Your code is: AADHEH

Put your name here:

Keep this exam **CLOSED** until advised by the instructor.

60 minute long closed book exam.

Fill out the bubble sheet: last name, first initial, student number, section number and **code**.

A two-sided 8.5 by 11 handwritten help sheet is allowed.

When done, hand in your **test** and your **bubble sheet**.

Thank you and good luck!

Possibly useful constants:

- g = 9.81 m/s^2
- G = 6.67×10^{-11} Nm^2/kg^2
- $\sigma = 5.67 \times 10^{-8}$ $W/(m^2K^4)$
- R= 0.0821 L*atm/(mol*K) = 8.31 J/(mol*K)

Possibly useful Moments of Inertia:

- Solid homogeneous sphere: $I_{CM} = (2/5)MR^2$
- Thin spherical shell: $I_{CM} = (2/3)MR^2$
- Thin uniform rod, axis perpendicular to length: $I_{CM} = (1/12)ML^2$
- Solid homogeneous cylinder, axis through center of mass and parallel to length: $I_{CM} = (1/2)MR^2$

Useful information for Geometry:

- Volume of a sphere: $V = (4/3)\pi r^3$
- Volume of a cylinder: $V = \pi r^2 h$

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6 pt Identify each of the statements as being either TRUE or FALSE.

▷ The unit of power, the watt is dimensionally the same as joule/second.
1. **A**◯ True **B**◯ False

▷ The unit of work, the joule is dimensionally the same as newton×meter.
2. **A**◯ True **B**◯ False

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6 pt

▷ Can a system of two or more objects have a total momentum that is not zero but a total kinetic energy that is zero?
3. **A**◯ Yes **B**◯ No

▷ Can a system of two or more objects have a total kinetic energy that is not zero but a total momentum that is zero?
4. **A**◯ Yes **B**◯ No

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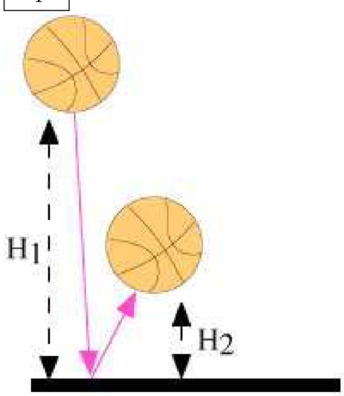
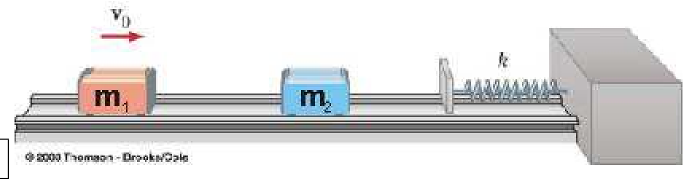
8 pt



A ball of mass 1.5 kg is dropped from a height of $h_1 = 9$ m, bouncing back up to a height of $h_2 = 4.6$ m. Assuming that there is no air resistance, how much energy is lost in the bounce off the floor?

5.**A**◯ 31.10 **B**◯ 35.14 **C**◯ 39.71 **D**◯ 44.87
E◯ 50.71 **F**◯ 57.30 **G**◯ 64.75 **H**◯ 73.16



12 pt

The mass m_1 enters from the left with velocity v_0 and strikes a mass $m_2 > m_1$ which is initially at rest. The collision between the blocks is perfectly elastic. The mass m_2 then compresses the spring an amount x. (positive velocities move to the right)

▷ The maximum energy stored in the spring is ...... the initial energy of m_1.
6. **A**◯ greater than **B**◯ equal to
C◯ less than

▷ Immediately after colliding with m_2, the velocity of mass m_1 is .... zero.
7. **A**◯ greater than **B**◯ equal to
C◯ less than

▷ Immediately after the collision, the momentum of m_2 is .... the initial momentum of m_1.
8. **A**◯ greater than **B**◯ equal to
C◯ less than

▷ Immediately after the collision, the energy of m_2 is ...... the initial energy of m_1.
9. **A**◯ greater than **B**◯ equal to
C◯ less than

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9 pt A proposed space station includes living quarters in a circular ring 61.5 m in diameter. At what angular speed should the ring rotate so the occupants feel that they have the same weight as they do on Earth?
(in `rad/s`*)*

10.**A**◯ 7.67×10^{-2} **B**◯ 1.02×10^{-1} **C**◯ 1.36×10^{-1}
D◯ 1.81×10^{-1} **E**◯ 2.40×10^{-1} **F**◯ 3.19×10^{-1}
G◯ 4.25×10^{-1} **H**◯ 5.65×10^{-1}

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9 pt The flywheel of a steam engine begins to rotate from rest with a constant angular acceleration of 1.33 rad/s^2. It accelerates for 28.7 s, then maintains a constant angular velocity. Calculate the total angle through which the wheel has turned 51.7 s after it begins rotating.
(in `rad`*)*

11.**A**◯ 7.74×10^{2} **B**◯ 8.74×10^{2} **C**◯ 9.88×10^{2}
D◯ 1.12×10^{3} **E**◯ 1.26×10^{3} **F**◯ 1.43×10^{3}
G◯ 1.61×10^{3} **H**◯ 1.82×10^{3}

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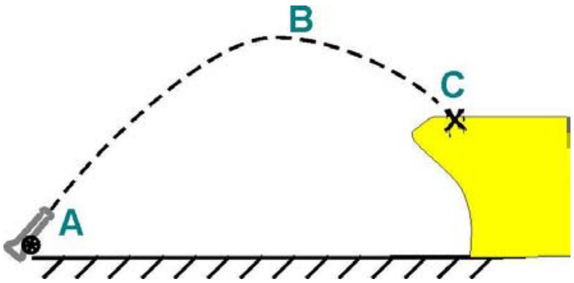
9 pt Consider a projectile which strikes a target as shown below. Ignore all forces except gravity. Point A refers to a point just beyond the muzzle of the cannon, B refers to the highest point in the trajectory and C refers to a point just before landing on the cliff.



▷ The acceleration at B is ____ the acceleration at C.

12. **A**◯ greater than **B**◯ less than **C**◯ equal to

▷ The magnitude of the vertical component of the velocity at A is ____ the magnitude of the vertical component of the velocity at C

13. **A**◯ greater than **B**◯ less than **C**◯ equal to

▷ The horizontal component of the velocity at A is ____ than the horizontal component of the velocity at C.

14. **A**◯ greater than **B**◯ less than **C**◯ equal to

A billiard ball moving at 5.3 m/s strikes a stationary ball of the same mass. After the collision, the first ball moves at 2.90 m/s at an angle of -56.79° with respect to the original line of motion.

8 pt What is the speed of the second ball after the collision? *(in* `m/s`*)*

15.A◯ 1.48 **B**◯ 1.73 **C**◯ 2.02 **D**◯ 2.37
E◯ 2.77 **F**◯ 3.24 **G**◯ 3.79 **H**◯ 4.43

8 pt At what angle did the second ball move relative to the direction of the first ball? (Give answer in degrees)

16.A◯ 2.46 **B**◯ 3.57 **C**◯ 5.18 **D**◯ 7.51
E◯ 10.89 **F**◯ 15.80 **G**◯ 22.90 **H**◯ 33.21

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9 pt Identify the statements as being either True or False.

▷ An object moving in a circle with constant speed has zero acceleration.

17. **A**◯ True **B**◯ False

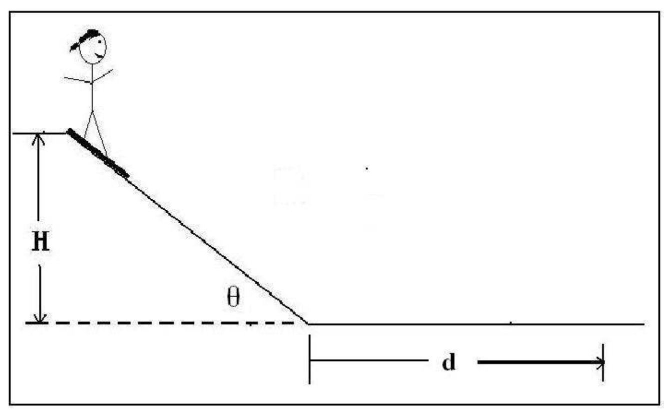
▷ If two planets have the same mass, but the second has twice the gravity, the second planet must also have half the radius.

18. **A**◯ True **B**◯ False

▷ Consider two planets orbiting a star. If one planet has three times the period of another, it must also have two times the average orbital distance.

19. **A**◯ True **B**◯ False

A 61.8 kg snowboarder starts from rest at the top of a 22.5 m high hill. The hill is inclined at an angle of 16 degrees relative to the horizontal. The hill is frictionless, but the horizontal surface at the bottom of the hill is rough. The coefficient of kinetic friction between the snowboard and the horizontal surface is 0.24. The incline makes an angle of 16 degrees with the horizontal.



8 pt What is the snowboarder's speed when she reaches the bottom of the hill?

20.A◯ 5.0 **B**◯ 6.7 **C**◯ 8.9 **D**◯ 11.9
E◯ 15.8 **F**◯ 21.0 **G**◯ 27.9 **H**◯ 37.2

8 pt How far does the snowboarder travel (d) after reaching the bottom of the hill before she comes to rest?

21.A◯ 29.96 **B**◯ 39.85 **C**◯ 53.00
D◯ 70.49 **E**◯ 93.75 **F**◯ 124.69
G◯ 165.83 **H**◯ 220.56