

Instructor(s): *C. Parks*PHYSICS DEPARTMENT
EXAM 2 – The Simpsons

PHY2053, Summer 2015

July 9, 2015

Name (print, last first): _____ Signature: _____

*On my honor, I have neither given nor received unauthorized aid on this examination.***YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.**

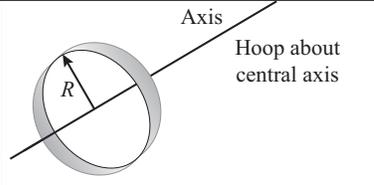
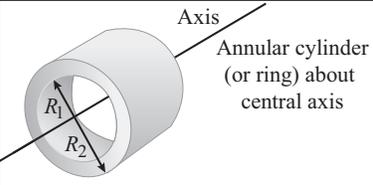
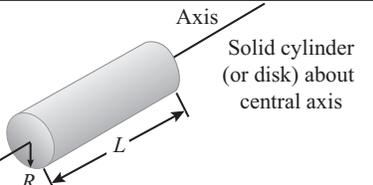
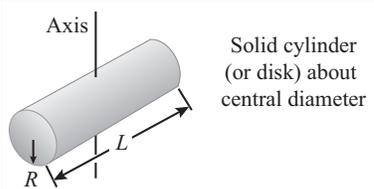
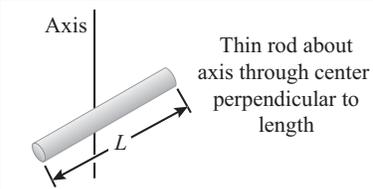
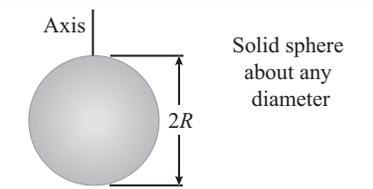
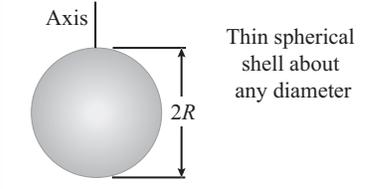
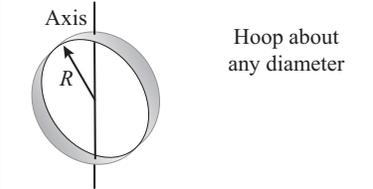
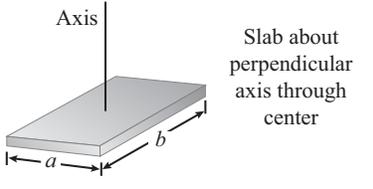
- (1) **Code your test number on your answer sheet (use lines 76–80 on the answer sheet for the 5-digit number).** Code your name on your answer sheet. **DARKEN CIRCLES COMPLETELY.** Code your UFID number on your answer sheet.
- (2) Print your name on this sheet and sign it also.
- (3) Do all scratch work anywhere on this exam that you like. **Circle your answers on the test form.** At the end of the test, this exam printout is to be turned in. No credit will be given without both answer sheet and printout.
- (4) **Blacken the circle of your intended answer completely, using a #2 pencil or blue or black ink.** Do not make any stray marks or some answers may be counted as incorrect.
- (5) **The answers are rounded off. Choose the closest to exact.** There is no penalty for guessing. **If you believe that no listed answer is correct, leave the form blank.**
- (6) Hand in the answer sheet separately.

Given Information:

$g = 9.80 \text{ m/s}^2$

$1 \text{ m} = 100 \text{ cm}$

$1 \text{ kg} = 1000 \text{ g}$

 <p>Hoop about central axis</p> $I = MR^2$	 <p>Annular cylinder (or ring) about central axis</p> $I = \frac{1}{2} M(R_1^2 + R_2^2)$	 <p>Solid cylinder (or disk) about central axis</p> $I = \frac{1}{2} MR^2$
 <p>Solid cylinder (or disk) about central diameter</p> $I = \frac{1}{4} MR^2 + \frac{1}{12} ML^2$	 <p>Thin rod about axis through center perpendicular to length</p> $I = \frac{1}{12} ML^2$	 <p>Solid sphere about any diameter</p> $I = \frac{2}{5} MR^2$
 <p>Thin spherical shell about any diameter</p> $I = \frac{2}{3} MR^2$	 <p>Hoop about any diameter</p> $I = \frac{1}{2} MR^2$	 <p>Slab about perpendicular axis through center</p> $I = \frac{1}{12} M(a^2 + b^2)$

1. While driving, Marge does not remember that the fuel gauge is broken and runs out of gas. The 750-kg automobile is moving at 10.0 m/s at a height of 5.0 m above the bottom of a hill when the engine stops. The car coasts down the hill and then continues coasting up the other side until it comes to rest. Ignoring frictional forces and air resistance, what is the value of h , the highest position the car reaches above the bottom of the hill?

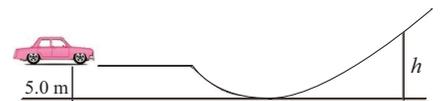


- (1) 10 m (2) 5.0 m (3) 15 m (4) 20 m (5) None of these.

2. While driving, Marge does not remember that the fuel gauge is broken and runs out of gas. The 750-kg automobile is moving at 10.0 m/s at a height of 5.0 m above the bottom of a hill when the engine stops. Seeing a gas station at the bottom of the hill she uses the brake to slow the car so that it just barely enters the station (its speed is essentially zero). How much work is done by the brakes to stop the car?

- (1) -7.4×10^4 J (2) -3.8×10^4 J (3) -3.7×10^4 J (4) -5.7×10^4 J (5) None of these.

3. While driving, Marge does not remember that the fuel gauge is broken and runs out of gas. The 1000-kg automobile is moving at 14.0 m/s at a height of 5.0 m above the bottom of a hill when the engine stops. The car coasts down the hill and then continues coasting up the other side until it comes to rest. Ignoring frictional forces and air resistance, what is the value of h , the highest position the car reaches above the bottom of the hill?



- (1) 15 m (2) 10 m (3) 20 m (4) 25 m (5) None of these.

4. While driving, Marge does not remember that the fuel gauge is broken and runs out of gas. The 1000-kg automobile is moving at 14.0 m/s at a height of 5.0 m above the bottom of a hill when the engine stops. Seeing a gas station at the bottom of the hill she uses the brake to slow the car so that it just barely enters the station (its speed is essentially zero). How much work is done by the brakes to stop the car?

- (1) -1.5×10^5 J (2) -9.8×10^4 J (3) -4.9×10^4 J (4) -1.2×10^5 J (5) None of these.

5. At the Kwik-E-Mart, Apu weighs a 7.0-kg piece of 2 week old meat. The spring scale is stretched 5.0 cm. He adds an additional 5.0 kg piece of meat to the scale. What is the additional stretch of the spring?



- (1) 3.6 cm (2) 8.6 cm (3) 12 cm (4) 7.0 cm (5) None of these.

6. At the Kwik-E-Mart, Apu weighs a 8.0-kg piece of 2 week old meat. The spring scale is stretched 5.0 cm. He adds an additional 5.0 kg piece of meat to the scale. What is the additional stretch of the spring?



- (1) 3.1 cm (2) 8.1 cm (3) 13 cm (4) 8.0 cm (5) None of these.

7. Bart uses a spring gun ($k = 28 \text{ N/m}$) to shoot a 56 g ball horizontally. Initially the spring is compressed by 18 cm. The ball loses contact with the spring and leaves the gun when the spring is still compressed by 12 cm. What is the speed of the ball when it leaves the gun?

- (1) 3.0 m/s
- (2) 4.0 m/s
- (3) 2.7 m/s
- (4) 5.1 m/s
- (5) None of these.



8. Bart uses a spring gun ($k = 16 \text{ N/m}$) to shoot a 45 g ball horizontally. Initially the spring is compressed by 18 cm. The ball loses contact with the spring and leaves the gun when the spring is still compressed by 12 cm. What is the speed of the ball when it leaves the gun?

- (1) 2.5 m/s
- (2) 3.4 m/s
- (3) 2.3 m/s
- (4) 3.9 m/s
- (5) None of these.



9. Flanders rides his bicycle for exercise. The power required to ride at 6.0 m/s on level ground is 120 W. What is the force exerted on Flanders and his bike by the air and friction?

- (1) 20 N
- (2) 10 N
- (3) 15 N
- (4) 0.050 N
- (5) None of these.



10. Flanders rides his bicycle for exercise. The power required to ride at 8.0 m/s on level ground is 120 W. What is the force exerted on Flanders and his bike by the air and friction?

- (1) 15 N
- (2) 20 N
- (3) 10 N
- (4) 0.067 N
- (5) None of these.



11. Homer drops his Lard Lad donut. "D'oh!" he says. The donut's mass is 0.90 kg and it falls from a height of 1.4 m. After hitting the ground, the donut bounces up and reaches a height of 1.0 m above the floor. What is the impulse of the floor on the donut?

- (1) 8.7 N-s
- (2) 0.73 N-s
- (3) 2.4 N-s
- (4) 2.2 N-s



- (5) None of these.

12. Homer drops his Lard Lad donut. "D'oh!" he says. The donut's mass is 1.2-kg and it falls from a height of 1.5 m. After hitting the ground, the donut bounces up and reaches a height of 1.1 m above the floor. What is the impulse of the floor on the donut?

- (1) 12 N-s
- (2) 0.93 N-s
- (3) 2.6 N-s
- (4) 2.5 N-s



- (5) None of these.

13. Bart finds a firecracker. Borrowing a match from Snake, he sets off the firecracker. The explosion breaks the firecracker into two pieces, one has mass $2m$ and the other $3m$. The lighter piece flies off at 50 m/s . What is the speed of the heavier piece?

- (1) 33 m/s
- (2) 75 m/s
- (3) 50 m/s
- (4) 67 m/s
- (5) None of these.



14. Bart finds a firecracker. Borrowing a match from Snake, he sets off the firecracker. The explosion breaks the firecracker into two pieces, one has mass $2m$ and the other $3m$. The heavier piece flies off at 50 m/s . What is the speed of the lighter piece?

- (1) 75 m/s
- (2) 33 m/s
- (3) 50 m/s
- (4) 67 m/s
- (5) None of these.



15. At the Springfield Fall Carnival, Bart and Millhouse are riding the bumper cars. Bart is headed to the left at 3.0 m/s and his cart's mass is 50 kg . Millhouse's cart heads to the right at 2.5 m/s and its mass is 45 kg . The carts collide head on elastically. What is the final speed of each cart after the collision? Do not include signs with your answers.

- (1) Bart: 2.2 m/s , Millhouse: 3.3 m/s
- (2) Bart: 3.3 m/s , Millhouse: 2.2 m/s
- (3) Bart: 2.5 m/s , Millhouse: 3.0 m/s
- (4) Bart: 2.7 m/s , Millhouse: 2.8 m/s
- (5) None of these.



16. At the Springfield Fall Carnival, Bart and Millhouse are riding the bumper cars. Bart is headed to the left at 4.0 m/s and his cart's mass is 50 kg . Millhouse's cart heads to the right at 3.0 m/s and its mass is 45 kg . The carts collide head on elastically. What is the final speed of each cart after the collision? Do not include signs with your answers.

- (1) Bart: 2.6 m/s , Millhouse: 4.4 m/s
- (2) Bart: 4.4 m/s , Millhouse: 2.6 m/s
- (3) Bart: 3.0 m/s , Millhouse: 4.0 m/s
- (4) Bart: 3.5 m/s , Millhouse: 3.5 m/s
- (5) None of these.



17. While driving home from the nuclear power plant, Homer is distracted and does not see the stop sign and crashes into a car in front of him. Homer is traveling at 45 mph (miles/hour) and his car's mass is 750 kg . The car he hits is originally at rest and has a mass of 1000 kg . The cars stick together after the collision. What is the speed of the cars immediately after the collision?

- (1) 19 mph
- (2) 23 mph
- (3) 26 mph
- (4) 29 mph



- (5) None of these.

18. While driving home from the nuclear power plant, Homer is distracted and does not see the stop sign and crashes into a car in front of him. Homer is traveling at 40 mph (miles/hour) and his car's mass is 750 kg. The car he hits is originally at rest and has a mass of 1200 kg. The cars stick together after the collision. What is the speed of cars immediately after the collision?



- (1) 15 mph (2) 20 mph (3) 25 mph (4) 28 mph (5) None of these.

19. Carl and Lenny are shooting pool at Moe's tavern. Carl's cue ball strikes a stationary ball. After the elastic collision, the cue ball's direction changes by 30° . The target ball is also moving after the collision. What is the direction of the target ball relative to the initial direction of the cue ball?



- (1) 60°
 (2) 30°
 (3) 45°
 (4) 55°
 (5) None of these.

20. Carl and Lenny are shooting pool at Moe's tavern. Carl's cue ball strikes a stationary ball. After the elastic collision, the cue ball's direction changes by 20° . The target ball is also moving after the collision. What is the direction of the target ball relative to the initial direction of the cue ball?



- (1) 70°
 (2) 20°
 (3) 45°
 (4) 35°
 (5) None of these.

21. Lisa's art project is a mobile made of balsa wood and clay. The wooden rod is 0.30 m long and holds two pieces of clay. On the left side of the rod is a 0.30 kg piece of clay and on the right side is a 0.20 kg piece of clay. Since balsa wood is so light, its mass can be neglected. The rod and clay are held up by a string so that the rod is horizontal. If the rod spins about the string so that the rod remains horizontal, what is the mobile's rotational inertia?



- (1) $0.012 \text{ kg}\cdot\text{m}^2$ (2) $0.018 \text{ kg}\cdot\text{m}^2$ (3) $0.014 \text{ kg}\cdot\text{m}^2$ (4) $0.036 \text{ kg}\cdot\text{m}^2$ (5) None of these.

22. Lisa's art project is a mobile made of balsa wood and clay. The wooden rod is 0.30 m long and holds two pieces of clay. On the left side of the rod is a 0.40 kg piece of clay and on the right side is a 0.10 kg piece of clay. Since balsa wood is so light, its mass can be neglected. The rod and clay are held up by a string so that the rod is horizontal. If the rod spins about the string so that the rod remains horizontal, what is the mobile's rotational inertia?



- (1) $0.0072 \text{ kg}\cdot\text{m}^2$ (2) $0.023 \text{ kg}\cdot\text{m}^2$ (3) $0.011 \text{ kg}\cdot\text{m}^2$ (4) $0.048 \text{ kg}\cdot\text{m}^2$ (5) None of these.

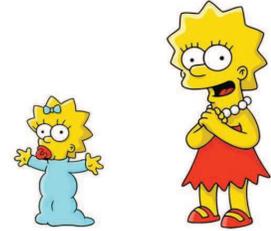
23. Flanders is painting his house. His 3.0 m, 20 kg ladder is leaning against the house and makes a 65° angle with the level ground. Remembering his physics, Flanders raises the ladder so that it makes a 75° angle with the ground, changing the force that the wall exerts on the ladder. Does the force increase or decrease and by how much does it change? Assume the center of mass of the ladder is at its geometrical center and that the wall does not exert a frictional force on the top of the ladder.

- (1) decreases by 19 N (2) increases by 19 N (3) decreases by 39 N (4) increases by 39 N (5) None of these.

24. Flanders is painting his house. His 3.0 m, 25 kg ladder is leaning against the house and makes a 65° angle with the level ground. Remembering his physics, Flanders raises the ladder so that it makes a 75° angle with the ground, changing the force that the wall exerts on the ladder. Does the force increase or decrease and by how much does it change? Assume the center of mass of the ladder is at its geometrical center and that the wall does not exert a frictional force on the top of the ladder.

- (1) decreases by 24 N (2) increases by 24 N (3) decreases by 49 N (4) increases by 49 N (5) None of these.

25. Maggie and Lisa are riding the merry-go-round. The merry-go-round is a 500-kg, 10-m diameter disk. It takes 15 s for the ride to reach its operating speed of 2.6 rad/s. How much torque is needed to bring the merry-go-round to its operating speed? Assume the ride starts from rest and that frictional forces can be neglected.



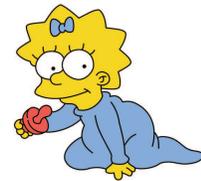
- (1) 1100 N-m (2) 2200 N-m (3) 870 N-m (4) 1500 N-m (5) None of these.

26. Maggie and Lisa are riding the merry-go-round. The merry-go-round is a 500-kg, 10-m diameter disk. It takes 15 s for the ride to reach its operating speed of 4.0 rad/s. How much torque is needed to bring the merry-go-round to its operating speed? Assume the ride starts from rest and that frictional forces can be neglected.



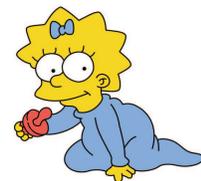
- (1) 1700 N-m (2) 3300 N-m (3) 1300 N-m (4) 2200 N-m (5) None of these.

27. Maggie rolls a ball down a hill. The ball is a thin spherical shell. Its radius is 10 cm and its mass is 0.50 kg. What is the linear speed of the sphere after it has descended 2.0 m down the hill? Assume the ball is released from rest.



- (1) 4.8 m/s (2) 6.3 m/s (3) 5.3 m/s (4) 2.4 m/s (5) None of these

28. Maggie rolls a ball down a hill. The ball is a thin spherical shell. Its radius is 10 cm and its mass is 0.50 kg. What is the linear speed of the sphere after it has descended 3.0 m down the hill? Assume the ball is released from rest.



- (1) 5.9 m/s (2) 7.7 m/s (3) 6.5 m/s (4) 2.5 m/s (5) None of these

29. Eager to impress Marge, Homer decides to take up figure skating. He begins his spin with his leg and arms extended. Pulling his leg and arms in, his rotational inertia is reduced by $1/3$. By what factor is his angular velocity changed?

- (1) 1.5
 (2) 3.0
 (3) 0.33
 (4) 0.66
 (5) None of these.



30. Eager to impress Marge, Homer decides to take up figure skating. He begins his spin with his leg and arms extended. Pulling his leg and arms in, his rotational inertia is reduced by $1/4$. By what factor is his angular velocity changed?

- (1) 1.33
- (2) 4.0
- (3) 0.25
- (4) 0.50
- (5) None of these.



THE FOLLOWING QUESTIONS, NUMBERED IN THE ORDER OF THEIR APPEARANCE ON THE ABOVE LIST, HAVE BEEN FLAGGED AS CONTINUATION QUESTIONS: 2 4 FOLLOWING GROUPS OF QUESTIONS WILL BE SELECTED AS ONE GROUP FROM EACH TYPE

TYPE 1

Q# S 1 2

Q# S 3 4

TYPE 2

Q# S 5

Q# S 6

TYPE 3

Q# S 7

Q# S 8

TYPE 4

Q# S 9

Q# S 10

TYPE 5

Q# S 11

Q# S 12

TYPE 6

Q# S 13

Q# S 14

TYPE 7

Q# S 15

Q# S 16

TYPE 8

Q# S 17

Q# S 18

TYPE 9

Q# S 19

Q# S 20

TYPE 10

Q# S 21

Q# S 22

TYPE 11

Q# S 23

Q# S 24

TYPE 12

Q# S 25

Q# S 26

TYPE 13

Q# S 27

Q# S 28

TYPE 14

Q# S 29

Q# S 30