**Mark scheme for 2022 Physics Prelim Practical Exam**

**Bid Ideas:**
Precision - minus max 1 m per question.
Units - minus max 1 m per question.
Accuracy of readings (outside acceptable range of values) - minus max 1 m per question.
Significant figures – penalty applicable only to Q3(c).
Allow ECF for calculations.

**Question 1**

No need to penalise wrong s.f. for Q1.

(a)(i) $V_0$ = 4.50 V (2 d.p. in V, accept 4.00 to 5.00 V) [1]

(ii) $V_1$ = 2.80 V (2 d.p. with correct unit, accept 1.80 to 3.80 A) [1]
$I_1$ = 0.14 A (2 d.p. with correct unit, accept 0.04 to 0.24 A) [1]

(iii) $P_1$ = 2.80 x 0.14 = 0.39 W (2 s.f.) (correct calculation and unit) [1]

(b)(i) $V_2$ = 0.25 V (2 d.p. with correct unit, accept 0.15 to 0.35 V)
$I_2$ = 0.30 A (2 d.p. with correct unit, accept 0.20 to 0.40 A) [1]

(ii) $R$ = 0.25 / 0.30 = 0.83 Ω (2 s.f.) (correct calculation and unit) [1]

(c) $Q$ = 0.14 x 0.83 / 2.80 = 0.042 (2 s.f.) (correct calculation) [1]
(no unit as $Q$ is a proportion/no penalty if unit is indicated)

(d) 1. Adjust the height of the rod using the boss until the motor just stops spinning.
2. Measure the new length of the spring.
3. Remove the string from the spring, hang the slotted masses to the spring.
4. Adjust the number of slotted masses until the same length of the spring is obtained.
5. $F$ is determined by noting the weight of the slotted masses.
(W = mg is not a marking point although such calculation is needed to calculate force)

[2 marks for all 5 points / 1 mark for 2 to 4 points / 0 mark for 1 point and below]

(e) Replace the spring by a newton meter / spring balance. [1]

**Question 2**

No need to penalise wrong s.f. for Q2.

(b) $x$ = 30.1 cm (Correct d.p.and unit, accept 29.0 to 31.0 cm) [1]

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

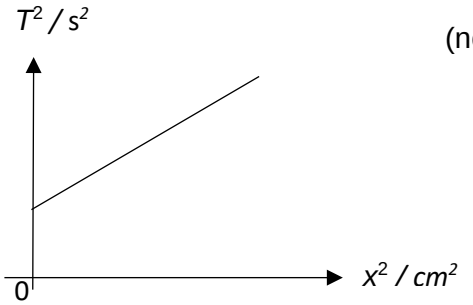
$t_1$ = 29.05 s & $t_2$ = 29.04 s for 20 oscillations.

average $T$ = 1.45 s (with unit) [1] (accept 4 sf (due to rule of calculation), 2 dp (due to precision of stopwatch) or 1 dp(due to human reaction))

(d) Energy is lost due to air resistance / friction at the optical pin. [1]

(e) Constant variables: any 2
mass of the metre rule
mass of the mass
same angle of oscillation
same number of oscillations
same pivot distance from top of ruler (2 cm). [1] (or implied in the procedure).

1. Set up the apparatus as shown in Fig. 2.4.
2. Set $x$ = 30.0 cm.
3. Measure and record $t_1$, use a stopwatch to measure the time taken for 10 oscillations of the metre rule. [1] (accept at least 5 oscillations)
4. Repeat step 3 to obtain another value of $t_2$. Calculate an average value of $T$. [1]
5. Repeat step 2 to 5 for (at least) 4 more sets of readings by varying $x$. [1]
6. Calculate $x^2$ and $T^2$.
7. Tabulate values of $x$, $x^2$, $t_1$, $t_2$, $T$, $T^2$.
8. Plot a graph of $T^2$ against $x^2$. [1]




(no penalty for wrong or no axis units for planning only)

Sketch of straight line with positive gradient and y-intercept ≠ 0. [1]

**Question 3**

**Remember big ideas.**

(a) $L_o$ = 0.022 m (3 d.p. in m) (accept 0.020 to 0.024 m) [1]

(b)(i) $L$ = 0.145 m (3 d.p. in m) (accept 0.130 to 0.160 m) [1]
$x$ = 0.123 m (correct calculation and unit) [1]

(ii) - View the scale of the ruler at right angles / [1]
- Ensure that the ruler is aligned vertically in the same plane as the spring / ensure the ruler is parallel to the spring [1]

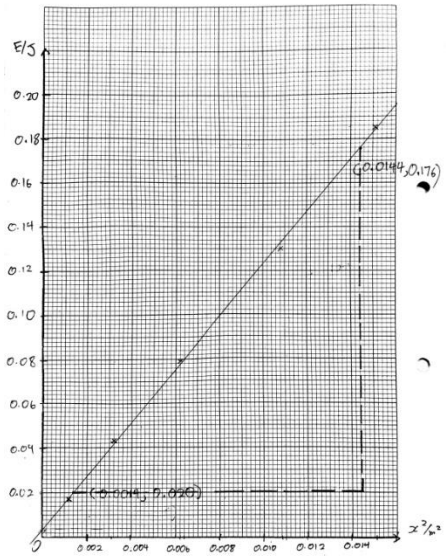
(iii) $k$ = 0.300 x 10 / 0.123
= 24.4 N/m ((correct calculation [1] and unit [1])

(iv) $E$ = 0.300 x 10 x 0.123 / 2 = 0.185 J (correct calculation and unit) [1]

(c)
1. Correct headings of $m$, $L$, $x$, $x^2$ and $E$ with correct units. [1]
2. At least 5 sets of readings with correct trend ($E$ increases as $x$ increases). [1]
3. Correct precision for $L$. [1]
4. Correct calculation of *E and correct s.f. for E & $x^2$.* [1]

| $m$ / g | $L$ / m | $x$ / m | $x^2$ / m$^2$ | $E$ / J |
|---|---|---|---|---|
| 50 | 0.035 | 0.013 | 0.00017 | 0.0033 |
| 100 | 0.056 | 0.034 | 0.0012 | 0.017 |
| 150 | 0.079 | 0.057 | 0.0032 | 0.043 |
| 200 | 0.101 | 0.079 | 0.0062 | 0.079 |
| 250 | 0.126 | 0.104 | 0.0108 | 0.130 |
| 300 | 0.145 | 0.123 | 0.0151 | 0.185 |

(d)
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)




(e)(i)
1. use of a triangle that uses more than half the drawn line [1]
2. correct calculation of gradient [1]
($G$ = 12.0 (not in mark scheme))

(ii) Yes. As G is approximately half of k.
OR
No. As G is NOT half of k. [1]

(f) When mass is doubled, x is also doubled.
Since E α $x^2$ or E = mgx / 2, energy increases four times.
$E$ = 4 x value of $E$ when $m$ = 300 g [1]
*For example E* = 4 x 0.185 = 0.74 J