Name: ______________________

Teacher: __________________________

DO NOT OPEN THE EXAMINATION PAPER UNTIL

YOU ARE TOLD BY THE SUPERVISOR TO BEGIN

PHYSICS 2204

FINAL EXAMINATION

June 2010

Value: 100%

General Instructions

This examination consists of two parts. Both parts are contained in this booklet and further general instructions are provided on appropriate pages.

Part I – Multiple Choice (40%)

Select the letter of the correct response from those provided. EITHER shade the letter on your computer scorable card OR place the letter in the blank provided on your Multiple Choice Answer Sheet, whichever format is being used by your school for this exam. **Do ALL questions in this section**.

Part II – Constructed Response (60%)

Answer ALL questions fully and concisely in the space provided. Show all work and use correct units and significant digits in all final answers.

A Formulae Sheet is provided.

Student Checklist

The items below are your responsibility. Please ensure that they are completed.

- □ Write your name and teacher's name on the top of this page.
- □ Write your name, teacher's name, course name and number on the Part I answer sheet.
- □ Check the exam to see that there are no missing pages.

ALL MATERIALS MUST BE PASSED IN WITH THIS EXAM. Use your time wisely. Good luck!

Part I
Total Value: 40%

1. Which represents a vector quantity?

   (A) displacement

   (B) mass

   (C) speed

   (D) time

2. Mary walks 6 m [E] then 10 m [W] then 8 m [E]. What is her displacement?

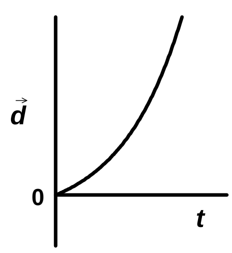
   (A) 4 m [E]

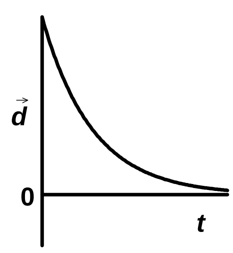
   (B) 4 m [W]

   (C) 24 m [E]

   (D) 24 m [W]

3. Which graph represents an object with uniform motion?

   (A)


   (B)


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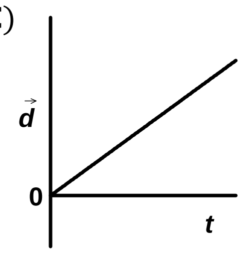

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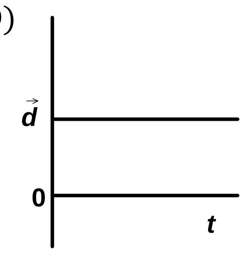
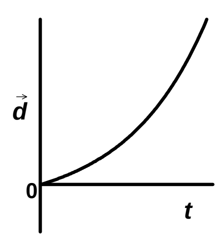
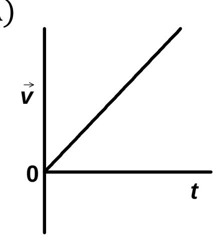


4. Which velocity-time graph matches the displacement-time graph shown below?



   (A)


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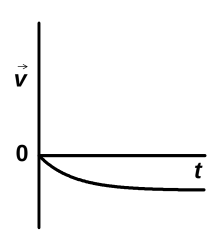

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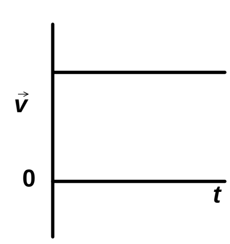
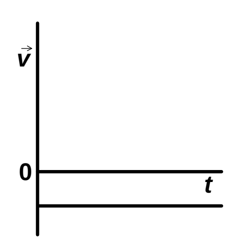


   (D)


5. A car starts from rest and accelerates uniformly at 6.6 m/s^2 for 10.0 s. How far does it travel?

   (A) 33 m

   (B) 66 m

   (C) 330 m

   (D) 660 m

6. A ball is tossed straight up with an initial velocity of 5.0 m/s. What is the speed of the ball at its maximum height?

(A) 0.0 m/s

(B) 5.0 m/s

(C) 9.8 m/s

(D) 14.8 m/s

7. The driver of a car travelling at 25 m/s sees a moose ahead. He applies the brakes and the car slows down at a rate of $8.3\ m/s^2$. If the driver's reaction time is 0.60 s, what is the total distance travelled from the time the driver sees the moose until the car stops?

(A) 14 m

(B) 15 m

(C) 38 m

(D) 53 m

8. An object accelerates at $2.2\ m/s^2$ for 3.0 s. If the final velocity of the object is 15 m/s, what was the initial velocity?

(A) 2.3 m/s

(B) 8.4 m/s

(C) 16 m/s

(D) 22 m/s

9. A car travelling 90 km/h [W] is passed by a truck travelling 120 km/h [W]. What is the velocity of the truck relative to the car?

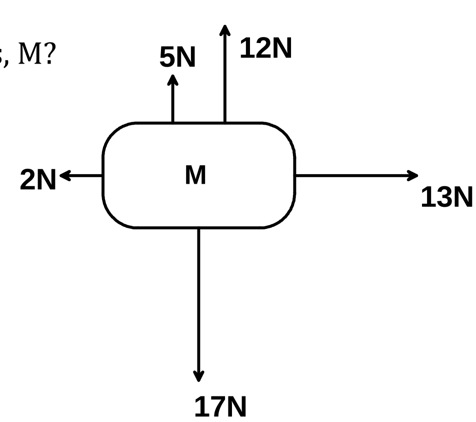
(A) 30 km/h [E]

(B) 30 km/h [W]

(C) 210 km/h [E]

(D) 210 km/h [W]

10. What is the magnitude of the net force on mass, M?



(A) 11 N

(B) 15 N

(C) 19 N

(D) 49 N

11. What is the weight of a 45 kg person on earth?

(A) 9.8 N

(B) 45 N

(C) 99 N

(D) 440 N

12. Force F_A causes an object to move with a constant speed over a rough surface as shown. How does the force of friction f_f compare to F_A?

(A) $f_f = F_A$

(B) $f_f > F_A$

(C) $f_f < F_A$

(D) $f_f = 0$

13. What are the units for impulse?

(A) N · kg

(B) N · m

(C) N · m/s^2

(D) N · s

14. Which of Newton's Laws explains why a plate stays on the table when a table cloth is quickly pulled from beneath it?

(A) Newton's First Law

(B) Newton's Second Law

(C) Newton's Third Law

(D) Newton's Law of Universal Gravitation

15. What is the magnitude of the acceleration when a 1.25 kg dynamics cart experiences a net force of 5.0 N?

(A) 0.25 m/s^2

(B) 3.8 m/s^2

(C) 4.0 m/s^2

(D) 6.3 m/s^2

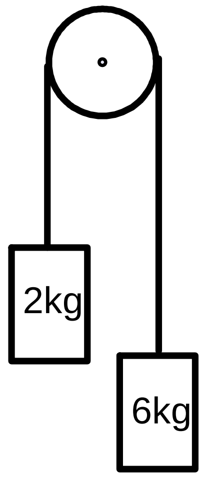
16. Two masses are connected by a string over a frictionless pulley as shown. What is the acceleration of the system of masses?

(A) 4.9 m/s^2

(B) 6.5 m/s^2

(C) 7.4 m/s^2

(D) 9.8 m/s^2



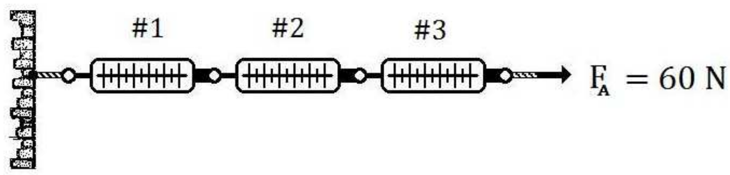
17. Three spring scales are connected and a 60 N force is applied to scale #3. What would be the reading on scale # 2?

(A) 20 N

(B) 30 N

(C) 40 N

(D) 60 N



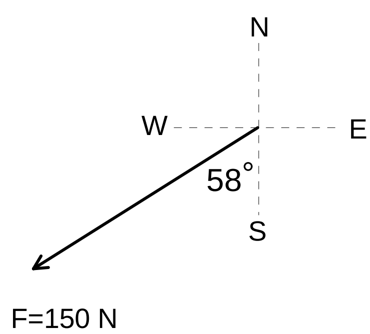
18. What is the horizontal component of the force shown?

(A) 79 N [E]

(B) 79 N [W]

(C) 130 N [E]

(D) 130 N [W]



19. A 16.5 kg mass and a 25.0 kg mass experience a gravitational force of attraction of 1.36×10^{-7}N. What is the distance between the centres of their masses?

(A) 0.202 m

(B) 0.450 m

(C) 2.22 m

(D) 4.94 m

20. Which object has the greatest momentum?

(A) 1.0 kg mass moving at 6.0 m/s

(B) 2.0 kg mass moving at 4.0 m/s

(C) 5.0 kg mass moving at 2.0 m/s

(D) 7.0 kg mass moving at 1.0 m/s

21. A teacher has twice the mass of a student. If they both run up the same flight of stairs in the same amount of time, which statement is true?

(A) The student generated greater power.

(B) The student was faster.

(C) The teacher did less work.

(D) The teacher generated greater power.

22. If a motor is 80% efficient, which statement regarding energy is true?

(A) input > output

(B) input < output

(C) input = output

(D) input = zero

23. A book is on top of a book shelf. Which type of energy does the book have with respect to the floor?

(A) chemical

(B) elastic

(C) gravitational

(D) kinetic

24. A 65 kg girl climbs a 4.0m ladder in 5.0 s. How much power does she generate?

(A) 52 W

(B) 510 W

(C) 13 000 W

(D) 51 000 W

25. A bungee cord has a spring constant of 112 N/m. How far will it stretch if a 50.0 kg mass is hung from it?

(A) 0.229 m

(B) 0.446 m

(C) 2.24 m

(D) 4.38 m

26. A truck pulls a trailer with a forward force of 3500 N while moving at a constant velocity of 22 m/s. How much work does the truck do in 36 s?

(A) 7.7×10^2 J

(B) 7.7×10^5 J

(C) 2.8×10^6 J

(D) 2.8×10^7 J

27. What is the kinetic energy of a 0.060 kg tennis ball travelling at 55 m/s?

(A) 1.7 J

(B) 3.3 J

(C) 91 J

(D) 180 J

28. Object A has half the mass and four times the speed as Object B. How does the kinetic energy of Object A compare to the kinetic energy of Object B?

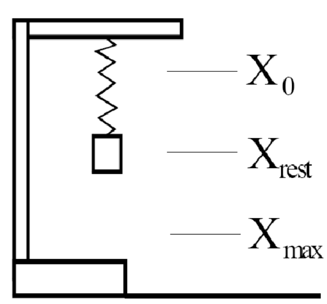
(A) A has 2 times the energy of B.

(B) A has 4 times the energy of B.

(C) A has 8 times the energy of B.

(D) A has 16 times the energy of B.

29. A block on a spring demonstrates simple harmonic motion by bobbing up and down. Which statement about the block's energy is true as it travels from position X_0 to X_{max}?



(A) Elastic potential energy is constant.

(B) Gravitational potential energy is constant.

(C) Kinetic energy is constant.

(D) Total mechanical energy is constant

30. When a listener approaches a stationary sound source, what happens to the perceived frequency?

(A) decreases

(B) increases

(C) subsonic

(D) unchanged

31. What is the expected angle of refraction as a beam of light travels from glass ($n_1 = 1.52$) at an angle of 23.0° from the normal, into water ($n_2 = 1.33$)?

(A) 20.0°

(B) 26.5°

(C) 52.2°

(D) 56.8°

32. A student is 3.0 m from a mirror. What distance from the student does the virtual image appear to be?

(A) 1.5 m

(B) 3.0 m

(C) 6.0 m

(D) 9.0 m

33. What type of mechanical wave has particle motion in the same direction as energy transfer?

(A) infrared

(B) longitudinal

(C) transverse

(D) ultrasonic

34. A buoy bobs up and down on the ocean a total of 12 times in 6.0 seconds. What is the frequency of the motion?

(A) 0.50 Hz

(B) 2.0 Hz

(C) 12 Hz

(D) 72 Hz

35. What is the speed of an airplane travelling at Mach 2 if the speed of sound is 332 m/s?

(A) 166 m/s

(B) 332 m/s

(C) 334 m/s

(D) 664 m/s

36. A radio station sends out electromagnetic waves of length 3.11 m. At what frequency is the radio station operating?

(A) 92.6 MHz

(B) 96.5 MHz

(C) 104 MHz

(D) 108 MHz

37. A block of glass with an index of refraction of 1.42 is placed in front of a light source. What is the speed of light in the block?

(A) 1.26×10^8 m/s

(B) 2.11×10^8 m/s

(C) 4.26×10^8 m/s

(D) 7.14×10^8 m/s

38. A hiker is standing at one end of a canyon that is 175 m wide on a day when the speed of sound is 341 m/s. How long does it take the hiker to hear his echo?

(A) 0.513 s

(B) 0.974 s

(C) 1.03 s

(D) 1.95 s

39. When a guitar string of unknown frequency is sounded with a 512 Hz tuning fork, 15 beats are heard in 5.0 s. Which is a possible frequency of the guitar string?

(A) 497 Hz

(B) 512 Hz

(C) 515 Hz

(D) 527 Hz

40. A distant star is known to produce a frequency of 6.00×10^{14}Hz. If it is moving away from the Earth at 5.35×10^6m/s, what wavelength is observed on Earth?

(A) 8.92×10^{-9} m

(B) 4.91×10^{-7} m

(C) 5.09×10^{-7} m

(D) 5.73×10^{-7} m

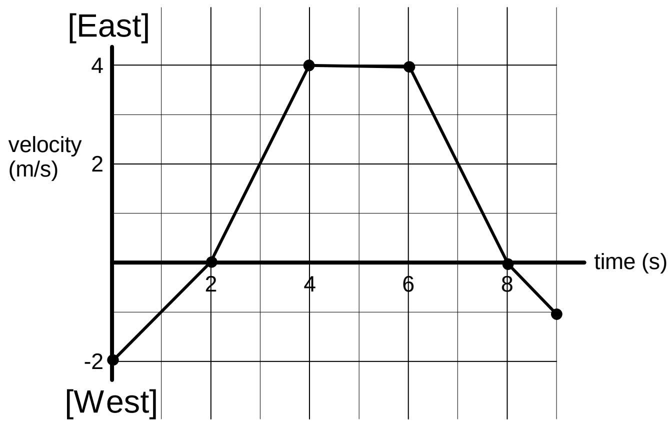
End of Part I

PART II
Total Value: 60%

Answer **ALL** questions in the space provided. *Show all workings and report all final answers with correct significant digits and units.*

Value

41. a)



1 (i) At what time(s) was the object stopped?

2 (ii) Calculate the acceleration of the object between 2 s and 4 s.

3 (iii) Calculate the displacement between 0 s and 4 s.

Value

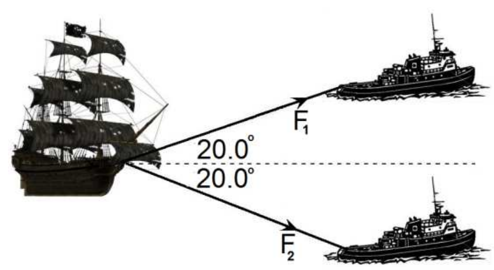
4 b) A river flows at 2.5 m/s [S]. A boater heads 3.5 m/s [E].
Calculate the boater's resultant velocity with respect to the shore.
Include a **labelled** vector diagram in your answer.

4 c) A car starts from rest and accelerates at 6.8 m/s^2 for a period of 3.1 s. The brakes are then applied and the car immediately slows to a stop at a rate of $-7.6 m/s^2$. Calculate whether the car will hit a garbage can that is located 25 m ahead of the position where the brakes were applied.

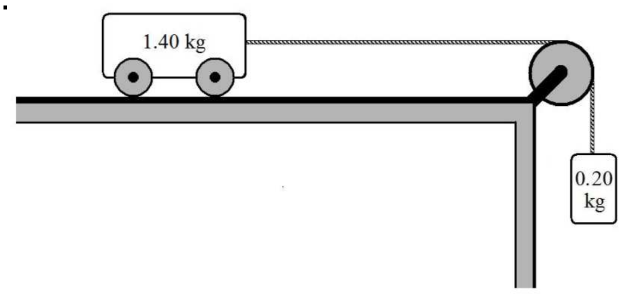
Value

4 42. a) A 65 kg hockey player is standing on the ice wearing her skates and holding her 15 kg hockey bag. She then throws the hockey bag to the right at 5.0 m/s. Assuming there is no friction, calculate the hockey player's velocity immediately after throwing the bag.

4 b) A ship is being towed by two tugboats. Tugboat 1 exerts a force of 2.7×10^3 N [E 20.0° N] and tugboat 2 exerts a force of 2.7×10^3 N [E 20.0° S]. Calculate the net force exerted by the tugboats on the ship.



Value c) A dynamics cart is connected to a 0.20 kg hanging mass by a massless string over a frictionless pulley. The force of friction between the cart and the table is 0.36 N.



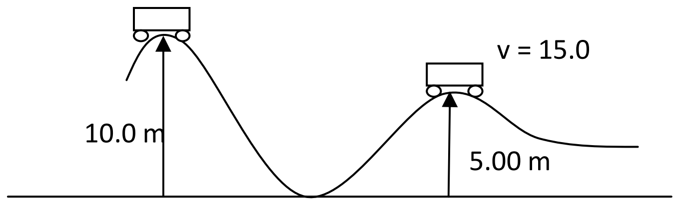
2 i) Calculate the magnitude of the acceleration of the system when the 0.20 kg mass is released.

2 ii) Calculate the tension in the string when the 0.20 kg mass is released.

4 d) A 1200 kg car is travelling along a highway where the posted speed limit is 25 m/s. The driver fully applies the brakes and comes to a stop, leaving a skid mark 83 m long. The coefficient of friction between the tires and the road is 0.45. Using physics, determine if the driver was speeding before she slammed on her brakes.

Value

43. (a) A 5.00×10^2 kg roller coaster travels at a speed of 15.0 m/s when at a height of 5.00 m above the ground (assume mechanical energy is conserved).



1 i) Calculate the kinetic energy at 5.00 m.

1 ii) Calculate the gravitational potential energy at 5.00 m.

3 iii) Calculate the speed of the roller coaster when it is at a height of 10.0 m.

b) A 605 kg race car accelerates from 20.0 m/s to 60.0 m/s.

3 i) Calculate the work done during the acceleration.

2 ii) If the car generates 582 kW of power, calculate the time it took to accelerate.

Value

4 c) A horizontal spring having a spring constant of 40.0 N/m undergoes simple harmonic motion when a 1.20 kg mass stretches it 20.0 cm from its rest position. Calculate the speed of the mass when it is 5.00 cm from the rest position.

44. a) A bass guitar string is 1.3 m long and is vibrating in the third harmonic.

1 i) Sketch the standing wave pattern produced.

2 ii) Calculate the frequency if the speed of the wave is 181 m/s.

Value

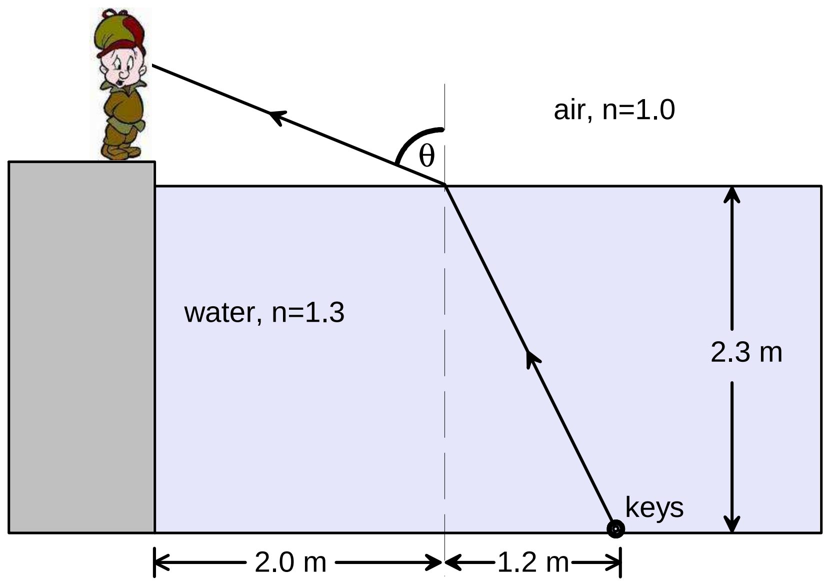
3 b) A 310 Hz tuning fork is held over the mouth of an air column open at one end. If the speed of sound is 352 m/s, calculate the length of the air column which produces the second resonant sound.

4 c) An ambulance siren emits a frequency of 440 Hz. If the air temperature is 22°C, calculate the frequency heard by an observer if the ambulance is coming toward him at 26 m/s.

3 d) A light with a wavelength of 5.50×10^{-7} m is shone through two slits which are 3.0×10^{-6} m apart. Calculate the angle at which the first order maxima occur.

Value

3 e) A student is standing at the edge of a pool that is 2.3 m deep. A set of keys is at the bottom of the pool, 3.2 m from the wall. The index of refraction for air is 1.0 and for water is 1.3. What is the angle of refraction in air?



End of Part II