf)
and is above the threshold frequency
as the photon energy is greater than the work function of the metal
but light source 1 has a photon energy less than the work function of the metal
so its frequency is below the threshold frequency.
To demonstrate work function
The light source should be kept the same, and the metal varied
Use light source 2 as the other two will either cause all three metals to lose their charge, or none of the metals to lose their charge.
Use each metal in turn, so that zinc loses its charge, due to its low work function, but copper and iron do not lose their charge.

(c) Work function in joules = $1.6 \times 10^{-19} \times 4.3 = 6.9 \times 10^{-19}$ J ✓

The first mark is for converting the work function into J

1

Use of hf = work function + KE_{max}

The second mark is for substituting into the photoelectric equation

1

KE_{max} = hf – work function

$= (6.63 \times 10^{-34}) \times (1.2 \times 10^{15}) + 6.9 \times 10^{-19}$ ✓

$= 7.9 \times 10^{-19} - 6.9 \times 10^{-19}$

$= 1.0 \times 10^{-19}$ J ✓

The third mark is for the final answer

Allow 1.1

1

(d) The work function is the minimum amount of energy needed to remove the electron from the zinc surface ✓

Alternative

Reference to max ke corresponding to emission of surface electrons whilst electrons from deeper in the metal will be emitted with smaller ke

1

[12]