



The University of Zambia
Department of Physics
Term Test-I December 2014
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 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:

$g = 9.8 \text{ m/s}^2$: $P_A = 1.013 \times 10^5 \text{ N/m}^2$: 1 Pascal = 1 N/m² : $\rho_{\text{water}} = 1000 \text{ kg/m}^3$
1 hp = 746 W : 1 ton = 1000 kg

Some equations you may find useful:

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

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

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

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

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

- (a) kg/s
- (b) m³
- (c) km/s² ✓
- (d) hours

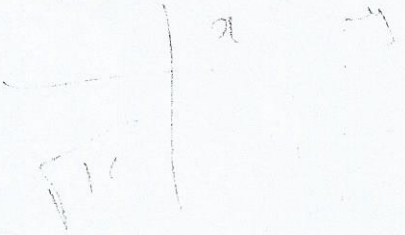
(B) The resultant of a 4 N force acting along the north direction and a 3 N force acting along the east direction is:

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

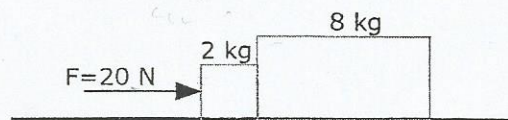


(C) At a launch angle of 45°, the range of a projectile is given by:

- (a) $\frac{v_i^2}{g}$
- (b) $\frac{2v_i^2}{g}$
- (c) $\frac{v_i^2}{2g}$
- (d) $\frac{2v}{g}$



(D) A 20 N force is pushing two blocks horizontally along a frictionless floor as shown. What is the magnitude of the force that the 8 kg mass exerts on the 2 kg mass?



- (a) 4 N
- (b) 16 N
- (c) 8 N
- (d) 20 N

Handwritten notes: $F = mg$, $F = 8 \times 10$, $F = 80$

E) Two unequal masses are dropped simultaneously from the same height. The two masses will experience the same change in;

- (a) acceleration
- (b) kinetic energy
- (c) potential energy
- (d) velocity ✓

(F) A man standing on a cliff shoots a bullet horizontally and drops one out of his hand at the same time. The time taken for the two bullets to reach the ground:

- (a) Is the same for both
- (b) Is shorter for the one shot off the cliff
- (c) Is greater for the one shot off the cliff
- (d) Depends on the initial velocity of the one shot off the cliff

(G) The frictional force acting on a body sliding down an inclined plane is:

- (a) $\mu mg \sin \theta$
- (b) μmg
- (c) $\mu mg \cos \theta$ ✓
- (d) mg

(H) A uniform acceleration results when velocity:

- (a) Remains constant
- (b) Varies linearly with time ✓
- (c) Depends inversely on time
- (d) Is a quadratic function of time

(I) Mass is a scalar quantity and:

- (a) May vary in magnitude ✗
- (b) Is the same as weight ✗
- (c) Is always constant
- (d) Depends on the size of the body

(J) The limit of the average velocity over a path length that approaches zero but always includes a point A is defined:

- (a) Average velocity A
- (b) Average acceleration at A
- (c) Instantaneous velocity at A ✓
- (d) Instantaneous acceleration at A

Attempt any three questions from the following:

Q 2 (a) A jogger runs 145 m in the direction 20.0° east of north (displacement vector \vec{A}) and then 105 m in the direction 35.0° south of east (displacement vector \vec{B}).

- Sketch the movements and show the resultant.
- Using components, determine the magnitude and direction of the resultant vector \vec{C} for these two displacements. [10]

(b) A hot-air balloon is rising upward with a constant speed of 8 m/s. When the balloon is 12.5 m above the ground, the balloonist accidentally drops a compass over the side of the balloon. How much time elapses before the compass hits the ground? [9]

(c) A person can throw a ball to a maximum horizontal range of 120 m. How high would the ball go straight up? [6]

3 (a) A car starts from rest and accelerates uniformly reaching a velocity of 25 m/s after travelling 100m. It travels at this velocity for 750 m. Then it decelerates uniformly and comes to rest in 5 s. Use the method of velocity-time graph to:

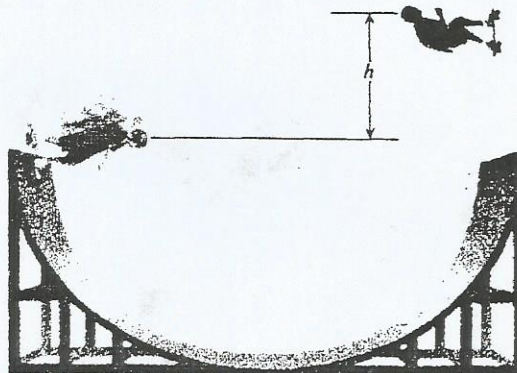
- Find its displacement in the first 20 s,
- Find its total displacement, and
- the total time taken. [11]

(b) The skateboarder in the drawing starts down the left side of the ramp with an initial speed of 5.4 m/s. If non-conservative forces, such as kinetic friction and air resistance, are negligible, what would be the height h of the highest point reached by the skateboarder on the right side of the ramp? [7]

$$v_f = 0$$

$$v_i = 5.4 \text{ m/s}$$

$$v = at$$

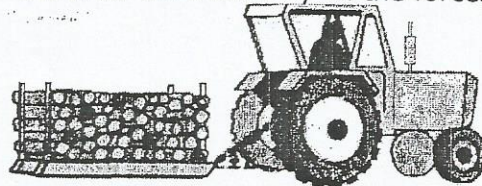


(c) The speed limit along a certain road is 80 km/h. To stop at a junction, the driver slammed on the brakes and the car skidded for 55 m before stopping. The coefficient kinetic friction μ_k is between the tyres and the road 0.75. Determine if the driver exceeded the speed limit. [7]

Q 4 (a) A farmer hooks her tractor to a sled loaded with firewood and pulls it a distance of 20 m along the ground. The total mass of the sled and its load is 1500 kg. The tractor exerts a constant 5000 N force at an angle of 36.9° above the horizontal. There is a 3500 N friction force opposing the sled's motion. Find:

- i) The work done by each force acting on the sled, and
- ii) the total work done by all the forces.

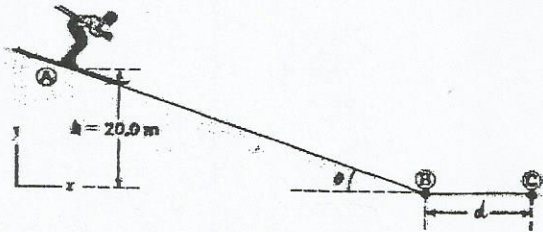
[8]



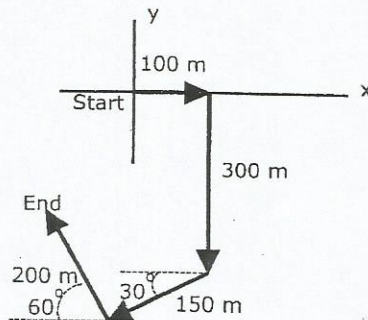
(b) A skier starts from rest at the top of a frictionless incline of height 20.0 m as shown below. At the bottom of the incline at B, the skier encounters a horizontal surface where the coefficient of kinetic friction between the skier and the snow is 0.210. Use the energy conservation principle to find:

- i) the skier's speed at the bottom, and
- ii) the further distance the skier travels on the horizontal surface before stopping at C, neglect air resistance.

[9]



(c) A person going for a walk follows the path shown in the figure below. The total trip consists of four straight line paths. At the end of the walk, what is the person's resultant displacement measured from the starting point? [8]



Handwritten notes:
 A person's path
 100m
 300m
 150m
 200m
 60°
 30°

Handwritten symbol: ≡

Handwritten equations:
 $F + f \cos \theta$
 $= F \sin \theta + mg$

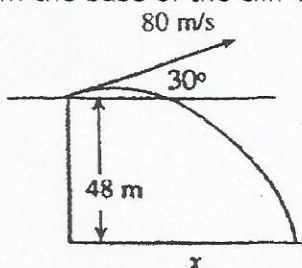
Handwritten notes:
 $v = mg$

Handwritten symbol: ≡

Handwritten notes:
 ...
 $F \sin \theta + mg$

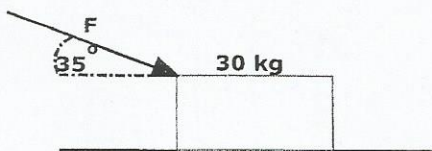
Q 5 (a) An archer standing on a cliff 48 m above the level field below shoots an arrow at an angle of 30° above the horizontal with a speed of 80 m/s.

- What is the maximum height the arrow rises to with respect to the level field?
- How far from the base of the cliff will the arrow land?



[10]

(b) A 450 N force directed at an angle of 35° to the horizontal is applied to the top edge of a 30 kg box. It is set in motion and achieves a velocity of 1.5 m/s in 3 s. What is the coefficient of friction between the box and the floor?



[10]

(c) A locomotive is accelerating at 1.6 m/s^2 . It passes through a 20 m wide crossing in a time of 2.4 s. After the locomotive leaves the crossing, how much time is required until its speed reaches 32 m/s? [5]

-END OF TEST 1-