ver. A

Honors Physics
Spring, 2017

Honors Physics Mock Final Exam

Name: _____
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.

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

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

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

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

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

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

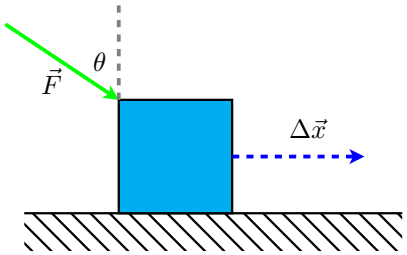
8. When two resistors are connected in parallel, the equivalent resistance is always lower than the resistance of either of the two resistors by themselves.

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.

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.

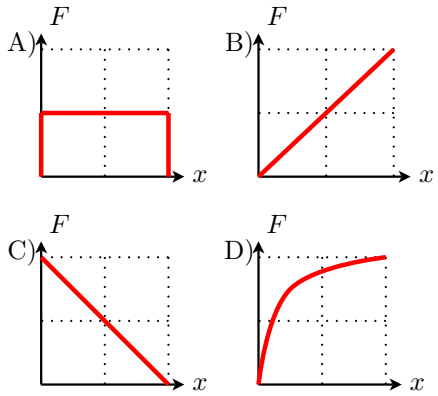
For problems 11-35, chose the option that best answers each question. Each question on this portion of the exam is worth 2 points.

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) $F\,\Delta x\tan\theta$

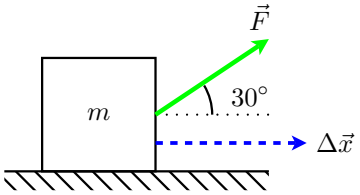
12. The following graphs, all drawn to the same scale, represent the net force F as a function of displacement x for an object that moves along a straight line. Which graph represents the force that will cause the greatest change in the kinetic energy of the object?



(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) $F\,\Delta x\sin(30°)$

(C) $F\,\Delta x\cos(30°)$ (D) $F\,\Delta x\tan(30°)$

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

(A) 0 J (B) $-m\,g\,\Delta x\sin(30°)$

(C) $+m\,g\,\Delta x\sin(30°)$ (D) $-m\,g\,\Delta x\cos(30°)$

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

(A) 0 J (B) $-m\,g\,\Delta x\sin(30°)$

(C) $+m\,g\,\Delta x\sin(30°)$ (D) $-m\,g\,\Delta x\cos(30°)$

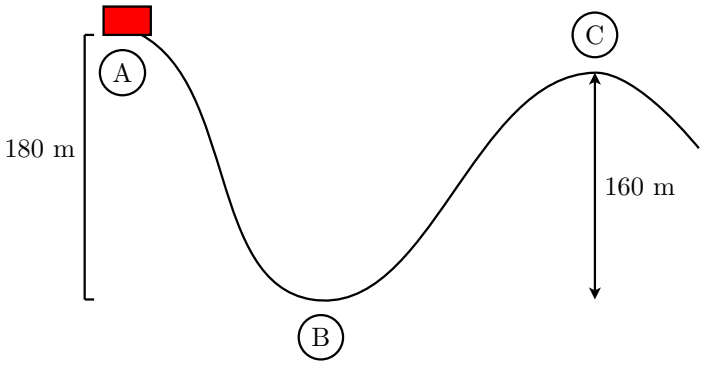
16. How much work was done by friction?

(A) $-F\,\Delta x$ (B) $-F\,\Delta x\sin(30°)$

(C) $-F\,\Delta x\cos(30°)$ (D) $-F\,\Delta x\tan(30°)$

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

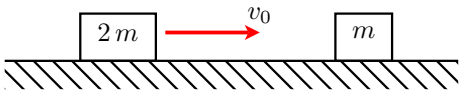
(C) −40 kJ (D) 2.4 kJ

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?

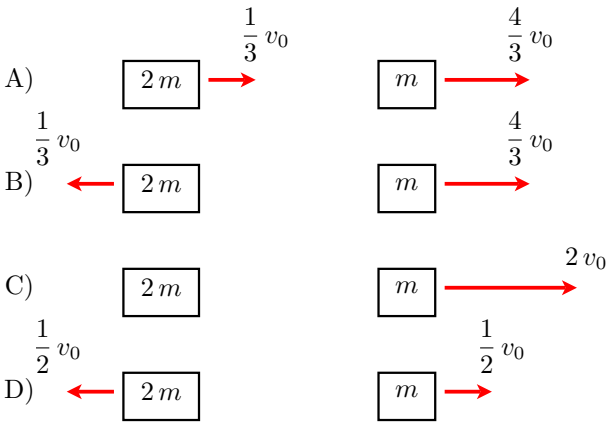
(A) 10 N (B) 550 N

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

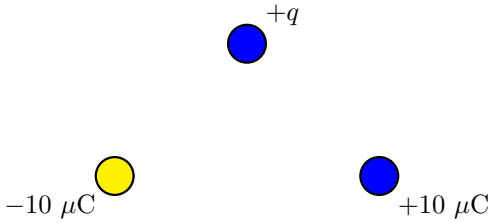
22. A 3 kg cart is traveling 10 $\frac{\text{m}}{\text{s}}$ North when it collides with a 2 kg cart traveling 20 $\frac{\text{m}}{\text{s}}$ East. If the two carts stick together after the collision, what is the final speed of the two carts?

(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) $2v_\text{f}$ (B) v_f
(C) $v_\text{f}/2$ (D) $v_\text{f}/3$

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

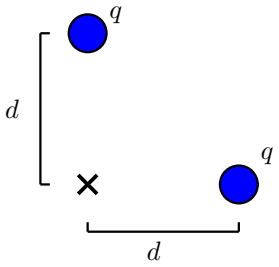


(A) Up (B) Down
(C) Left (D) Right

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) $\text{J}\cdot\text{C}$ (B) $\frac{\text{N}}{\text{C}}$
(C) $\text{N}\cdot\text{C}$ (D) $\frac{\text{J}}{\text{C}}$

29. Two identically charged spheres are placed 2 cm apart. Each sphere has a mass of 0.1 kg and a charge of 2 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?

(A) 6 $\frac{\text{m}}{\text{s}}$ (B) 48 $\frac{\text{m}}{\text{s}}$

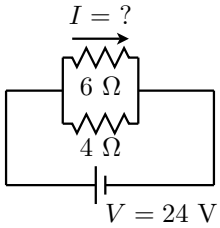
(C) 36 $\frac{\text{m}}{\text{s}}$ (D) 12 $\frac{\text{m}}{\text{s}}$

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.

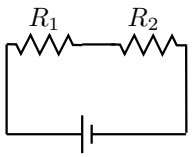


(A) 2.4 A (B) 4 A

(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.

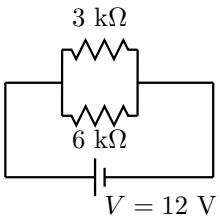
Series



Parallel

Series	Parallel
(A) R_1	R_1
(B) R_1	R_2
(C) R_2	R_1
(D) R_2	R_2

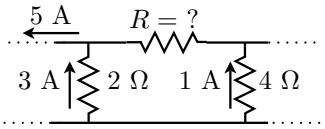
33. What is the **total** current flowing through the circuit?



(A) 1.3 mA (B) 6 mA

(C) 4 mA (D) 2 mA

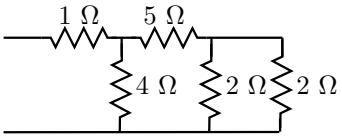
34. Determine the unknown resistance in the circuit below. (The dotted lines indicate that the wires on the left and right continue, and connect to other circuits.)



(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