



The University of Zambia
Physics Department
Term Test-II October 2018/19
PHY 1010: Introductory Physics

All questions carry equal marks. The marks are shown in brackets. **Question 1 is compulsory.** Attempt **three more** questions. Clearly indicate on the answer script cover page which questions you have attempted.

Time: Two hours.

Maximum marks = 100.

Write clearly your name, computer number, and tutorial group number on the answer book.

Wherever necessary use:

$g = 9.8 \text{ m/s}^2$: $\rho_{\text{water}} = 1000 \text{ kg/m}^3$: 1 ton = 1000 kg : Atm. Press. $1.013 \times 10^5 \text{ Pa}$
1 Cal (food calorie) = 1 cal

Some equations you may find useful:

$$\rho = \frac{m}{V} \quad : \quad \text{stress} = \frac{F}{A} \quad : \quad \text{strain} = \frac{\Delta L}{L_0} \quad : \quad \text{shear-strain} = \frac{\Delta L}{L_0} = \phi \quad : \quad Y = \frac{F/A}{\Delta L/L_0}$$

$$S = \frac{F/A}{\Delta L/L_0} = \frac{F/A}{\phi} \quad : \quad P = \frac{F_{\perp}}{A} \quad : \quad P_G = P_{\text{tot}} - P_a \quad : \quad P_G = \rho gh \quad : \quad F_B = \rho Vg, \text{ for submerged object}$$

$$F_B = Mg, \text{ floating } M \quad ; \quad B = \frac{\Delta P}{\Delta V/V_0} \quad : \quad v_T = \omega r \quad : \quad \omega_f = \omega_0 + \alpha t \quad : \quad \omega_f^2 = \omega_0^2 + 2\alpha\theta \quad : \quad \theta = \omega_0 t + \frac{1}{2}\alpha t^2$$

$$a_T = \alpha r \quad : \quad L = I\omega \quad : \quad \tau = I\alpha = Fr \quad : \quad v_T = (2\pi r)/T \quad : \quad \tan \theta = v^2 / rg \quad : \quad I = \sum mr^2 \quad ;$$

$$F_C = (mv^2 / r) \quad : \quad I = mk^2 \quad KE_{\text{total}} = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2 \quad : \quad 1 \text{ rev} = 360^\circ = 2\pi \text{ rad} \quad : \quad F = G \frac{m_1 m_2}{r^2} \quad ;$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3 \quad : \quad P_1 V_1 = P_2 V_2 \quad \quad G = 6.67 \times 10^{-11}$$

For Question 1, you **must use the blank answer sheet** provided.

For other questions, clearly indicate the answered questions:

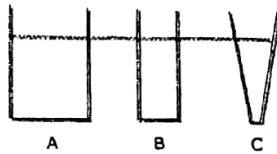
Example:

Question 2(b)

DO NOT write the question number in the top left corner of the page, and then staple over it!! We need to see the question answered during the marking.

Question 1: Sample answers: F (a), G (d).... etc. For each correct answer, 2.5 marks. For each wrong answer, (0.83) will be deducted. No answer, zero mark. No deduction of marks for not attempting. Minimum total mark for Question 1 is zero. **So don't be afraid to attempt!!** [10 × 2.5 = 25]

- (A) The drawing shows three vessels filled to the same height with the same liquid. In which container, if any, is the pressure at the bottom greatest?



- a) Container A, because it has the greatest surface area
 b) Container C, because it has the greatest surface area
 c) All three containers have the same pressure at the bottom
 d) Container C, because its bottom has the least surface area
- (B) When a mass is rotating in a plane about a fixed point its angular momentum is directed along:
- a) radius
 b) the tangent to the orbit
 c) the line at 45° to the plane of rotation
 d) the axis of rotation
- (C) If the radius of the earth was reduced by 1.5 %, its mass remaining the same, the acceleration due to gravity on the earth would:
- a) decrease
 b) remain unchanged
 c) increase
 d) decrease by 1.5 %
- (D) A piece of ice is floating in a liquid of relative density 1.2 contained in a beaker. When the ice melts completely what happens to the liquid level?
- a) Level rises
 b) Level falls
 c) Level remains the same
 d) None of the above
- (E) Temperature is a property which determines:
- a) How much heat a body contains
 b) In which direction heat will flow between two systems
 c) Whether a body will feel hot or cold to touch
 d) How much heat must be removed to bring a body to absolute zero

$$F = G \frac{Mm}{r^2}$$

$$F = m \frac{v^2}{r}$$

$$\frac{G M_s m_c}{R_e} = m \frac{v^2}{r}$$

(F) A flask containing air at 27 °C at atmospheric pressure is corked up. A pressure of 2.5 atm inside the flask would force the cork out, the temperature at which this will occur is:

- a) 670 K
- b) 577 K
- c) 750 K
- d) 675 K

(G) When a certain weight is suspended from a long uniform wire its length increases by 1 cm. If the same weight is suspended from another wire of the same material and length, but having a diameter half the first one, the increase in length is:

- a) 0.15 cm
- b) 4 cm
- c) 8 cm
- d) 2 cm

$$\gamma \left(\frac{\Delta l}{l_0} \right) = \frac{F}{A}$$
$$\Delta l = \frac{l_0 F}{A \gamma}$$

(H) A force passing through the centre of gravity of an object:

- a) results only in rotational motion
- b) holds the object in equilibrium
- c) results in both translational and rotational motion
- d) results only in translational motion

(I) The total amount of work that must be done to compress a spring against the restoring force represents the:

- a) kinetic energy of the spring
- b) potential energy of the spring
- c) force constant
- d) force potential

(J) Shearing forces may be produced on:

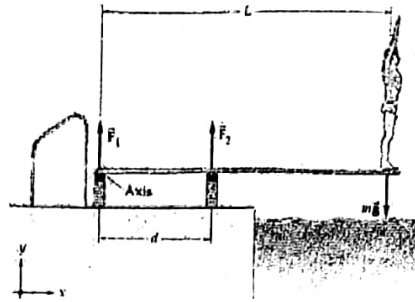
- a) Liquids
- b) Solids
- c) Solids and liquids
- d) Solids, liquids, and gases

Attempt any three questions from the following:

Q 2 (a) A disk rotating at 30 rad/s slows to 20 rad/s while turning through 60 revolutions.

- i) How long does it take to make the 60 revolutions [4]
- ii) For the deceleration of this disk, how many revolutions does it take for the disk to stop? [6]

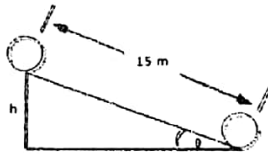
- (b) A 5.00 m long diving board of negligible mass is supported by two pillars. One pillar is at the end of the diving board; the other is 1.50 m away. Find the forces exerted by the pillars when a 90.0 kg diver stands at the far end of the board. [10]



- (c) A piece of wood with density of 706 kg/m^3 is tied with a string to a bottom of a water filled container. The wood is completely immersed, and has a volume of $8 \times 10^{-6} \text{ m}^3$. What is the tension in the string? [5]

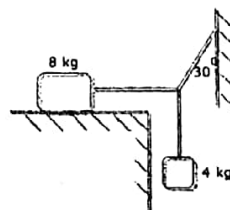


- Q 3 (a) A hollow ball of mass m and radius r starts rolling from rest down an inclined plane 15m long and reaches the bottom 10 seconds later. What angle does the plane make with the horizontal? (I hollow sphere = $\frac{2}{3}mr^2$) [10]



- (b) In the arrangement shown below, massless strings are holding the system in equilibrium. What is the minimum coefficient of friction that prevents the 8.0 kg mass from sliding? [10]

$$F = \frac{G m_1 m_2}{R^2} = m_1 a$$



$$F = m a$$

- (c) The radius of the planet Mars is $3.4 \times 10^6 \text{ m}$ and on its surface the acceleration due to gravity is 3.7 m/s^2 . Calculate the mass of Mars. [5]

- Q 4 (a) A 300 g disk and radius R is dropped on a second rotating disk with the same radius and mass of 1.5 kg. The second disk is rotating freely with an angular speed of 10 rad/s and no torque against it. Find the angular speed of the coupled disk system. (I disk = $\frac{1}{2}mr^2$) [7]

- (b) An air bubble of volume 0.5 cm^3 rises from the bottom of a lake 35 m deep where the water temperature is 15°C . To what volume will it grow when it reaches just below the surface which is at a temperature of 29°C . [10]

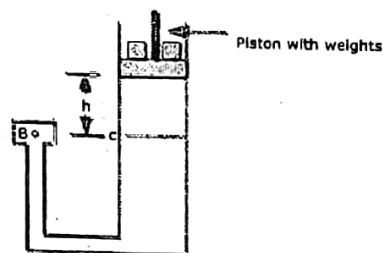
- (c) A 7 m uniform ladder weighing 150 N is placed against a frictionless wall at angle of 75° . The foot of the ladder is 1.8 m from the wall. Find the:
- reaction forces at the ground and the wall? and
 - minimum coefficient of the ground.

[8]

Q 5 (a) A weighted piston confines a fluid of density ρ in a closed container as shown below. The combined weight of the piston and weight is 200 N, and the cross sectional area of the piston is 8.0 cm^2 .

- Find the total pressure at point B if the fluid is mercury ($\rho_{\text{Hg}} = 13.6 \times 10^3 \text{ kg/m}^3$).
- What would an ordinary pressure gauge read at point B?

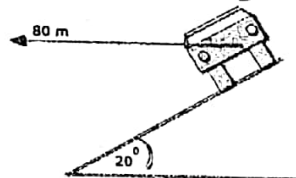
[10]



(b) A car moves round a curve with a radius of 80 m on a banked road of inclination 20° .

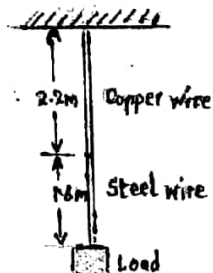
- What is the safe speed designed for this banked road?
- If the speed of the car is 70 km/h, is there any friction acting on the car by the road? If yes, draw the friction acting on the car.

[7]



(c) A composite wire of uniform diameter 3 mm consisting of a copper wire of length 2.2 m and a steel wire of length 1.6 m stretches by 0.7 mm. Calculate the load, given that the Young's modulus of copper is $1.1 \times 10^{11} \text{ N/m}^2$ and for steel is $2.0 \times 10^{11} \text{ N/m}^2$.

[8]



END OF TEST 2