

Practice Question Set For A-Level
Subject : Physics
Paper-1 Topic: Particle And Radiation

Name of the Student: _____

Max. Marks : 21 Marks

Time : 21 Minutes

Mark Schemes

Q1.

(a) $\lambda = 656 \text{ nm}$ ✓

Power of 10 error allow 2

Use of $E = hc/\lambda$ ✓ = $3.0 \times 10^{-19} \text{ (J)}$

Allow ecf for wrong choice of wavelength

$E/ 1.6 \times 10^{-19}$

= 1.9 (1.88) (allow 1sf if correct)

Treat as skill mark – allow conversion for any value of E

3

(b) They are (just) free ✓

Allow released from atom

1

(c) This is the ground state ✓

or

This is the lowest level an electron can occupy

Allow lowest energy state

Condone level for state

Allow description of ground state

1

(d) To become free / to remove an electron (reach zero energy) energy has to be supplied ✓

or

Energy decreases from 0 as electrons move to lower energy levels/relate to energy needed to move from that state to 0

Or

Electrons release energy as they move lower

Or

Zero is the maximum energy

1

(e) **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
6	All three aspects analysed. 6 marks can be awarded even if there is an error and/or parts of one aspect missing.
5	A fair attempt to analyse all 3 aspects. If there are a couple of errors or missing parts then 5 marks should be awarded.
4	Two aspects successfully discussed, or one discussed and two others covered partially. Whilst there will be gaps, there should only be an occasional error.
3	Two aspects discussed, or one discussed and two others covered partially. There are likely to be several errors and omissions in the discussion.
2	Only one aspect discussed successfully, or makes a partial attempt at 2 or all 3.
1	None of the three aspects covered without significant error.
0	No relevant analysis.

The following statements are likely to be present.

A Reason for high potential difference

pd accelerates electrons/produces high speed / high energy electrons in the tube L1

electrons have to have sufficient energy to excite the atoms/raise electrons into higher levels L3

B Relation between spectrum and energy level diagram

Visible spectrum results from excited electrons moving into the lower level at -3.4 eV L3

Each transition results in a photon of light L2

Energy of photon is the difference in the energies of the two levels L2

Frequency of light in the spectrum given by $\Delta E = hf$ L1

C Relevant calculation clearly communicated

Gives an example: eg the lowest frequency is due to a transition from the -1.5 eV level to the -3.4 level L1

Uses an energy difference to deduce one of the wavelengths: eg energy difference in $J = 3 \times 10^{-19}$ L2

$\lambda = hc/E = 660 \text{ nm}$ L2

6

[12]

Q2.

(a) $7.3(4) \times 10^5$ ✓

Numerical answer (in terms of powers of 10) must match unit prefixes where used

Penalise rounding errors (733944.9541)

C kg^{-1} ✓

Do not allow use of solidus in unit:

C / kg

Condone a capital k or lower case c but not a capital g

2

(b) $(1300 \text{ eV}) = 2.08 \times 10^{-16} \text{ (J)}$

OR

$2.1 \times 10^{-16} \text{ (J)}$ ✓

1

(c) Correct answer of 3.59×10^7 gains 3 marks (without working)

(Number of Xe ions per second) =

$\frac{2.1 \times 10^3}{\text{ans to (b)}}$ OR $1(.01) \times 10^{19}$ seen ✓
Ecf from part (b)

(Mass of Xe ions per second)

$= 2(.2) \times 10^{-6}$ ✓
Ecf from part (b)

$(\text{time} = \frac{\text{total mass}}{\text{mass per second}} = \frac{79}{2(.2) \times 10^{-6}} =) 3.59 \times 10^7 \text{ (s)} \text{ or } 3.6 \times 10^7 \text{ (s)}$

OR

(Total number of Xe ions) =

$\frac{79}{2.18 \times 10^{-25}}$ OR 3.6×10^{26} seen ✓
Ecf from part (b)

(total energy available)

$3.6 \times 10^{26} \times (\text{ans to (b)})$ OR $7.5(4) \times 10^{10}$ ✓
Ecf from part (b)

$(\text{time} = \frac{E}{P} = \frac{7.5(4) \times 10^{10}}{2.1 \times 10^3} =) 3.59 \times 10^7 \text{ (s)}$ ✓

If both 'methods' attempted, restrict marks awarded to optimum method.

3

(d) Speed of He ions will be greater ✓

(Momentum depends on mass and speed, although) He (has higher speed) has (considerably) less mass, therefore less momentum (gained by He ion during the acceleration) ✓

He ion exerts less thrust (on spacecraft therefore xenon is better)

OR

Xenon ion exerts more thrust (on spacecraft therefore xenon is better)



Must address these points

Other points (e.g. He smaller so more can be stored) are neutral: no credit awarded

Must be clear about which ion candidate is discussing

Condone use of terms such as 'heavier' / 'lighter'