The University of Zambia
Department of Physics
Term Test-I July 2019
PHY1010: Introductory Physics

All questions carry equal marks. The marks are shown in square 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 cover page.

==========

Wherever necessary use:

$g = 9.8 m/s^2$: $P_A = 1.013 \times 10^5$ N/m^2 : 1 Pascal =1 N/m^2 : ρ_{water} = 1000kg/m^3
1 hp = 746 W : 1 ton = 1000 kg

Some equations you may find useful:

$$v_f = v_i + at \; : \; v_f^2 = v_i^2 + 2as \; : \; s = v_i t + \tfrac{1}{2} a t^2 \; : \; s = \bar{v}t \; : \bar{v} = \frac{v_i + v_f}{2} \; : \; a = \frac{v_f - v_i}{t}$$

$$y = x\tan\theta - \frac{g}{2v_o \cos^2\theta} x^2 \; : \; R = \frac{2v_i^2 \sin\theta\cos\theta}{g} = \frac{2v_i^2 \sin 2\theta}{g} \; : \; t = \frac{2v_i \sin\theta}{g}$$

$$f = \mu F_N \; : \; W = F.s.\cos\theta \; : \; P(power) = \frac{Work}{time} = F.v \; : \; KE = \tfrac{1}{2}mv^2 \; : \; PE = mgh \; :$$

$$F = ma \; : \; \bar{F}\Delta t = mv_f - mv_i \; : \; P(momentum) = mv$$

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

For other questions, clearly indicate the number of the question answered, noting that each question has more than one part:

Example:

Question 2(b)

DO NOT write the question number in the top left corner of the page, and then staple over it!! Preferably indicate it at the center of the page.

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 distance travelled by a freely falling body starting from rest is directly proportional to:

(a) The mass of the body
(b) The time to fall
(c) The square of the time to fall
(d) The square of the acceleration due to gravity

(B) An aeroplane starting from rest takes 25 s and 500 m of runway at constant acceleration to leave the ground. Its velocity when it leaves the ground is

(a) 80 m/s
(b) 40 m/s
(c) 20 m/s
(d) 32 m/s

(C) A ball is thrown at 40^0 angle below the horizontal at 8.0 m/s. What will be the horizontal component of its velocity at any time?

(a) 6.7 m/s
(b) 5.1 m/s
(c) 10.4 m/s
(d) 6.1 m/s

(D) In Newton's third law of motion the action and reaction forces

(a) act on the same object
(b) act on different objects
(c) have the same magnitude but do not necessarily have the same line of action
(d) do not necessarily have the same magnitude and do not necessarily have the same line of action

(E) If a bomb is dropped from a fighter plane explodes in midair:

(a) Its total kinetic energy increases
(b) Its total momentum decreases
(c) Its total momentum increases
(d) Its total kinetic energy decreases

(F) A body of mass m moving with constant velocity v collides with another body of the same mass with the same velocity in the opposite direction and they stick together. The velocity of the compound body is:

(a) 3 v
(b) 2 v
(c) zero
(d) -1 v

(G) A truck and a car are moving on a straight road with the same kinetic energy. They are brought to rest by application of brakes providing equal force.

(a) The car moves a greater distance
(b) The truck covers a greater distance before it stops
(c) Both will cover equal distance before stopping
(d) Nothing can be decided from this information

(H) The frictional forces between two surfaces in contact <u>does not</u> depend on:

(a) Whether a lubricant is used or not
(b) The normal force pressing one against the other
(c) Whether the surfaces are stationary or in relative motion
(d) The areas of the surfaces

(I) Which of the following units could be associated with a vector quantity?

(a) km/s^2
(b) kg/s
(c) hours
(d) m^3

(J) A crate remains stationary after it has been placed on a slope inclined at an angle with the horizontal. Which of the following statements must be true about the magnitude of the frictional force that acts on the crate.

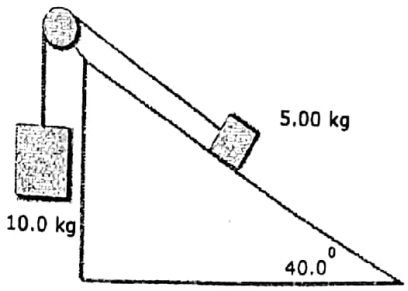
(a) It is less than the component of the weight acting down the slope
(b) It is equal to the weight of the crate
(c) It is larger than the weight of the crate
(d) It is greater than the component of the weight acting down the slope

Attempt any three questions from the following:

Q 2 (a) The following ~~horizontal~~ forces act on an object: **A**, 6 N along the y-axis; **B**, 10 N along the negative y-axis; and **C**, 8 N at an angle of 45^0 clockwise from the positive x-axis. Find the magnitude of **A+B-C**. **[9]**

(b) Two packing crates of mass 10.0 kg and 5.00 kg are connected by a light string that passes over a frictionless pulley as shown. The 5.00 kg crate lies on a smooth (frictionless) incline of angle 40.0^0.

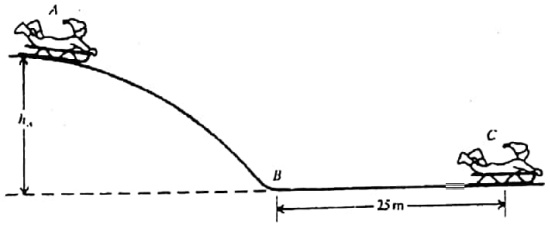
i) Find the acceleration of the 5.00 kg crate.
ii) The tension in the string. **[10]**



(c) A girl standing on top of the roof of a 22 m high building throws a coin upward with a speed of 8.8 m/s. The coin just misses the edge of the roof and drops to the ground.

i) How long does it take for the coin to hit the ground?
ii) What is the velocity of the coin just as it hits the ground? **[6]**

3 (a) A child and a sled, weighing 290 N, slide down an ice-covered (frictionless) hill that is 10 m high. At the bottom of the hill there is an ice-free, rough horizontal surface that brings the sled to a stop within a distance of 25 m. What is the coefficient of fiction between the sled runners and the horizontal surface? **[11]**



(b) A 20 g bullet moving at 400 m/s passes through a sheet of foam plastic 20 cm thick and emerges with a speed of 100 m/s. What is the average force that impeded its motion through the foam plastic? Assume uniform slowing down. **[9]**

(c) A ball is thrown straight upward with an initial velocity of 20 m/s.

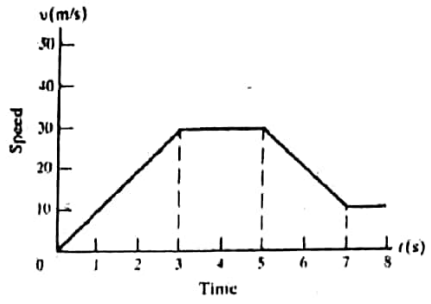
i) How high will it go?
ii) How long will it take to return? **[5]**

Q 4 (a) A 1 kg ball *A* has a velocity of 4 m/s along the positive *x*-axis, it strikes a second ball *B* with a mass of 3 kg and initially at rest. The collision is a glancing one, that ball *A* is deflected through an angle of 50^0 above its original direction and its speed is now 2m/s.

i) What is the speed of ball *B* after the collision?
ii) What is the direction of motion of ball *B* after the collision? **[10]**

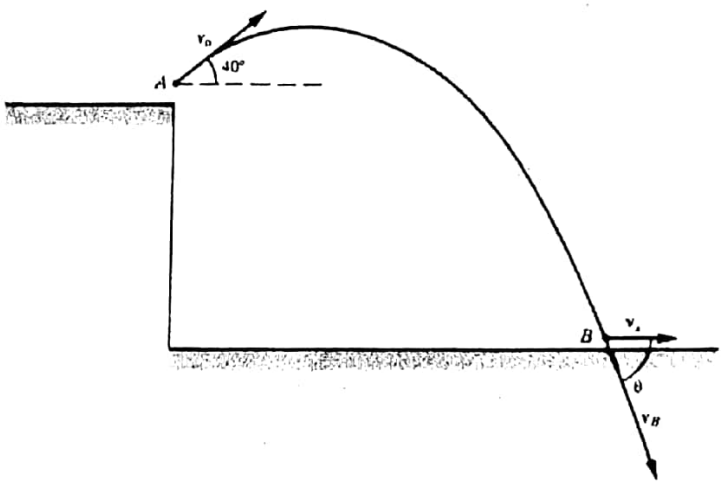
(b) If a vector **B** is added to vector **A**, the resultant vector has *x* component equal to 6 and *y* component equal to 1. When vector **A** is subtracted from vector **B**, the resultant vector has *x* component equal to -4 and the *y* component equal to 7. Find the magnitude of vector **A**. **[11]**

(c) The speed of a moving object as a function of time is shown in the figure below. How far did the object move during the first 7 seconds? **[4]**



Q 5 (a) An arrow is shot from the top of an 8 m building with an initial speed of 6 m/s at an angle of 40^0 above the horizontal as shown in the diagram below.

i) Determine the velocity v_B of the arrow when it strikes the ground; and
ii) Its direction at point *B*. (Use projectile motion principles). **[12]**



(b) Solve the problem in Question 5 (a), (i) and (ii) using the principle of energy conservation. **[8]**

(c) A 2.0 kg block is on a frictionless horizontal surface. It is connected to a second block by means of a string passing over a frictionless pulley. The second block is hanging vertically. What is the acceleration of the system? **[5]**

-END OF TEST ONE-2018