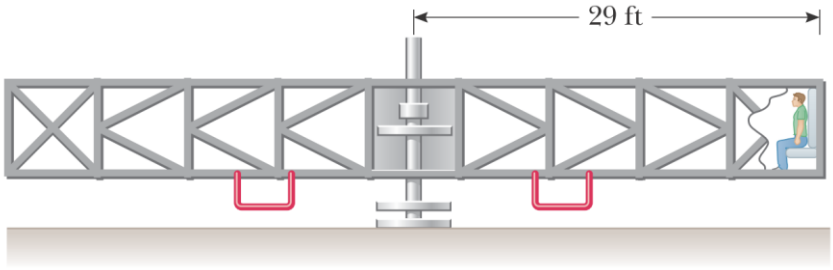
HCMC UNIVERSITY OF TECHNOLOGY AND EDUCATION
Faculty of International Education
Group of Fundamental Sciences

FINAL EXAMINATION
SEMESTER 2 – ACADEMIC YEAR 2022-2023
Course name: **Physics 1**
Course ID: PHYS130902E
Exam code: 01 Number of pages: 02
Duration: 90 minutes.

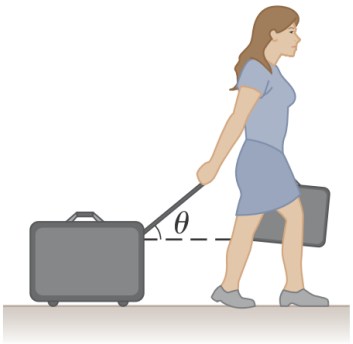
Note:
+ Proctors are not allowed to give any unauthorized explanation.
+ Students are allowed to use one A4 paper sheet as a memory aid.

Question 1: (1.0 marks/10)
If global warming continues over the next one hundred years, it is likely that some polar ice will melt and the water will be distributed closer to the equator. (a) How would that change the moment of inertia of the Earth? (b) Would the duration of the day (one revolution) increase or decrease, and why?

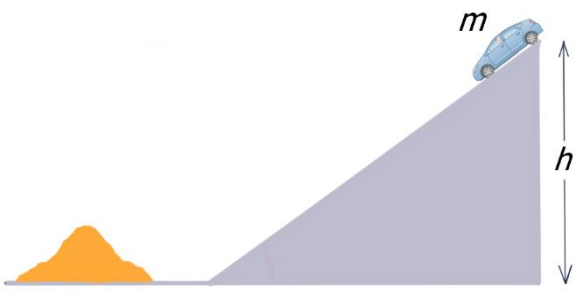
Question 2: (2.0 marks/10)
The 20-g centrifuge at NASA's Ames Research Center in Mountain View, California, is a horizontal, cylindrical tube 58.0 ft long and is represented in the figure below. Assume an astronaut in training sits in a seat at one end, facing the axis of rotation 29.0 ft away. Determine the rotation rate, in revolutions per second, required to give the astronaut a centripetal acceleration of 20.0g. *Note: 1 foot (ft) = 30.5 cm; g = 9.81 m/s^2.*



Question 3: (2.0 marks/10)
A woman at an airport is towing her 20.0-kg suitcase at constant speed by pulling on a strap at an angle θ above the horizontal (see figure). She pulls on the strap with a 35.0-N force, and the friction force on the suitcase is 20.0 N.
(a) Draw a freebody diagram of the suitcase.
(b) Find the angle θ.
(c) Find the magnitude of the normal force that the ground exerts on the suitcase.



Question 4: (2.0 marks/10)
A driver parked her car on top of a hill with no brakes. When she left, the car moved down the hill from rest. Fortunately, nobody was on the road, and right at the end of the slope, the car hit a pile of sand and came to a full stop. The height of the hill is h = 17.4 m and the mass of the car is m = 987 kg. Friction force between the car and the road is negligible.



(a) Model the car as a particle, find its speed at the end of the hill using the energy approach.
(b) Time duration of the collision is 4.00 s, determine the magnitude of the average force that the sand exerted on the car during the collision.

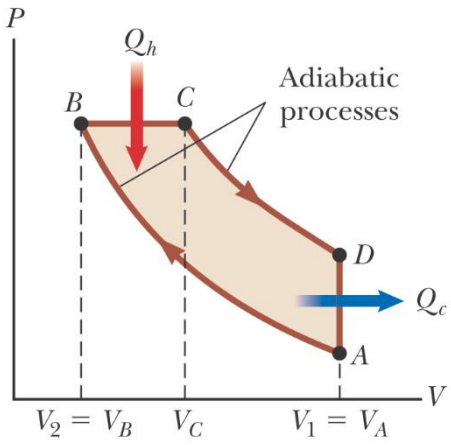
Question 5: (3.0 marks/10)

An idealized diesel engine operates in a cycle known as the air-standard diesel cycle shown in the figure. Fuel is sprayed into the cylinder at the point of maximum compression, B. Combustion occurs during the expansion B → C, which is modeled as an isobaric process. The exhaust process D → A is modeled to be isovolumetric. Given the temperatures T_A = 333 K, T_B = 984 K, T_C = 1968 K, and T_D = 879 K, determine:

(a) thermal efficiency of the diesel engine,

(b) thermal efficiency of a Carnot engine operating between the highest and lowest temperatures in this cycle,

(c) the compression ratio $r_C = V_1/V_2$.



Note: assume the working substance of this engine is air, with the average degrees of freedom i = 5, and heat capacity ratio $\gamma = \frac{C_P}{C_V}$*=1.4. The universal gas constant is R = 8.31 J/(mol.K).*

Learning outcome mapping	**Assessed in**
[ELO 1.1]: Understanding various concepts, theorems, and laws related to classical mechanics and fluid mechanics. [ELO 2.1]: Applying the knowledge and skills required to solve the problems in mechanics.	Questions 1, 2, 3, 4
[ELO 1.3]: Understanding the concepts, the process of change and the principles of thermodynamics.	Question 5
[ELO 2.3]: Applying the principles of thermodynamics to explain the phenomena related to the temperature as well as solving the related problems.	Question 5

30th May, 2023

Approved by program chair

(signed and named)