

**FINAL**  
Alternative Assessment

(COVER PAGE)

Session : August 2021

Programme : Foundation in Science (CFSI)

Course : PHY1205: Physics 1

Date of Examination : 9 December 2021 (Thursday)

Time : 9:00am – 11:30am Reading Time : Nil

Duration : 2 hours + 30 minutes (uploading time)

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. Adele Kam

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

FOUNDATION IN SCIENCE (CFSI)  
PHY1205: PHYSICS 1  
FINAL ALTERNATIVE ASSESSMENT: AUGUST 2021 SESSION

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

**Question 1**

a) Complete the table and show your calculations

| Quantity                 | inHg | PSI | kPa |
|--------------------------|------|-----|-----|
| Atmospheric pressure     | 30   |     | 101 |
| Boeing 747 tire pressure |      | 200 |     |

Given: density of mercury,  $\rho_{\text{Hg}}=13600 \text{ kg/m}^3$ ,  $1 \text{ N} = 0.22 \text{ lbf}$ , and  $1 \text{ m} = 39.4 \text{ in}$ .

[7 marks]

b) A water bottle rocket starts from rest and accelerates at  $a=4 \text{ m/s}^2$  upwards for in the first 10s. Determine the maximum height reached by the rocket. [7 marks]

c) At  $t = 0 \text{ s}$  a car  $0.5 \text{ kg}$  is at position,  $\vec{d} = (10\vec{i} + 15\vec{j} - 6\vec{k}) \text{ m}$  and is travelling with velocity,  $\vec{u} = (2\vec{i} - 4\vec{j} + 3\vec{k}) \text{ m/s}^2$ . The car is being acted by a force,  $\vec{F} = (5\vec{i} - 3\vec{j} - 2\vec{k}) \text{ N}$  for  $7 \text{ s}$ . Determine the

- i. magnitude of acceleration of the car, [4 marks]
- ii. velocity of the car at  $t = 7 \text{ s}$  in  $\vec{i}, \vec{j}$  and  $\vec{k}$  form, [3 marks]
- iii. position of the car in  $\vec{i}, \vec{j}$  and  $\vec{k}$  form. [4 marks]

**Question 2**

a) A projectile is launched from an elevated platform  $120 \text{ m}$  above ground level at a speed of  $25 \text{ m/s}$  and at an angle,  $\theta = 40^\circ$  below the horizontal. The projectile lands on another elevated platform  $30 \text{ m}$  above the ground level. Determine the

- i. time taken for the projectile to land, [4 marks]
- ii. horizontal distance travelled by the projectile. [3 marks]

- b) A short train with one engine pulls two identical cars as shown Fig. 2(b). The link between the last two cars experiences a force of 40 N. The mass of the car and the engine are 10 kg and 25 kg. Determine the pulling force of the engine. [4 marks]

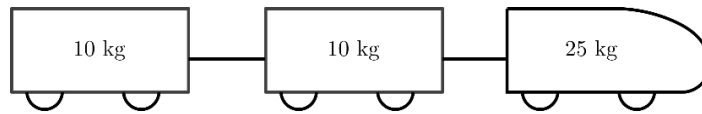


Fig. 2(b)

- c) A stuntman rides his bike in a vertical loop with diameter,  $D = 20$  m as shown in Fig. 2(c). He maintains the minimum speed for him to clear the loop safely. The coefficient of friction between the tire and loop surface,  $\mu_s = 0.3$ . The combined mass of the stuntman and his bike is 300 kg. Determine

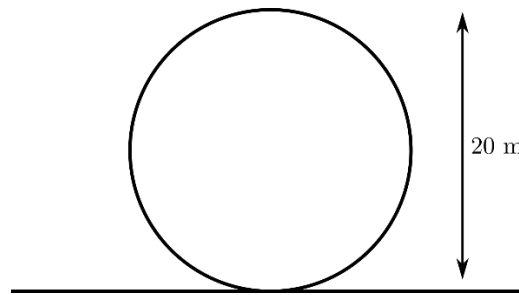


Fig. 2(c)

- i. the minimum speed for him to clear the loop [3 marks]
  - ii. frictional force at the bottom of the loop [3 marks]
  - iii. frictional force at the top of the loop [1 mark]
- d) A spring is used to propel a 30 g steel ball along a circular path with radius,  $R = 1$  m. The mechanism is shown in Fig. 2(d). The spring has spring constant 60 N/m. Determine
- i. the minimum speed of the ball at the lowest point such that it leaves the mechanism, [3 marks]
  - ii. the amount of compression in the spring if the steel ball leaves the top at 0.5 m/s. [4 marks]

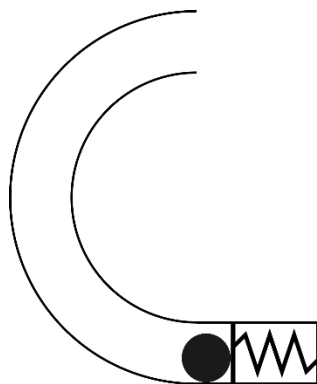
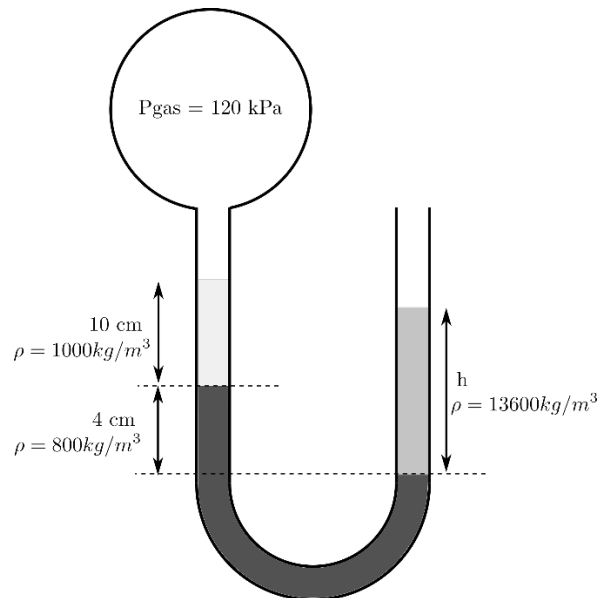


Fig. 2(d)

**Question 3**

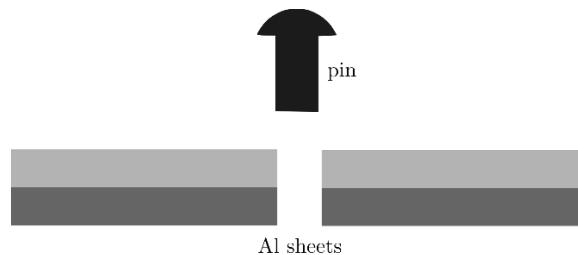
- a) A 6 kg object is slowed from 10 m/s to 8 m/s after colliding with a 3 kg stationary object. Determine
- the speed of the 3 kg object right after collision [3 marks]
  - the difference in kinetic energy of the system before and after the collision [3 marks]
  - whether the collision is elastic or inelastic. [1 mark]
- b) A 30 kg little girl wants to loosen a lug nut from the wheel of a punctured tire. Her 70 kg father uses a regular 30 cm tire iron and loosens the nut by standing at the end of the tire iron. Assume the tire iron is horizontal when they stand on it. Determine
- the torque required to loosen the lug nut, [3 marks]
  - the torque developed if the girl stands on the same tire iron [1 mark]
  - the amount the tire iron must be lengthened for the girl to loosen the lug nut just by standing on the tire iron [3 marks]
- c) Derive and calculate the minimum speed a baseball can be thrown upwards from the surface of Mars to escape its gravitational pull. Given mass of Mars is  $6.39 \times 10^{23}$  kg and average diameter of Mars is 6800 km. [7 marks]
- d) Given the setup at sea level shown in Fig 3(d), determine the height,  $h$  of the column [4 marks]

**Fig 3(d)**

**Question 4**

- a) The average density of a human is 98% the density of water. Determine the % volume of human that is submerged in salt water which is 102% the density of water. [4 marks]
- b) A simple pendulum with mass 2 kg is released from a height 3 cm above equilibrium position on Earth. The pendulum makes 20 oscillations in 40 s. Under the same conditions on Planet X the pendulum makes 32 complete oscillations in 20 s on planet X. Determine
- the gravitational field strength of Planet X [3 marks]
  - the ratio of maximum speed of pendulum on Planet X to Earth [4 marks]
- c) A 2 m long string with mass 20 g is stretched taut with a 400 N force. The string is then plucked. Determine the
- linear density of the string, [1 marks]
  - wave speed in the string, [2 marks]
  - wavelength of the fundamental frequency, [2 marks]
  - frequency of the fundamental frequency. [2 marks]
- d) An engineer forces a 10.03 mm titanium pin into a 10 mm hole to fasten two pieces of aluminium sheets together at  $25^{\circ}\text{C}$  as in Fig 4(d). Given the thermal expansion coefficient of titanium is  $8 \times 10^{-6} \text{ }^{\circ}\text{C}^{-1}$  and the thermal expansion coefficient aluminium is  $20 \times 10^{-6} \text{ }^{\circ}\text{C}^{-1}$ . Determine the highest operating temperature for this fastening method.

[7 marks]

**Fig 4(d)****--THE END--**