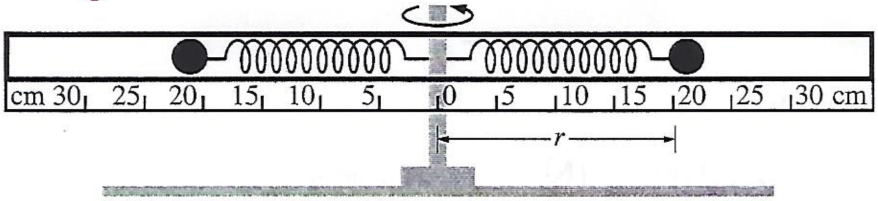
Name Key

AP Review #10



3. (15 points)

The apparatus shown above consists of two identical springs of negligible mass, each with spring constant K $k = 20.4\ \text{N/m}$ and each attached at one end to a vertical rotating pole. Identical small spheres of mass m are attached to the other ends of the springs. The spheres are constrained to horizontal motion by horizontal guides of negligible friction, each of which has a ruler below it for measuring the radial position r of the sphere. The system can be manually rotated about the pole's axis. In a lab experiment, a student adjusts the rotational speed so that the spheres move to a desired radius r. For each such value of r, the student measures the rotational period T. The student's partially completed data table is shown below. The length of each unstretched spring is $L = 0.15$ m.

l_o

Trial	Radial Position r (m)	Period T (s)	Acceleration a_c (m/s^2)	Spring Force F_{spring} (N)
1	0.300	0.440	61.2	3.06
2	0.270	0.475	47.2	2.45
3	0.240	0.530	33.7	1.84
4	0.210	0.570	25.5	1.22
5	0.180	0.795	11.2	0.61

5 (a) Calculate the missing values from the table above. Show your work in the space below.

① (1) a_c (1) v in terms of T

$$a_c = \frac{v^2}{r} = \frac{\left(\frac{2\pi r}{T}\right)^2}{r} = \frac{4\pi^2 r}{T^2} = \frac{4\pi^2(.240\text{m})}{(.530\text{s})^2} = 33.7\ \text{m/s}^2$$

(1) answer

② $F_s = kx$ (1) eqn

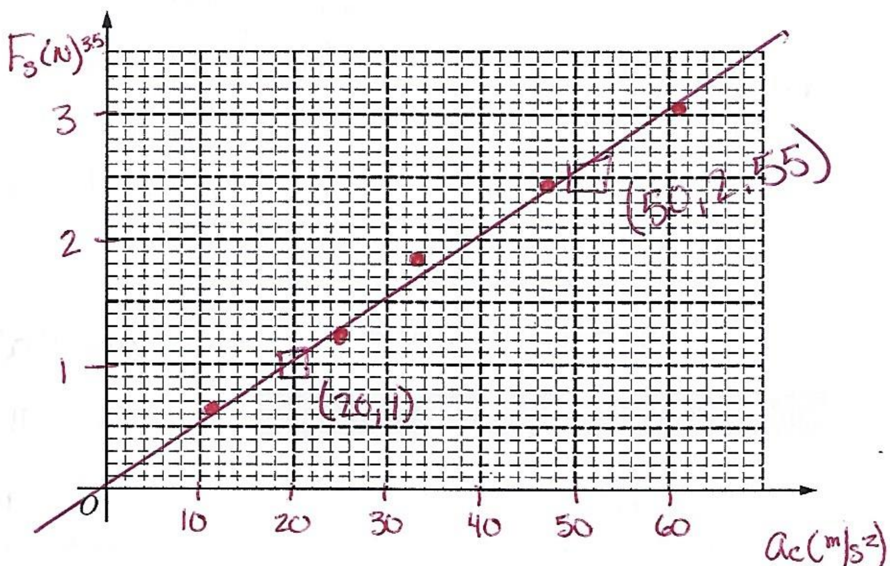
$= 20.4\ \frac{\text{N}}{\text{m}}(.240\text{m} - .15\text{m})$ (1) stretch sub

② ~~F_{net}~~ $= 1.84\ \text{N}$

~~$=(1.052\text{kg})(33.7\ \text{m/s}^2)$~~

~~$= 1.75\text{N}$~~

4 (b) On the axes below, plot the data points for the spring force F_{spring} as a function of the acceleration a_c. Label the axes, including the scale. Draw a straight line that best represents the data.



(1) label w/ variable + unit

(1) scale

(1) data

(1) best fit

GO ON TO THE NEXT PAGE.

(c)

2 i. Calculate the slope of your line.

$m = \frac{\Delta y}{\Delta x} = \frac{2.55\,N - 1N}{50\,m/s^2 - 20\,m/s^2} = .052\ kg$

(1) pts on line (1) answer w/units

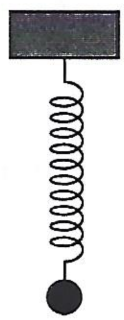
- still full credit if axes reversed

1 ii. Indicate what the slope calculated in part (c)-i represents.

$\frac{F}{a} = m$ mass (1)

- $1/m$ if axis reversed

(d) One sphere and one spring are removed from the rotation apparatus. They are hung vertically so that the sphere is now suspended from the spring, as shown below.



2 i. Describe a procedure you could use, and the measurements you would make, to verify the value obtained in part (c) using the setup shown above.

(1) procedure (1) measurement

Equilibrium

- Let the mass hang from the spring
- measure the new length of the spring w/a ruler.

Oscillation

- Gently pull the mass down and release
- use a stopwatch to measure and record the period.

1 ii. Show how you would use the measurements described in part (d)-i to verify the value obtained in part (c).

(1) correct indication

Equilibrium

$F = kx$

$mg = kx$

$m = \frac{k(l - l_0)}{g}$

Oscillation

$T_p = 2\pi\sqrt{\frac{m}{k}}$

$\frac{T^2}{4\pi^2} = \frac{m}{k}$ $m = \frac{T^2 k}{4\pi^2}$

Question 3 aligns to the new Physics 1 exam.

Questions 4 to 6 did not align with either new course and have been removed.

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