Final exam 5 2017, questions and answers

Physics I (Ryerson University)

RYERSON UNIVERSITY
DEPARTMENT OF PHYSICS
FACULTY OF SCIENCE

FINAL EXAMINATION **Version A** **DURATION: 120 minutes**

Student number (Last five digits)	**Section**	**Print First Name**	**Print Last Name**	*First letter of your LAST name*

Your Instructor (Check) ☐ **Dr. T. Antimirova**

☐ **Dr. R. Karshafian**

READ THE INSTRUCTIONS:

DO NOT OPEN THE TEST UNTIL YOU ARE TOLD TO DO SO.

- This is a closed book evaluation. Only pens, pencils, erasers, calculators and your Ryerson ID are allowed on your desk.
- A formula sheet is attached. No other aids are permitted.
- Your ***Ryerson photo ID*** must be on your desk at all times.
- Pagers and cell phones must be silenced **and placed in the bags**. Earphones are not allowed.
- Talking to another student or glancing over another student's paper is not permitted and it may result in a charge of academic misconduct.
- For each numerical question: write your solution in the space provided in this exam booklet.
- Select the option that is closest to your answer, circle it in the exam booklet and then copy it to the bubble sheet carefully using a pencil.
- The work shown in your exam booklet may be checked, at least for one of the questions, selected randomly. If no work is shown to justify the answer to a question, the resultant mark may be zero, even if the answer in the bubble sheet is correct.
- Exam pages must not be detached. You may detach a formula sheet.
- The exam consists of 24 questions on pages 2-12. Please verify that your exam paper has all pages.
- **Bubble your version of the exam (A or B) into question 100 of your bubble sheet.**

Please sign here indicating you have read and understood the above instructions.

SIGNATURE:_____

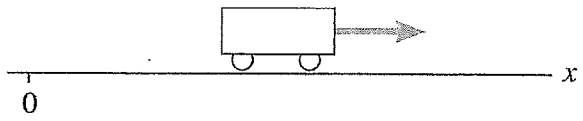
DO NOT OPEN THE EXAM PAPER UNTIL YOU ARE TOLD TO DO SO.
Note: Verify that you have all pages (all questions) before you start writing the exam.

Solve the problem in the exam paper. **Circle** the correct option in the exam paper AND **bubble the answer** into bubble sheet.

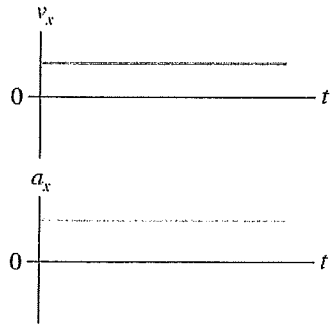
1. A small ball is tossed vertically up into the air with a speed of 30.0 m/s. Calculate the maximum height the ball reaches during the flight. The air resistance is negligible.

(A) 90.8 m
(B) 45.9 m
(C) 10.0 m
(D) 180.0 m
(E) 25.0 m

2. A cart **speeds up** while moving **away from the origin**. What do the velocity and acceleration graphs look like?



A.



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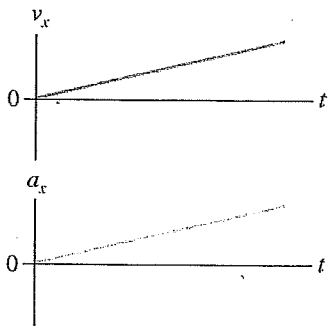
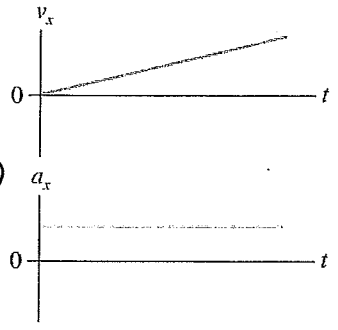
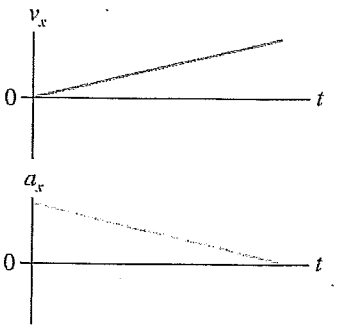


B.



D.

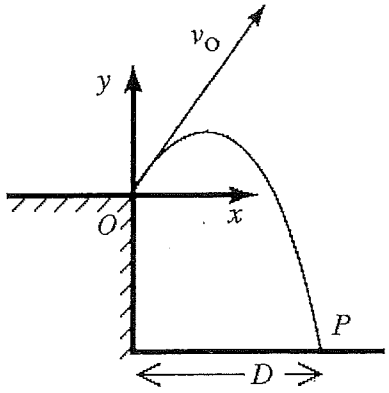


(E) none of the above

3. Two objects are dropped from a bridge, an interval of 1.0 s apart, and experience no appreciable air resistance. As time progresses, the **difference** in their speeds

(A) increases
(B) remains constant
(C) decreases
(D) increases at first, but then stays constant
(E) decreases at first, but then stays constant

4. A projectile is fired from point O at the edge of a cliff, with initial **velocity components** of $v_{0x} = 60$ m/s and $v_{0y} = 175$ m/s. The projectile rises and then falls into the sea at point P. The time of flight of the projectile is 40.0 s, and it experiences no appreciable air resistance during flight. What is the **magnitude of the velocity** of the projectile 21.0 s after it is fired?



(A) 60.0 m/s
(B) 30.7 m/s
(C) 67.6 m/s
(D) 84.0 m/s
(E) 108.6 m/s

5. A box with weight of 50.0 N is sliding on a rough horizontal floor, and the only horizontal force acting on it is friction. You observe that at one instant the box is sliding to the right at 1.75 m/s and that it stops in 2.25 s. What is the magnitude of friction force exerted on this box?

(A) 3.97 N
(B) 8.93 N
(C) 38.9 N
(D) 50.0 N
(E) 490 N

6. A 10,000-kg rocket blasts off from earth with a uniform **upward** acceleration of 2.00 m/s^2 and feels no air resistance. The upward **thrust force** its engines must provide during this acceleration is closest to

(A) 20,000 N
(B) 980,000 N
(C) 118,000 N
(D) 78,000 N
(E) 67,000 N

7. A construction worker pulls a box of tools on a smooth horizontal floor with a force of 100 N in a direction of 37.0° above the horizontal. The mass of the box and the tools is 40.0 kg. How hard does the floor push up on the box?

(A) 0 N
(B) 392 N
(C) 332 N
(D) 452 N
(E) 600 N

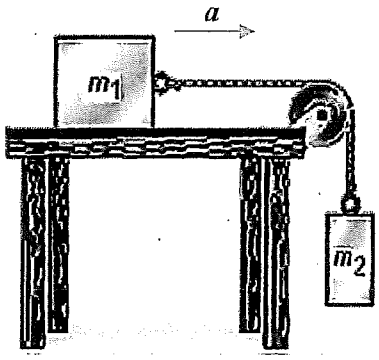
8. A 60.0-kg person rides in elevator while standing on a scale. The elevator is traveling downward and slowing down at a rate of 2.00 m/s^2. The reading on the scale is closest to

(A) 589 N
(B) 708 N
(C) 469 N
(D) 120 N
(E) 349 N

9. A driver in a 1000-kg car traveling at 20 m/s slams on the brakes and skids to a stop. If the coefficient of friction between the tires and the horizontal road is 0.80, how long will the skid marks be?

(A) 26 m
(B) 21 m
(C) 33 m
(D) 24 m
(E) 40 m

10. Two objects having masses m_1 and m_2 are connected to each other as shown in the figure and are released from rest. The table and the pulley are frictionless. The masses of the pulley and the string connecting the objects are completely negligible. What must be true about the tension T in the string just after the objects are released?

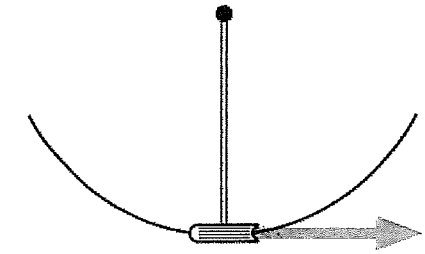


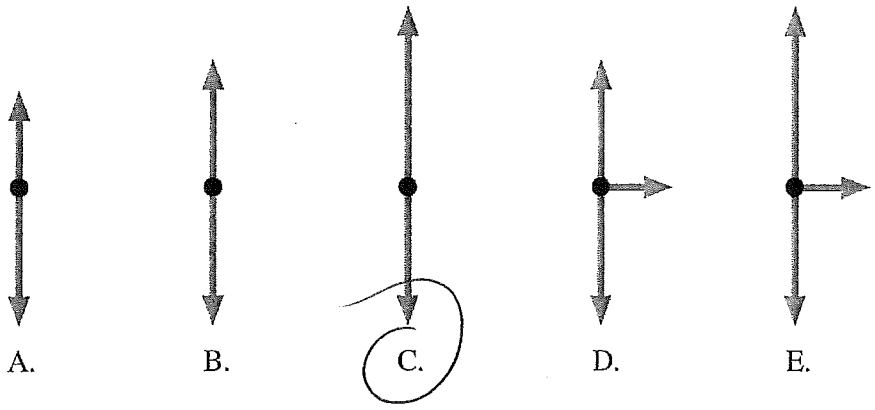
(A) $T = m_2 g$
(B) $T > m_2 g$
(C) $T = m_1 a$
(D) $T = m_1 g$
(E) $T = m_2 a$

11. A new roller coaster contains a loop-the-loop in which the car and rider are completely upside down. If the radius of the loop is 13.2 m with what **minimum speed** must the car traverse the loop so that the rider does not fall out while upside down at the top? Assume the rider is not strapped to the car.

(A) 11.4 m/s
(B) 12.5 m/s
(C) 10.1 m/s
(D) 14.9 m/s
(E) 2.1 m/s

12. A heavy pendulum swings back and forth. Which is the correct free-body diagram when the pendulum is at the **bottom** and moving to the right? Neglect air resistance.

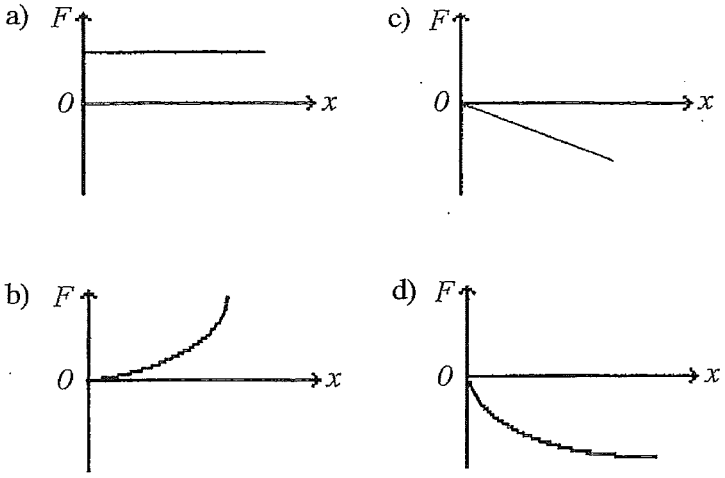




13. A car drives over a hilltop that has a radius of curvature 120 m at the top of the hill. At what speed would the car be traveling when its tires just barely lose contact with the road when the car is at the top of the hill?

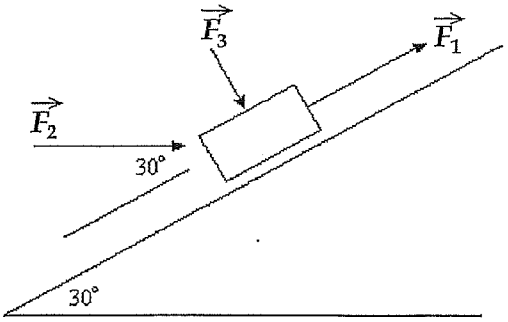
(A) 45.5 m/s
(B) 41.8 m/s
(C) 34.3 m/s
(D) 22.2 m/s
(E) 27.6 m/s

14. Which of the graphs in the figure illustrates Hooke's Law? The ***F*** represents the spring force and *x* represents compression/elongation of the spring.



(A) Graph a
(B) Graph b
(C) Graph c
(D) Graph d
(E) None of the above

15. Three forces with the magnitudes $F_1 = 20.0$ N, $F_2 = 40.0$ N, and $F_3 = 10.0$ N act on an object with a mass of 2.00 kg which can move along a **frictionless** inclined plane as shown in the figure. The questions refer to the instant when the object has moved through a distance of 0.600 m **along the surface** of the inclined plane in the **upward** direction. Calculate the amount of work done by the force F_2.

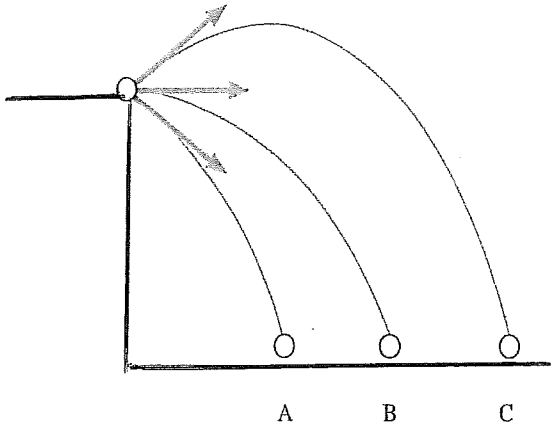


(A) 12.0 J
(B) 20.8 J
(C) 0.00 J
(D) 24.0 J
(E) 49.6 J

16. A student slides her 80.0-kg desk across the level floor of her dormitory room a distance 4.00 m at **constant speed**. If the coefficient of kinetic friction between the desk and the floor is 0.400, how much work did she do?

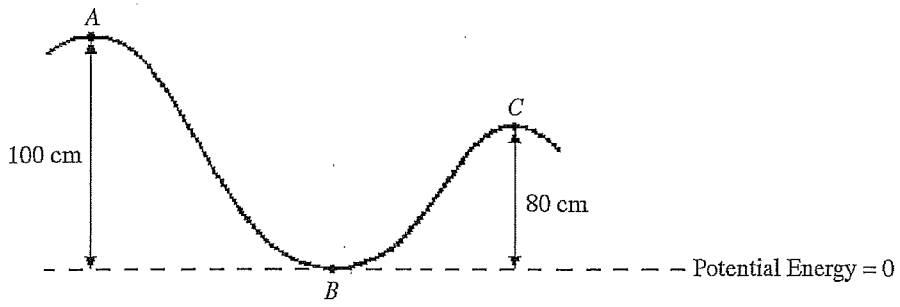
(A) 128 J
(B) 3140 J
(C) 26.7 J
(D) 1260 J
(E) 24.0 J

17. Three balls are thrown from a cliff with the same speed but at different angles. Which ball has the greatest speed just before it hits the ground?



(A) Ball A
(B) Ball B
(C) Ball C
(D) Balls A and C
(E) All balls have the same speed

18. A 2.0×10^{-3} kg bead slides along a frictionless wire, as shown in the figure. At point *A*, the bead is moving to the right but with negligible speed. What is the speed of the bead at point *C*?



(A) 4.4 m/s
(B) 0.0 m/s
(C) 6.8 m/s
(D) 2.0 m/s
(E) 0.5 m/s

19. A 2.50-kg stone is **dropped from rest** at a height of 3.75 m. What **impulse** does gravity impart to this stone from the instant it is dropped until it hits the ground, assuming negligible air resistance?

(A) 21.4 N · s
(B) 73.5 N · s
(C) 58.0 N · s
(D) 14.1 N · s
(E) 18.4 N · s

20. In a collision between two objects having **unequal** masses, how does magnitude of the impulse imparted to the lighter object by the heavier one compare with the magnitude of the impulse imparted to the heavier object by the lighter one?

(A) The lighter object receives a larger impulse.
(B) The heavier object receives a larger impulse.
(C) Both objects receive the same impulse.
(D) The answer depends on the ratio of the masses.
(E) The answer depends on the ratio of the speeds.

21. Find the **orbital speed** of a piece of ice in the rings of Saturn. The mass of Saturn is 5.68×10^{26} kg and the rings have an average radius of 100,000 km.
$G = 6.67 \times 10^{-11}\ \text{N} \cdot \text{m}^2/\text{kg}^2$.

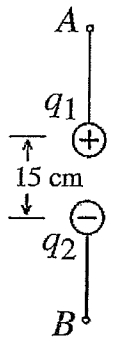
(A) 19.5 km/s
(B) 27.5 km/s
(C) 13.8 km/s
(D) 1.95 km/s
(E) 38.95 km/s

22. A **negative charge** is moved from point *A* to point *B* along an **equipotential surface.** Which of the following statements must be true for this case?

A) The negative charge performs work in moving from point *A* to point *B*.
B) Work is required to move the negative charge from point *A* to point *B*.
C) No work is required to move the negative charge from point *A* to point *B*.
D) The work done on the charge depends on the distance between *A* and *B*.
E) Work is done in moving the negative charge from point *A* to point *B*.

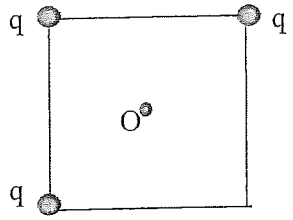
23. Two small insulating spheres are attached to silk threads and aligned vertically as shown in the figure. These spheres have equal masses of 40 g, and carry charges q_1 and q_2 of equal magnitude 2.0 μC but **opposite sign**. The spheres are brought into the positions shown in the figure, with a vertical separation of 15 cm between them. Note that you cannot neglect gravity.
($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2, 1 μC $=10^{-6}$ C.)

The tension in the **lower** thread is closest to



A) 1.2 N
B) 1.4 N
C) 1.6 N
D) 1.8 N
E) 2.0 N

24. Three equal **negative** point charges are placed at three of the corners of a square of side *d*. What is the magnitude of the **net electric field** at the **center of the square (point O)**? $k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9\ \mathrm{N \cdot m^2/C^2}$.



(A) $E = kq/d^2$

(B) $E = 2kq/d^2$

(C) $E = kq/(2d^2)$

(D) $E = kq/(4d^2)$

(E) $E = 4kq/d^2$

THE END

Department of Physics
Faculty of Science
Ryerson University

Print your name: _____

PCS 120 CONSTANTS AND FORMULAE

$$m_p = 1.67\times10^{-27}\,kg$$
$$m_e = 9.11\times10^{-31}\,kg$$
$$e = 1.60\times10^{-19}\,C$$
$$k = 8.99\times10^{9}\,N\cdot m^2/C^2 = \frac{1}{4\pi\varepsilon_0}$$
$$\varepsilon_0 = 8.85\times10^{-12}\,C^2/(N\cdot m^2)$$
$$G = 6.67\times10^{-11}\,N\cdot m^2/kg^2$$
$$g_E = 9.8\frac{m}{s^2}$$

$$F_g = G\frac{m_1 m_2}{r^2}$$
$$g = G\frac{M}{r^2}$$
$$g_{surface} = G\frac{M}{R^2}$$
$$\vec{g} = \frac{\vec{F}_g}{m}$$

$$F = k\frac{q_1 q_2}{r^2}$$
$$\vec{E} = \frac{\vec{F}}{q_0};\ E = \frac{kq}{r^2}$$
$$U_{12} = \frac{Kq_1q_2}{r} = \frac{q_1q_2}{4\pi\varepsilon_0 r}$$
$$V = \frac{kq}{r} = \frac{q}{4\pi\varepsilon_0 r}$$
$$\Delta V = -Ed$$
$$I_{ave} = \frac{\Delta Q}{\Delta t};\ I = \frac{\Delta V}{R}$$
$$P = I\Delta V = I^2R = \frac{(\Delta V)^2}{R}$$
$$R = \rho\frac{L}{A}$$

$$x_f = x_i + v_{ix}\Delta t + \frac{1}{2}a_x(\Delta t)^2$$
$$v_f = v_i + a\Delta t$$
$$v_{fx}^2 = v_{ix}^2 + 2a_x\Delta x$$
$$(v_x)_{ave} = \frac{\Delta x}{\Delta t}$$
$$(a_x)_{ave} = \frac{\Delta v_x}{\Delta t}$$

$$E = K + U$$
$$K = \frac{1}{2}mv^2$$
$$U_g = mgy$$
$$U_{sp} = \frac{k(\Delta x)^2}{2}$$
$$K_i + U_i + W_{ext} = K_f + U_f$$
$$W = \vec{F}\cdot\Delta\vec{r} = F\Delta r\cos(\theta)$$

$$\Delta\theta = \theta - \theta_o$$
$$\overline{\omega} = \frac{\theta-\theta_o}{t-t_o} = \frac{\Delta\theta}{\Delta t}$$
$$\overline{\alpha} = \frac{\omega-\omega_o}{t-t_o} = \frac{\Delta\omega}{\Delta t}$$
$$v_T = r\omega$$
$$a_c = \frac{v_T^2}{r} = r\omega^2$$

$$\vec{F}_{net} = \sum\vec{F} = m\vec{a}$$
$$\vec{w} = (mg, downwards)$$
$$F_{sp} = -k\Delta x$$
$$f_s^{\max} = \mu_s n$$
$$f_k = \mu_k n$$

$$\vec{P} = M\vec{v}$$
$$\Delta P_x = J_x$$
$$J_x = \int_{t_i}^{t_f} F(t)\,dt$$

$$(F_{net})_r = \frac{mv^2}{r} = m\omega^2 r$$
$$v = \omega r$$
$$T = \frac{1}{f} = \frac{2\pi r}{v} = \frac{2\pi}{\omega}$$