COMMONWEALTH OF AUSTRALIA

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Warning

CHARLES DARWIN UNIVERSITY

Family Name	
Given Names	
Student Number	
Teaching Period	Semester 2, 2016

FINAL EXAMINATION	**DURATION**
SPH141 – Concepts of Physics	Reading Time: **10** minutes Writing Time: **180** minutes

INSTRUCTIONS TO CANDIDATES

The examination has **FIVE** questions. Please answer **ALL** questions.

Note that all questions **ARE NOT** of equal value.

The total marks for this examination is **85 marks**.

EXAM CONDITIONS

You may begin writing from the commencement of the examination session. The reading time indicated above is provided as a guide only.

This is a CLOSED BOOK examination

Any non-programmable calculator is permitted

One A4 sheet of handwritten double-sided notes permitted

No dictionaries are permitted

ADDITIONAL AUTHORISED MATERIALS	EXAMINATION MATERIALS TO BE SUPPLIED
none	1 x 20 Page Book Manuscript Paper

THIS EXAMINATION IS PRINTED DOUBLE-SIDED.

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Question 1 (17 marks)

Part 1 **(7 marks)**

A runner covers one lap of a circular track 80 m in diameter in 70 s.

a) For that lap, what were her average speed and average velocity? (*5 marks*)

b) If she covered the first half-lap in 50 s, what were her average speed and average velocity for that half-lap? (*2 marks*)

Part 2 **(10 marks)**

A physics book slides off a horizontal tabletop with a speed of 1.65 m/s. It strikes the floor in 0.69 s. Ignore air resistance. Find:

a) The height of the tabletop above the floor. (*3 marks*)

b) The horizontal distance from the edge of the table to the point where the book strikes the floor. (*3 marks*)

c) The horizontal and vertical components of the book's velocity, and the magnitude and direction of its velocity, just before the book reaches the floor. (*4 marks*)

Question 2 (13 marks)

Part 1 **(7 marks)**

A factory worker moves a 22.0 kg crate a distance of 4.8 m along a level floor at constant velocity by pushing horizontally on it. The coefficient of kinetic friction between the crate ad the floor is 0.30.

a) What magnitude of force must the worker apply? (*2 marks*)

b) How much work is done on the crate by the worker's push and by friction? (*3 marks*)

c) What is the net work done on the crate? (*2 marks*)

Part 2 **(6 marks)**

A force of magnitude 690.0 N stretches a certain spring by 0.230 m from its equilibrium position.

a) What is the force constant of this spring? (*2 marks*)

b) How much elastic potential energy is stored in the spring when it is:

i) stretched by 0.370 m from its equilibrium position? (*1 mark*)

ii) compressed by 0.370 m from its equilibrium position? (*1 mark*)

c) How much work was done in stretching the spring by the original 0.23 m? (*2 marks*)

Question 3 (19 marks)

Part 1 **(13 marks)**

Two cars collide at an intersection. Car A, with a mass of 2000 kg, is going from west to east, while Car B, of mass 1500 kg, is going from north to south at 15 m/s. As a result of this collision, the two cars become enmeshed and move as one afterwards. After collision, the enmeshed cars moved at an angle of 65° South of East from the point of impact.

a) How fast were the enmeshed cars moving just after the collision? (*8 marks*)

b) How fast was Car A going just before collision? (*5 marks*)

Part 2 **(6 marks)**

The piston of a hydraulic automobile lift is 0.3 m in diameter.

a) What gauge pressure, in Pascals, is required to lift a car with a mass of 1200 kg? (*5 marks*)

b) Express this pressure in atmospheres. (*1 mark*)

Question 4 (17 marks)

Part 1 **(12 marks)**

A container holds 0.550 kg of ice at -15.0 °C. The mass of the container can be ignored. Heat is supplied to the container at the constant rate of 0.8 kJ/min for 500 mins. [For ice, c = 2.01 x 10^3 J/kg·K. Heat of fusion (melting) of water = 3.34 x 10^5 J/kg]

a) After how many seconds does the ice starts to melt? (*4 marks*)

b) After how many minutes, from the time when the heating was first started, does the temperature begin to rise above 0 °C? (*4 marks*)

c) Plot a curve showing the temperature as a function of the time elapsed. (*4 marks*)

Part 2 **(5 marks)**

One end of a horizontal rope is attached to a prong of an electrically driven tuning fork that vibrates at 150 Hz. The other end passes over a pulley and supports a 1.50 kg mass. The linear mass density of the rope is 6.5 x 10^{-2} kg/m.

a) What is the speed of a transverse wave on the rope? *(2 marks)*

b) What is the wavelength? *(2 marks)*

c) How would your answers to parts (a) and (b) change if the mass were increased to 3.00 kg? *(1 mark)*

Question 5 (19 marks)

Part 1 **(13 marks)**

One suggested treatment for a person who has suffered a stroke is to immerse the patient in an ice-water bath at 0 °C to lower the body temperature, which prevents damage to the brain. In one set of tests patients were cooled until their internal temperature reached 32.0 °C.

To treat a 70 kg patient, what is the minimum amount of ice (at 0 °C) that you need in the bath so that its temperature remains at 0 °C?

[The specific heat capacity of the human body is 3480 J/(kg·K), heat of fusion (melting) of water is 334.1 kJ/kg, and assume a normal body temperature is 36.5 °C]

Part 2 **(6 marks)**

Two point charges are placed on the x axis as follows: Charge q_1 = +4.0 nC is located at x = 0.20 m, and charge q_2 = +5.00 nC is at x = -0.30 m.

What are the magnitude and direction of the net force exerted by these two charges on a negatively point charge q_3 = -0.60 nC placed at the origin?