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

Mark Schemes

Q1.

(a) Clear indication of correct process

two correct values for λv from working plus conclusion

(7.35; 7.25; 7.35) ✔

three correct values plus conclusion ✔

Condone no or misuse of powers of 10

Allow use of value of h as the constant to show that v values in table are consistent with the λ values

1

.....

ratio approach $v_1/v_2 = \lambda_2/\lambda_1$ shown for 2 sets of data ✔

shown for two other sets of data + conclusion ✔

May predict one of the values assuming inverse proportionality and compare with table value

(once for 1 mark; twice for 2 marks)

1

(b) $h = \lambda mv$ or substitution of correct data in any form ✔

May determine average value using mean constant from 2.1 or average 3 calculations in this part

1

$6.7(0) \times 10^{-34}$ from first and third data set; $6.6(0) \times 10^{-34}$ from second ✔

1

(c) Particle behaviour would only produce a patch/circle of light /small spot of light or Particles would scatter randomly ✔

Wave property shown by diffraction/ interference ✔

Graphite causes (electron)waves/beam to spread out /electrons to travel in particular directions ✔

Bright rings/maximum intensity occurs where waves

interfere constructively/ are in phase ✔

for a diffraction grating maxima when sinθ = $n\lambda/d$ ✔

Marks are essentially for

1. Explaining appearance of screen if particle

2. Identifying explicitly a wave property

3. Explaining what happens when diffraction occurs

4. Explaining cause of bright rings

5. Similar to diffraction grating formula (although not same)

NB Not expected: For graphite target maxima occur when sinθ =$\lambda/2d$ (d =spacing of atomic layers in crystal)

1
1
1

(d) Electrons must provide enough (kinetic) energy

'instantly' to cause the excitation

OR

the atom or energy transfer in 1 to 1 interaction

OR

electron can provide the energy in discrete amounts

OR

energy cannot be provided over time as it would be in a wave

Description of Photoelectric effect = 0

Not allowed: any idea that wave cannot pass on energy, e.g. waves pass through the screen

1

Any 2 from

Idea of light emission due to excitation and de-excitation of electrons/atoms ✔

Idea of collisions by incident electrons moving electrons in atoms between energy levels/shells/orbits ✔

Light/photon emitted when atoms de-excite or electrons move to lower energy levels ✔

1
1

[10]

Q2.

(a) Waves travel to the boundaries and are reflected ✔

Not bounce off ...

1

two waves travelling in opposite directions interfere/superpose ✔

Not superimpose or interferes with itself

1

Fixed boundaries (cannot move so) are nodes ✔

creates nodes and antinodes bland = 0

In some positions the waves always cancel /interfere destructively to give zero amplitude/no vibration/nodes)
OR
interfere constructively to produce positions of maximum amplitude/maximum vibration/antinodes ✔

1
Max 3

(b) Use of $f=\frac{1}{2l}\sqrt{\frac{T}{\mu}}$ ✔

Either rearranges for μ without substitution or substitutes correctly in the formula

1

4.2 (4.19) × 10^{-4} (kg) ✔

1

(c) 240 (244) (m s^{-1})

1

(d) 1 rotation of the peg = 22 mm ✔

Or Reads increase in tension produced by the extra extension (about 10 N) from graph and adds to 25

1

extra extension = 22 × 75/360 = 4.6 mm

(ecf for incorrect circumference) ✔

πd × 75/360 not evaluated =1

1

Total extension = 11 + 4.6 (15.6 mm) so tension 35 - 36N ✔

Inspect their length and their tension in the substitution

1

Calculates frequency **for their tension**

T must <u>be greater than</u> the original 25N

Condone adding or subtracting <u>extra</u> extension to 0.33 m

If 4.0 × 10^{-4} kg used then answer will be in range 448 Hz to 455 Hz

If 4.19 × 10^{-4} used 438 to 444 Hz

1

[10]