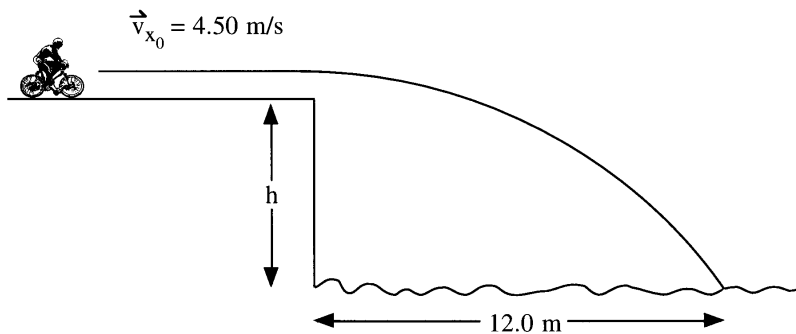


Mechanics Review**Name:** _____Instructions:

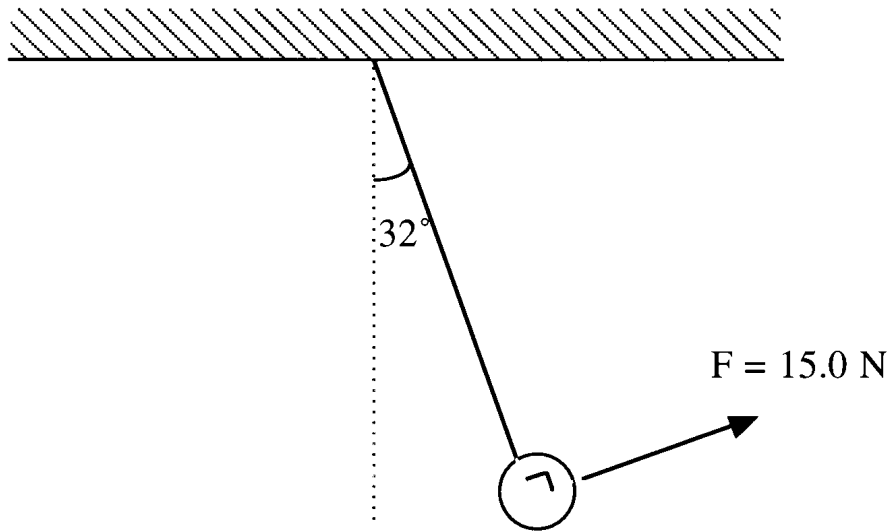
Using a pencil, answer the following questions on a separate piece of paper. The assignment is marked, based on effort, completeness, neatness, and accuracy. Do your best!

1. A daredevil BMX rider runs his bike off a cliff with a horizontal velocity of 4.5 m/s, and lands in the water 12 m from the base of the cliff.



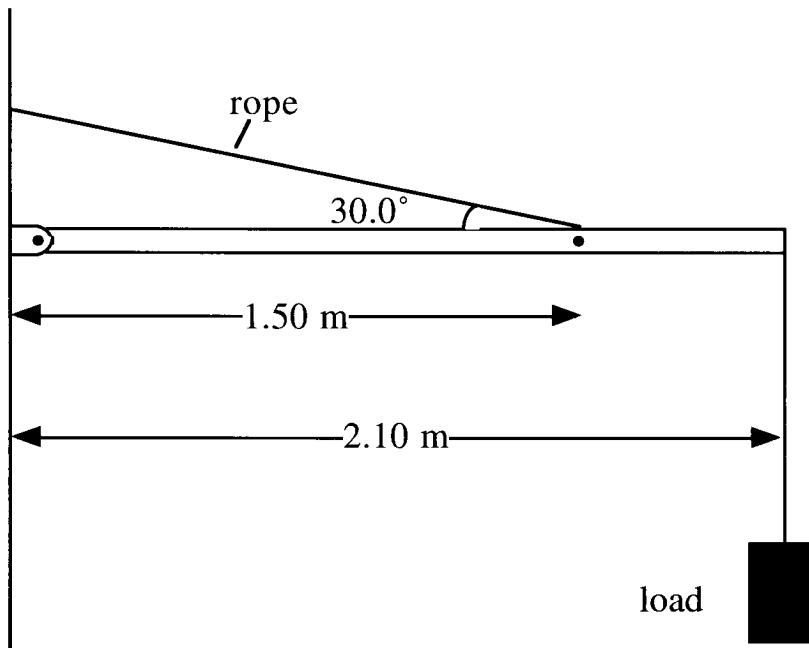
- How long does it take the rider to hit the water? (*ans: 2.7 s*)
 - How high is the cliff? (*ans: 35 m*)
2. As part of a NASA experiment, golfer Tiger Woods drives a golf ball on the moon, where $g = 1.60 \text{ m/s}^2$. He 'launches' a golf ball with a speed of 285 km/h, at an angle of 42° with the horizontal. What horizontal distance will his drive travel before landing back on the surface of the moon. Ignore the curvature of the moon (*ans: 3.9 kilometres!*)
3. A projectile is launched with a speed of 128 m/s, at an angle of 60° with the horizontal.
- After 2.0 s, what is the vertical component of the projectile's velocity? (*ans: 91 m/s*)
 - After 2.0 s, what is the speed of the projectile? (*ans: 112 m/s*)
4. Golfer Arnold Hacker requires three putts from position A to put his ball in the hole. His first putt, from A to B, travels 8.0 m south. His second putt, from B to C, travels 1.2 m southwest. His third putt, from C to the hole at D, travels 0.50 m northwest. What would be the magnitude and direction of the single putt that would have put the ball into the hole, from A to D? (*ans: One putt would travel 8.0° W of S, a displacement of 8.6 m*)
5. The current in a river is such that the water flows toward the north at 2.1 m/s. An alligator swims toward the west, at 2.4 m/s relative to the water. What is the resultant direction of travel of the alligator? (*ans: 49° W of N*)

6. An airplane heads due west with an airspeed of 84 m/s . Because of a wind blowing due north, the speed of the airplane relative to the ground is 98 m/s . What is the wind speed? (*ans: 50 m/s toward north*)
7. A 15.0 N force is used to hold a mass on a string at an angle of 32° from the vertical, as in the below diagram.



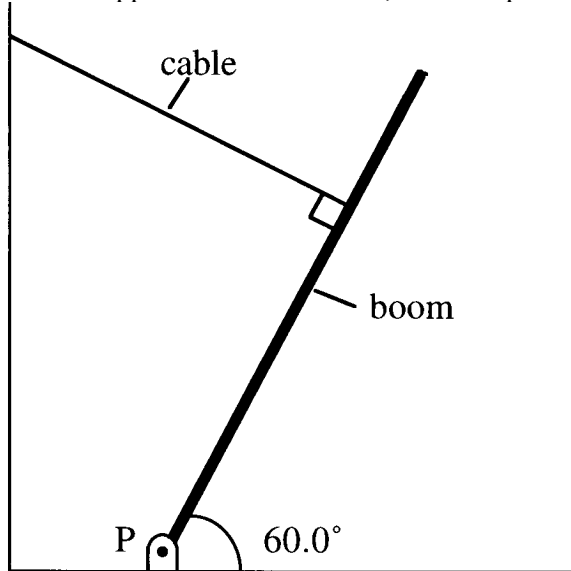
What is the mass? (*ans: 2.9 kg*)

8. A horizontal beam 2.10 m long has negligible mass.



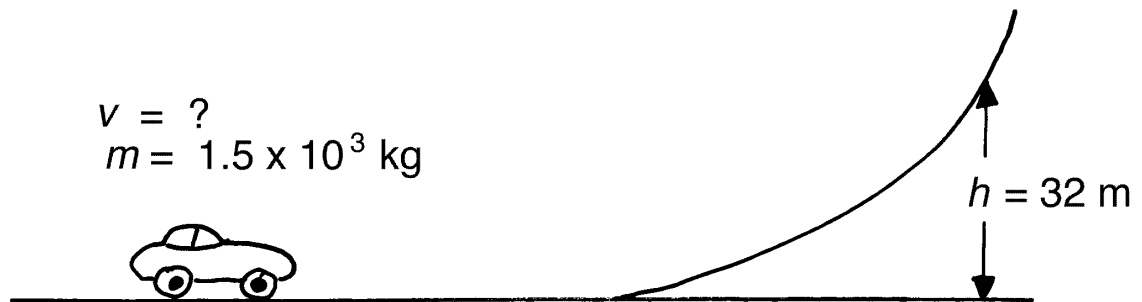
If the rope exerts a 50.0 N *horizontal* force on the beam, what is the force of gravity on the load?
(ans: . 20.6 N)

9. A cable supports a uniform boom, which is pivoted at point P.



If the cable is attached two-thirds of the way along the boom from P, and the tension force in the cable is 840 N, what is the force of gravity on the boom? (ans: 2.24×10^3 N)

10. How long will it take a $6.0 \times 10^3 \text{ W}$ motor to lift a $5.0 \times 10^3 \text{ kg}$ load through a height of 2.5 m?
(ans: 20 s)
11. The force of gravity on a wooden crate is 500.0 N. If it requires $1.5 \times 10^3 \text{ J}$ of work to push the crate at steady speed along the floor for a distance of 5.0 m, what is the coefficient of friction between the floor and the crate? (ans: $\mu = 0.60$)
12. A car loses its brakes while travelling along a highway, so the driver aims it up the hill of a runaway lane, as in the below diagram.



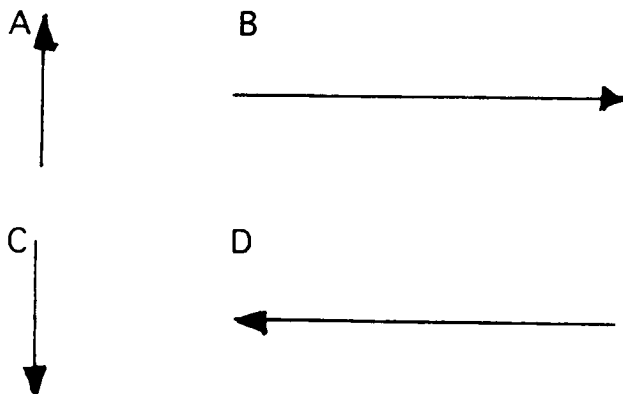
If the car comes to a stop when it reaches a vertical height of 32 m, what is the minimum speed it must have had when it entered the runaway lane? (ans: 25 m/s)

13. In a perfectly elastic collision, what is 'conserved'?
- total energy, momentum and translational kinetic energy
 - momentum only
 - total energy only
 - translational kinetic energy
 - only momentum and total energy
- (ans: a)
14. A conveyor belt lifts 60 pieces of luggage, averaging 25 kg each, 3.0 m up to the baggage compartment of an aircraft. If this work is done in 49 s, what is the power rating of the conveyor?
(ans: $9.0 \times 10^2 \text{ W}$)
15. A 2.5 g steel ball moving 0.40 m/s collides elastically with a stationary, identical ball. As a result, the incident ball is deflected 30.0° from its initial path (remember the 90° rule for same masses).
- Draw a vector diagram showing the momentum of each ball after the collision.
 - What is the velocity of the incident ball *after* the collision? (ans: 0.35 m/s, 30° to incident direction)
 - What is the velocity of the struck ball *after* the collision? (ans: 0.20 m/s, 60° to incident ball direction)

16. An object at rest explodes into three pieces: X, Y and Z. Piece X has a mass of 6.0 kg, and it moves off at 3.0 m/s. Piece Y has a mass of 1.5 kg, and it moves off at 8.0 m/s in a direction perpendicular to the direction taken by X. At what speed does piece Z move off, if its mass is 4.0 kg? (ans: 5.4 m/s)
17. A 1.2 kg toy car moving toward the east at 6.8 m/s collides with a 3.6 kg toy truck moving toward the north at 4.2 m/s. If they lock together, how many degrees east of north do they head after the collision? (ans: 28°)
18. The below diagram shows the momentum vectors, $\vec{p}_o$ and $\vec{p}_f$ of a ball striking a horizontal table, and rebounding with no change in speed.



Which of the following vectors shows the direction of the **change in momentum**, $\Delta\vec{p} = \vec{p}_f - \vec{p}_o$, of the ball during the collision?

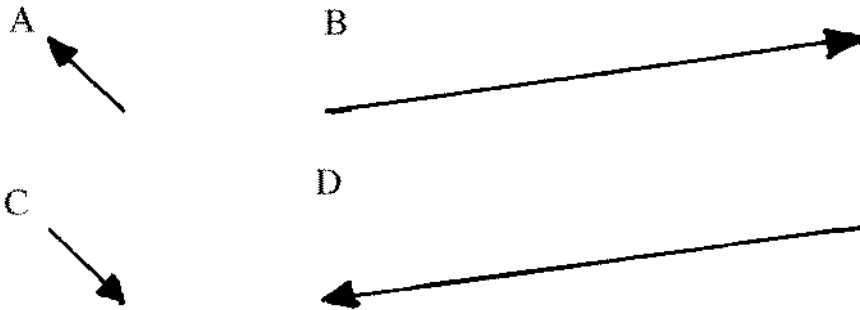


(ans: A)

19. The vectors below represent the momenta of a hockey player before and after he was body checked.

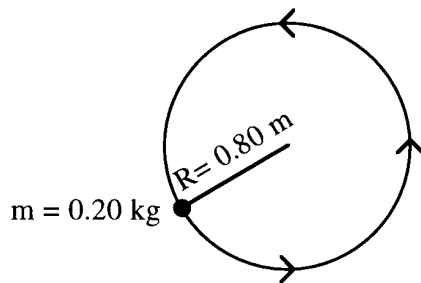


Which of the following vectors represents the impulse imparted to the hockey player by the opponent who body checked him?



(ans: A)

20. In the diagram below, a 0.20 kg air puck on the end of a string is moving in a horizontal circular path of radius 0.80 m.



- If the tension in the string is 25 N, what is the period of revolution of the air puck? (ans: 0.50s)
 - If the period of the revolving air puck is reduced by one half, and the radius is kept the same, what will the tension in the string have to be? (ans: 100 N)
21. An earth satellite orbits the earth in a circular orbit at a distance of 1.5×10^4 km from the centre of the earth
- What is the speed of the satellite? (ans: 5200 m/s)
 - What is the gravitational field strength of earth at this altitude? (ans: 1.8 m/s^2 or 1.8 N/kg)
 - If the satellite's mass is increased from m to $10m$, how will this affect the answers to (a) and (b)? (ans: No effect because m cancels)

22. Ganymede, one of Jupiter's moons, is larger than planet Mercury! Its mass is 1.54×10^{23} kg, and its radius is 2.64×10^6 m.
- a. What is the gravitational field strength, g , on Ganymede? (*ans: 1.47 N/kg , or 1.47 m/s^2*)
 - b. What is the escape velocity for a space vehicle trying to leave Ganymede? (*ans: $2.79 \times 10^3 \text{ m/s}$*)