TOPIC 1: MEASUREMENT QUIZ **Time: 30 minutes** **Score: / 15**

Name: _____ **CG:** _____

1 A student carries out an experiment to determine the gravitational acceleration, using a pendulum, and obtains a value 9.81 m s^{-2}. The uncertainties in the measurements are shown.

Uncertainty in length L of pendulum = 0.7 %
Uncertainty in period T of pendulum = 0.1 %

The equation for the period *T* of pendulum is $T = 2\pi\sqrt{\frac{L}{g}}$

How should the answer for gravitational acceleration be stated?

$g \pm \Delta g$ = (…… ± ……..) m s^{-2} [2]

2 The power generated by a turbine of an ideal wind turbine is given by

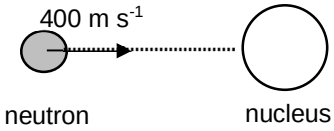
$$P = \frac{1}{2}k\rho(v-b)^3$$

where *k* is a constant of the turbine, ρ is density of the fluid, *v* is the velocity of the fluid.

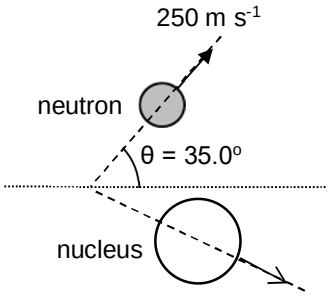
Determine the unit *k*. [Hint: Power = Force x velocity]

unit of *k* = …….. [2]

3 The figure shows the speed and direction of a neutron just before and after collision with a nucleus.



Before collision



After collision

What is the change in velocity of the neutron?

change in velocity = ……. m s^{-1} [2]

4 Provide a reasonable estimate of the land area of Sentosa Island.

area = …….. [3]

5 (a) Distinguish between a random error and a systematic error in the measurement of a physical quantity.

……

……

……

……[2]

(b) The spring constant *k* of a spring may be determined by finding the extension of the spring and the load applied, using the apparatus shown in Fig. 7.

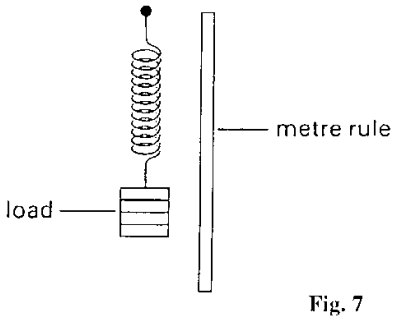


Fig. 7

(i) Give one example of a systematic error and one example of a random error which could occur in this experiment.

……

……

……

……[2]

(ii) Readings of the position of the lower end of the spring are made using the metre rule.

Suggest a method by which the error in these readings may be kept to a minimum.

……

……

……

……[2]

MEASUREMENT Quiz Solutions

1

$$T = 2\pi\sqrt{\frac{L}{g}}$$

$$g = (2\pi)^2 \frac{L}{T^2}$$

$$\frac{\Delta g}{g} = \frac{\Delta L}{L} + 2\frac{\Delta T}{T}$$

$$\frac{\Delta g}{9.81} = 0.007 + 2(0.001)$$

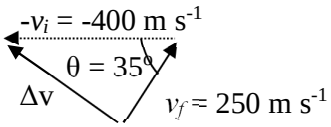
$$\Delta g = 0.09 \text{ (to 1 sf)}$$ [1]

g = (9.81 ± 0.09) m s^{-2} [1]

2 b has the same units as v.
Using P = Fv =mav,
[P] = kg m s^{-2} m s^{-1} = kg m^2 s^{-3} [1]

kg m^2 s^{-3} = [k][ρ][v^3]
kg m^2 s^{-3} = [k] kg m^{-3} m^3 s^{-3}
[k] = m^2 [1]

3 $\Delta v = v_f - v_i = v_f + (-v_i)$



[1] for vector diagram

$$(\Delta v)^2 = 250^2 + 400^2 - 2(250)(400)\cos 35^\circ$$

$\Delta v = 242$ m s^{-1} [1]

4

2 km

3.5 km

Sentosa is about 2 km north-south and 3.5 km east-west.
Area of such a rectangle is 6 km^2
By estimating that Sentosa is roughly 60% to 80% of the rectangle, [1] explanation

the area of the island of Sentosa is about 5 km^2. (Actual area is 4.71 km^2)
An acceptable answer could be between 2 km^2 and 10 km^2. [1]

5 (a) Random error is an error which causes measurements to be sometimes larger than the true value and sometimes smaller than the true value while [1]

systematic error is an error which causes measurements to be either, always larger than the true value, or always smaller than the true value. [1]

(b) (i) A possible systematic error is if the original (unloaded) length of the spring was misread. This would result in every extension reading (loaded length – unloaded length) to effectively be different from the true value by amount of the original length misread. [1]

A possible random error is the failure to read the readings at eye level each time (ie. parallax error). [1]

(ii) A horizontal pointer can be attached to the bottom of the mass and positioned such that it is beside the scale of the metre rule. [1]

Ensure that the pointer and scale are aligned horizontally at eye level when taking the reading. This will significantly reduce parallax error. [1]