Mark scheme for 2021 Physics Prelim Practical Exam

Question 1

Minus maximum 1 m for each type of unit. For wrong s.f., minus max 1 m for Q1.
Allow ECF for calculations.

(a) d = 0.38 mm (2 d.p. in mm, accept 0.36 to 0.40 mm) [1]

(b) A = π $(0.38)^2$ / 4 = 0.11 mm^2
= 1.1 x 10^{-7} m^2 (2 s.f.) (correct calculation with units) [1]

OR: A = π $(0.38 \times 10^{-3})^2$ / 4
= 1.1 x 10^{-7} m^2 (2 s.f.) (correct calculation with units) [1]

(c) I = 0.30 A (2 d.p. with correct units, accept 0.20 to 0.40 A) [1]

V = 2.40 V (2 d.p. with correct units, accept 1.60 V to 3.20 V) [1]

(d)(i) R = 2.40 / 0.30 = 8.0 Ω (2 s.f.) (correct calculation with units) [1]

(ii) $\rho = RA / l$ = 8.0 x 1.1 x 10^{-7} / 0.800 (correct use of formula) [1]
= 1.1 x 10^{-6} Ωm (2 s.f.) (correct calculation and units) [1]
(do not accept ohm per metre)

(iii) P = 0.30 x 2.40 = 0.72 W (2 s.f.) (correct calculation and units) [1]

(e) P = 0.40 x 1.60 = 0.64 W (2 s.f.) (correct calculation and units) [1]

(f) P is not directly proportional to l as the value of P did not decrease / increase by half when l decrease / increase by half.
(accept ECF according to their data)

Question 2

Minus maximum 1 m for each type of unit. No need to penalise s.f. for Q2.

(a) Correct d.p.and units [1]

h = 6.6 cm
j = 30.4 cm
k = 12.0 cm

(b) Show evidence of taking average value of at least two readings. [1]

t = 5.39 s (2 d.p. with units) [1] (accept 1 d.p due to human reaction time)

(c) $P_1 = 5 \times (10 \times 10^{-3}) / 5.39$ (correct substitution) [1]
$= 9.3 \times 10^{-3}$ W (2 s.f.) (correct calculation and units) [1]

Accept non SI units: For example

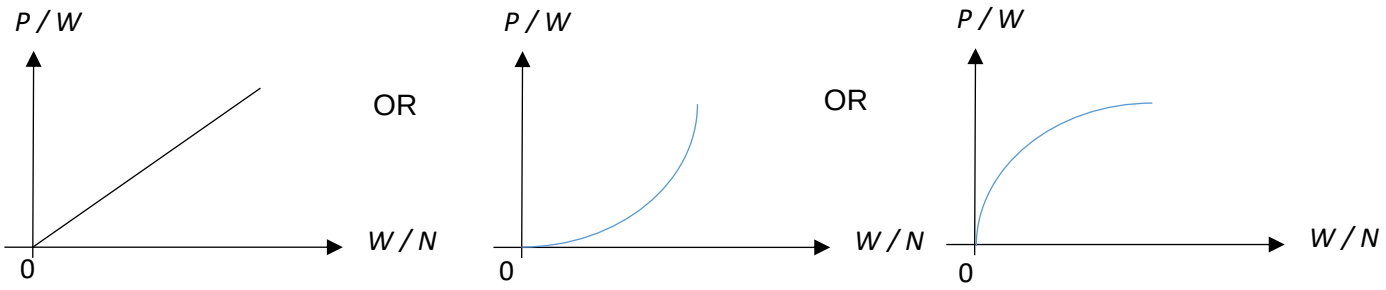
P_1 = 5 N x (10 mm) / 5.39 s = 9.3 Nmm / s
P_1 = 5 N x (1.0 cm) / 5.39 s = 0.93 Ncm / s

The value of W is a constant as it is not measured. So its s.f. does not affect P.
The increase in height Δh is measured using a ruler. Hence its s.f. is taken into account in the calculation of P.

(d) $P_2 = 2 \times (10 \times 10^{-3}) / 4.84 = 4.1 \times 10^{-3}$ W (2 s.f.)
(W = 2 and value less than P_1 with units) [1]

(e) At least two constant variables: Δh *and j &/or k,* [1] (or implied in the procedure).

1. Set up the apparatus as shown in Fig. 2.1.
2. Rotate the weight clockwise till Δh = 10 mm.
3. Release the weight and record t, the time taken for the string to fully unwind.
4. Repeat step 3 to get an <u>average value of t</u>. [1]
5. Repeat step 2 to 4 for 4 more set of readings by <u>changing the value of W</u> by removing 1 slotted mass each time (i.e. W = 4N, 3N, 2N ,1N). [1]
6. Calculate power using the formula $P = \frac{W\Delta h}{t}$
7. Tabulate values of W, t and P.
8. Plot a graph of P against W.



Sketch of straight line or curve with positive gradient passing through the origin. [1]
Should indicate the origin in the sketch.

Question 3
Note: There are 2 different kinds of slotted masses and 2 different kinds of springs used.

(a) l_o = 5.1 cm (1 d.p. in cm) (accept 5.0 to 5.4 cm)
(BOD - Accept 2 d.p. in cm if student use vernier calipers)

(b) L = 50.0 cm (1 d.p. in cm) [1] (accept 49.5 to 50.5 cm)

(c) d = 3.18 cm or 3.78 cm (2 d.p. in cm) [1] (accept 3.15 to 3.81 cm)

(d)(i) l = 8.4 cm (1 d.p. in cm) [1]
OR: l = 6.6 cm (1 d.p. in cm) [1] (different spring in Chem lab 2)
(no need to consider acceptable range of values as the rulers are not uniform)

(ii) e = 3.3 cm (correct calculation and unit) [1] (correct d.p. penalty under (f)(i))

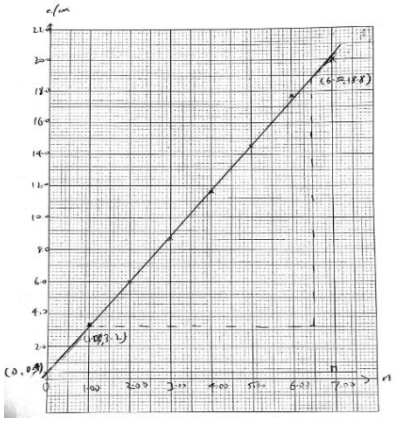
(e) l = 11.1 cm (1 d.p. in cm) [1]
(no need to consider acceptable range of values as the rulers are not uniform)

(ii) e = 6.0 cm (correct calculation and unit) [1] (correct d.p. penalty under (f)(i))

(f)(i)
1. Correct headings of n, l and e with correct units for l and e. [1]
2. At least 5 sets of readings with correct trend (l increases as n increases). (Must include n = 1 & n = 2. No need to look for acceptable range of values). [1]
3. Correct precision for l. [1]
4. Correct calculation of *e and correct d.p.* [1]

n	l / cm	e / cm
1	8.4	3.3
2	11.1	6.0
3	13.8	8.7
4	16.7	11.6
5	19.2	14.5
6	22.8	17.7
7	25.1	20.0

(ii)
1. axes labelled with units and correct orientation [1]
2. suitable scale, not based on 3, 6, 7 etc. with plotted data occupying at least half the page in both directions (allow graph to start at the origin) [1]
3. all points plotted correctly (points must be at most half a small square from the correct position) [1]
4. best fit line and fine crosses [1]
(no penalty if graph does not start from the origin)



(iii)
1. use of a triangle that uses more than half the drawn line [1]
2. correct calculation of gradient [1]
(G = 2.84 cm (not in mark scheme))

(g) $k = mg\,(dn + L) / 2GL$
= 0.100 x 10 x (3.82 x 3 + 50.0) / 2 x 2.84 x 50.0 (correct substitution of values) [1]
= 0.216 N / cm (if g is treated as a constant) or 0.22 N / cm (if consider g as 2 sf value)
(correct calculation [1] and correct units) [1] (no need to penalize sf)