

Centennial Collegiate and Vocational Institute
Final Examination REVIEW
Physics OAC (SPH OA1)

Teacher: Mr. Sutherland
 Mr. Hrycshyn

Date: Monday, Jan.26, 2004
 Time: 1:00 p.m.
 Length: 2.5 h
 No. of Pages: 7

Name _____

- NOTE:
1. You may use an information page which has been authorized by the teacher. This is to be submitted with your examination answers.
 2. You may use a calculator, ruler, protractor, compass and mathematical tables.
 3. Assume all data is accurate to the number of digits given and round off your answers appropriately.
 4. Your solutions to mathematical problems should contain enough detail that part marks may be allocated for incorrect solutions.
 5. Your clarity and correctness of written expression will be taken into account in determining the final mark for this paper.
 6. The marks for each part and the time you should take to answer the questions are shown below. Answer the multiple choice questions on the grid below. Answer the written questions in the booklet that has been provided. Place this page and the rest of the questions in the booklet for submission.

Section	Question Type	Mark allotted	Time allotted	Mark
Part A	Multiple Choice	28 marks	38 min.	
Part B	Short Answer	12 marks	14 min.	
Part C	Problems	38 marks	56 min.	
Part D	Laboratory Problems	10 marks	20 min.	
Part E	Extended Response	12 marks	22 min.	

	Significant digits and metric usage	2 marks		
	Grammar and spelling	2 marks		

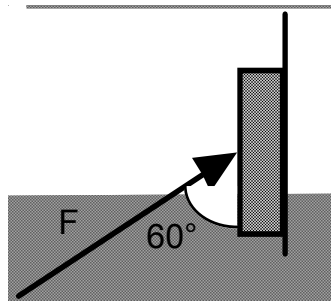
TOTAL	104 marks	150 min.		
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PLACE YOUR ANSWERS TO THE MULTIPLE CHOICE QUESTIONS ON THE GRID BELOW.
 CIRCLE THE BEST POSSIBLE CHOICE.

- | | | |
|--------------|---------------|---------------|
| 1. A B C D E | 10. A B C D E | 19. A B C D E |
| 2. A B C D E | 11. A B C D E | 20. A B C D E |
| 3. A B C D E | 12. A B C D E | 21. A B C D E |
| 4. A B C D E | 13. A B C D E | 22. A B C D E |
| 5. A B C D E | 14. A B C D E | 23. A B C D E |
| 6. A B C D E | 15. A B C D E | 24. A B C D E |
| 7. A B C D E | 16. A B C D E | 25. A B C D E |
| 8. A B C D E | 17. A B C D E | 26. A B C D E |
| 9. A B C D E | 18. A B C D E | 27. A B C D E |
| | | 28. A B C D E |

Part A - Multiple Choice - 27 marks (38 min.)

- A 1000 kg car accelerates from 10 m/s to 30 m/s in 10 s. What is its acceleration?
 (A) 1.0 m/s² (B) 2.0 m/s² (C) 3.0 m/s²
 (D) 4.0 m/s² (E) 6.0 m/s²
- A force of 196 N is applied, as shown, to a 20.0 kg object in contact with a frictionless wall. Up is the positive direction.

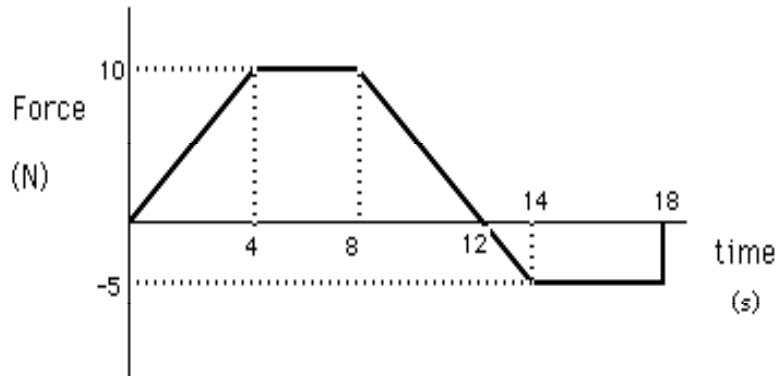


- The acceleration, a , in m/s², is
 (A) +4.90 (B) +9.80 (C) 0.0 (D) -9.80 (E) -4.90
- An object of mass 12 kg is moving in a circle of radius 90 m, at a speed of 3.0 m/s. What is the magnitude of the centripetal force on the particle?
 (A) 0.38 N (B) 1.2 N (C) 2.7 N (D) 1.5 N (E) 0.67 N
 - Using the data in the table below determine the value of k and n in the equation $y = kx^n$

x	y
1	512
2	64
4	8
8	1

- (A) 256, 3 (B) 512, 3 (C) 144, -2
 (D) 512, -3 (E) 256, -2
- The factor that affects the period of a pendulum the most is
 a) length b) mass c) amplitude d) air resistance e) temperature
 - Kepler's Third Law states that the cube of the radius of a planet's orbit R is directly proportional to the square of its period of revolution about the sun T . This law can be written as $R^3 = kT^2$, where k is the same for planets orbiting the sun. If planet I has twice the orbital radius of planet II, what is the ratio of the period of planet I to the period of planet II?
 (A) 2:1 (B) 4:1 (C) 8:1 (D) $\sqrt{8}$:1 (E) none of these
 - 20 J of work is done on of an ideal spring and produces an extension of 20 cm. The spring constant is
 (A) 10 N/m (B) 100 N/m (C) 200 N/m
 (D) 500 N/m (E) 1000 N/m
 - The astronomer whose accurate observations resulted in the development of Kepler's three laws was
 (A) Aristotle (B) Galileo (C) Brahe
 (D) Kepler (E) Newton
 - In a head on elastic collision between two masses m_1 and m_2 , where m_2 was initially at rest, which condition will result in the greatest final velocity of m_2 .
 (A) masses of objects are equal, $m_1 = m_2$
 (B) mass of the moving object is much less, $m_1 \ll m_2$
 (C) mass of the moving object is much more, $m_1 \gg m_2$
 (D) mass of the moving object is exactly two times greater, $m_1 = 2m_2$
 (E) mass of the moving object is exactly two times smaller, $2m_1 = m_2$

10. What would be the final velocity at 18 s of a 11.0 kg mass with an initial velocity of 4.0 m/s if it was subjected to the force described by the graph below ?



- (A) 5.0 m/s (B) 11 m/s (C) 9.0 m/s
(D) 198 m/s (E) 605 m/s
11. Two objects have the same momentum but do not have the same mass. Consider the following statements about them:
- I. The one with more mass has more kinetic energy.
 - II. The one with less mass will always require more force to stop it.
 - III. Both deliver the same impulse when stopped.
- Which of the following statements is/are correct?
- (A) I only (B) II only (C) III only
(D) I and III only (E) II and III only
12. A 10 kg mass falls through a distance of 100 m what is its change in kinetic energy
- (A) 9.8 J (B) 980 J (C) -9.8 J
(D) -980 J (E) 9 800 J
13. A 7000 kg satellite is in a circular orbit 620 km above the surface of the earth. The gravitational force in N acting on it is
- (A) 3.40×10^{11} (B) 6.86×10^4 (C) 3.99×10^{11} (D) 9.8
(E) 5.70×10^4
14. A 7000 kg satellite is in a circular orbit 620 km above the surface of the earth. The magnitude of its acceleration in m/s^2 is
- (A) 0 (B) 8.93 (C) 8.10 (D) 9.80 (E) 5.70×10^4
15. The person who was the main supporter of the corpuscular theory of light was
- (A) Huygens (B) Newton (C) Hertz (D) Maxwell (E) Coulomb
16. A 5.0 Hz water wave, traveling at 30 cm/s in deep water, enters shallow water so that the angle between the incident wave and the boundary is 50° . If the speed of the wave in shallow water is 27 cm/s, what is the wavelength of the wave in shallow water?
- (A) 4.0 cm (B) 5.4 cm (C) 10.1 cm (D) 11.1 cm (E) 6.0 cm
17. In a ripple tank two point sources in phase are making circular waves. When the depth is 1.25 cm the frequency is 8.0 Hz and the wavelength is 3.2 cm. When the depth is increased to 2.5 the new frequency is
- (A) 16 Hz (B) 8.0 Hz (C) 4.0 Hz (D) 2.0 Hz (E) 0
18. In a double slit interference experiment the distance between adjacent nodal lines was found to be 1.2 cm. If the screen was located 2.0 m from the double slits and the wavelength of the light used was 400 nm, what was the separation of the slits?
- (A) 670 nm (B) 67 μm (C) 300 μm (D) 480 μm (E) 961 μm
19. In a single slit diffraction experiment, at what angle will 518 nm light produce a third minimum if the single slit width is 6.0 μm ?
- (A) 6.0° (B) 11° (C) 15° (D) 45° (E) 90°
20. A soap film of thickness 100 nm has a refractive index of 1.30. When viewed perpendicularly with white light, what colour is strongly reflected?
- (A) 400 nm (B) 520 nm (C) 173 nm (D) 480 nm (E) 600 nm
21. Two large parallel charged plates are 4.0 cm apart. The field between the plates is 2000 N/C. What is the potential difference between the plates?
- (A) 80 000 V (B) 800 V (C) 80 V (D) 500 V (E) 50 000 V
22. Two similar charges Q_1 and Q_2 exert a force of 36 N on each other when they are 10 cm apart. If the charges remain the same and the distance is increased to 30 cm, the force exerted will be
- (A) 4.0 N (B) 8.0 N (C) 36 N (D) 48 N (E) 108 N
23. What is the magnitude and direction of the electric field at a point that is 3.00 m to the right of a +4000 μC charge?
- (A) 4.00 MN /C left (B) 1.20 MN /C left (C) 0 (D) 4.00 MN /C right

(E) 1.20 MN /C right

24. What is the magnitude of the electric potential 3.00 m to the right of a +4000 μC charge?
(A) 4.00 MJ (B) 12.0 MJ (C) 0 (D) -4.00 MJ
(E) -12.0 MJ
25. The experiment where x-rays underwent an elastic collision with an electron showed that photons have momentum. This experiment was performed and explained by
(A) Einstein (B) de Broglie (C) Cavendish (D) Michelson (E) Compton
26. What is the energy in, eV, of a photon of wavelength 400 nm?
(A) 1.6 (B) 3.1 (C) 2.6×10^{-31} (D) 0 (E) -1.6×10^{-19}
27. The statement "to understand a specific experiment, one must use either the wave or photon theory but not both." is known as the
(A) Heisenberg Uncertainty Principle
(B) Principle of Wave-Particle Duality
(C) Special Theory of Relativity
(D) General Theory of Relativity
(E) Principle of Complementarity
28. Several statements about the photoelectric effect are given below:
- I. The number of electrons emitted is proportional to the intensity of the incident light.
 - II. Whether or not photoelectrons are emitted depends on the frequency of the incident light.
 - III. The proportion of its energy which each photon transfers to each electron depends on the material used in the surface.

Which of the above statements correctly describes the photoelectric effect?

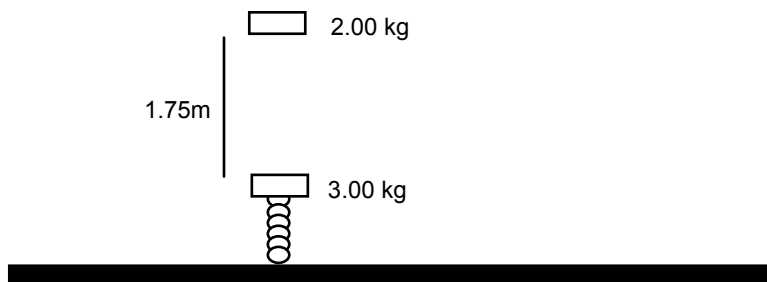
- (A) I only (B) I and II only (C) I and III only
(D) II and III only (E) I, II and III

Part B - Short Answer - 12 marks (14 min.)

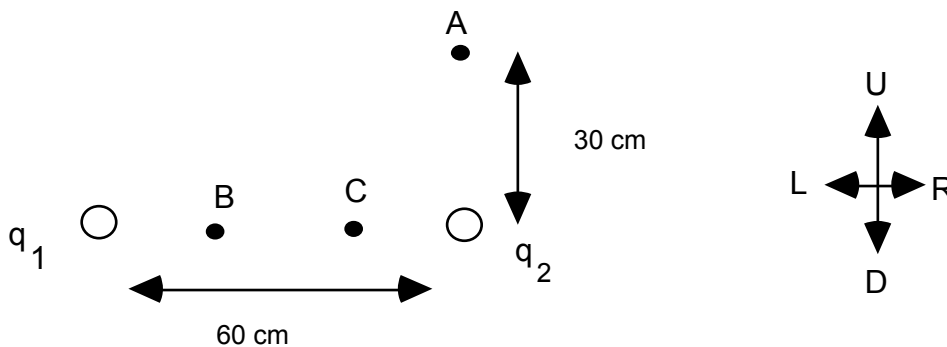
- (3 marks) 1. When a bullet is fired from a gun into a sandbag suspended from a string, the bullet stays in the sand and the system rises through a height 'h' before coming to rest. Using appropriate numerical approximations show how the muzzle velocity of the bullet can be determined.
- (3 marks) 2. Explain how you can determine the coefficient of static friction using a 2 kg block and an adjustable inclined plane. Give a numerical example.
- (3 marks) 3. Which has a larger wavelength: a 2.0 eV electron or a 2.0 eV photon? Explain using appropriate equations.

Part C - Problems - 38 marks (56 min.)

1. A pilot wishes to fly directly from her airport across the province to a city that is flooded. The city is 1250 km [E 30° N] of her present position. The plane has an airspeed of 300 km/h and the wind is blowing at 80 km/h [S].
- (2 marks) a) Draw a vector diagram approximately to scale to show the relationship of the three velocity vectors. (The velocity of the plane relative to the ground, the velocity of the plane relative to the air, and the velocity of the air relative to the ground).
- (2 marks) b) Calculate the direction in which the plane should head.
- (4 marks) c) Calculate the time required for the trip
2. A 2.0 kg projectile is fired from a high building that is 80.0 m high. The initial velocity of the projectile was 80 m/s 36.9° above the horizontal.
- (3 marks) a) How long did it take, from the time of firing, for the projectile to hit the ground?
- (2 marks) b) How far from the base of the building did the projectile hit the ground?
- (3 marks) c) What was the instantaneous velocity of the projectile as it hit the ground?
3. A 2.00 kg mass starting from rest falls 1.75 m onto a 3.00 kg mass that is at rest on an ideal spring. The collision is perfectly inelastic. A force of 200 N will compress the spring by 40 cm. What is the maximum compression of the spring as the masses first come to rest?



4. Two charges $q_1 = -20 \mu\text{C}$ and $q_2 = +20 \mu\text{C}$ are arranged as shown below. Point A is 30 cm vertically above q_2 . Point B is 20 cm from q_1 . Point C is 20 cm from q_2 .



- (5 marks) a) Determine the electric field at point A.
- (2 marks) b) If a charge of $-6.0 \mu\text{C}$ were placed at A, what would be the net force acting on it?
- (4 marks) c) If a 12.0 g mass with a charge of $+20 \mu\text{C}$ is released at C what is its speed as it passes B?
5. Light of wavelength 310 nm falls on a clean metal surface whose work function is 2.0 eV. The emitted photoelectron passes through a retarding voltage of 1.4 V before reaching the collector. What was the speed of the electron when it reached the collector?

Part D - Laboratory Problems -10 marks (20 min.)

- (5 marks) 2. You are given a helium-neon laser ($\lambda = 633 \text{ nm}$), a double slit of unknown separation, and a bright yellow light of unknown wavelength. By means of a diagram, explain how you could determine the wavelength of the yellow light. Indicate on your diagram approximate numerical dimensions and include all relevant equations in your explanation.
- (5 marks) 3. How can you experimentally show that the velocity of the centre of mass in a collision between two different masses is conserved. Draw a diagram and show a sample calculation.

Part E - Extended response - 12 marks (22 min.)

- (6 marks) 1. Answer only **one (1)** of the following.
- a) What is meant by the term “quantized”? What properties of an atom are quantized and how are these properties determined experimentally?
 - c) Discuss how the field concept allows scientists to explain and quantify physical phenomena. Use examples and diagrams.
- (6 marks) 2. Answer only **one (1)** of the following.
- a) Discuss the operation of a toy that moves using appropriate physics terminology, numerical examples, equations and diagrams.
 - b) Discuss how physical systems and problems can be simulated on a computer. What advantages and disadvantages are there? Use appropriate physics terminology, numerical examples, equations and diagrams.