NJSL Physics II (AP1 PHYSICS) GOLDEN ROD

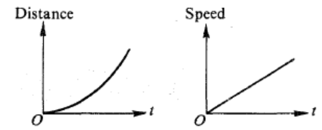
JANUARY 15, 2015

This exam is for all students currently enrolled in ap physics I.

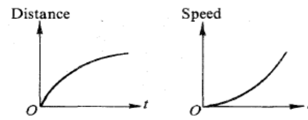
Directions: For each question or statement fill in the appropriate space on the answer sheet. Use the letter preceding the word, phrase, or quantity which best completes or answers the question. Each of the 25 questions is worth 4 points. ***Use: g =10 m/s²***

1. Which one of the following pairs of graphs - one is a distance/time graph and the other is a speed/time graph - show the same object over the same time interval?

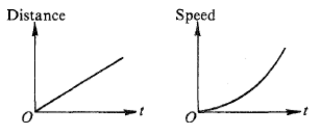
(A)



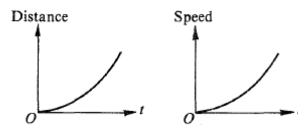
(B)



(C)



(D)



2. A projectile is shot upward and toward the right at some initial non-zero velocity at some angle larger than 0^o, but smaller than 90^o, to the horizontal. When the projectile reaches its maximum height above the ground, which combination of horizontal velocity, V_H, vertical velocity, V_V, and acceleration, **a**, is true? Ignore air resistance and use the ***x-y*** plane conventions of *up* and *right* as positive (+) directions.

	V_H	V_V	a
(A)	Positive	Positive	Positive
(B)	Positive	Zero	Zero
(C)	Zero	Negative	Zero
(D)	Positive	Zero	Negative

Use the following information for Questions #3 - 5: For a Lab activity in Physics AP1, your instructor constructs a large Spud Gun; a cannon that shoots potatoes using a chemical propellant. When fired on level horizontal ground, you note the flaming potatoes leaves the barrel at an astonishing velocity of 200 m/s. The cannon is aimed and fired at an angle of 37^o above horizontal. Ignore air resistance. (***Use*** $\sin 37^o = 0.6$ ***and/or*** $\cos 37^o = 0.8$)

3. What is the total time the potato projectile was in the air?

(A) 12 s (B) 16 s (C) 24 s (D) 32 s

4. What was the maximum height above the ground reached by the spud?

(A) 120m (B) 720m (C) 1280m (D) 3840m

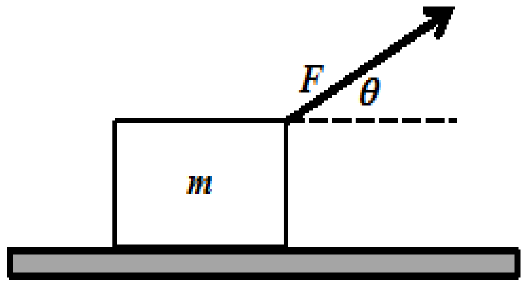
5. How far away horizontally did the spud land on the level ground?

(A) 120m (B) 720m (C) 1280m (D) 3840m

6. The science world was recently rocked by the discovery of a new planet, *Fizzoid*. Fizzoid has a radius about four times Earth radius, R_E, yet the gravitational force at the surface of Fizzoid is the same as here at the surface of Earth. Relative to the mass of Earth, M_E, what is the mass of Fizzoid?

(A) $\frac{M_E}{16}$ (B) $\frac{M_E}{4}$ (C) $4M_E$ (D) $16M_E$

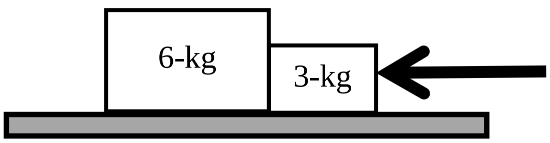
Use the following information for Questions #7 & 8: Consider a mass ***m*** being pulled across a rough floor at constant velocity by a rope providing a force ***F*** that makes an angle of θ to the horizontal. The coefficient of kinetic friction is μ.



7. What is the normal force exerted by the surface on the block?
(A) mg (B) $mg + F\sin\theta$
(C) $F\sin\theta$ (D) $mg - F\sin\theta$

8. What is the magnitude of the frictional force?
(A) $F\cos\theta$ (B) $F\sin\theta$
(C) Zero (D) $\mu F\cos\theta$

9. In another Physics class demo, your instructor shows the following:



A 27N force is applied to the left on two solid blocks in contact with each other on a frictionless surface, acting directly on the 3kg block. What is the magnitude of the force the 6-kg block exerts on the 3-kg block?
(A) 3 N (B) 6 N (C) 18 N (D) 27 N

10. During a Physics class field trip you travel to the surface of Mars where you test the acceleration due to gravity on the surface. You note that a Mars rock falls a vertical distance of 2 meters in one second. How far would this same rock fall during a ***second*** **second** of fall, if dropped from a sufficiently large height?
(A) 2 m (B) 4 m (C) 6 m (D) 10 m

11. The *Iridium* fleet of satellites, 72 operational & in orbit around the Earth, is used for communications and cover the entire surface of the planet. The original plan was for 77 satellites, thereby the name *Iridium*; element #77. If one such Iridium satellite is in stable circular orbit around Earth with a speed of v_i and an orbital radius ***R*** from the center of Earth, what is the speed of an identical Iridium satellite in stable circular orbit at an orbital radius of $R/2$?

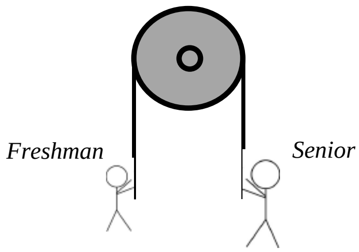
(A) $v_i/2$ (B) $\sqrt{2}v_i$ (C) $v_i/\sqrt{2}$ (D) $2v_i$

12. If F_E is the magnitude of the force of gravity exerted by Earth on the Iridium satellite at radius ***R*** mentioned in the previous question, and F_S is the magnitude of the force exerted by the satellite on the Earth, what is the relationship between F_E and F_S?
(A) F_E is much larger than F_S (B) Both F_E and F_S are zero
(C) F_E is non-zero and equal to F_S (D) F_E is zero and F_S is small, but non-zero

13. At the instant a stationary observer, standing along a roadside, notices a bicyclist zip past with a speed v_C to the east, the cyclist looks to his left away from the observer and observes an eagle flying due north at a speed of v_E relative to the cycle. What is the speed of the eagle as observed by the stationary observer?

(A) $v_C + v_E$ (B) $v_C - v_E$ (C) $\sqrt{v_C^2 - v_E^2}$ (D) $\sqrt{v_C^2 + v_E^2}$

Use the following information for Questions #14 - 17: Shown below is an Atwood machine with a 50kg *freshman* on the left and a 75kg *senior* on the right hanging by massless ropes from a frictionless massless pulley that is locked in place.



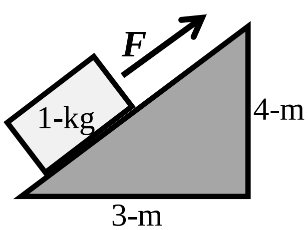
14. While the pair is stationary, what is the tension in the rope holding the senior?
(A) 250 N (B) 500 N (C) 750 N (D) 1250 N

Now, the pulley is released and free to rotate.
15. What acceleration does the freshman experience?
(A) 2 m/s^2 upward (B) 2 m/s^2 downward
(C) 5 m/s^2 upward (D) 5 m/s^2 downward

16. After the pulley is released, what is the magnitude of the tension in the rope the senior is holding onto?

(A) 1250 N (B) 600 N (C) 300 N (D) 250 N
17. If the senior and freshman started at rest from a height of 4 m above the floor, with what speed does the one traveling downward strike the floor?
(A) 2 m/s (B) 4 m/s (C) 6 m/s (D) 10 m/s

18. An inclined plane is shown, not to scale, with a mass moving upward at constant speed under the influence of a force ***F***. If the coefficient of kinetic friction is 0.5, what is the magnitude of ***F*** so the block continues at a constant speed up the plane?

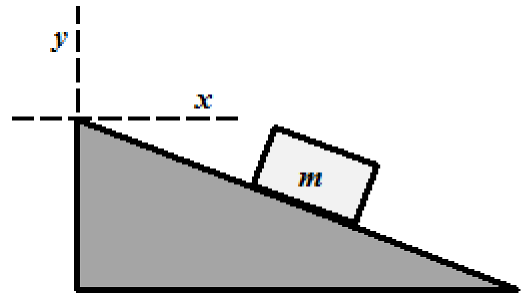


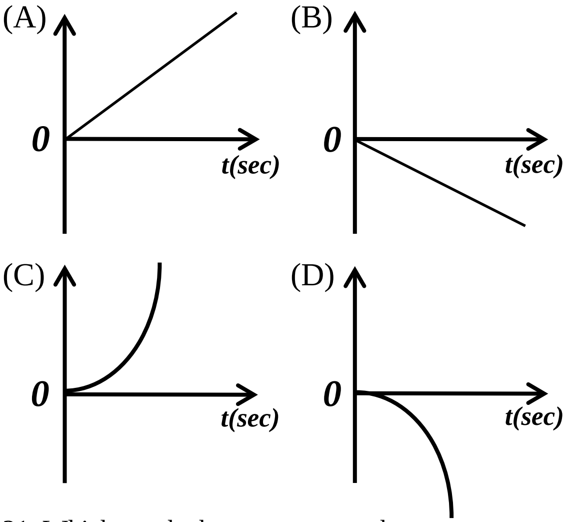
(A) 5 N (B) 8 N (C) 11 N (D) Not enough info provided.

19. What happens to the gravitational attraction, ***F***, between two objects if you cut the distance between them in half and at the same time doubling both masses? Answer in terms of ***F***.
(A) 16***F*** (B) 4***F*** (C) 2 ***F*** (D) ***F***

20. Of the following quantities, which is the most important in determining the maximum time a projectile, shot at an initial velocity of $\boldsymbol{V_o}$ at a non-zero angle $\boldsymbol{\theta}$ above horizontal, will have? Assume level horizontal ground so the projectile ends at the same vertical height as it was fired and neglect air resistance.
(A) Initial vertical velocity (B) Initial horizontal velocity
(C) Horizontal displacement (D) Horizontal acceleration

Use the following information for Questions #21 & 22: A block of mass ***m*** slides down a frictionless ramp as shown lower right. Using the conventional directions for the *x*-*y* axis, the block begins at rest at the origin of the axis (top of the ramp) at $t = 0$. The following four graphs represent possible relationships of the motion of the block down the ramp.

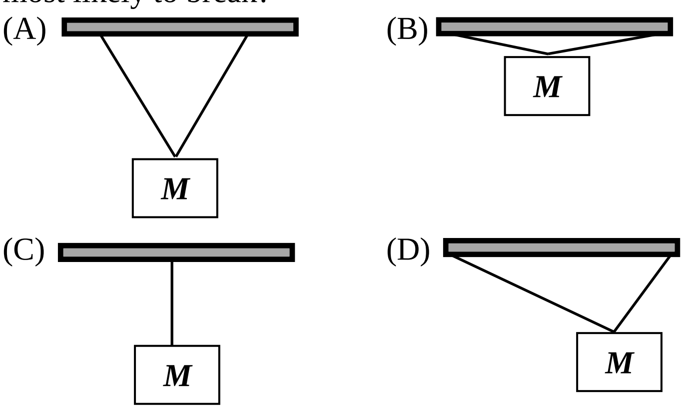




21. Which graph above represents the x-component of the *velocity* as a function of time?
(A) A (B) B (C) C (D) D

22. Which graph above represents the x-component of the *position* as a function of time?
(A) A (B) B (C) C (D) D

23. A mass ***M*** can be suspended by a string in any of the four methods shown below. In which case is the string most likely to break?



24. Of the following list, which features of an automobile can directly cause the car to undergo an acceleration?

I. Gas pedal II. Brake Pedal III. Steering wheel IV. Radio

(A) I only (B) II only (C) I & II only (D) I, II, & III only

25. A nearby star has a mass of 5 times our Sun, $\boldsymbol{M_{Sun}}$. One of the planets orbiting this nearby star has an average orbital radius of 5 times the orbital radius of Earth, $\boldsymbol{R_E}$. What is the orbital period of this planet in terms of Earth years?

(A) $\sqrt{5}$ (B) 5 (C) 25 (D) 125

NJSL Physics II (AP1 PHYSICS) **<u>GOLDEN ROD</u>**

JANUARY 15, 2015

SOLUTIONS

1. A	14. C
2. D	15. A
3. C	16. B
4. B	17. B
5. D	18. C
6. D	19. A
7. D	20. A
8. A	21. A
9. C	22. C
10. C	23. B
11. B	24. D
12. C	25. B
13. D	

NJSL Physics II (AP1 PHYSICS) <u>GOLDEN ROD</u>

FEBRUARY 12, 2015

<u>This exam is for all students currently enrolled in ap physics I.</u>

Directions: For each question or statement fill in the appropriate space on the answer sheet. Use the letter preceding the word, phrase, or quantity which best completes or answers the question. Each of the 25 questions is worth 4 points.

Use: g =10 m/s^2.

1. In order for a system to be considered to be in *simple harmonic motion*, which statement below must be true?
(A) The net force must obey Hooke's Law.
(B) It is in periodic motion.
(C) The net force must equal zero
(D) The net force acting on the system must cause only positive acceleration.

2. A simple pendulum consists of a massless string of length ***L*** and a mass ***M*** attached at one end which oscillates with period ***T***. If you double *both* the length ***L*** and the mass ***M***, the period of oscillation is

(A) $T/\sqrt{2}$ (B) T (C) $\sqrt{2}\ T$ (D) $2T$

3. Which of the following statements is true of a system consisting of a mass oscillating at the end of an ideal spring?
(A) The kinetic and potential energies are equal at all times.
(B) The kinetic and potential energies are both constant.
(C) The maximum potential energy is achieved when the mass passes through its equilibrium position.
(D) The maximum kinetic energy and maximum potential energy are equal, but occur at different times.

Use the following information for Questions #4 - 6: A 10-kg mass (***m***) is attached to a vertically oriented un-stretched massless ideal spring of spring constant 100 N/n (***k***).

4. When the mass is released from rest, what is the resulting amplitude, ***A***, of the simple harmonic motion?

(A) $1/5\,m$ (B) $2/5\,m$ (C) $1/2\,m$ (D) $1m$

5. At what time ***t***, after release, does the mass first return back to the original position?

(A) $\pi/5\ s$ (B) $\pi/2\ s$ (C) $\pi\ s$ (D) $2\pi\ s$

6. Which of the following expressions correctly identifies the speed of the mass as it passes through the *equilibrium* position?

(A) $A\sqrt{\frac{k}{m}}$ (B) $A\sqrt{\frac{m}{k}}$ (C) $\frac{1}{A}\sqrt{\frac{k}{m}}$ (D) $\frac{1}{A}\sqrt{\frac{m}{k}}$

7. A box of unused Fizzix texts is attached to the lower end of a vertical ideal spring and oscillates up and down. The period of oscillation depends on which of the following?

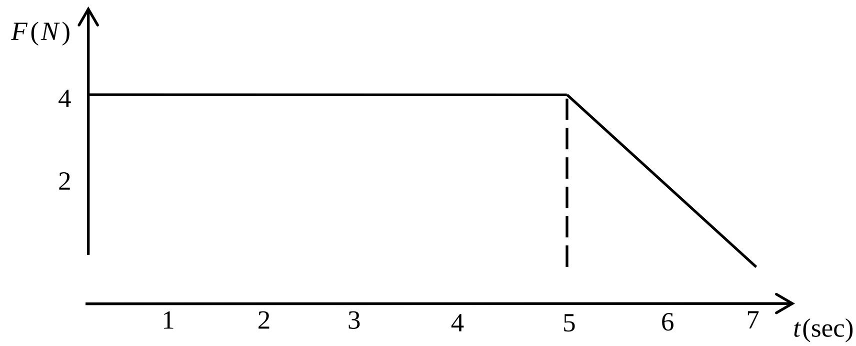
I. The mass of the box
II. The amplitude of the oscillation
III. The spring constant of the spring

(A) I only (B) II only (C) I & II only (D) I & III only

8. During a physics laboratory exercise, you construct a simple pendulum and an unknown mass hanging on a spring. You construct both the pendulum and the spring-mass system to have exactly the same period of oscillation in your New Jersey Lab room. They are then taken to Planet *Kepler 2014-NJ* during a class field trip. *Kepler 2014-NJ* is a recently discovered exo-planet that has the same diameter as Earth, but twice the mass. Which of the following statements is true about the periods of these same two objects, the pendulum and spring-mass system, on *Kepler 2014-NJ* compared to when you were safely on Earth in NJ?
(A) Both systems are shorter.
(B) Both systems are longer.
(C) The period of the spring-mass system is shorter, but that of the pendulum is the same.
(D) The period of the pendulum is shorter, but that of the spring-mass system is the same.

9. On a recent holiday trip to *Rockefeller Center* in NYC, your physics teacher, of mass ***M***, was skating along frictionlessly in a straight line with speed ***V***, showing off for the TV cameras, not looking where he/she was headed. All of a sudden, he/she slams into and grabs on tightly for balance to a famous celebrity morning news show anchor, also of mass ***M***, who was standing still doing a news interview thing. Besides the inevitable law suit, which of the following must be true of the resulting motion after the embarrassing collision?
(A) The total momentum is MV and the total kinetic energy is $\frac{1}{2}MV^2$
(B) The total momentum is MV and the total kinetic energy is $\frac{1}{4}MV^2$
(C) The total momentum is $\frac{1}{2}MV$ and the total kinetic energy is $\frac{1}{2}MV^2$
(D) The total momentum is $2MV$ and the total kinetic energy is $\frac{1}{4}MV^2$

10. A 4-kg mass experiences a force as represented in the accompanying graph of force as a function of time. What is the increase in the speed of the object from ***t*** = 0 to ***t*** = 7 seconds?



(A) 4 m/s (B) 5 m/s (C) 6 m/s (D) 7 m/s

11. A stationary Uranium-238 nucleus, ${}^{238}_{92}U$, decays by emitting an alpha particle; essentially a Helium nucleus, ${}^{4}_{2}He$. It is noted the alpha particle has a speed v_α after being emitted. If the kinetic energy of the alpha particle is K_α, what is the kinetic energy of the recoiling leftover nucleus?

(A) K (B) $\frac{4}{234}K$ (C) $\left(\frac{4}{234}\right)^2 K$ (D) $\sqrt{\frac{4}{234}}\,K$

Use the following information for Questions #12, 13, 14: For a class demonstration, your teacher uses an ideal spring of spring constant 200 N/m and unstretched/relaxed length of 20 cm to demonstrate a multi-topic concept. Your teacher attaches a 0.5-kg mass to one end of the relaxed spring then twirls the mass around his head in a horizontal circle by tightly grasping the other end of the spring. While twirling in a circle at a constant speed, it is noted the spring length is now 24 cm.

12. What is the centripetal force acting on the mass?

(A) 8 N (B) 50 N (C) 800 N (D) 5000 N

13. What is the constant speed of the mass while moving in the circle?

(A) 2 m/s (B) 3.8 m/s (C) 20 m/s (D) 38 m/s

14. How much power, in Watts, is generated by the restoring force in the spring?

(A) Zero (B) 16 W (C) 3.8 π (D) 16 π

Use the following information for Questions #15 & 16: A satellite of mass ***m*** is in stable circular orbit of radius ***R*** about a planet of mass ***M***.

15. Which of the following expressions represents the gravitational potential energy of the satellite?

(A) $G\frac{Mm}{R^2}$ (B) $G\frac{Mm}{R}$ (C) $-G\frac{Mm}{R^2}$ (D) $-G\frac{Mm}{R}$

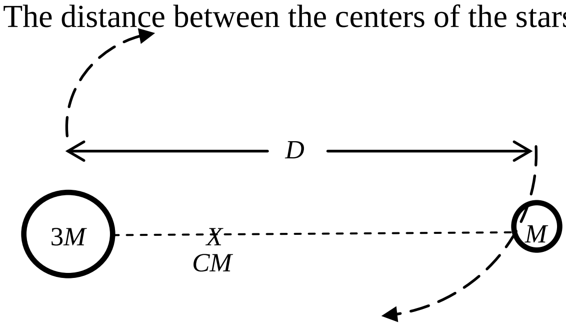
16. Which of the following expressions represents the kinetic energy of the satellite?

(A) $G\frac{Mm}{2R^2}$ (B) $G\frac{Mm}{2R}$ (C) $G\frac{Mm}{4R^2}$ (D) $G\frac{Mm}{4R}$

17. As a mass free falls from rest, the kinetic energy of the mass is proportional to which of the following? d is the distance fallen.

(A) $\frac{1}{d^2}$ (B) $\sqrt{d}$ (C) d (D) d^2

Use the following information for Questions #18 & 19: A binary star system consists of two stars in orbit around a common center of mass, labeled ***CM***. The diagram below represents this system consisting of a star of mass 3***M*** and the other of mass ***M***. The distance between the centers of the stars is ***D***.



18. Which expression below correctly represents the gravitational potential energy of the smaller mass star?

(A) $-G\frac{M^2}{D^2}$ (B) $G\frac{M^2}{D^2}$ (C) $-G\frac{3M^2}{D^2}$ (D) $-G\frac{3M^2}{D}$

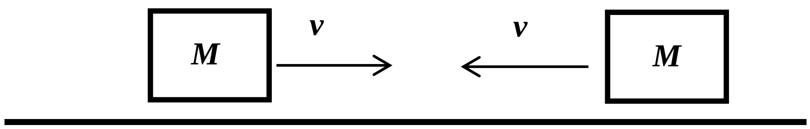
19. What is the period of revolution about the common center of mass of the 3M star?

(A) $\frac{3\pi}{4}\sqrt{\frac{D^3}{GM}}$ (B) $\pi\sqrt{\frac{D^3}{GM}}$ (C) $\pi\sqrt{\frac{D^3}{3GM}}$ (D) $2\pi\sqrt{\frac{D^3}{GM}}$

20. A physics student throws a large rock of mass ***m*** off the top of the science building of height ***h*** at some initial angle $\boldsymbol{\theta}$ above horizontal and an initial speed of $\boldsymbol{v_o}$. Ignore the effects of air resistance. With what speed does the rock strike the level ground?

(A) $v_o^2 + 2gh$ (B) $\sqrt{v_o^2 + 2gh}$ (C) $\sqrt{v_o^2 \sin^2\theta + 2gh}$ (D) $\sqrt{v_o^2 \sin^2\theta + 2gh\sin^2\theta}$

21. As depicted below, two identical blocks of mass ***M*** are moving at identical speed ***v*** toward each other on a frictionless surface. After the blocks collide, how much of the mechanical energy is "lost?"



(A) Zero (B) $\frac{1}{2}Mv^2$ (C) Mv^2 (D) $2Mv^2$

22. During another silly class demonstration, your teacher twirls a mass attached to a sturdy string in a horizontal circle about his/her head. The tension in the string is ***T***. What would be the tension if the mass, radius and speed were all doubled in magnitude?

(A) ***T*** (B) 2 ***T*** (C) 4 ***T*** (D) 8 ***T***

Use the following information for Questions #23 & 24: Your favorite physics teacher drives an older car of mass ***M*** not equipped with anti-lock brakes. On the way to school one crisp morning, your teacher has to slam on the breaks to avoid a cute furry creature in the roadway. The car skids to a stop, wheels locked in place with no rolling, in a distance ***d*** from an initial speed of $\boldsymbol{v_o}$.

23. If this car had a mass of 2***M***, double the original, it would skid how far to stop from the same initial speed?

(A) $\frac{d}{2}$ (B) d (C) $\sqrt{2}d$ (D) $2d$

24. If the original car of mass ***M*** had an initial speed of 2$\boldsymbol{v_o}$, how far would it skid to a stop?

(A) d (B) $\sqrt{2}d$ (C) $2d$ (D) $4d$

25. A box of unused physics textbooks are resting on a ramp inclined above the horizontal at 30^o. What is the minimum coefficient of static friction that will prevent the box of books from sliding down the ramp?

(A) $\frac{1}{2}$ (B) $\frac{\sqrt{3}}{2}$ (C) $\frac{1}{\sqrt{2}}$ (D) $\frac{1}{\sqrt{3}}$

NJSL Physics II (AP1 PHYSICS) <u>Golden Rod test</u>

FEBRUARY 12, 2015

SOLUTIONS (Corrections)

1. A(B)	14. A
2. C	15. D
3. D	16. B
4. D	17. C
5. C(All full credit)	18. D
6. A	19. B
7. D	20. B
8. D	21. C(All full credit)
9. B	22. C
10. C	23. B
11. B	24. D
12. A	25. D
13. A	

NJSL Physics II (AP1 PHYSICS) GOLDEN ROD

MARCH 12, 2015 (corrections)

This exam is for all students currently enrolled in ap physics I.

Directions: For each question or statement fill in the appropriate space on the answer sheet. Use the letter preceding the word, phrase, or quantity which best completes or answers the question. Each of the 25 questions is worth 4 points.
Use: g =10 m/s².

ADDITIONAL INFORMATION: *All axes of rotation are taken to be at the center of mass.*

Moment of Inertia of a *solid disc*: $\frac{1}{2}MR^2$ Moment of Inertia of a *hollow disc* (hoop or ring): MR^2

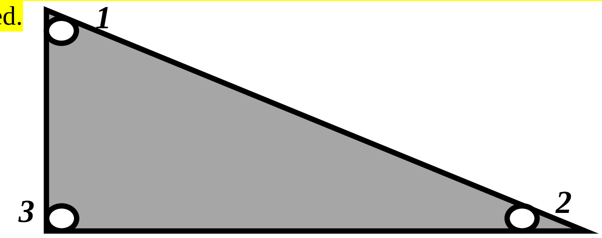
Moment of Inertia of a *solid sphere*: $\frac{2}{5}MR^2$ Moment of Inertia of a *hollow sphere*: $\frac{2}{3}MR^2$

Fundamental charge: $e = 1.60x10^{-19}C$

1. A solid disc has an initial angular velocity of 5 rad/s when it undergoes a constant angular acceleration. Three seconds later, the wheel has an angular velocity of 9 rad/s. Through what angular displacement did the wheel rotate during this 3 seconds?
(A) 12 radians (B) 15 radians. (C) 21 Radians (D) 27 radians

2. A rotating object starts from rest and has a constant angular acceleration. Three seconds later the centripetal acceleration of a point on the object has a magnitude of 2.0 m/s². What is the magnitude of the centripetal acceleration of this point six seconds after the motion begins?
(A) $2 m/s^2$ (B) $4 m/s^2$ (C) $6 m/s^2$ (D) $8 m/s^2$

3. Your teacher provides a homemade flat triangular piece of aluminum, diagrammed below. There are holes drilled into each vertex of the triangle; these represent three axes of rotation and are cleverly labeled ***1***, ***2***, & ***3***. By placing a thin sturdy rod through one hole at a time perpendicularly to the plane of the triangle, the triangle can spin or rotate around the rod (hole). Which axis requires the largest net external torque to cause the triangle to reach an angular speed of 10.0 rad/s in 10.0 s, starting from rest? Assume that the net torque is kept constant while it is being applied.



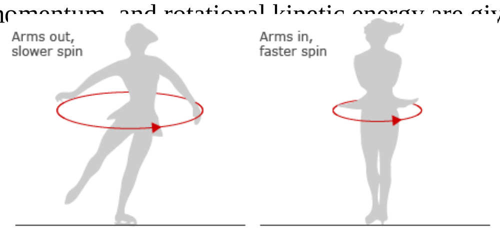
(A) ***1*** (B) ***2*** (C) ***3*** (D) Not enough information to determine.

Use the following information for Questions #4 & 5: Three uniform solid spheres, ***A***, ***B***, & ***C***, are placed side by side at the top of an incline plane and, starting from rest, are allowed to roll without slipping down the incline plane.

4. Which ball, if any, has the greatest translational speed at the bottom if each sphere is the same size, but ***A*** has a mass of ***M***, ***B*** = 2***M***, and ***C*** = ½ ***M***?
(A) Sphere A (B) Sphere B (C) Sphere C (D) It's a 3-way tie.

5. Which ball, if any, has the greatest translational speed at the bottom if each sphere is the same mass, but ***A*** has a radius of ***R***, ***B*** = 2***R***, and ***C*** = ½ ***R***?
(A) Sphere A (B) Sphere B (C) Sphere C (D) It's a 3-way tie.

6. The below stock image found on the famous *Wiki Commons* shows a figure skater increasing her rotation rate simply by bringing all available body parts closer to her axis of rotation. Let's assume she causes her initial moment of inertia to become one-half of the initial moment of inertia. If her initial angular velocity, angular momentum, and rotational kinetic energy are given as ω, L, & K, respectively, what are the new values when she pulls in?



	Angular Velocity (ω)	Angular Momentum (L)	Rotational KE (K)
A	2ω	$2L$	$2K$
B	2ω	L	K
C	2ω	L	$2K$
D	ω	L	K

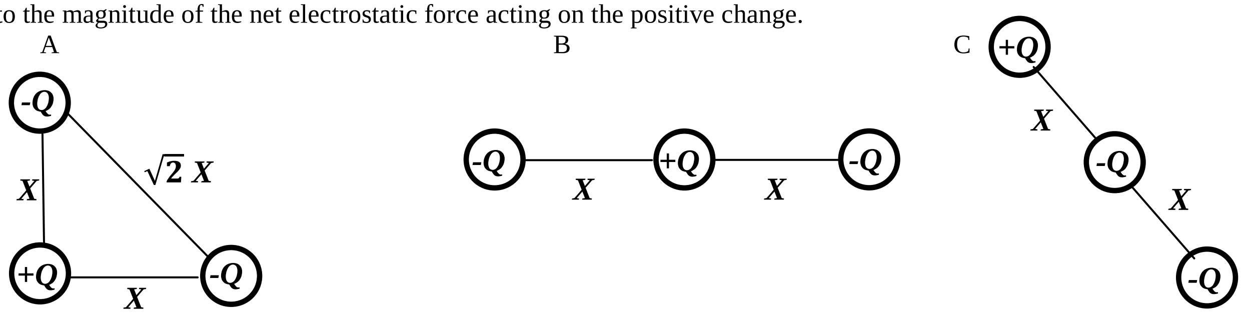
7. The Earth takes approximately one day to rotate about its axis of rotation. The accepted time value for this is 86,160 seconds. Based on this, what is the angular speed of the Earth about its axis?

(A) 1.99×10^{-7} rad/s (B) 2.32×10^{-6} rad/s (C) 7.29×10^{-5} rad/s (D) 9.95×10^{-5} rad/s

8. Two objects, labeled ***A*** and ***B***, are each electrically neutral and insulated from the environment. You devise a way of stripping electrons off objects and take 4 million electrons off of Object ***B*** and place them all on Object ***A***. What is the resulting charge on each object?

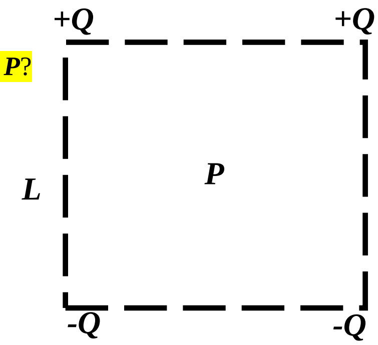
	Object A	***Object B***
A	$-6.4x10^{-13}C$	$+6.4x10^{-13}C$
B	$+6.4x10^{-13}C$	$-6.4x10^{-13}C$
C	$+4x10^{-6}C$	$-4x10^{-6}C$
D	$+4x10^{6}C$	$-4x10^{6}C$

9. The sketches below represent three different arrangements of electrical charges. Each charge has a magnitude of ***Q***, a sign as designated, and the distance ***X*** is the same for each labelled distance. Rank the arrangements in descending order (largest to smallest) according to the magnitude of the net electrostatic force acting on the positive change.

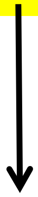


(A) ***A, B, C*** (B) ***B, A, C*** (C) ***C, A, B*** (D) ***A, C, B***

Use the following information for Questions #10 - 12: Four equal magnitude charges are placed at the corners of a square with sides ***L*** as shown below. Two positive charges, labelled **+*Q***, are located at the top corners and two negative charges labelled **-*Q*** are located at the bottom corners.



10. In what direction is the net electric field, if any, at the center of the box, labelled ***Point P***?

(A)  (B)  (C)  (D) It is Zero.

11. What is the net electric potential at the center of the box, labelled ***Point P***?

(A) $\frac{kQ}{r}$ (B) $\frac{2kQ}{r}$ (C) $\frac{4kQ}{r}$ (D) Zero

12. Now, suppose you switch the two charges on the right so the **–*Q*** is in the top right corner and the **+*Q*** is in the bottom right corner. Which expression below would represent the magnitude of the net electrostatic force acting on the top right negative charge?

(A) $\frac{kQ^2}{L^2}$ (B) $\frac{kQ^2}{L^2}\left(\sqrt{2}-\frac{1}{2}\right)$ (C) $\sqrt{2}\,\frac{kQ^2}{L^2}$ (D) Zero

Use the following information for Questions #13 & 14: An unknown charged particle of mass ***m*** starts at rest and is accelerated from ***Point 1*** to ***Point 2*** through a potential difference, ***V***.

13. Does the *electric potential energy* of this particle when reaching ***Point 2*** depend on the magnitude of its charge or its mass?

	Magnitude of Charge	***Mass, m***
A	Yes	No
B	No	No
C	No	Yes
D	Yes	Yes

14. Does the *final speed* of this particle when reaching ***Point 2*** depend on the magnitude of its charge or its mass?

	Magnitude of Charge	***Mass, m***
A	Yes	No
B	No	No
C	No	Yes
D	Yes	Yes

15. At what distance would two identical charges of magnitude 4 μC have to be placed from each other in order to experience an electrostatic force between them of 0.9 N?

(A) 1.6×10^{-6} m (B) 4×10^{-6} m (C) 0.16 m (D) 0.4 m

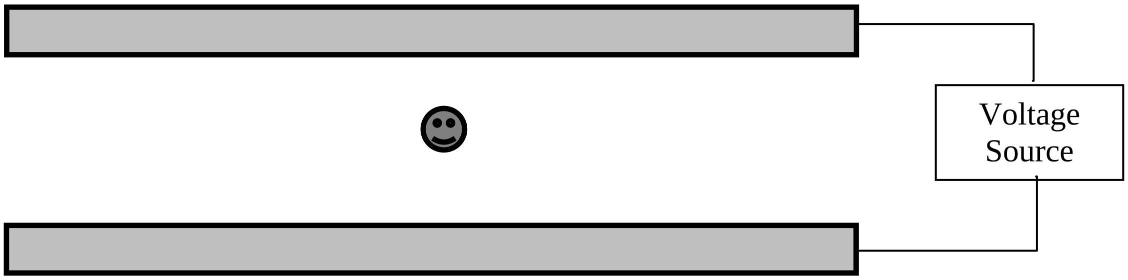
16. A single electron is moving horizontally to the right when it suddenly experiences a uniform electric field pointing upward. In what direction will the electron be deflected?

(A) Upward (B) Downward (C) To the right (D) To the left

17. A small object of mass 500 grams and charge +9 C is suspended from an insulated string of negligible mass in an electric field that has field lines that are horizontal. It is noted when released that the mass swings to the right and settles into a stationary position where the string makes an angle of 20^o to the vertical. What is the magnitude and direction of the electric field?

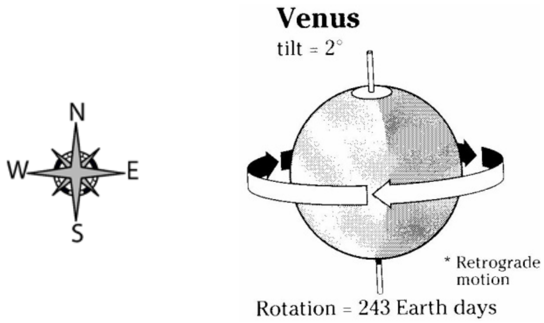
(A) 1.82 N/C to the right (B) 1.82 N/C to the left (C) 0.2 N/C to the right (D) 0.2 N/C to the left

18. In 1909, Robert Millikan and Harvey Fletcher performed one of the most respected experiments in all of modern physics; they calculated experimentally the fundamental charge (the charge on an electron). This was performed by simply placing small charged oil droplets between two charged plates adjusting the potential between the plates till the drops remained suspended; sketched below. As shown below, what is the potential difference between the plates so that the droplet shown is suspended? The mass of the droplet is 9.6×10^{-16} kg, it has a negative charge of 50***e***, and the distance between the plates is 25 cm.



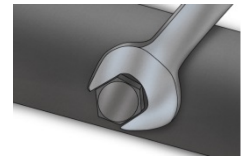
(A) 30 V (B) 120 V (C) 300 V (D) 1200 V

19. While the Earth rotates on its axis from West to East, Venus rotates on its axis "backwards"; from East to West. In reference to the diagram of Venus below, in what direction is the angular momentum vector for Venus as it rotates around its axis?

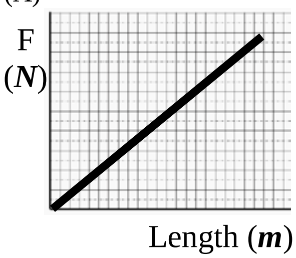


(A) Upward (North) (B) Downward (South) (C) To the left (East to West) (D) To the right (West to East)

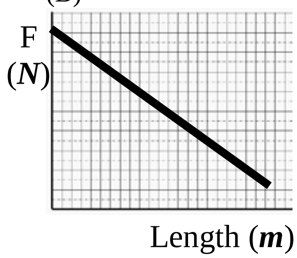
20. Several different length wrenches are used to produce the same torque on the head of a bolt as imaged to right. Which graph below best represents the force applied to the wrench as a function of length of the wrench assuming the force is applied perpendicularly to the end of the wrench furthest from the bolt?



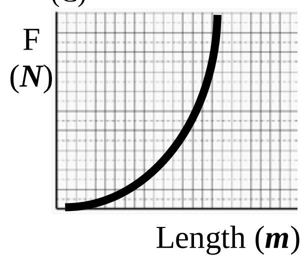
(A)



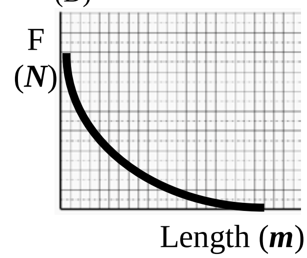
(B)



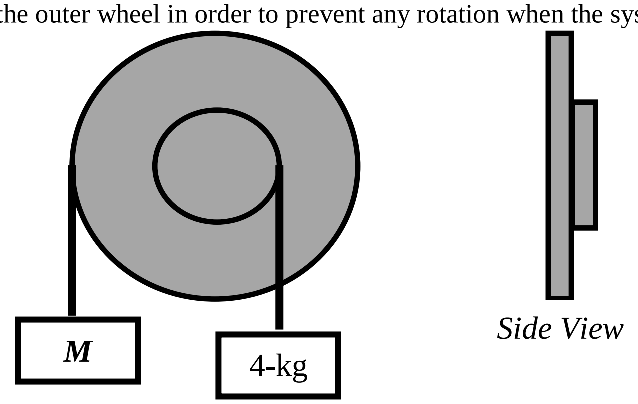
(C)



(D)

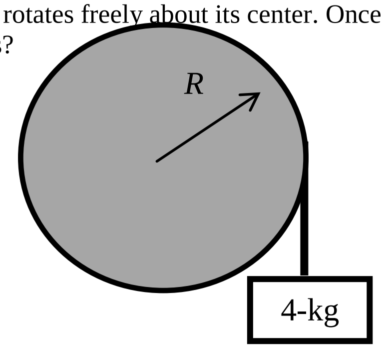


21. A "compound wheel" is shown below. It consists of a large outer wheel and a smaller inner wheel. The radius of the inner wheel is 25 cm and the outer wheel is 40 cm. A mass of 4 kg is allowed to hang freely from the inner wheel by use of a massless string. What mass must be hung from the outer wheel in order to prevent any rotation when the system is released from rest?



(A) 2 kg (B) 2.5 kg (C) 4 kg (D) 4.5 kg

22. A solid disc of mass 16-kg and radius 50 cm has a mass of 4-kg hanging from one side by a massless string. The disc acts like a frictionless pulley and rotates freely about its center. Once released from rest, how much time does it take for the wheel to rotate through 20 revolutions?



(A) $2\sqrt{2\pi}$ seconds

(B) $\sqrt{2\pi}$ seconds

(C) $2\sqrt{\pi}$ seconds

(D) $\sqrt{\pi}/2$ seconds

23. A wheel in the shape of a solid disc is rolling without slipping on a horizontal surface. The center of the wheel (the axis of rotation) has a speed of 12 m/s and the wheel has a mass of 4-kg. What is the total kinetic energy of the wheel as it rolls at this speed?

(A) 144 J (B) 288 J (C) 432 J (D) Cannot determine without knowing the radius.

24. For a final physics project, your team designs and builds a catapult system that launches projectiles at targets. It is noted that when a particular projectile is launched, it has a momentum of $400 \, {}^{kg \cdot m}\!/\!_{s}$ and a kinetic energy of $10{,}000 J$. What is the mass of this projectile?

(A) 4 kg (B) 8 kg (C) 16 kg (D) 32 kg

25. During the last minute of a big football game, from the one-yard line, a quarterback inexplicably throws the ball instead of running it in. The weight of the properly inflated NFL regulation football is 4.2-N, the quarterback applied a force on the football for 0.1 seconds, and the football was traveling at a speed of 20 m/s when an opposing player intercepted it. With what force did the quarterback apply to the ball during the throwing motion assuming the ball didn't slow down over the short distance from quarterback to interceptor?

(A) 0.84 N (B) 8.4 N (C) 84 N (D) 840 N

NJSL Physics II (AP1 PHYSICS) **GOLDEN ROD**

MARCH, 2015

SOLUTIONS (Corrected)

Record onto the area record the # correct

1. C	14. D(All full credit)
2. B(D)	15. D
3. D(B)	16. B(All full credit)
4. C(D)	17. C(All full credit)
5. D	18. C(All full credit)
6. C	19. B
7. C	20. D
8. A	21. B
9. D	22. A
10. A(All full credit)	23. C
11. D(All full credit)	24. B
12. B	25. C
13. A(All full credit)	

NJSL Physics II (AP1 PHYSICS) <u>GOLDEN ROD</u>
April 9, 2015
<u>This exam is for all students currently enrolled in ap physics I.</u>

Directions: For each question or statement fill in the appropriate space on the answer sheet. Use the letter preceding the word, phrase, or quantity which best completes or answers the question. Each of the 25 questions is worth 4 points. ***Use: g =10 m/s²*. Fundamental charge:** $e = 1.6x10^{-19}C$

Use the following for Questions #1 & #2: For a class demo, your teacher sets up a transverse wave on a long rope. The rope has an amplitude of ***A***. There is a visibly distinct red spot placed on the rope by a bold magic marker.

1. As one complete cycle of this wave travels past this red spot, what is the total distance traveled by the spot?
(A) $\frac{1}{2}$ ***A*** (B) ***A*** (C) 2***A*** (D) 4***A***

2. This transverse wave travels along the rope with a speed ***v*** and the maximum speed of the red dot is v_{max}. If your teacher doubles the amplitude of this wave, but leaves all other properties the same, what happens to ***v*** and v_{max}?

	v	v_{max}
A	Doubles	Doubles
B	Remains the Same	Doubles
C	Doubles	Remains the Same
D	Remains the Same	Remains the Same

Use the following for Questions #3 & #4: A periodic transverse wave is set-up on a 2-m long string clamped at both ends so that there are exactly five complete cycles traveling along the string at any instant. It is noted that the crests are traveling with a speed of 20 m/s.

3. What is the shortest horizontal distance between a crest of this wave and a point of zero acceleration?
(A) 0.1 m (B) 0.2 m (C) 0.4 m (D) 2.5 m

4. How long does it take a particle of the string to move from a crest to the closest point of no acceleration?
(A) 0.02 sec (B) 0.001 sec (C) 0.002 sec (D) 0.005 sec

5. Two tuning forks are struck simultaneously and a beat period of 1/3 second is noted. One tuning fork is exactly 588 Hz. What is the frequency of the other tuning fork?
(A) 587.7 or 588.3 Hz (B) 580.3 or 596.7 Hz (C) 585 or 591 Hz (D) 586 or 592 Hz

6. A string 1.33 m long is clamped at both ends. A vibration of 600 Hz is produced on this string that has a speed of 400 m/s. How many antinodes are on the resulting standing waves?
(A) 3 (B) 4 (C) 5 (D) 6

Use the following information for Questions #7 & 8: A string has a length of 3-m and has two adjacent resonances measured to be 112 Hz and 140 Hz.

7. What is the speed of the waves on the string when it vibrates at 140 Hz?
(A) 28 m/s (B) 56 m/s (C) 140 m/s (D) 168 m/s

8. How many nodes are contained in the standing wave that is vibrating at 112 Hz?
(A) 3 (B) 4 (C) 5 (D) 6

9. A guitar string of length L is clamped at each end. Which of the following is not a possible wavelength for a standing wave on this string?

(A) $\frac{2}{3}L$ (B) L (C) $2L$ (D) $4L$

10. A musical instrument has a vibrating string clamped at both ends that is noticed to show four nodes when vibrating at 240 Hz. What is the fundamental frequency of this string?

(A) 40 Hz (B) 60 Hz (C) 80 Hz (D) 120 Hz

11. Which of the following is most accurate in describing the graph of voltage V (y-axis) versus current I (x-axis) in a simple one-resistor DC circuit?

(A) Linear with negative slope (B) Linear with positive slope

(C) Parabolic starting at the origin (D) Hyperbolic with both x- and y-axes as asymptotes.

12. Two copper wires are tested for resistance. One wire tests at 2-Ω. The second wire is twice as long and has a cross-sectional area of one-half the first wire. What is the resistance of this longer wire?

(A) 1-Ω (B) 2-Ω (C) 4-Ω (D) 8-Ω

13. A single resistor ***R*** is connected across a battery that is providing a terminal voltage ***V***. Which of the following changes to ***R***, ***I*** and/or ***V*** would result in an *unchanged* power dissipation by the resistor?

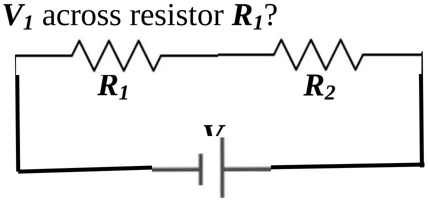
*I. Keep **R**, double **V** and decrease the current to **I**/2.*

*II. Keep **R**, double **V** and increase current to 4**I**.*

*III. Keep **V**, double **I** and cut the resistor to **R**/4.*

(A) I only (B) I & III only (C) II & III only (D) I, II, & III

14. Below is a simple DC circuit with a battery and two resistors. Which choice correctly shows the solution to the potential difference V_1 across resistor R_1?

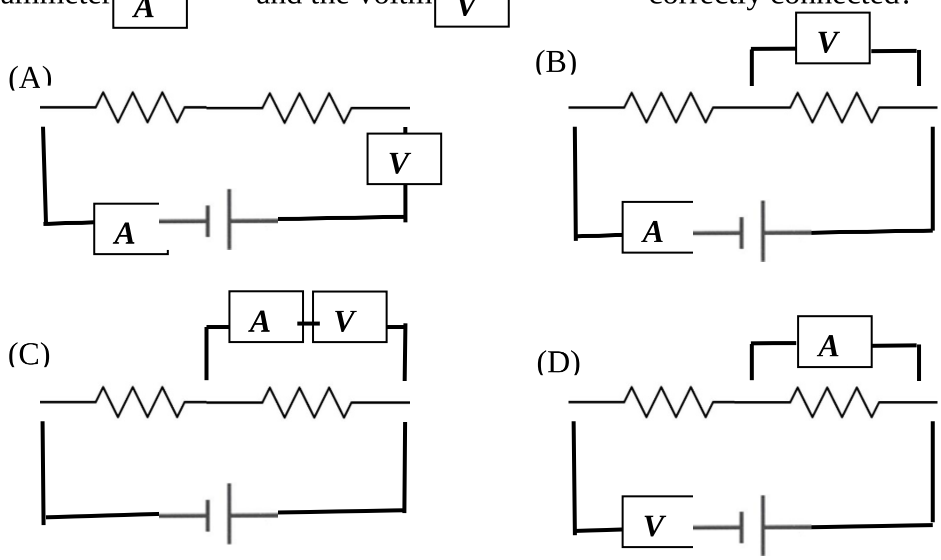


(A) $V_1 = \left(\frac{R_1}{R_2}\right)V$ (B) $V_1 = \left(\frac{R_1}{R_1 + R_2}\right)V$ (C) $V_1 = \left(\frac{R_1 + R_2}{R_1}\right)V$ (D) $V_1 = V$

15. You are provided two identical resistors and a constant voltage battery. You first connect the two resistors in series and measure the effective equivalent resistance, $\boldsymbol{R_S}$. You then redesign the circuit so the two resistors are in parallel and measure the equivalent resistance, $\boldsymbol{R_P}$. What is the ratio of R_S/R_P ?

(A) $1/4$ (B) $1/2$ (C) 2 (D) 4

16. Below are four circuits shown with ammeters and voltmeters connected. Which of the four circuits shown has both the ammeter **A** and the voltmeter **V** correctly connected?



Use the following information for Questions #17 & 18: Below are descriptions of four simple circuits that each contains a constant *emf* and one resistor.

	emf (V)	***Resistor (Ω)***
A	***V***	***R***
B	***V***	2***R***
C	2***V***	***R***
D	2***V***	2***R***

17. Which of the four circuits supplies the largest power to the resistor in that circuit?

(A) A (B) B (C) C (D) D

18. Which circuit delivers the largest current to the resistor in that circuit?

(A) A (B) B (C) C (D) D

19. Which of the following would result in a conventional current flowing eastward?
(A) A beam of electrons moving westward. (B) A beam of electrons moving eastward.
(C) A beam of protons moving westward. (D) A beam of neutrons moving eastward.

20. Kirchhoff's Loop Rule is a consequence of
(A) Ohm's Law (B) Conservation of charge (C) Conservation of energy (D) Coulomb's Law

21. Kirchhoff's Junction Rule is a consequence of
(A) Ohm's Law (B) Conservation of charge (C) Conservation of energy (D) Coulomb's Law

Use the following information for Questions #22 & 23: A 4-kg projectile is fired from the surface of Earth so that its initial horizontal velocity is 40 m/s and its initial vertical velocity is 30 m/s.
22. How much work is done in firing the projectile?
(A) 1800 J (B) 3200 J (C) 5000 J (D) 9800 J

23. What is the horizontal displacement of this projectile if the surface is long and horizontal?
(A) 120 m (B) 240 m (C) 360 m (D) 480 m

24. A bicyclist is out riding on a horizontal New Jersey back road. It is noticed the tires are rolling without slipping, have a radius of 70 cm, and an angular speed of 2 rev/sec. The rider applies the brakes and comes to a complete stop in five seconds. How far did the bicycle travel in those five seconds?
(A) 8.8 m (B) 11 m (C) 22 m (D) 44 m

25. One mole of hydrogen contains 6.02×10^{23} atoms. For a physics class project, you devise a method of separating all the protons from the electrons and placing both in sealed isolated non-conducting containers. You then contract with NASA to send the container full of electrons to the Moon at a distance of 385,000 km from the surface of Earth. What is the electrostatic force between the container of electrons on the Moon and your container of protons safely tucked in your book bag at school?
(A) 5.6×10^{-3} N (B) 5.6×10^{2} N
(C) 5.6×10^{6} N (D) 5.6×10^{8} N

NJSL Physics II (AP1 PHYSICS) **GOLDEN ROD**

April 9, 2015

SOLUTIONS

Record onto the area record the % correct (Corrections:none)

1. D	14. B
2. B	15. D
3. A	16. B
4. D	17. C
5. C	18. C
6. B	19. A
7. D	20. C
8. C	21. B
9. D	22. C
10. C	23. B
11. B	24. C
12. D	25. B
13. B(All full credit)	