

ver. A

Honors Physics
Summer, 2018

Honors Physics Mock Final Exam

Name: Answer Key

Mr. Leonard

Instructions: INDICATE WHICH VERSION OF THE EXAM YOU'VE BEEN GIVEN BY FILLING IN THE APPROPRIATE BUBBLE ON THE LEFT SIDE OF THE BUBBLE-SHEET.

The Exam is divided into two parts: a 35-question multiple-choice section and a four-question free-response section; the two sections are weighed equally. You may write on this exam, however, only the multiple-choice answers on the bubble-sheet will be graded.

Note: To simplify calculations, you may use $g = 10 \text{ m/s}^2$ and $k = 9(10^9) \text{ N} \cdot \text{m}^2/\text{C}^2$.

For problems 1-10, read each statement completely and determine whether the statement is True or False. Use the bubble-sheet to fill in an "A" for True or a "B" for False. A statement that is "sometimes true" is False. Each question in this section is worth 1 point.

1. Two conditions must be met for a force to do work on an object: 1. The object must move. 2. A component of the force must point in the direction of the object's motion.

Solution: True

2. Both the total energy and the total momentum of the universe are conserved.

Solution: True

3. The work done by a conservative force does not depend on the path taken.

Solution: True

4. The momentum of an object traveling in uniform circular motion is constant because the object's speed is constant.

Solution: False

5. Conservation of momentum is a consequence of Newton's Third Law.

Solution: True

6. Closely spaced electric field lines indicate a strong electric field.

Solution: True

7. Closely spaced equipotential lines indicate a strong electric field.

Solution: True

8. When two resistors are connected in parallel, the equivalent resistance is always lower than the resistance of either of the two resistors by themselves.

Solution: True

9. When two resistors are connected in series, the equivalent resistance is always lower than the resistance of either of the two resistors by themselves.

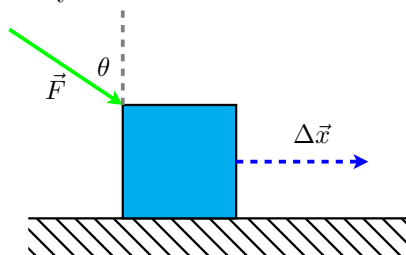
Solution: False

10. Batteries create charge, and can be thought of as a charge source. The charge created by a battery is lost when current flows through a resistor.

Solution: False

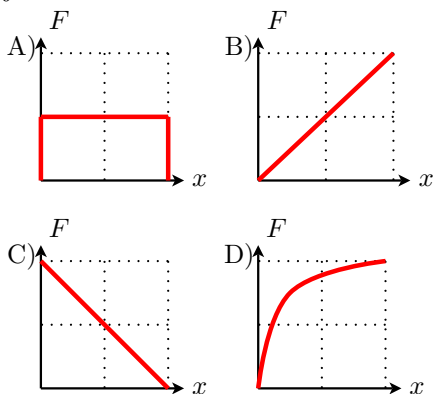
For problems 11-35, chose the option that best answers each question. Each question on this portion of the exam is worth 2 points.

11. A force is applied to a box as shown in the figure below. The box moves horizontally through a displacement $\Delta\vec{x}$. What is the expression for the work done by this force?



- (A) $F \Delta x \cos \theta$ (B) $F \Delta x \sin \theta$
 (C) $F \Delta x$ (D) $F \Delta x \tan \theta$

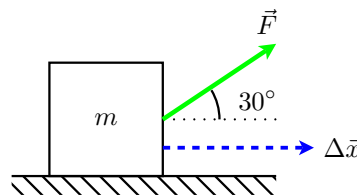
12. The following graphs, all drawn to the same scale, represent the net force F as a function of displacement x for an object that moves along a straight line. Which graph represents the force that will cause the greatest change in the kinetic energy of the object?



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

Use the following information to answer questions 13-16.

A force F is applied to a box of mass m , causing it to move through a displacement Δx as shown in the figure below. The forces acting on the box cause it to move at a constant speed.



13. What is the net work done by all the forces acting on the box?

- (A) 0 J (B) $F \Delta x \sin(30^\circ)$
 (C) $F \Delta x \cos(30^\circ)$ (D) $F \Delta x \tan(30^\circ)$

14. How much work was done by the normal force?

- (A) 0 J (B) $-m g \Delta x \sin(30^\circ)$
 (C) $+m g \Delta x \sin(30^\circ)$ (D) $-m g \Delta x \cos(30^\circ)$

15. How much work was done by the gravitational force?

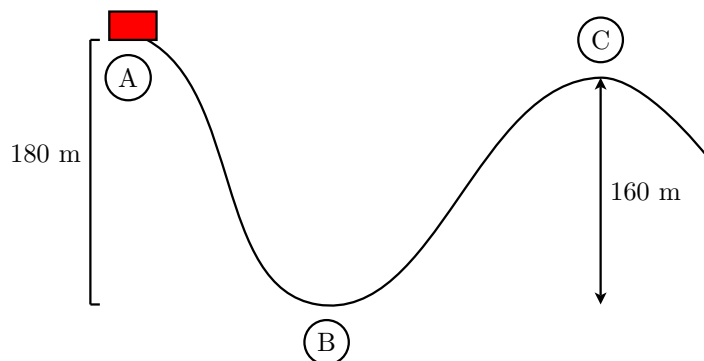
- (A) 0 J (B) $-m g \Delta x \sin(30^\circ)$
 (C) $+m g \Delta x \sin(30^\circ)$ (D) $-m g \Delta x \cos(30^\circ)$

16. How much work was done by friction?

- (A) $-F \Delta x$ (B) $-F \Delta x \sin(30^\circ)$
 (C) $-F \Delta x \cos(30^\circ)$ (D) $-F \Delta x \tan(30^\circ)$

Use the following information to answer questions 17-18.

A 600 kg roller coaster moves along the frictionless track shown in the figure below. The coaster has a speed of $0 \frac{\text{m}}{\text{s}}$ at point A.



17. How fast is the roller coaster moving at point B?

- (A) $42 \frac{\text{m}}{\text{s}}$ (B) $1800 \frac{\text{m}}{\text{s}}$
 (C) $3600 \frac{\text{m}}{\text{s}}$ (D) $60 \frac{\text{m}}{\text{s}}$

18. How fast is the roller coaster moving at point C?

- (A) $14.1 \frac{\text{m}}{\text{s}}$ (B) $28.3 \frac{\text{m}}{\text{s}}$
 (C) $20 \frac{\text{m}}{\text{s}}$ (D) $40 \frac{\text{m}}{\text{s}}$

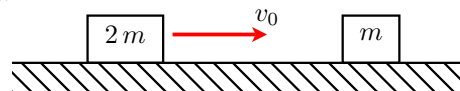
19. How much work would the brakes need to do to bring the roller coaster to rest at point C?

- (A) -120 kJ (B) -1.2 kJ
 (C) -40 kJ (D) 2.4 kJ

20. A 0.1 kg baseball is initially traveling in the x-direction with a velocity of $+30 \frac{\text{m}}{\text{s}}$. After hitting the bat, the ball is traveling in the x-direction with a velocity of $-25 \frac{\text{m}}{\text{s}}$. If the bat is in contact with the ball for 0.01 s, what was the average force exerted by the bat on the ball?

- (A) 10 N (B) 550 N
 (C) 50 N (D) 250 N

21. Two blocks collide elastically as shown in the figure below.



Which figure represents the final velocities of the two blocks?

- A) $2m$ moving right with $\frac{1}{3}v_0$, m moving right with $\frac{4}{3}v_0$
 B) $2m$ moving left with $\frac{1}{3}v_0$, m moving right with $\frac{4}{3}v_0$
 C) $2m$ at rest, m moving right with $2v_0$
 D) $2m$ moving left with $\frac{1}{2}v_0$, m moving right with $\frac{1}{2}v_0$
- (A) A (B) B
 (C) C (D) D

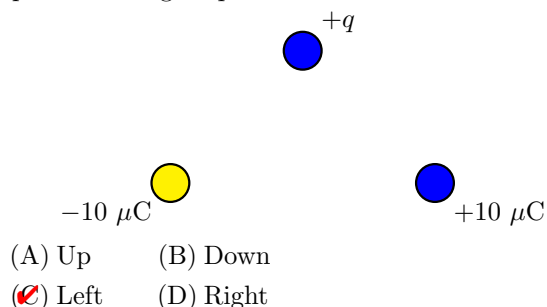
22. A 3 kg cart is traveling $10 \frac{\text{m}}{\text{s}}$ North when it collides with a 2 kg cart traveling $20 \frac{\text{m}}{\text{s}}$ East. If the two carts stick together after the collision, what is the final speed of the two carts?

- (A) 10 m/s (B) 14 m/s
 (C) 12 m/s (D) 2 m/s

23. An empty sled of mass M moves without friction across a frozen pond at a speed v_0 . Two objects are dropped vertically into the sled one at a time: first an object of mass m and then an object of mass $2m$. After wards the sled moves with a final speed v_f . What would the final speed of the sled be if the objects were dropped onto the sled in the reverse order?

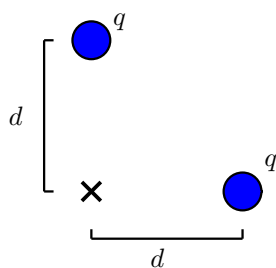
- (A) $2v_f$ (B) v_f
 (C) $v_f/2$ (D) $v_f/3$

24. What is the direction of the net force acting on the positive charge $+q$?



25. The Coulomb force exerted between two charged particles separated by a distance of 2 cm is 12 N. How large would the force be if the two charges were separated by 1 cm?
- (A) 24 N (B) 6 N
 (C) 3 N (D) 48 N

Use the figure below to answer questions 26 and 27.



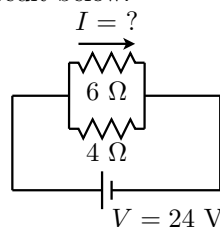
26. What is the **magnitude of the electric field** at point x?
- (A) $\sqrt{2} k \frac{q}{d^2}$ (B) $\sqrt{2} k \frac{q}{d}$
 (C) $2 k \frac{q}{d^2}$ (D) $2 k \frac{q}{d}$
27. What is the **voltage** at point x?
- (A) $\sqrt{2} k \frac{q}{d^2}$ (B) $\sqrt{2} k \frac{q}{d}$
 (C) $2 k \frac{q}{d^2}$ (D) $2 k \frac{q}{d}$
28. A volt is equivalent to which combination of units?
- (A) $J \cdot C$ (B) $\frac{N}{C}$
 (C) $N \cdot C$ (D) $\frac{J}{C}$

29. Two identically charged spheres are placed 2 cm apart. Each sphere has a mass of 0.1 kg and a charge of $2 \mu C$. One sphere is held in place, while the other is released. How fast is the sphere moving when the two spheres are very far apart? **NOTE: The practice exam mistakenly states the charges the two spheres is 2 C (an enormous amount of charge).**

- (A) $6 \frac{m}{s}$ (B) $48 \frac{m}{s}$
 (C) $36 \frac{m}{s}$ (D) $12 \frac{m}{s}$

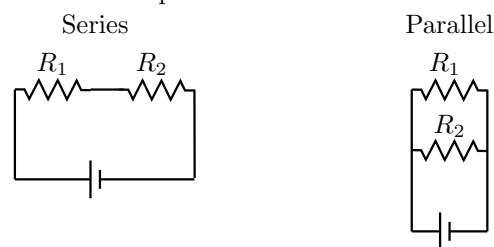
30. A wire carries 10 A of current. How much charge flows through the wire ever minute?
- (A) 10 C (B) 1 C
 (C) $1.6(10^{-18}) C$ (D) 600 C

31. Determine the current flowing through the **top** resistor in the circuit below.



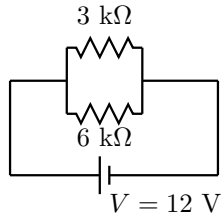
- (A) 2.4 A (B) 4 A
 (C) 10 A (D) 6 A

32. The figure below shows two circuits. In both circuits, $R_1 > R_2$. Determine which resistor dissipates **the most** power in each of the circuits.



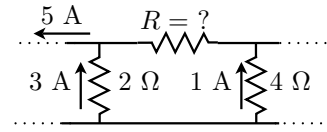
- | | |
|--|----------|
| Series | Parallel |
| (A) R_1 | R_1 |
| <input checked="" type="radio"/> (B) R_1 | R_2 |
| (C) R_2 | R_1 |
| (D) R_2 | R_2 |

33. What is the **total** current flowing through the circuit?



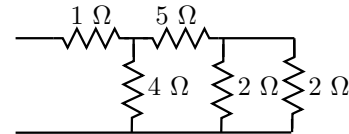
- (A) 1.3 mA (B) 6 mA
 (C) 4 mA (D) 2 mA

34. Determine the unknown resistance in the circuit below. (The dotted lines indicate that the wires on the left and right continue, and connect to other circuits.)



- (A) 1 Ω (B) 0.5 Ω
 (C) 2 Ω (D) 3 Ω

35. Determine the equivalent resistance of the circuit below.



- (A) 0.86 Ω (B) 14 Ω
 (C) 5 Ω (D) 3.4 Ω