The University of Zambia
Department of Physics
Term Test-I June 2018
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.

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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 : $\rho_{water} = 1000 kg/m^3$
1 hp = 746 W : 1 ton = 1000 kg

Some equations you may find useful:

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

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

$$f = \mu F_N \; : \; W = F.s.\cos\theta \; : \; P = \frac{W}{t} \; : \; KE = \tfrac{1}{2} mv^2 \; : \; PE = mgh \; : \; F = ma$$

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. **[10 × 2.5 = 25]**
So don't be afraid to attempt!!

(A) The resultant of a 3 N force acting horizontally and a 4 N force acting upward is

(a) 12 N
(b) 1 N
(c) 7 N
(d) 5 N

(B) A conveyor belt has a velocity of 3.0 m/s at angle of 60^0 above the floor level. The vertical component of its velocity is

(a) 1.8 m/s
(b) 2.6 m/s
(c) 3.5 m/s
(d) 1.5 m/s

(C) An arrow is shot at angle of 40^0 below the horizontal with a speed of 8.0 m/s. After 0.40 s the horizontal component of the velocity will be

(a) 10.4 m/s
(b) 2.5 m/s
(c) 6.1 m/s
(d) 6.7 m/s

(D) The frictional force between two surfaces in contact does not depend on

(a) whether a lubricant is used or not
(b) the normal force pressing the surfaces in contact
(c) the area of the surfaces in contact
(d) whether the surfaces are stationary or in relative motion

E) As an aeroplane climbs,

(a) its weight increases
(b) its mass decreases
(c) its weight decreases
(d) its mass increases

(F) A measure of the inertia of an object is termed

(a) force
(b) mass
(c) weight
(d) momentum

(G) On a distance-time graph, a straight line sloping upward to the right corresponds to motion at

(a) zero speed
(b) increasing speed
(c) constant speed
(d) decreasing speed

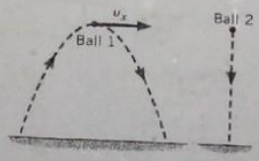
(H) What never changes when two or more objects collide is

(a) the kinetic energy of each one
(b) the momentum of each one
(c) the total momentum of all the objects
(d) the total kinetic energy of all the objects

(I) A lazy person requires about 6 million joules of energy per day. This rate of energy consumption is equivalent to approximately

(a) 335 W
(b) 600 W
(c) 70 W
(d) 250 W

(J) Ball 1 is thrown into the air and follows the trajectory for projectile motion shown in the diagram. At the instant ball 1 is at the top of its trajectory, ball 2 is dropped from rest from the same height. Which ball reaches the ground first?



(a) Ball 1 reaches the ground first, since it is moving at the top of the trajectory, while ball 2 is released from rest.
(b) Ball 2 reaches the ground first, because it has a shorter distance to travel.
(c) Both balls reach the ground at the same time.*
(d) There is not enough information to tell which ball reaches the ground first.

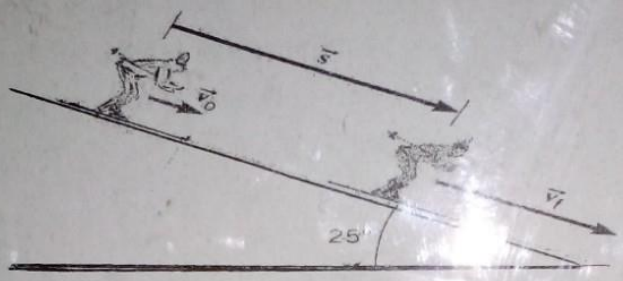
Attempt any three questions from the following:

Q 2 (a) A 50 kg skater travelling at 4.5 m/s collides with a 65 kg skater travelling at 2.5 m/s in the same direction.

i) If the two skaters remain in contact, what is their final velocity?
ii) How much kinetic energy is lost? [13]

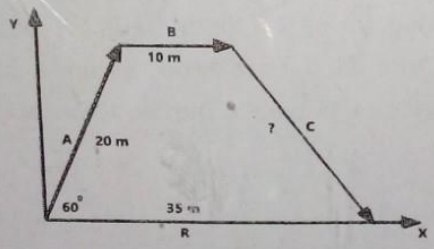
(b) The result of addition of four forces is **R**, which has a magnitude of 100 N along the negative *y*-axis. Three of the forces are **A** = 100 N at 60^0, **B** = 200 N at 140^0 and **C** = 250 N at 320^0, all with respect to the positive *x*-axis. Find the fourth force **D**. [12]

3 (a) A 58 kg skier is sliding a 25^0 slope as shown below. Near the top her speed is 3.6 m/s. She accelerates down the slope because of the gravitation force, even though a kinetic frictional force of magnitude 71 N opposes her motion. Ignore air resistance, determine her speed after sliding a distance of 57 m downhill.



[11]

(b) The figure below shows three displacement vectors **A**, **B** and **C**. These vectors are arranged in tail-to-head fashion, when added together they give the resultant vector **R**, which lies along the *x*-axis. What is the magnitude of vector **C**? [10]



(c) A golf ball is launched on a level golf course with speed of 65 m/s at some angle θ such that it lands 195 m from the launch point. At what angle was the golf ball shot? [4]

Q 4 (a) A stone is shot from a catapult at an angle of 60^0 with respect to the horizontal. It leaves the catapult at a height of 1.7 m above the ground level. Its initial speed is 10 m/s.

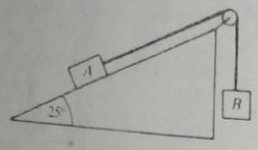
i) What is the maximum height of the stone with respect to the ground?
ii) How long does it take to hit the ground?
iii) What is the horizontal distance travelled by the stone at a point it hits the ground from the bottom of the launch point? [13]

(b) A stone whose mass is 100.0 g rests on a frictionless horizontal surface. A bullet of mass 2.50 g moving at a velocity 400 m/s strikes the stone and the bullet is deflected at 90^0 (with respect to the positive *x*-axis) with a velocity of 300 m/s.

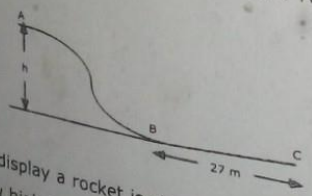
i) Calculate the direction of deflection of the stone after it is hit.

ii) Calculate the velocity of the stone after it is hit. [12]

Q 5 (a) An inclined plane making an angle of 25^0 with the horizontal has a frictionless pulley at its top. A 30 kg block on the plane is connected to a freely hanging 20 kg block by means of a light rope passing over the pulley. The coefficient of kinetic friction between A and the incline is 0.1. Calculate the distance the 20 kg block will fall in 2 s starting from rest. Neglect friction. [10]



(b) A boy and a sled, weighing 300 N, slide down an ice covered (frictionless) hill *AB*. At the bottom of the hill there is an ice free patch *BC*, the horizontal surface brings the sled to a stop within a distance 27 m. What is the coefficient of friction between the sled contact runners and the horizontal patch? [9]



(c) At a fireworks display a rocket is shot straight up into the sky with a speed of 30 m/s. How high is it when its speed is 10 m/s? Use the energy method assuming no energy losses due to air resistance. [6]

END OF TEST ONE-2018