Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2015

Physics

Assessment Unit AS 3

assessing

Practical Techniques

Session 2

[AY132]

MONDAY 18 MAY, MORNING

MARK SCHEME

Subject-specific Instructions

In numerical problems, the marks for the intermediate steps shown in the mark scheme are for the benefit of candidates who do not obtain the final correct answer. A correct answer and unit, if obtained from a valid starting-point, gets full credit, even if all the intermediate steps are not shown. It is not necessary to quote correct units for intermediate numerical quantities.

Note that this “correct answer” rule does not apply for formal proofs and derivations, which must be valid in all stages to obtain full credit.

Do not reward wrong physics. No credit is given for consistent substitution of numerical data, or subsequent arithmetic, **in a physically incorrect equation**. However, answers to subsequent stages of questions that are consistent with an earlier incorrect numerical answer, and are based on physically correct equation, must gain full credit. Designate this by writing **ECF** (Error Carried Forward) by your text marks.

The normal penalty for an arithmetical and/or unit error is to lose the mark(s) for the answer/unit line. Substitution errors lose both the substitution and answer marks, but 10^n errors (e.g. writing 550 nm as 550×10^{-6} m) count only as arithmetical slips and lose the answer mark.

Section A

AVAILABLE MARKS

1 (a) (i) Length = 15.0 cm approx given to ±1 mm [1]

(ii) typical results

Mass/g	New length/cm	Increase in length/cm consistent with their values
200	18.6	3.6
400	21.0	6.0
500	27.9	7.9

[1]

[–1] not increasing

(b) (i) Yes/No plus explanation consistent with **results**. [1]

(ii) Uncertainty = ±0.2 cm (or 0.4 cm)
(Uncertainty in each reading is 0.1 cm (or 0.05 cm [1])).
Therefore the uncertainty in extension is addition of two measurement uncertainties. [1]
Accept larger ⩽ ±2 uncertainties with parallax explanation/holding rule. [2] 5

2 (a) (i)

	Focal length/cm
lens/mirror combination	15.0 ±0.1 mm

[1]

(ii) u and v value recorded, u < v [1]
f consistent with u and v (ignore sig. fig.) [1] [2]
(first value in equation assumed to be u unless stated otherwise)

(b) % difference = difference/either focal length × 100 [1]
e.g. 0.2/15.1 × 100 = 1.3 consistent substitution [1] [2] 5

3 (a)

Mass/g	Time for 10 oscillations/s 1	2	t_{av}	T/s
200	5.72	5.68	5.70	0.57
400	8.05	8.22	8.14	0.81
500	8.85	8.95	8.90	0.89

(i) Headings – multiple oscillation → times ⩾ 5 s
units – for one heading only [1]

(ii) Repetition [1]

(iii) Values of T given to 0.01 s [1] [3]

(b) (i) $T = Am$ *eqn* 1 ☐
$T = \frac{A}{m}$ *eqn* 2 ☐
$T = Am^{\frac{1}{2}}$ *eqn* 3 x [1]

(ii) Can't be eqn 1 as m doubles T does not
Can't be eqn 2 as m increases so does T
Therefore must be eqn 3
or calculation to support [1] 5

		AVAILABLE MARKS
4 **(a)** **(i)**	Workable circuit with voltmeter, ammeter and power supply and correct PSU polarity [1]	
(ii)		

Voltage/V	Current/mA	
0	0	0
0.2	0	
0.6	0	values increasing
1.0	0	
1.3	0	
1.8	19.6	

[2]

(b) **(i)**	Need to take more readings just before first non-zero reading to find exact voltage (at which the led switches on or current ≠ 0) [1]	
(ii)	Switch on voltage = 1.75 V (typical) – consistent with Table 4.1 [1]	5
	Section A	**20**

Section B

AVAILABLE MARKS

5 (a) (i)

Rear Gear R	G when F = 44	G when F = 52
14	2.2	2.6
17	1.8	2.1
20	1.5	1.8
24	1.3	1.5
28	1.1	1.3

Penalty [–1] dp violation

[1] [1] [2]

(ii) Mention of at least one set of doubles

or 2.6,(2.2,2.1), 1.8, 1.5, 1.3, 1.1 [1]

There are **three sets** of double readings and **one set** which is very close. [1] [2]
Allow ECF for wrong data*

(b) (i) Scales [2]
Points plotted 9 ([–1] for each error) [2]
Straight line [1] [5]

(ii) Gradient = 40/2.7 = 14.8 ± .2 Large Δ + subs [1]
Value [1] [2]

(iii) $\omega = 14.8 \times 16.94/\pi$ (consistent with their slope value) [1]
$= 79.8$ [1] [2]

(c) (i) $G = \frac{0.48 \times 52}{14}$ subs [1]

G = 1.8 [1] [2]

(ii) 26.4 (km h^{-1}) approx consistent with their values [1]

(iii) $38.1 = \frac{\pi}{16.94}(1.8)\,\omega$ subs [1]

$\omega = 114$ (rev min^{-1}) [1] [2]
(use of values from table 5.2, max [1])

(d) 0.042 h 0.065 [1]

3.9 min [1] [2] 20

Section B **20**

Total **40**