

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:

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

Some equations you may find useful:

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

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

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

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

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

$$h = ut + \frac{1}{2}gt^2$$

$$h = \frac{g}{2}t^2$$


(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

$$t = 25 \text{ s}$$

$$s = 500 \text{ m}$$

$$v^2 = 2as$$

$$v^2 = 2(1.6)(500)$$

$$a = \frac{v^2}{2s}$$

$$v^2 = 2as$$

$$v^2 = 2(1.6)(500)$$

$$500 = \frac{1}{2}at^2$$

$$a = 1.6$$

(C) A ball is thrown at 40° 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

$$\theta = 40^\circ$$

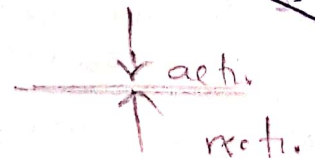
$$u \sin 40^\circ$$

$$8 \sin 40^\circ$$



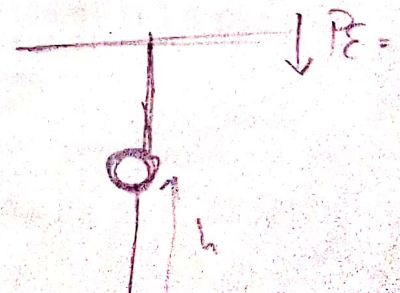
(D) In Newton's third law of motion the action and reaction forces

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

(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 does not 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

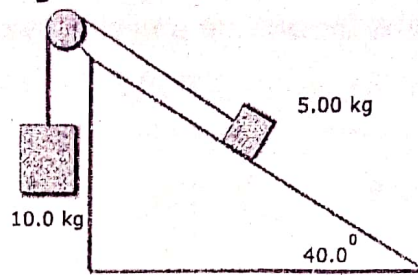
Attempt any three questions from the following:

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° 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° .

- i) Find the acceleration of the 5.00 kg crate.
 ii) The tension in the string.

[10]

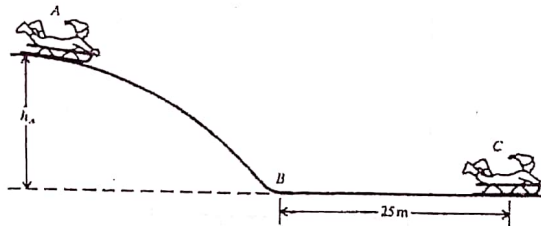


- (c) A girl standing on top of the roof of a 22 m high building throws a coin upward with a speed of 8.8 m/s. The coin just misses the edge of the roof and drops to the ground.

- 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 friction 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° 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]



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**The University of Zambia
Physics Department
PHY1010: Introductory Physics
Term Test-I March 2017**

Time: Two hours.

Maximum marks = 100.

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

Do not forget to write clearly your name, computer number, and tutorial group number on the answer book. Show your working clearly. Omission of essential work will lead to loss of marks.

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Wherever necessary use:

$g = 9.8 \text{ m/s}^2$: $\rho_{\text{water}} = 1000 \text{ kg/m}^3$: $1 \text{ hp} = 746 \text{ watts}$: $1 \text{ ton} = 1000 \text{ kg}$

Some equations you may find useful:

$x = v_{\text{avg}} \cdot t$: $v_{\text{avg}} = \frac{v_f + v_0}{2}$: $v_f = v_0 + at$: $a = \frac{v_f - v_0}{t}$: $v_f^2 = v_0^2 + 2ax$: $x = v_0 t + \frac{1}{2} at^2$:

$R = \frac{2v_0^2 \sin \theta \cos \theta}{g} = \frac{v_0^2 \sin 2\theta}{g}$: $y = x \tan \theta - \frac{g}{2v_0 \cos^2 \theta} x^2$: $y_{\text{max}} = \frac{v_0^2 \sin^2 \theta}{2g}$: $t = \frac{2v_0 \sin \theta}{g}$

$f = \mu F_N$: $\text{work} = Fs \cos \theta$: $F = ma$: $W = mg$: $PE = wh = mgh$: $KE = \frac{1}{2} mv^2$

$P = \frac{W}{t} = Fv \cos \theta$: $\sin(90 - \alpha_0) = -\sin(\alpha_0 - 90) = -(-\cos \alpha_0) = +\cos \alpha_0$

: $\cos(90 - \alpha_0) = \cos(\alpha_0 - 90) = \sin \alpha_0$

For Question 1, you must use the blank answer sheet provided. Attach it with the main answer book.

For other questions, clearly indicate which one you are attempting:

Example:

Question 2(b)

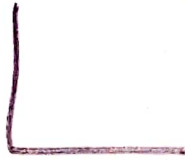
DO NOT write the question number in the top left corner of the page, and then staple over it!! We have to see it. Organize the answer script properly before stapling it.

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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) When two vectors are added together, their resultant is a minimum when the angle between them is

- (a) 90°
- (b) 0°
- (c) 180°
- (d) 45°



(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 stone is dropped from a building at the same time as another stone is thrown upward from the building. The two stones

- (a) reach the ground at the same time
- (b) have the same velocity as they reach the ground
- (c) have the same acceleration when they reach the ground
- (d) have different acceleration when they reach the ground

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

- (a) act on the same object
- (b) act on two 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) A ball is thrown vertically upward at 20 m/s. The ball will reach the highest point in approximately

- (a) 1.5 s
- (b) 2.0 s
- (c) 0.5 s
- (d) 1.0 s

$$S = ut + \frac{1}{2}at^2$$

$$a = \frac{2(S - ut)}{t^2}$$

$$1.6 \text{ m/s}^2$$

$$v = u + at$$
$$-0 +$$

$$t = \frac{v - u}{a}$$

$$0 - 20$$

(F) Compared with her mass and weight on Earth, an astronaut on the planet Venus, where acceleration is 8.8 m/s^2 , has

- (a) less mass and the same weight ✗
- (b) less mass and less weight ✗
- (c) the same mass and less weight ✓
- (d) less mass and more weight ✗

(G) The acceleration of a stone thrown upward is:

- (a) smaller than that of a stone thrown downward ✗
- (b) greater than that of a stone thrown downward ✗
- (c) zero until it reaches the highest point in its motion ✗
- (d) the same as that of a stone thrown downward

(H) Mulenga and Dalitso are loading identical blocks onto Dalitso's pickup truck. Mulenga lifts his block straight from the ground to the truck, whereas Dalitso slides his block up a ramp on massless, frictionless rollers. Which statement is true?

- (a) Mulenga does more than Dalitso ✗
- (b) Dalitso does more work than Mulenga ✗
- (c) Mulenga and Dalitso do the same work ✓
- (d) None of these statements is necessarily true because the angle of incline is unknown. ✗

(I) A baseball is thrown from the outfield toward a catcher. When the ball reaches the highest point, which statement is true?

- (a) Its velocity and acceleration are both zero ✗
- (b) Its velocity is not zero, but its acceleration is zero ✗
- (c) Its velocity is perpendicular to its acceleration ✓
- (d) Its acceleration depends on the angle at which it is thrown ✗

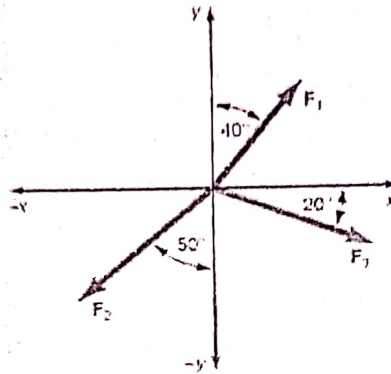
(J) A crate remains stationary after it has been placed on a slope inclined at an angle with the horizontal. Which of the following statements must be true about the magnitude of the frictional force that acts on the crate.

- (a) It is less than the component of the weight acting down the slope ✗
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- (c) It is larger than the weight of the crate ✗
- (d) It is greater than the component of the weight acting down the slope ✓

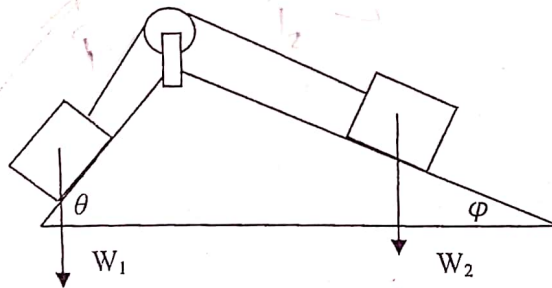
Attempt any three questions from the following. If you attempt ALL the questions, we will consider only the first three attempted!

Q2(a). Find the resultant (direction and magnitude) of the following three forces.

The magnitudes of the forces are $F_1 = 2.00 \text{ N}$, $F_2 = 8.00 \text{ N}$, and $F_3 = 6.00 \text{ N}$. [10]



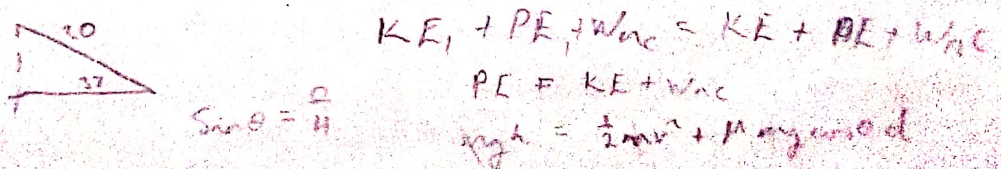
Q2(b). In the accompanying diagram $w_1 = 2\text{N}$, $w_2 = 5\text{N}$, and $\theta = 65^\circ$. Find the angle ϕ such that the components of the two forces parallel to the inclines are equal. There are no friction forces present. [6]



Q2(c) A ski jumper slides from rest down a 37° slope for 20 m before taking off from a negligibly short horizontal take-off. If the speed at take-off is 15 m/s, find the coefficient of kinetic friction on the slide. Use the principle of conservation of energy. [9]

Q3(a). A rock is thrown vertically upwards with a velocity of 6 m/s from a point situated 12 m above the ground.

- (i) What is the *velocity* of the rock when it hits the ground?
- (ii) What is the time taken for the journey?
- (iii) Calculate the average velocity and the acceleration for the journey. [12]





The University of Zambia
Department of Physics
Term Test-I June 2018
PHY1010: Introductory Physics

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Some equations you may find useful:

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

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

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Example:

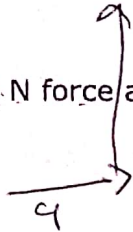
Question 2(b)

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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 resultant of a 3 N force acting horizontally and a 4 N force acting upward is

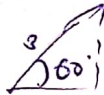
- (a) 12 N
(b) 1 N
(c) 7 N
(d) 5 N



$$R = \sqrt{3^2 + 4^2} = \sqrt{9 + 16} = \sqrt{25} = 5 \text{ N}$$

(B) A conveyor belt has a velocity of 3.0 m/s at angle of 60° 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



$$V_y = 3 \sin 60 = 2.59 \approx \underline{2.6 \text{ m/s}}$$

(C) An arrow is shot at angle of 40° 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

$$V_x = 8 \cos 40 = 6.1 \text{ m/s}$$



(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 ✓ $F_f = F_N \mu$
(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 ✗



$$W = mg$$

$$f = \frac{G m_1 m_2}{r^2}$$

$$mg = \frac{G m_1 m_2}{r^2}$$

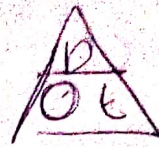
(F) A measure of the inertia of an object is termed r^2

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

$$W = mg$$

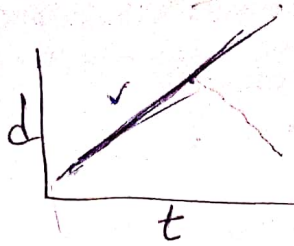
$$W = \frac{G m_1 m_2}{r^2}$$

$$f = W = \frac{G M m}{r^2}$$



(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



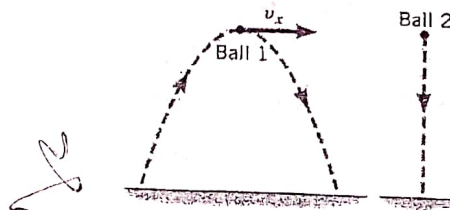
(H) What never changes when two or more objects collide is

- (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 ~~✓~~ (inelastic collision KE changes)

(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? ✓

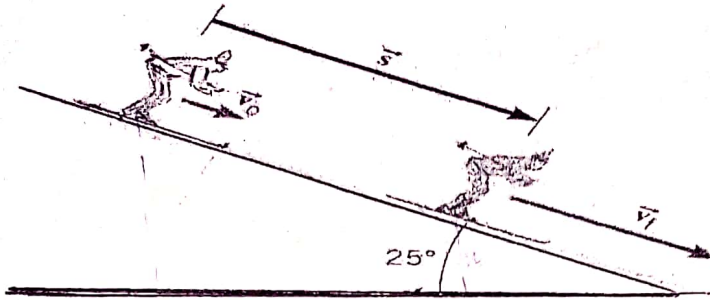
[13]

(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°, **B** = 200 N at 140° and **C** = 250 N at 320°, all with respect to the positive x-axis. Find the fourth force **D**.

[12] ✓

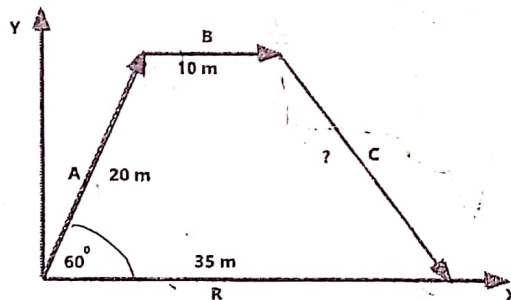
Saturday.

- 3 (a) A 58 kg skier is sliding a 25° 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]



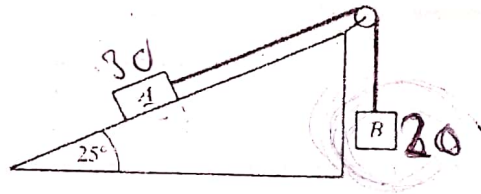
- (c) A golf ball is launched on a level golf course with speed of 65 m/s at some angle θ such that it lands 195 m from the launch point. At what angle was the golf ball shot? 13.9 [4]

- Q 4 (a) A stone is shot from a catapult at an angle of 60° 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.
- What is the maximum height of the stone with respect to the ground?
 - How long does it take to hit the ground?
 - What is the horizontal distance travelled by the stone at a point it hits the ground from the bottom of the launch point? [13]

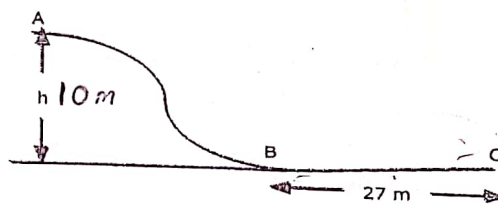
- (b) A stone whose mass is 100.0 g rests on a frictionless horizontal surface. A bullet of mass 2.50 g moving at a velocity 400 m/s strikes the stone and the bullet is deflected at 90° (with respect to the positive x-axis) with a velocity of 300 m/s.

- 17
- 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° 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