

Name of the Student: _____

Max. Marks : 25 Marks

Time : 25 Minutes

Mark Schemes

Q1.

- (a) Capacitor must not lose charge through the meter ✓ 1
- (b) Position on scale can be marked / easier to read quickly etc ✓ 1
- (c) Initial current = $\frac{6}{100000} = 60.0 \mu\text{A}$ ✓
 100 μA or 200 μA ✓ (250 probably gives too low a reading)
 Give max 1 mark if 65 μA (from 2.6) used and 100 μA meter chosen 2
- (d) 0.05 V ✓ 1
- (e) Total charge = $6.0 \times 680 \times 10^{-6}$ (C) (= 4.08 mC) ✓
 Time = $4.08 \times 10^{-3} / 60.0 \times 10^{-6} = 68$ s ✓
 Hence 6 readings ✓ 3
- (f) Recognition that total charge = $65 t \mu\text{C}$ and final pd = $0.098 t$
 so $C = 65\mu / 0.098$ ✓
 660 μF ✓
Allow 663 μF 2
- (g) (yes) because it could lie within 646 – 714 to be in tolerance ✓
 OR
 it is 97.5 % of quoted value which is within 5% ✓ 1
- (h) Suitable circuit drawn ✓
 Charge C then discharge through R and record V or I at 5 or 10 s intervals ✓
 Plot $\ln V$ or $\ln I$ versus time ✓

gradient is $1 / RC$ ✓

OR

Suitable circuit drawn ✓

Charge C then discharge through R and record V or I at 5 or 10 s intervals ✓

Use V or I versus time data to deduce half-time to discharge ✓

$1 / RC = \ln 2 / t_{1/2}$ quoted ✓

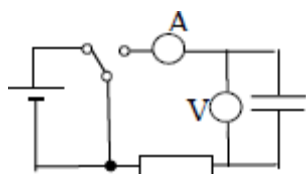
OR

Suitable circuit drawn ✓

Charge C then discharge through R and record V or I at 5 or 10 s intervals ✓

Plot V or I against t and find time T for V or I to fall to 0.37 of initial value ✓

$T = CR$ ✓



Either A or V required

For 2nd mark, credit use of datalogger for recording V or I .

4

[15]

Q2.

- (a) Concave mirror with parallel incident rays reflecting to different focal points. ✓
PA does not need to be drawn.

1

Rays further from PA brought to focus nearer the mirror. ✓

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	All three aspects covered: A full comparison of location in terms of the affect of atmosphere on the GTC, and the difficulties of maintaining, servicing and obtaining data from IUE.	The student presents relevant information coherently, employing structure, style and sp&g to render meaning clear. The text is legible

	<p>A quantitative comparison of the collecting power with conclusion that GTC has 530x collecting power of IUE.</p> <p>A quantitative comparison of minimum angular resolution, with conclusion that GTC is 5x better.</p>	
5	Two of the three aspects fully covered, with some detail missing from the third.	
4	<p>One aspect fully covered, with some detail missing from the other two</p> <p>Or</p> <p>Two aspects fully covered, with little or no relevant information about the third.</p>	<p>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.</p>
3	<p>All three aspects partially covered, with some detail missing from each</p> <p>Or</p> <p>One aspect fully covered, with little or no relevant information about the other two.</p>	
2	Two aspects partially covered, with little or no relevant information about the third.	
1	One aspect partially covered, with little or no relevant information about the other two.	<p>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.</p>
0	Little or no relevant information about any of the three aspects.	
		<p>The student's presentation, spelling punctuation and grammar seriously obstruct understanding.</p>

The following statements are likely to be present:

Location

- light must travel through some of the atmosphere to reach GTC which affects the amount

of light arriving and resolution.

- IUE In orbit needs its own power source,
- and information needs to be sent to ground for analysis.
- position of IUE inconvenient as, if something goes wrong, it is difficult to service an orbiting satellite.

Collecting power

- Collecting power is proportional to D^2 .
- So ratio is $10.4^2 / 0.45^2 = 530$
- GTC has 530x collecting power.
- GTC better as bigger diameter telescopes make brighter images.

Minimum angular resolution

- Minimum angular resolution is proportional to $1 / D$
- $\theta = \lambda / D$ so ratio of min angular resolution is $(1 \times 10^{-6} / 10.4) / (2 \times 10^{-7} / 0.45) = 0.2$
- GTC is 5x better at resolving
- GTC better as bigger diameter telescopes make clearer images.

6

no. of photons arriving at detector and being detected

(c) $QE. = \frac{\text{total arriving at detector}}$

1

For CCD $QE > 80\%$ ✓

For eye $QE = 1\%$ ✓

Both needed

1

[10]