Name of the Student:_____
Max. Marks : 16 Marks **Time : 16 Minutes**

Mark Schemes

Q1.

(a) Use of $P = \sigma A T^4$ ✔

Ratio = $= \frac{\sigma A_M T_M^4}{\sigma A_S T_S^4} =$

$(1.4 \times 10^{10})^2 \times 53000^4 / (7.0 \times 10^8)^2 \times 5700^4 = 3.0 \times 10^6$ ✓

Award mp 1 for substituting data for either the Sun or Melncik 34

2

(b) Star will undergo supernova collapse or

Star will form a neutron star/black hole ✔

which produces a gamma ray burst

and

consequence for life or reference to being highly collimated ✔

Examples of consequence for life: kills cells / damages DNA.

2

[4]

Q2.

(a) MAX 2

Uncertainty in one/each reading is 1 mm $_1$✔

Allow the uncertainty in (reading) the position of a spot is 1 mm. $_1$✔

OR
The measurement involves making two readings / there are two uncertainties (to be considered) in this measurement $_1$✔

Owtte

Difficulty / uncertainty in locating (exact) position of (centre of) spot $_2$✔

Or
Difficulty / uncertainty in lining up the (centre of the) spot with a graduation on the ruler $_2$ ✔

Or

Difficulty / uncertainty in locating the position of A / B $_2$✔

Do not allow:

- *because the smallest division is 1 mm*
- *hard to see measurements to less than 1 mm (need to link to position of spot (or A or B)*
- *"because of both sides of the ruler" on its own*
- *"ruler slightly misaligned" too vague*

the uncertainties from two (readings) are added $_3$✔

insufficient includes:

- *uncertainty doubles*
- *uncertainty is twice the smallest division*
- *Random error or human error or error without further detail.*

However:

The uncertainty doubles because there are two readings scores MP1

Also:

The uncertainty doubles because there are two readings <u>with identical uncertainties</u> would score 2 marks.

Mention of range of repeated measurements ÷ 2 is not applicable in this case.

2

(b) (Adds the uncertainties =) 4 (mm) $_1$✔

Or

Use of by substitution

(percentage uncertainty=) $\frac{\text{uncertainty}}{\text{value}}$ (×100) (%) $_1$✔

(% uncertainty =) 0.74 **or** 0.7 (c.a.o) $_2$✔ (**1 or 2 significant figures only**)

1st mark

Expect to see:

(percentage uncertainty=) $\frac{4}{544}$ *(×100) (%)*

Maximum 1 mark for

Condone (in substitution):

- *2/289, 2/255, 2/272, 2/544, 4/289, 4/255, 4/272*
- *power of ten errors (POT errors)*
- *must be a recognisable uncertainty*

Maximum 1 mark for

use of

(percentage uncertainty=) $\frac{\text{uncertainty}}{\text{mean (value)}}$ *(value)(×100) (%)*

along with substitutions of

- *2/289, 2/255, 2/272, 2/544, 4/289, 4/255, 4/272, 4/544*
- *power of ten errors*

condone for 1 mark

((2/289 + 2/255) × 100 =)

1.48% or 1.5%

2nd mark

Condone working leading to 2nd mark for:

Use of (percentage uncertainty=) $\frac{2}{272}$

Do not allow mean of two separate % uncertainties ***or*** *incorrect formula quoted and used in workings*

2

(c) MAX 2

The <u>percentage</u> uncertainty in c is smaller <u>than for a or b</u> because c has a larger value (than a or b separately)$_1$✔

or % uncertainty in c is half the percentage uncertainty in a + b $_1$✔

or The <u>percentage</u> uncertainty in c is smaller <u>because</u> its uncertainty is smaller for the same data value $_1$✔

Insufficient:

- *c has a smaller uncertainty*
- *a + b has a larger uncertainty*
- *The uncertainty of a + b is combined*

c's (% uncertainty =) 0.37 or 0.4 $_2$✔ or *c*'s (% uncertainty =) $\frac{2}{544} \times 100$ $_2$✔

idea that *c*'s measurement involves fewer readings than the sum of a and b $_3$✔
or
idea that c requires fewer measurements than the sum of a and b $_3$✔

Accept converse

Where numbers are quoted, these must be consistent with terms used.

4 readings, 2 readings

2 measurements, 1 measurement

2

(d) (when laser is switched on) always stand behind the laser (unless taking readings) ✔

Or
if <u>in front of laser</u> (when switched on) look away from the laser (eg when taking readings) ✔

Or
if <u>in front of laser</u> (when switched on) don't look at/towards the laser (eg when taking readings) ✔

Or
don't look directly into the laser (beam)✔

Or
direct laser towards nearest wall ✔

Or
switch off laser when not in use ✔

Or
ensure (glass) reflective surfaces are covered (prevent reflections) ✔

Or
Do not shine the laser onto a reflective surface ✔

Or
place safety notices outside the laboratory [room] ✔

Or
don't shine laser at eye level ✔

Or
mark positions with pen/pencil and measure after laser switched off ✔

Or
laboratory is normally illuminated (not darkened) ✔

Where a list of safety measures has been given:

- *Treat more than one correct as neutral*
- *Penalise incorrect safety measure in a list that may include correct safety measures.*

Do not credit weak statements:

- *Do not look at the laser*
- *Don't point the laser anywhere except at the grating*
- *Don't look directly at the laser*

Beware of references to "the light".

1

(e) $(\tan\theta = \frac{0.544}{1.280} \ = \theta =) \ 23.0(°)$ ✔

allow 2 or more significant figure answer
acceptable common answers:
23, 23.0, 23.03, 23.025, 23.0255
Where more than 3 sf quoted, the number must be correct.
alternative method
*(valid attempt to determine distance from grating to spot **E**, eg*
(distance = $(\sqrt{0.544^2+1.280^2})$ *= 1.391)*
(sin $\theta = \frac{0.544}{1.391}$ *= 0.391)*
(θ *=) 23.0(°)* ✔
allow 2 or more significant figure answer
acceptable common answers:
23, 23.0, 23.03, 23.025, 23.0255
Condone mid-calculation rounding leading to errors in 4th sf where quoted.

1

(f) use of $n\lambda = d\sin\theta$ ✔ 1

or
(if nothing else seen) d = 3.3×10^{-6}m ✔ 1

Use of:
Correct rearrangement where subject would be λ
or correct substitution of n, d and θ
Expect to see n = 2 , $d = 3.3(3) \times 10^{-6}$ *,* $\theta = 23(.0)$

*Condone **one** error in substitution for n or d in a correctly rearranged equation where subject would be λ*

(or where answer indicates the correct working for incorrect numbers, d error leads to 5.86×10^{4})

Condone power of ten errors in working

$\lambda = 6.5(2) \times 10^{-7}$ (m) $_2$✔ ecf

2 or 3 sf only

where 3 sf quoted answer must be in range 651 to 652 nm (or ecf)

Common ecf (sin θ error in 1.5):

Expect to see an answer that rounds to 7.1×10^{-7}m to 2 sf

2

(g) The second mark ($_2$✔) is contingent on the award of the first mark ($_1$✔).

Increase distance from grating to screen / increase y $_1$✔

(This will increase distance y (and/or c) therefore) decreasing the percentage uncertainty in y / c / fringe spacing / θ / sin θ $_2$✔

Do not accept:

- *darkened room*
- *use a (vernier) caliper*
- *use a travelling microscope*
- *Repeat*
- *Repeat and average*
- *Computer / data logger / camera*
- *Ruler with smaller divisions*
- *Make the maxima further apart (details on how this is achieved are required)*
- *Increase distance between laser and screen.*

Decreases the <u>percentage</u> uncertainty in y $_2$✔

Or

Use a higher-order spot $_1$✔

(This will increase distance from centre spot to higher-order spot therefore) decreasing the <u>percentage</u> uncertainty in the fringe spacing/θ /sin θ $_2$✔

Condone reference to this distance as c

Or
Measure distance between A and E $_1$✔

(This increases the distance therefore) decreasing the <u>percentage</u> uncertainty in c $_2$✔

No details of determination of c are required.

2

[12]