Practice Question Set For A-Level
Subject : Physics
Paper-3 Topic: Section A(Practical Skills Set-1)

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Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Mark Schemes

Q1.

(a) 37.8 ✔

CAO

1

(b) <u>random</u> (error)

condone 'statistical' ✔

the following are neutral:
'parallax' / 'human (error)' / '(some) results are anomalous'

1

(c) advantage (of using thinner beam):

(same load produces) larger (values of) *s* or wtte 1✔

so

the <u>percentage</u> uncertainty / error (in *s*) is reduced 2✔

for 1✔ accept 'beam bends / deflects more'
'beam extends more' / 'easier to bend' are neutral
for 2✔ the following are neutral:
'easier to make readings' / 'values (of s) are more accurate' / 'more precise' / 'less mass needed' / 'wider range of readings'

disadvantage (of beam bending more):

idea that beam may undergo plastic deformation 3✔

so

the graph will be non-linear / curve or wtte 4✔

or

beam 'may break' / 'slip off knife edges' **and** relevant comment about safety / health / hazard / 'cannot get unload data'

or

reduces range of *m* or wtte **and** relevant comment about the effect on the graph, eg increase scatter 34✔ = 1 MAX

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for 3✔ accept / 'beam may become permanently deformed' or wtte / 'necking may occur' / 'hysteresis may occur' / 'beam can reach (go past) elastic limit'

the following are neutral:

'causes systematic error' / 'beam may go past limit of proportionality' / 'need to increase height of supports' / 'beam may bend under own weight'

MAX 3

(d) $E \approx 10^9$

or

1.14×10^9 seen 1✔

for 1✔ accept 10^9 seen in working

1

correct manipulation seen in **body of answer** of $s = \frac{\eta m}{E}$ 2✓

*for 2✔ **either***

*substitution of their E and data from **Figure 8***

leaving η as only unknown: allow POT in s but not in m

eg $\eta = \frac{\text{their } E \times 25.5\left(\times 10^{-3}\right)}{0.25}$ **or**

substitution of their E and result of a gradient calculation: allow POT in Δs but not in Δm

*eg $\eta = 1.14 \times 10^9 \times 1.02\ (\times 10^{-1})$ **or***

calculation involving orders of magnitude (expect 10^{-1} but allow 10^2 for gradient)

eg $\eta \approx 10^9 \times 10^{-1}$

2

correct raw result (allow POT in E) 3✔

for 3✔ expect 1.16×10^8 but allow 1 sf gradient eg leading to 1.14×10^8

(on answer line) order of magnitude consistent with their raw result 4✔

for 4✔ $\eta = 10^8$ or 8 only; allow use of their E

award 34✔ = 1 MAX for use of gradient ≈ 100
leading to order of magnitude = 10^{11} or 11 only

1

(e) identifies that s and L are linked by a power law ✔

accept any correct expression (unless there is talk-out) with s or log s as the subject;

treat any quantities other than s and L as constant except E and η

possible answers are:

$s \propto L^n$

allow $s \propto L^m$ if m identified as constant

$s \propto L^3$

$s = kL^n$

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log s = n log L + (log) k

log s = 3 log L + (log) k

log s = log L^3 + (log) k

reject

$s = L^n$

log s = n log L

log s $\propto$ n log L

$10^s \propto 10^L$

's and L are linked logarithmically'

's is directly proportional to L'

1

(f) (log L =) −0.097 seen

for 1✔ accept any log L rounding to −0.097;

1

or

working on **Figure 5** confirming a value of log L between −0.095 and −0.100 1✔

uses **Figure 5** to obtain *s* in range 2.9 to 3.1 × 10^{-2} (m) 2✔

working can be suitable ruled line or mark on the best-fit line / on graph axes

for 2✔ accept 29, 30 or 31 mm etc

reject 1sf 3 × 10^{-2} (m)

1

use of wrong base

ln L = −0.22(3);

uses **Figure 5** to obtain *s* in range 1.49 to 1.51 × 10^{-1} or 1.5 × 10^{-1} (m) 12✔

accept 15 cm etc

(g) use of **Figure 4** to determine M ✔

*their (final answer to) (f) × gradient of **Figure 4** (9.8 ± 2.5%)*

minimum 2sf

condone use of 1sf s

1

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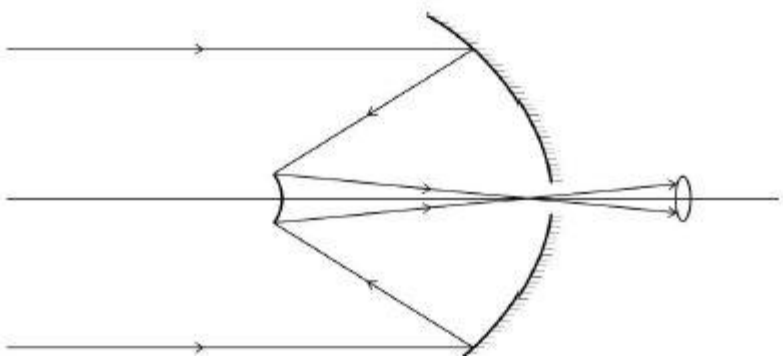
Q2.

(a) Diagram of Cassegrain telescope with

both mirrors correct ✔

two rays correct ✔

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The first mark is for a concave primary mirror and convex secondary.

Condone lack of shading. Hole in primary can be inferred from rays passing through.

Primary must not look like two mirrors.

Condone flat secondary if labelled convex. Do not condone if concave.

The second mark is for the two rays, initially parallel to the principal axis, reflecting from the primary mirror to the secondary, and then crossing on the principal axis after secondary and before passing through primary. Condone crossing after primary if before a lens.

Ignore arrows on rays. No lens needed; ignore rays after lens if drawn.

Poorly drawn rays, eg curved, loses mark.

2

(b) Resolution = $\frac{450 \times 10^{-9}}{0.21}$ = 2.14×10^{-6} (rad) ✔

Smallest detail = $2.14 \times 10^{-6} \times 12.5 \times 10^{6} = 27$ m ✔

Sensible comment about comparison and decision made ✔

For MP2 student may find angle subtended by 1 km crater (8.0×10^{-5} rad) then compare angles for MP3

MP3 for example 27 m is 1/40th of crater.

3

(c) Collecting power ∝ area ✔

$$\text{Ratio} = {2.4^2}/{.21^2} = 130$$

OR calculates both areas and states Hubble is much bigger ✔

MP1 is for student showing they know dependence on area. Condone collecting power $\propto d^2$ if it is clear that d is diameter.

MP2 for clear comparison

2

(d) At least 2 clear comparisons made ✔ ✔
Decision made about which telescope, justified in terms of the impact of at least one comparison on the image (likely to be reflecting).✔

Problems of refractors:

Can suffer spherical aberration and chromatic aberration.

Reflecting are lighter. Reflecting are shorter. Mirrors do not suffer from chromatic aberration.

Problems of reflectors:

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Spider/secondary mirror block some of the light/reduce image brightness/cause diffraction effects.

Ignore discussion of cost/difficulty of construction/air trapped in refracting telescope.

3

[10]

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