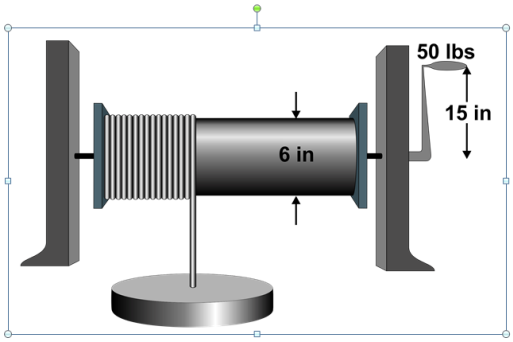
1. How much can this winch lift if 50 lbs. of force are applied to the handle with a 15 inch sweep arm?



(A) 25 lbs.
(B) 50 lbs.
(C) 100 lbs.
(D) 250 lbs.
(E) 500 lbs.

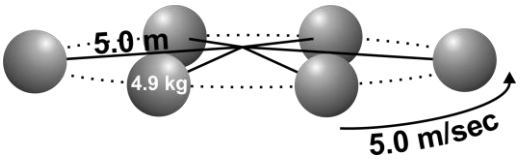
2. A ball is steadily accelerated from rest in a circular direction with an angular acceleration of 4 radians per second squared ($4\ \frac{rad}{sec^2}$). How long will it take the ball to make three revolutions?

(A) 3π sec
(B) 3.5πsec
(C) $\sqrt{(3.5\pi)\ \text{sec}}$
(D) $\sqrt{(3\pi)\ \text{sec}}$
(E) 3.7π sec

3. What is the tangential velocity of the ball in question 2 after being spun 2 revolutions if it starts out with an angular velocity of 2 radians per second, accelerates at 4 radians per second squared, and the radius of rotation is 20 centimeters?

(A) $40\sqrt{8\pi+1}\ \frac{cm}{sec}$
(B) $20\sqrt{4\pi+1}\ \frac{cm}{sec}$
(C) $80\sqrt{2\pi+1}\ \frac{cm}{sec}$
(D) $20\sqrt{8\pi+1}\ \frac{cm}{sec}$
(E) $40\sqrt{4\pi+1}\ \frac{cm}{sec}$

4. A ball weighing 4.9 newtons is swung in a circle at 5 $\frac{m}{sec}$ using a 5 meter wire. What force is exerted by the wire?



(A) 2.5 N
(B) 0.5 N
(C) 25.0 N
(D) 9.8 N
(E) 4.9 N

5. The next five questions refer to a ball at rest that is suddenly spun horizontally by a 3 meter string with an angular acceleration of 2π radians per second squared. After 5 seconds, what is its angular velocity?

(A) $2\pi \frac{rad}{sec}$
(B) $4\pi \frac{rad}{sec}$
(C) $6\pi \frac{rad}{sec}$
(D) $8\pi \frac{rad}{sec}$
(E) $10\pi \frac{rad}{sec}$

6. How many revolutions did the ball make after 5 seconds?

(A) 5 revolutions
(B) 7.5 revolutions
(C) 10 revolutions
(D) 12.5 revolutions
(E) 15 revolutions

7. What is its tangential velocity after 5 seconds?

(A) $25\pi \frac{m}{sec}$
(B) $30\pi \frac{m}{sec}$
(C) $35\pi \frac{m}{sec}$
(D) $40\pi \frac{m}{sec}$
(E) $45\pi \frac{m}{sec}$

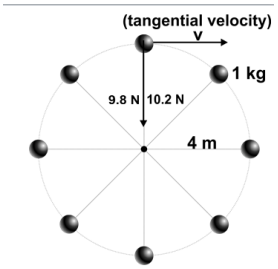
8. What is its centripetal acceleration after 5 seconds?

(A) $150\pi \frac{m}{sec^2}$
(B) $200\pi \frac{m}{sec^2}$
(C) $250\pi \frac{m}{sec^2}$
(D) $300\pi \frac{m}{sec^2}$
(E) $350\pi \frac{m}{sec^2}$

9. What is its tangential acceleration after 5 seconds?

(A) $2\pi \frac{m}{sec^2}$
(B) $4\pi \frac{m}{sec^2}$
(C) $6\pi \frac{m}{sec^2}$
(D) $8\pi \frac{m}{sec^2}$
(E) $10\pi \frac{m}{sec^2}$

10. This ball with a mass of 1 kg is being swung in a vertical circle by a 4 meter wire. The force exerted by the wire is 10.2 newtons. What is the ball's tangential velocity when the ball is at 12 o'clock high?

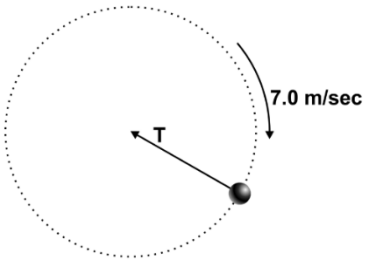


(A) $\sqrt{5}$
(B) $2\sqrt{5}$
(C) $3\sqrt{5}$
(D) $4\sqrt{5}$
(E) $5\sqrt{5}$

11. At what tangential velocity must a 200 gram ball be spun in the vertical direction by a 5 meter string in order for the ball to maintain a circular path?

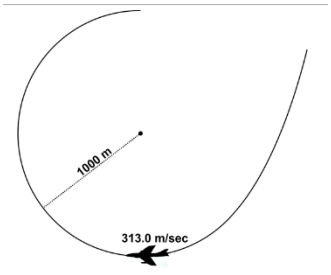
(A) $4.0\ \frac{m}{sec}$
(B) $5.0\ \frac{m}{sec}$
(C) $6.0\ \frac{m}{sec}$
(D) $7.0\ \frac{m}{sec}$
(E) $8.0\ \frac{m}{sec}$

12. What is the tension in this 5 meter string when the 200 gram ball being spun vertically at $7\ \frac{m}{sec}$ reaches the 4 o'clock position in its rotation?



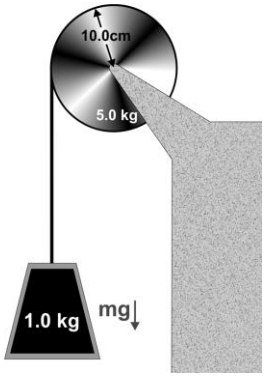
(A) 2.9 N
(B) 3.4 N
(C) 3.9 N
(D) 4.4 N
(E) 4.9 N

13. Fighter jets often have to perform steep dives. How many g's of acceleration must the pilot of this jet airplane endure if he enters the dive at 313 meters per second and has to pull out of the dive along a circular path of 1000 meter radius?



(A) 7.0 g
(B) 8.0 g
(C) 9.0 g
(D) 10.0 g
(E) 11.0 g

14. A 13.0 kg pulley with a radius of 2.0 meters is being spun by a falling 1.0 kg block. What is the angular acceleration and the tangential acceleration of the pulley?

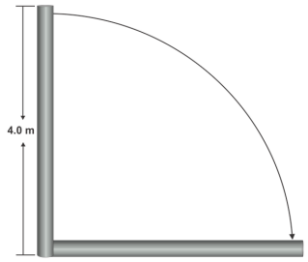


(A) $2.5\ \frac{m}{sec^2}$, 6.0 N
(B) $2.7\ \frac{m}{sec^2}$, 6.5 N
(C) $2.8\ \frac{m}{sec^2}$, 7.0 N
(D) $3.1\ \frac{m}{sec^2}$, 7.5 N
(E) $3.5\ \frac{m}{sec^2}$, 8.0 N

15. What is the angular velocity of the pulley after it has made 3 revolutions?

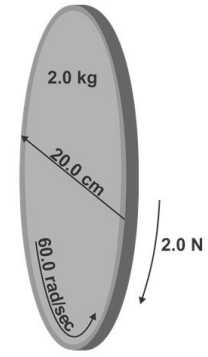
(A) $2\sqrt{(21\pi)}\ \frac{rads}{sec}$
(B) $4\sqrt{(21\pi)}\ \frac{rads}{sec}$
(C) $4\sqrt{(41\pi)}\ \frac{rads}{sec}$
(D) $2\sqrt{(41\pi}\ \frac{rads}{sec}$
(E) $6\sqrt{(41\pi)}\ \frac{rads}{sec}$

16. When this 4.0 meter rod keels over, what is the tangential speed of the top of the rod just before impact?



(A) 6.2 $\frac{m}{sec}$
(B) 6.2 $\frac{rad}{sec}$
(C) 5.4 $\frac{m}{sec}$
(D) 10.8 $\frac{m}{sec}$
(E) 12.1 $\frac{m}{sec}$

17. A 2 kg disc, 20 cm in diameter, spinning at 60 rads per second is brought to a halt with a tangential force of 2 newtons. How long does it take for the disc to come to a halt?



(A) 2.4 sec
(B) 2.6 sec
(C) 2.8 sec
(D) 3.0 sec
(E) 3.2 sec

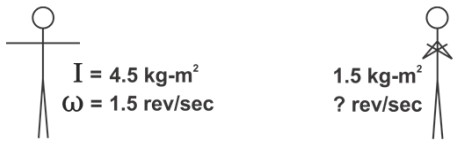
18. We've stopped a spinning disc. How about we try to stop the earth from spinning! How much force would it take to stop the earth within 1 hour?

(A) 3.1 x 10^{23} N
(B) 8.1 x 10^{23} N
(C) 3.1 x 10^{21} N
(D) 8.1 x 10^{21} N
(E) 3.1 x 10^{25} N

19. How does the force needed to stop the world from rotating over the course of 1 hour compare to the force exerted by the sun on the earth?

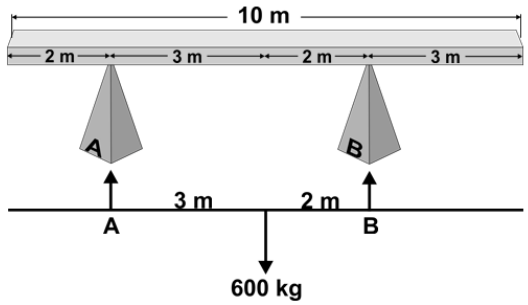
(A) 2.5 times as much
(B) 6.6 times as much
(C) 8.6 times as much
(D) 10.5 times as much
(E) 12.7 times as much

20. How much more work energy is expended by a skater spinning at 1.5 revolutions per second when she folds her arms in and reduces her moment of inertia from 4.5 kg-m^2 to 1.5 kg-m^2?



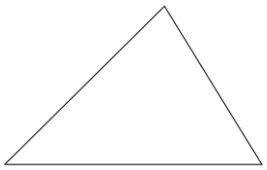
(A) half as much
(B) twice as much
(C) three times as much
(D) four times as much
(E) six times as much

21. How much weight does each pyramid support when holding up this beam weighing 600 kg?



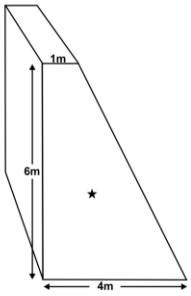
(A) A = 200 kg, B = 400 kg
(B) A = 220 kg, B = 380 kg
(C) A = 240 kg, B = 360 kg
(D) A = 260 kg, B = 340 kg
(E) A – 280 kg, B – 320 kg

22. If the center of gravity for a triangle is where the three median lines intersect, and a median line is the line that bisects an angle, how high up the vertical height of a triangle is the center of gravity?



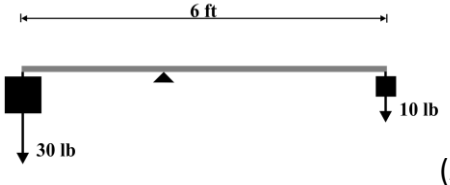
(A) 1/4 of the vertical height
(B) 1/3 of the vertical height
(C) 3/8 of the vertical height
(D) 1/2 of the vertical height
(E) 5/8 of the vertical height

23. Where is the center of gravity for this retaining wall?



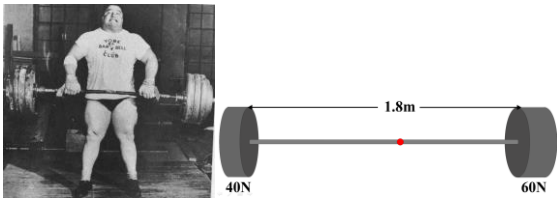
(A) 1.4m to the right of the vertical side and 2.4m up from the base
(B) 1.6m to the right of the vertical and 2.6m up from the base
(C) 1.8m to the right of the vertical and 2.4m up from the base
(D) 1.6m to the right of the vertical and 2.4m up from the base
(E) 1.8m to the right of the vertical and 2.6m up from the base

24. Where should the fulcrum be placed to balance the 30 pound weight and the 10 pound weight hanging from the ends of this 6 foot long rod?



(A) 1.0 foot to the right of the 30 pound weight
(B) 1.5 feet to the right of the 30 pound weight
(C) 2.0 feet to the right of the 30 pound weight
(D) 2.5 feet to the right of the 30 pound weight
(E) 3.0 feet to the right of the 30 pound weight

25. Here is a man lifting a set of barbells. The barbell to his left weighs 60 kg and the one to his right weighs 40 kg. His right arm, being stronger, lifts with a force of 85 kg while his left arm can only lift with a force of 65 kg. The distance between the two barbells is 1.8 meters. His hands are 0.6 meters apart. Where along the barbell should he place his hands so that the barbells remain balanced?



(A) Right hand: 0.42 meters from the right barbell, left hand 0.48 meters from the left barbell
(B) Right hand: 0.42 meters from the right barbell, left hand 0.34 meters from the left barbell
(C) Right hand: 0.32 meters from the right barbell, left hand 0.68 meters from the left barbell
(D) Right hand: 0.62 meters from the right barbell, left hand 0.48 meters from the left barbell
(E) Right hand: 0.82 meters from the right barbell, left hand 0.38 meters from the left barbell