SUR – Physics

T095

Friday, 13/11/2015

14:00 – 17:00

WORKFORCE DEVELOPMENT AUTHORITY

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ADVANCED LEVEL NATIONAL EXAMINATIONS, 2015, TECHNICAL AND PROFESSIONAL TRADES

EXAM TITLE: Physics (PHY)

OPTION: Surveying (SUR)

DURATION: 3hours

INSTRUCTIONS:

This paper consists of **three** sections **I, II** and **III.**

Section I: Seventeen (17) compulsory questions.	**55 marks**
Section II: Attempt **any three (3)** out of five questions.	**30 marks**
Section III: Attempt **any one (1)** out of three questions.	**15 marks**

Every candidate is required to strictly obey the above instructions. Punishment measures will be applied to anyone who ignores these instructions.

Section I. Seventeen (17) Compulsory questions. **55marks**

01. State the fundamental physical quantities that are used to derive the following derived physical quantities:

(a) Speed

(b) volume **3marks**

02. A Physicist measured the radius of a circular board and found $R = 9.0\ cm \pm 0.1\ cm$

(a) What is the lower limit of the tolerance interval for this measurement?

(b) What is the higher limit of the tolerance interval for this measurement? **3marks**

03. Copy and complete the following table: **4marks**

Physical quantity	**Symbol of SI unit**
Length	
Temperature	
Time	
Mass	

04. State three types of equilibrium. **3marks**

05. Define and give two (2) examples of fluid. **2marks**

06. State the Pascal's law (Pascal's principle) of fluid pressure. **2marks**

07. A mass of 10 g causes a spring to extend 4 cm.

(a) Convert 10 g and 4 cm into kilograms and metres respectively.

(b)Calculate the spring constant k of the spring. Take g = 9.81m/s^2. **4marks**

08. Find the hydrostatic pressure on an object which is 5 m below the surface of the lake. Use the density of lake water ρ = 1.03 x10^3 kg/m^3 and the acceleration due to gravity g = 9.81 m/s^2. **3marks**

09. A particle moves as function of time as follows $X = 4\sin(10\pi t + \frac{\pi}{5})$, where distance is in metres and time is in seconds.

(a) What is the amplitude of this simple harmonic motion?

(b) What is the angular velocity of this motion?

(c) Calculate the period of this motion. **4marks**

10. A particle moves for 20 s with a velocity of 3 m/s and finally moves with a velocity of 5 m/s for next 20 s.

(a) Calculate the travelled distance for each step.

(b) What is the average velocity of the particle? **4marks**

11. Consider the following physical situations. Identify whether the indicated force does positive or negative work or no work and explain your choice.

(a) A cable is attached to a bucket and the force of tension is used to pull the bucket out of well.

(b) A breaking system exerts an applied force upon the car to bring it to a stop. **4marks**

12. a) What do you understand by the term pressure in Physics? **1mark**

b) The pressure exerted on a surface is 100 Pa. What is the force exerted vertically on an area of 0.4 m^2. **3marks**

13. A mass is vibrating in a system in which the restoring constant is 100 N/m; the amplitude of vibration is 0.200 m. The motion of this system is simple harmonic. Find:

(a) the energy of the system.

(b) the maximum kinetic energy of the system.

(c) the maximum potential energy of the system. **4marks**

14. What are two factors on which the time period of the simple pendulum on the earth's surface depends? **2marks**

15. If the period of a pendulum on earth is 2s, what is the length of the pendulum? Take g = 9.81 m/s^2. **2marks**

16. a) Define the term specific heat capacity (specific heat) of a material. **1mark**

b) The quantity of heat equal to 2 $x10^4$ J is added to 2 kg of an unknown metal to cause the temperature change of 50°C. What is the specific heat capacity (specific heat) of the unknown metal? **3marks**

3marks

17. The kinetic energy of rotation of the wheel is 13.5 J. The moment of inertia about the centre is 3 kg m^2. What is the uniform angular speed of this wheel? **3marks**

Section II. Answer any three (3) questions of your choice (do not choose more than three questions). 30marks

18. Copy the following table and complete the properties of the three states according to some general properties of matter given below. **10marks**

Properties	**Solid**	**Liquid**	**gas**
Shape			
Volume			
Density			
Compressibility			

19. (a) (i) I weigh 60 kg. Is this an acceptable statement? Explain. **(2marks)**

(ii)What is the relation between 1N and 1kg? **(1mark)**

(iii) A and B are two objects with masses 100 kg and 750 g respectively, which object has more inertia? **(1mark)**

(iv) How much support force does a table exert on a book that weighs 15 N when the book is placed on the table? Explain your answer. **(2marks)**

(b) A force of 10 N is acting on an object of mass 10000 g. What is the acceleration produced on it? **(2marks)**

(c) An object of mass 10 kg is moving with a uniform velocity of 10 m/s. What is the acceleration of this object? **(2marks)**

20. (a) With the aid of four characteristics, differentiate between speed and acceleration. **(4marks)**

(b) A car travelling along a straight road at 8.0 m/s accelerates to a speed of 15.0 m/s in 5.0 s.

(i) Express 15 m/s in km/h; **(1mark)**

(ii) Determine its acceleration; **(2marks)**

(iii) Calculate the distance travelled during this period; **(2marks)**

(iv) Does this car speed up? Justify your answer. **(1mark)**

21. **(a)** Describe an elastic pendulum. **(2marks)**

(b) (i) A mass is attached to a vertical spring and moves up and down between points A and B. Where is the mass located when its kinetic energy is maximum? Is it at point A, at point B or at midway between A and B? Use the total mechanical energy of the system to support your answer. **(3marks)**

(ii) A mass oscillates on the end of a spring, on both Earth and on the Moon. Where is the period the greatest? Explain your answer on the basis of the expression of the period. **(2marks)**

(c) A mass M hangs in equilibrium on a spring. M is made to oscillate about the equilibrium position by pulling it down 10 cm and releasing it. The system executes simple harmonic motion (SHM) with a time period of 2s.

(i)What is the amplitude of this SHM? **(1mark)**

(ii)Determine the frequency at which this SHM is executed. **(2marks)**

22. **(a)** What is meant by the following terms:

(i) Archimedes' principle **(1mark)**

(ii) Static fluid **(1mark)**

(b) A body is at rest in a fluid. The fluid density is 0. 75 g/cm^3 and 0.8 of the body volume (0.8 V_b) is below the fluid surface.

(i) What is the condition for an object to float in a fluid? **(1mark)**

(ii) Identify two forces acting on this body. **(2marks)**

(iii) Does the body float in the fluid? Explain. **(2marks)**

(iv) Using Archimedes' principle, find the density of the body. **(3marks)**

Section III. Answer any one (1) question of your choice
(do not choose more than <u>one question</u>). 15marks

23. A physicist heated a block of ice with an electric kettle and plotted the graph of temperature (T) of the system against time (t) as shown below (figure1).

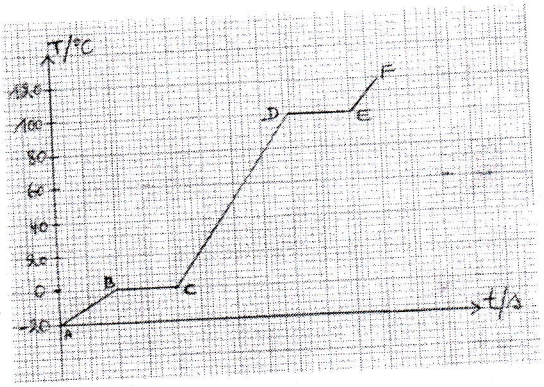

Figure 1

From the graph, answer the questions below:

(a) What is the initial temperature of the block of ice? **(2marks)**

(b) On the heating curve diagram provided above, name the different parts of the graph namely AB, BC, CD, DE, EF using appropriate terms like: gas only, gas-liquid only, solid only, liquid only, liquid-solid only. **(5marks)**

(c) (i)Identify the processes that take place during the segment BC and DE. **(2marks)**

(ii)Why does the temperature remain constant at regions BC and DE? **(2marks)**

(iii)Differentiate evaporation from ebullition. **(2marks)**

(iv)What are the temperature values at which the vaporization and fusion occur? **(2marks)**

24. A student carried out an experiment to verify Boyle's law using a syringe and obtained the following table.

Pressure/kPa	Volume/10^{-6} m^3
50	8
100	16
200	32
250	40
400	64
500	80

Note that some of the data have been omitted.

(a) (i) State Boyle's law (sometimes called Boyle–Mariotte law) related to ideal gas. **(2marks)**

(ii) Copy and complete the table above for an ideal gas and using mathematical formula, explain how you obtain the results.Assume that Boyle's law is respected. **(7marks)**

(iii) What experimental factor (thermodynamic parameter) is assumed to be constant in this experiment? **(1mark)**

(b) If you have to represent Boyle's law on the graph,

(i) Which variable will be plotted on the graph's vertical axis? **(1mark)**

(ii) Which variable will be plotted on the graph's horizontal axis? **(1mark)**

(c) The experiment is carried out at 300 K.

(i) Convert 300 K into degree Celsius. **(2marks)**

(ii) Which of the following is that temperature closer to?

Room temperature, human body temperature, freezer temperature. **(1mark)**

25. (a) A fluid of constant density ρ is flowing steadily through the following horizontal tube (figure 2).

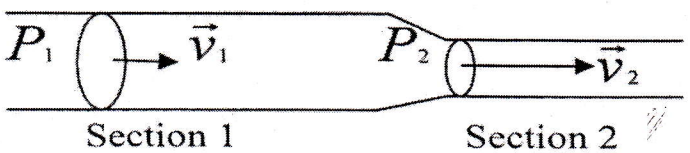

Figure 2

(i) Use Bernoulli's equation to name P_1, P_2, v_1 and v_2 **(4marks)**

(ii)Compare the physical quantities v_1 and v_2 and explain your answer. Use the continuity equation and the figure 2. **(4marks)**

(b) A liquid flows through a pipe (see the figure 2 above) with a diameter of 8 cm at a velocity of 10 cm/s then the diameter of the pipe decreases to 5 cm.

(i) Find the cross sectional area of the section1. **(2marks)**

(ii) Calculate the cross sectional area of the section 2. **(1mark)**

(iii) Use the continuity equation to determine the new velocity v_2 in m/s of the liquid. **(4marks)**