DO NOT OPEN THE EXAMINATION PAPER UNTIL YOU ARE TOLD BY THE SUPERVISOR TO BEGIN

PHYSICS 3204

MIDTERM EXAMINATION

2010/2011

Value: 100 marks **Time: 3 hours**

GENERAL INSTRUCTIONS

1. This is a two-part test. All parts are contained in this booklet. The examination consists of items arranged as follows:
   SECTION I – 50 selected response items – Do ALL items –50%
   SECTION II – constructed response items – Do ALL items – 50%

2. **Section I** may be answered using the answer sheet provided. Instructions for completing this answer sheet are given on the sheet itself. Please complete it according to those instructions and any other given by the supervisor.

3. **Section II** – is to be answered on the loose leaf provided. Please pass in the entire test to the supervisor when you have finished the examination.

4. Rough work may be done in any blank spaces in this test booklet.

REGULATIONS FOR CANDIDATES

Candidates are expected to be thoroughly familiar with all regulations pertaining to their conduct during the examinations. These were explained by the chief supervisor prior to the first session, and have been posted for further reference near the entrance to the examination room. Candidates should ensure that they understand and comply with all requirements governing the following matters:

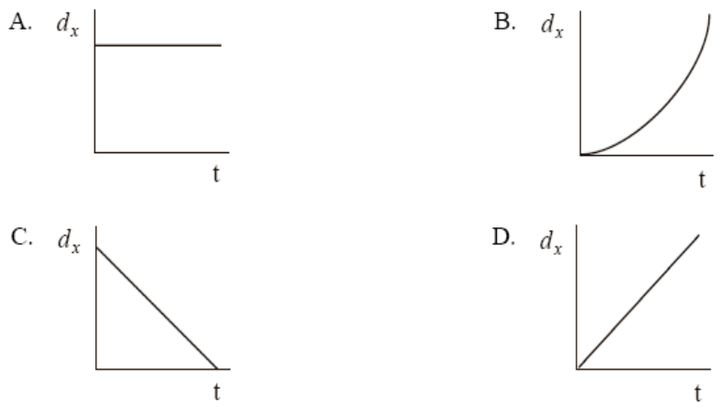
– Materials required
– Materials not permitted
– Models of calculators permitted
– Use of pen or pencil
– Punctuality
– Leaving the room
– Use of answer booklets
– Completion of required information
- Communication and movement during the examination
– Use of unauthorized means, and penalties

PART I
Total Value: 50%

Instructions: Shade the letter of the correct answer on the computer scorable answer sheet provided.

1 Which of the following correctly applies to a projectile in the absence of friction?
A The horizontal acceleration is changing.
B The horizontal velocity is changing.
C The vertical acceleration is changing.
D The vertical velocity is changing.

2 Assuming no friction, which graph best represents the horizontal displacement of a projectile,?



3 Two arrows are launched at the same time with the same initial velocity. Arrow X is fired at an angle of 60° to the horizontal, and arrow Y is fired at an angle of 45° to the horizontal. Which best describes the motion of arrow X compared to the motion of arrow Y?
A Arrow X has a longer flight time and longer horizontal range.
B Arrow X has a longer flight time and shorter horizontal range.
C Arrow X has a shorter flight time and longer horizontal range.
D Arrow X has a shorter flight time and shorter horizontal range.

4 Three identical objects are thrown from the same height through a window at the same time. Object A is thrown horizontally at 4.0 m/s, object B is thrown horizontally at 8.0 m/s, and object C is simply dropped. If air resistance is negligible, which object will reach the ground first?
A Object A
B Object B
C Object C
D Objects A, B, and C will land at same time.

5 If a projectile is launched from ground level with an initial velocity of 65 m/s at 30.0° above the horizontal, what is its total time in the air?
A 3.3 s
B 6.6 s
C 12 s
D 13 s

6 An object is projected horizontally from a 0.95 m high table at a velocity of 12 m/s. How far from the base of the table will the object hit the floor?
A 2.3 m
B 5.3 m
C 11 m
D 27 m

7 Which represents the range for a projectile launched horizontally with velocity, v, from height, h?

(A) $v \sin\theta \sqrt{\frac{h}{4.9}}$

(B) $-v \cos\theta \sqrt{\frac{h}{4.9}}$

(C) $v \sqrt{\frac{h}{4.9}}$

(D) $v \left(\frac{h}{4.9} \right)$

8 A ball kicked from the ground at 12.0 m/s and 28° from the horizontal, returns to the ground in 5.0 s. What is the ball's speed just before it hits the ground?

A 0 m/s
B 5.6 m/s
C 11 m/s
D 12 m/s

9 A ball is launched at a 60^{o} angle to the horizontal. If, 3.0 s later, it lands 12 m from the launch site, what was the magnitude of the initial velocity?

A 2.3 m/s
B 4.0 m/s
C 4.6 m/s
D 8.0 m/s

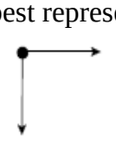
10 If a coin is pushed horizontally from a 1.2 m high table and lands 0.75 m from the base, what was the speed at which it left the table?

A 0.38 m/s
B 1.5 m/s
C 1.9 m/s
D 3.0 m/s

11 A baseball is hit upward and travels along a parabolic arc before it strikes the ground. Which one of the following statements is true?

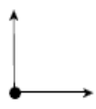
A The acceleration of the ball decreases as the ball moves upward.
B The acceleration of the ball is zero when the ball is at the highest point in the arc.
C The velocity of the ball is zero when the ball is at the highest point in the arc.
D The x-component of the velocity of the ball is the same throughout the ball's flight.

12 Which best represents the velocity components of a projectile at its maximum height?

(A) 

(B) 

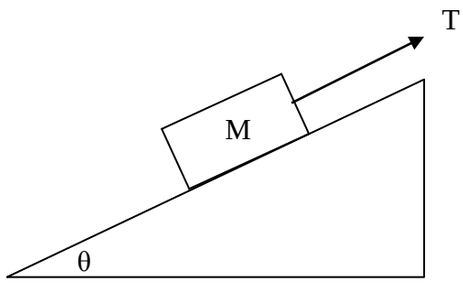
(C)

(D) 

13 An object sits at rest on a ramp. As the angle of inclination of the ramp increases, the object suddenly begins to slide. Which of the following explanations best accounts for the object's movement?

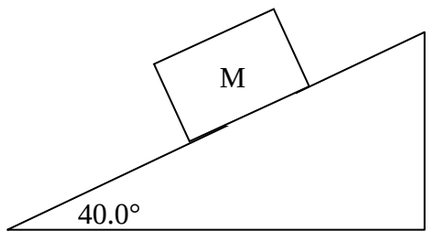
A The coefficient of static friction has decreased sufficiently.
B The component of gravity along the ramp has increased sufficiently.
C The force of gravity acting on the object has increased sufficiently.
D The friction has decreased sufficiently while the normal force has remained unchanged.

14 A box of mass M is pulled at a constant speed up an incline as shown below. Which expression represents the coefficient of friction required to maintain a constant speed?



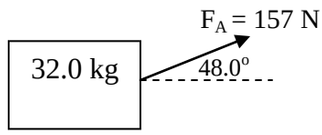
A $Mg\cdot\cos\theta/(T - Mg\cdot\sin\theta)$
B $Mg\cdot\sin\theta/(T - Mg\cdot\cos\theta)$
C $(T - Mg\cdot\cos\theta)/ Mg\cdot\sin\theta$
D $(T - Mg\cdot\sin\theta)/ Mg\cdot\cos\theta$

15 A box slides down an incline at a constant velocity. Find the coefficient of friction.



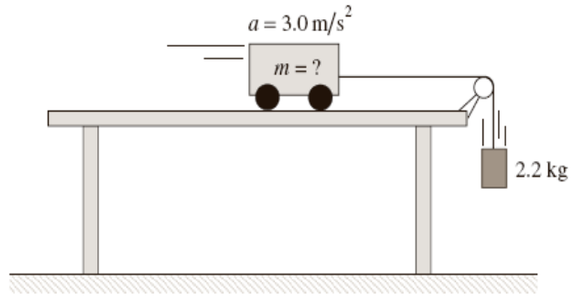
A 0.643
B 0.839
C 1.19
D 1.31

16 Calculate the normal force on the block below.



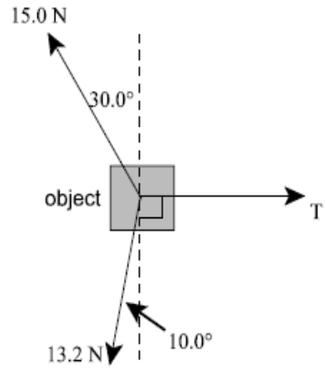
A 31 N
B 173 N
C 197 N
D 209 N

17 A cart of unknown mass is attached to a 2.2 kg mass hanging over the edge of a table as shown. The cart accelerates at 3.0 m/s^2 . (Ignore friction.)
What is the mass of the cart?



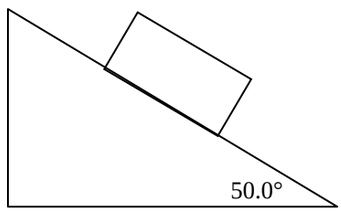
A 1.2 kg
B 5.0 kg
C 6.6 kg
D 7.2 kg

18 In the diagram below, three forces are acting on an object. If the object is at rest, what is the value of the tension, T?



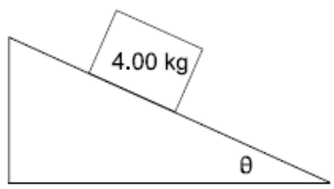
A 1.80 N
B 5.21 N
C 9.79 N
D 26.0 N

19 A 10.0 kg box is at rest on an inclined plane as shown in the diagram below. What is the normal force acting on the box?



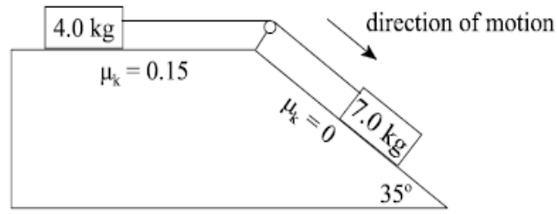
A 6.43 N
B 7.66 N
C 63.0 N
D 75.1 N

20 If the box shown below slides down the frictionless incline with an acceleration of 4.90 m/s^2, what is the angle of the incline?



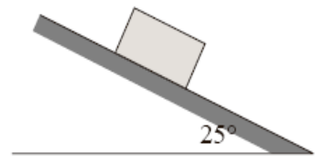
A 15.0°
B 30.0°
C 45.0°
D 60.0°

21 The diagram below shows two blocks connected by a massless string over a frictionless pulley. If the blocks accelerate at 3.0 m/s^2 in the direction shown, what is the tension in the connecting string?



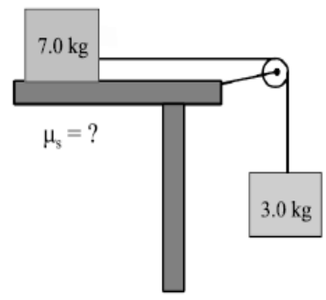
A 6 N
B 12 N
C 18 N
D 49 N

22 A 5.0 kg block remains stationary on an inclined surface. What is the friction force acting on the block?



A 21 N
B 23 N
C 44 N
D 49 N

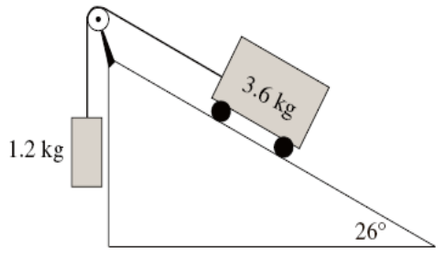
23 If the system below is at rest, what is the coefficient of static friction?



A 0
B 0.30
C 0.43
D 0.70

24 A 1.2 kg mass is connected via a pulley to a 3.6 kg cart sitting on a frictionless incline as shown.

Which of the following is correct, if the 3.6 kg cart is allowed to move freely?



	MAGNITUDE OF ACCELERATION	DIRECTION OF ACCELERATION
A.	0.77 m/s^2	up the incline
B.	0.77 m/s^2	down the incline
C.	1.0 m/s^2	up the incline
D.	1.0 m/s^2	down the incline

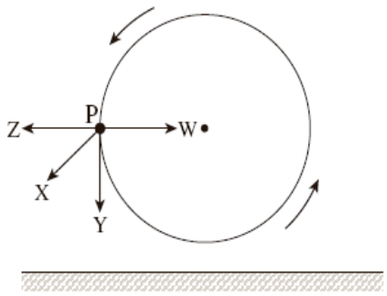
25 A rock is tied to the end of a string and whirled around in a circle that describes a vertical plane. At which position is the tension in the string the least?

A At the bottom of the circle.
B At the top of the circle.
C On the ascending side of the circle.
D On the descending side of the circle.

26 Which is the centripetal force for a car in a frictionless banked curve?

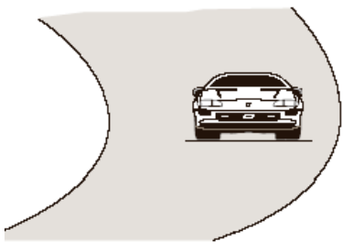
A Horizontal component of the normal force.
B Horizontal component of the weight.
C Vertical component of the normal force.
D Vertical component of the weight.

27 An object moves in uniform circular motion in a vertical plane. Which is the direction of the acceleration at P?



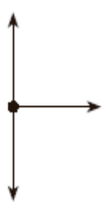
A W
B X
C Y
D Z

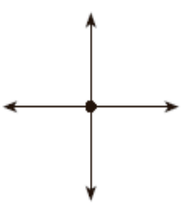
28 A car is going around a curve at constant speed on a level road as shown in the diagram below.



Which of the following free body diagrams shows the forces acting on the car?

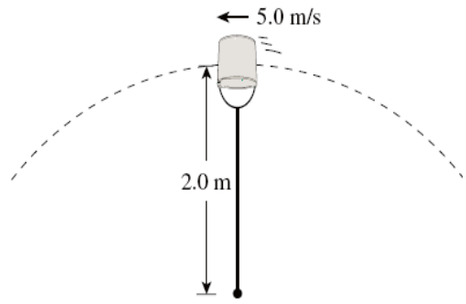
A. 

B. 

C. 

D. 

29 A 4.0 kg bucket of paint tied to a rope is being swung in a vertical circle with a radius of 2.0 m. The speed of the bucket at the top of its swing is 5.0 m/s.



What is the tension in the rope at this point?

A. 11 N
B. 39 N
C. 50 N
D. 89 N

30 A 1600 kg car moves at a constant speed of 28 m/s around a level 100 m radius circular track. What is the minimum coefficient of friction between the tires and the road surface?

A 0.18
B 0.57
C 0.80
D 1.25

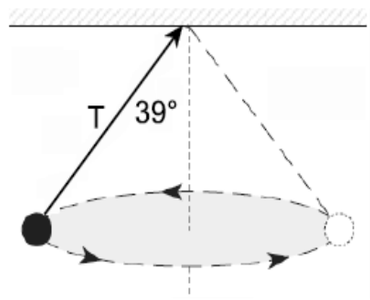
31 If a car, travelling at 25.0 m/s, moves around a banked frictionless curve angled at 7.32°, what is the radius of the curve?

A 19.9 m
B 37.7 m
C 63.8 m
D 496 m

32 By which factor does the centripetal force change if a car goes around a curve at $\frac{1}{3}$ of its original speed?

A $\frac{1}{9}$
B $\frac{1}{3}$
C 3
D 9

33 The diagram below shows a 3.0 kg ball, suspended by a string, travelling in a horizontal circular path. If the tension in the string is 37.8 N and the radius of the circle is 1.2 m, what is the speed of the ball?



A 3.1 m/s
B 3.4 m/s
C 3.9 m/s
D 9.5 m/s

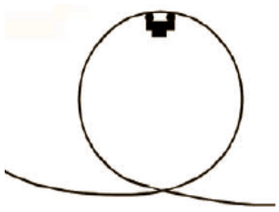
34 A 1200 kg car travels with a maximum speed of 24 m/s in a circular path on a dry level road surface where m = 0.90 between the car tires and the road. What is the radius of this circular path?

A 27 m
B 59 m
C 65 m
D 640 m

35 A 45 kg child stands on the rim of a merry-go-round of radius 2.3 m. The child completes 5 rotations in 72 s. What is the centripetal force acting on the child?

A 0.44 N
B 0.79 N
C 20 N
D 280 N

36 The roller coaster cart shown below, passes the point at the very top of a loop, which has a radius of 7.00 m. If the normal force is equal to one half the weight of the cart, what is the speed of the roller coaster at this point?

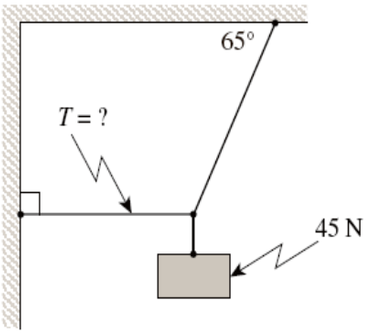


A 4.14 m/s
B 8.28 m/s
C 10.1 m/s
D 14.3 m/s

37 A 0.300-kg mass, attached to the end of a 0.750 m string, is whirled around on a smooth level table. If the maximum tension that the string can withstand is 250.0 N, what is the maximum allowable rpm's?

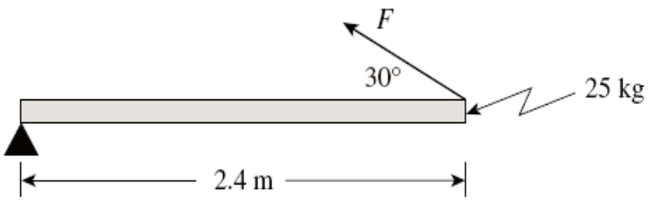
A 247 rpm
B 285 rpm
C 318 rpm
D 416 rpm

38 A 45 N block is suspended as shown in the diagram. What is the tension, *T*, in the horizontal cable?



A 19 N
B 21 N
C 23 N
D 97 N

39 A uniform 2.4 m long beam with a mass of 25 kg is kept horizontal by a force *F*.



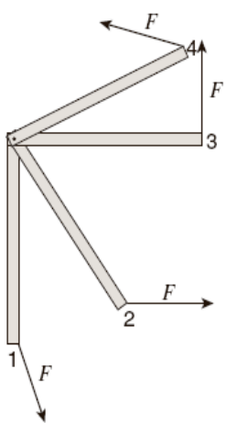
What is the magnitude of the force *F*?

A 1.2×10^2 N
B 1.4×10^2 N
C 2.5×10^2 N
D 4.9×10^2 N

40 Which of the following demonstrates the application of torque?

A Pulling a block across a floor.
B Pushing a block up an incline.
C Stopping a block from sliding down an incline.
D Using a screwdriver to turn a screw.

41 A force is used to rotate a beam. As the beam rotates, the direction of the force changes but its magnitude does not. What happens to the torque on the beam due to this force, as the beam is rotated from position 1 to position 4?

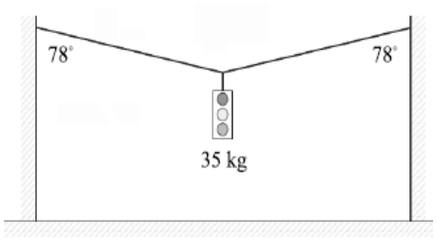


A Always increases
B Always decreases
C Decreases then increases
D Increases then decreases

42 Which of these is an acceptable definition of rotational equilibrium?

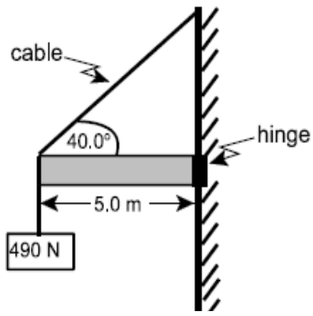
A. $\Sigma\tau = 0$
B. $\Sigma v = 0$
C. $\Sigma F = \Sigma\tau$
D. $\Sigma F_x = \Sigma F_y$

43 If a traffic light is suspended by two wires as shown, what is the tension in each wire?



A 180 N
B 340 N
C 820 N
D 1 600 N

44 What is the tension in the cable below if a 490 N object is suspended from the end of a 5.0 m long uniform beam? Assume the beam is massless.



A 490 N
B 590 N
C 760 N
D 4800 N

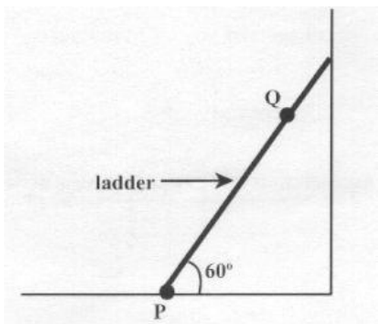
45 A 1.0×10^2 N uniform beam, 10.0 m in length, is supported by a rope at each end. If a 4.0×10^2 N person sits 2.0 m from the left end of the beam, what is the magnitude of the tension in the rope supporting the right end of the beam?

A 1.3×10^2 N
B 2.5×10^2 N
C 3.7×10^2 N
D 5.0×10^2 N

46 A 45.0 kg boy and a 35.0 kg girl are trying to balance a 3.00 m long seesaw, which is supported in the center. If the girl sits at one end, how far from the center must the boy sit?

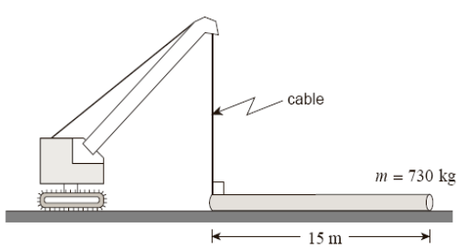
A 1.17 m
B 1.40 m
C 1.50 m
D 1.93 m

47 In the diagram below a 65.0 kg person is 3.0 m up a ladder at Q. What is the magnitude and direction of the torque produced by the person about torque P?



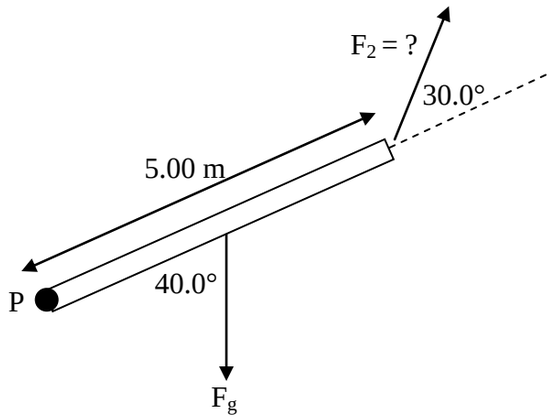
	Magnitude	Direction
A	1.7×10^3 Nm	clockwise
B	1.7×10^3 Nm	counterclockwise
C	9.6×10^2 Nm	clockwise
D	9.6×10^2 Nm	counterclockwise

48 A crane is used to lift one end of a uniform 15 m long pipe with a mass of 730 kg as shown in the diagram below.



A 3.7×10^2 N
B 4.8×10^2 N
C 3.6×10^3 N
D 7.2×10^3 N

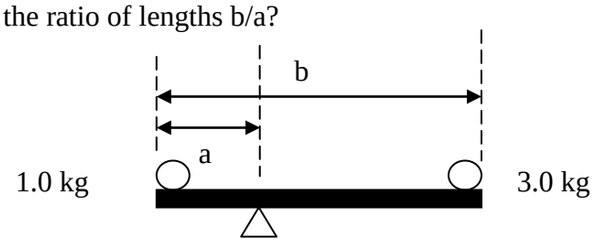
49 If the 3.20 kg uniform beam shown is in static equilibrium, what is the magnitude of F_2?



A 13.9 N
B 20.2 N
C 40.3 N
D 806 N

50. A 3.0 kg ball and a 1.0 kg ball are placed at opposite ends of a massless beam so that the system is in equilibrium as shown What is the ratio of lengths b/a?

A 2.0
B 2.5
C 3.0
D 4.0



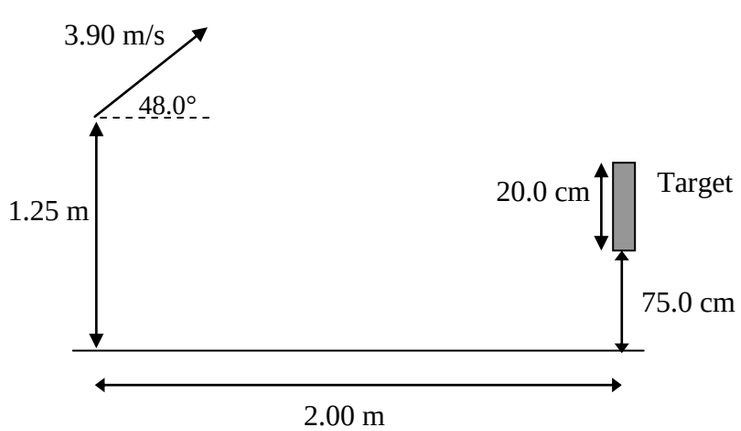
PART II
Total Value: 50%

Instructions: Complete all items in this section. Write your solutions on the paper provided. Your responses should be clearly presented in a well organized manner with proper use of units, formulae and significant figures where appropriate.

Value

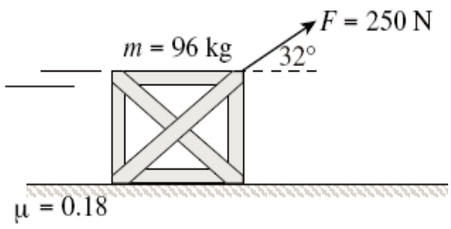
4% 51. (a) A ball is thrown from a 75.0 m high cliff, with an initial velocity of 82.0 m/s, at an angle of 53.0° above the horizontal. Calculate the range of the ball?

5% (b) A young boy is practicing his aim with a sling shot, trying to hit a homemade target that is 20.0 cm wide. He releases a pebble from a height of 1.25 m with a velocity of 3.90 m/s [48.0° above the horizontal]. If the target is 2.00 m away, at a height of 75.0 cm, will he hit the target?



3% (c) A juggler throws a ball at a 71^{o} angle to the horizontal from a height of 1.40 m. If the room is 3.05 m high, what is the maximum velocity at which the ball can be thrown to avoid hitting the ceiling?

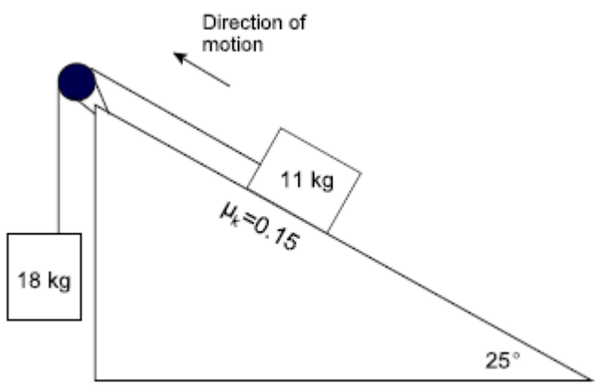
52. (a) A 250 N force is applied at an angle of 32°above the horizontal to a 96 kg wooden box causing it to slide along a floor as shown.



1% i) Draw a free body diagram for the box.

4% ii) The coefficient of friction between the floor and the box is 0.18. What is the acceleration of the wooden box?

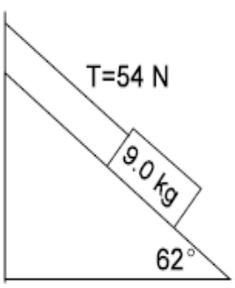
(b) Two objects of masses 11 kg and 18 kg are connected by a light string that passes over a frictionless pulley as shown. Calculate the magnitude of the acceleration of the 18 kg box.



1% (i) draw a free body diagram for the 11.0 kg mass, and

4% (ii) determine the tension in the string.

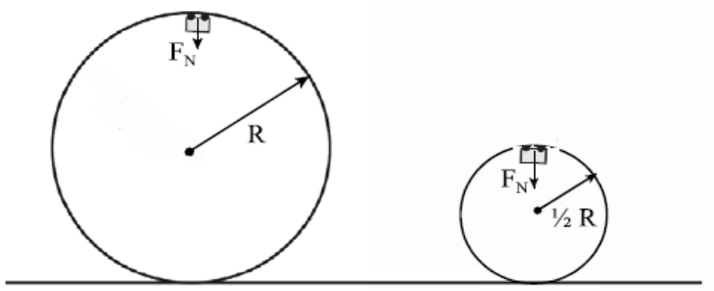
3% (c) A 9.0 kg mass is at rest on a 62ºincline and is attached to a wall by a string having a tension of 54 N. Calculate the coefficient of static friction between the mass and the incline.



3% 53. (a) A coin is placed 0.30 m from the center of a rotating horizontal turntable. The coin is observed to slip when its speed is 1.25 m/s. What is the coefficient of static friction (μ_s) between the coin and the turntable?

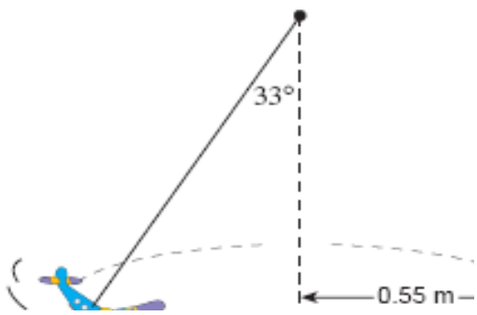
3% (b) Tarzan plans to cross a gorge by swinging in an arc from a hanging vine. If his arms are capable of exerting a force of 1300 N on the rope, what is the maximum speed he can tolerate at the lowest point of his swing? His mass is 88 kg and the vine is 5.3 m long.

3% (c) During a roller coaster ride the riders move through two loops, the second being one half the radius of the first. The riders travel at the same speed at the top of each of these two loops.

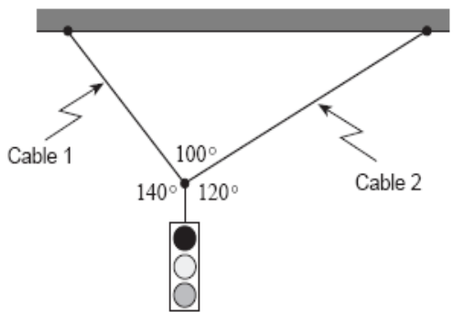


Using principles of physics, explain why riders would experience a greater normal force at the top of the second, smaller loop than at the top of the first, larger loop.

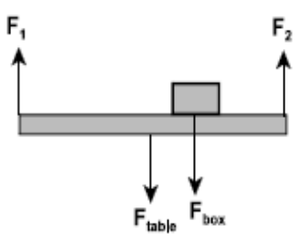
4% (d) A 0.15 kg toy airplane is suspended as shown. It travels in a horizontal circle at a constant speed. What is the speed of this airplane**?**



4% 54. (a) A 35 kg traffic light is suspended from two cables as shown in the diagram. What is the tension in each of these cables?



4% (b) A 75 kg box is placed 0.60 m from the right edge of a uniform 25 kg table that is 2.0 m long. How much force is required (F_1 and F_2) to lift the table from both ends?



4% (c) As shown in the diagram below, an unknown horizontally applied force is required to hold a fish, mass = 2.75 kg, at the end of a uniform 0.35 kg fishing rod so that the system is in static equilibrium. Calculate the applied force. (**Include a free body diagram)**