FINAL
Alternative Assessment

(COVER PAGE)

Session	:	**August 2020**
Programme	:	Foundation in Science (CFSI)
Course	:	**PHY1205: Physics 1**
Date of Examination	:	16 December 2020 (Wednesday)
Time	:	9:00am – 1:00pm Reading Time : Nil
Duration	:	4 hours
Special Instructions	:	

This paper consists of **FOUR (4)** questions. Answer **ALL** questions.

All questions carry equal marks.

Materials permitted :

Non-Programmable Calculator

Materials provided :

Nil

Examiner(s)	:	Mr. Dinash Kandasamy
Chief Moderator	:	**Dr. Beh Boon Chun**

*This paper consists of **5** printed pages, including the cover page.*

FOUNDATION IN SCIENCE (CFSI)
PHY1205: PHYSICS 1
FINAL ALTERNATIVE ASSESSMENT: AUGUST 2020 SESSION

Instructions: This paper consists of **FOUR (4)** questions. Answer all questions. All questions carry equal marks.

Question 1

a) A 75 kg and 5'11" basketball player (defensive) wishes to block another player (offensive) who is 6'4" from scoring. The taller player leaps vertically upwards with an initial speed of 1.8 m/s, the shorter player leaps 0.1 second after the leap of the taller player. It is known that the shot will be made once the taller player reaches the maximum height. Assuming both players hands can reach 0.5 m above their own head. Determine the

i. maximum height reached by the taller player (from fingers to the ground),
[3 marks]

ii. time taken by the tall player to reach the max height,
[2 marks]

iii. minimum initial velocity of the short player to be able to block the taller player and
[3 marks]

iv. force exerted by the shorter player exerts onto the ground prior to takeoff.
[4 marks]

b) A quarter pound ball attached to the end of a 1.5 yard rope is spun vertically by 6'2" boy standing on the rooftop of a 100 m building. The boy spins the ball at his shoulder level which is 8" lower than the top of his head. The ball is spun from rest (hanging vertically down) with an angular acceleration of 4π rad/s^2. The rope breaks at the lowest point in the fifth revolution. Determine the

i. linear speed of the ball in m/s at the point when the rope breaks,
[3 marks]

ii. maximum tension the rope can withstand before breaking,
[3 marks]

iii. time taken by the ball to fall on the ground and
[3 marks]

iv. velocity of the ball when it hits the ground.
[4 marks]

Question 2

a) In a game of tennis, the ball is served at a speed of 140 mph. The receiver swings the racquet with angular speed 30 rad/s. The receiver receives the ball at a distance of 1.20 m from himself and returns it to the server at a speed of 90.0 mph. The ball is in contact with the racquet for only 0.200 second. Assume the ball has no spin and air resistance is negligible. The mass of the tennis ball is 2.00 oz, the mass of the tennis racquet is 200 grams and the mass of both player's arms is 6.50 kg. Determine the

i. angular speed of the racquet after the ball leaves the racquet,

[5 marks]

ii. type of collision using appropriate calculations and

[3 marks]

iii. torque experienced by the receiver due to the ball.

[4 marks]

b) A group of cosmonauts landed on a small planet. Based on images taken prior to landing they estimated the surface diameter of the planet to be about 4000 km. They landed on a plateau which has some unknown height. Since the instruments on their spacecraft were damaged they constructed a mercury barometer and a simple pendulum using a 1.1 yd long string. The height of the mercury in the barometer was 890 mm and the period of the simple pendulum was 1.2 seconds. It is known that the density of the air at the surface (ground level) of the planet is 1.4 $\mathrm{kg/m^3}$ and decreases linearly with altitude and goes to zero at 30000 ft. Determine the

i. gravitational field strength on the plateau,

[4 marks]

ii. height of the plateau and

[6 marks]

iii. mass of the planet.

[3 marks]

Question 3

a) A bird leaves its nest to look for worms. It flies 100 m [N 30° E] and continues to fly in a clockwise circle of diameter 15 m for two and a half times. It spots no worms and continues to fly 300 m [N 40° W] and then flies anti clockwise for half a circle of radius 25 m and notices a worm in the middle of its circular path and heads towards it to catch it.

i. Sketch the path travelled by the bird.

[4 marks]

ii. Determine the total distance travelled by the bird.

[2 marks]

iii. Determine the displacement of the bird from its nest.

[4 marks]

iv. If it took the bird 4 minutes to notice and capture the worm, determine the average velocity and average speed in m/s.

[4 marks]

b) A 20 kg mass falls 40 cm from a raised platform onto a platform supported by two identical springs in parallel. The 20 kg mass compresses the platform by 5 cm, then the platform and the 20 kg mass execute a simple harmonic motion. The mass experiences an average drag force of 5 N during the fall. Determine the

i. speed of the mass when it hits the platform,

[2 marks]

ii. spring constant of the spring,

[4 marks]

iii. amplitude of the oscillation and

[3 marks]

iv. period of the oscillation.

[2 marks]

Question 4

a) A wave is described by

$$y = (10\ \text{cm})\cos(20\pi t - 30\pi x)$$

i. Determine the amplitude, period and wavelength of the wave.

[3 marks]

ii. Determine the speed and direction of the wave.

[2 marks]

iii. Sketch two complete cycles of the waveform at t = 2 s.

[3 marks]

iv. Sketch the displacement time graph and velocity time graph of particle at x = 2.5 m for one cycle.

[5 marks]

b) A 10 cm long bimetallic strip is made of a 0.5 mm strip of copper and another 0.5 mm strip of steel at room temperature. The bimetallic strip is then placed between two metallic contacts as shown in **Figure Q4**. One lamp glows blue indicating temperature is below a set point, while the other lamp glows red indicating temperature is above another set point. The thermal expansion coefficient for copper and steel is $17 \times 10^{-6}\ ^{\circ}\text{C}^{-1}$ and $13 \times 10^{-6}\ ^{\circ}\text{C}^{-1}$.

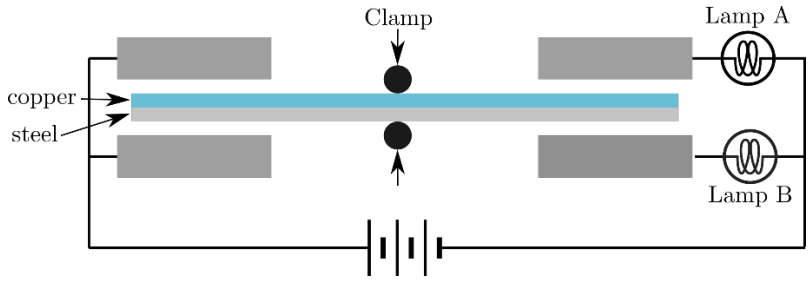

Figure Q4

i. Identify the lamps (which is blue and which is red) and explain your answer with appropriate sketches.

[6 marks]

ii. Calculate the bending angle and radius of curvature of the bimetallic strip when temperature T = 200°C.

[6 marks]

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