FIJI NATIONAL UNIVERSITY

COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY (CEST)

SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING

Diploma in Electrical Engineering (Electronics and Instrumentation)

FINAL EXAMINATION Semester 1 *Stage 1*

EEE 405: Engineering Science Date: 05 /06/2012

Time: 9:00 – 11:10 am VENUE: TBA ROOM: As per timetable

Instructions to Students:

You are allowed **10 minutes** extra **reading time** during which you are **not** allowed to write.

1) Begin each question on a **new (fresh) page** and use **both sides** of the sheet.
2) Where the Answer Sheet is provided mark your answers to the questions in the answer sheet as per given instructions. All working papers should be marked clearly and attached with the answer sheet.
3) **Write your Name (as per ID card), Group and student ID at the top right hand corner of each sheet used.**
4) Write clearly the question number(s) of attempted at the top of each page.
5) Insert all written foolscaps, graphs papers, drawings, in their correct order and secure it with strings provided.
6) You may use calculator(s) provided they are non-programmable.
7) There are four sections in this paper. All questions are compulsory.

Section A	**Multiple Choice**	**(15 questions)**	**30 marks**
Section B	**Matching**	**(5 questions)**	**10 marks**
Section C	**True or False**	**(5 questions)**	**10 marks**
Section D	**Long answer**	**(5 questions)**	**50 marks**
Total			**100 marks**

ATTEMPT ALL QUESTIONS

Section A Multiple Choice (15 questions -2 marks each) 30 marks

Circle the correct answer in the answer space provided.

Use this information to answer questions 1-6

Let's say a researcher SAM measures the mass of a sample A to be 50.8 g. The actual mass of the sample is known to be 50.516 g. He carries this sample A up the stairs and places it on display table at 10.446 ±0. 05 m height from ground in 20 s . (Use g=10 ms^{-2} and exclude sources of error unless required)

Question 1

What is the percentage (%) error of the measurement of the mass of sample A

A) 0.0562 B) 0.562 C) 50.8 D) .284

Question 2

What is the energy spent by SAM to carry sample A up the stairs and display on the table? (**Ignore errors**)

A) 5.3 J B) 500.3066 J C) 5.3066 J D) 53.066 J

Question 3

What is the Potential Energy of sample A when it sits on the display table? (**Correct to 2 decimal places**)

A) 5.3 J B) 500.3066 J C) 5.31 J D) 53.066 J

Question 4

What is the energy spent by SAM to carry sample A up the stairs and places it on display table **correct to 2 significant figures (SF)**?

A) 5.3 J B) 500.3066 J C) 5.3066 J D) 53.066 J

Question 5

The sample A accidently falls -freely to the ground. What is the final velocity of the sample A when it strikes the ground? (Use mass = 50 g and write answers correct to 2 decimal places)

A) 14 ms^{-1} B) 14.48 ms^{-1} C) 10.446 ms^{-1} D) 0 ms^{-1}

Question 6

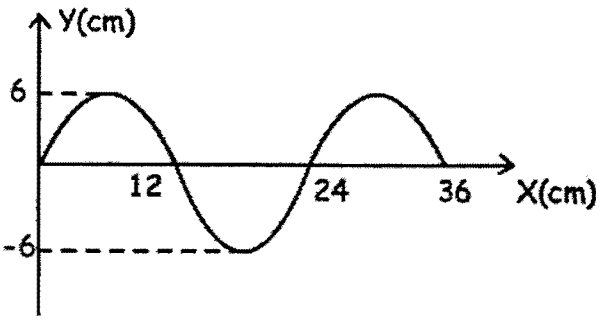
What is the work done by SAM in carrying sample A up the stairs to the display table? (**Include errors correct to 2 decimal places**)

A) 5.3 ± 0.05 J B) 5.225 ± 0.05 J C) 5.22 ± 0.05 J D 5.22 ± 1.04 J

Question 7-10 use information below as in figure 1.0

Picture given below in Figure 1 shows wave motion of a source having frequency $2s^{-1}$ (2Hz)

(Figure 1.0)



Question 7

What is the wavelength?

A) 12 cm B) 24 cm C) 36 cm D 6 cm

Question 8

What is the Velocity of the wave?

A) 12 cm/s B) 24 cm/s C) 48 cm/s D 6 cm/s

Question 9

What is the Amplitude of the wave?

A) 12 cm B) 24 cm C) 36 cm D 6 cm

Question 10

Which is the correct equation for Snell's Law

A) $n_1 \sin\Theta_1 = n_2 \sin\Theta_2$ B) $\sin\Theta_1 = \sin\Theta_2$ C) $n_1 = n_2$ D $\sin\Theta_1 / \sin\Theta_2$

Question 11

In which of the Gas Law's the temperature is kept constant and relationship is expressed in terms of Volume and pressure?

A) Charles's Law B) Boyle's Law C) Ideal Gas Law D Gay-Lussac's Law

Question 12

How much is 1 calorie of heat?

A) 1000 cal B) 420 J C) 4186J D -273J

Question 13

Max Planck suggested that light was made up of "packets of energy' given by E_{photon}= hf. What's the value of h – Planck's constant?

A) 1000 cal B) 4200 J C) 4186J D 6.63×10^{-34} Js

Question 14

Specific heat *(c)* is defined as the amount of heat required to change the temperature of one kilogram of a substance by ___ ?

A) -273 K B) 1 ° C C) 1° F D 4200 J

Question 15

Which of the following is a scalar quantity?

A) Speed B) Force C) momentum D velocity

Section B Matching (5 questions -2 marks each) 10 marks

Question 16 -20

Mark the letters that matches the words with the given definitions **(Figure 2.0)**

Table 1.1 (Figure 2.0)

Question number	Corresponding Word	Letter	Description and Definition
16	Potential Energy	A	The rate of work done in a unit of time or Rate of doing work
17	Power	B	This is defined as Objects energy because of their positions relative to other objects.
18	Wave	C	Is the amount of heat energy required to raise the temperature of 1 kg of substance by 1º C.
19	Period	D	A disturbance that propagates through a material medium or space
20	Specific Heat	E	The shortest time interval during which the motion of the wave repeats itself (T= 1/f)

Section C True or False (5 questions -2 marks each) 10 marks

In the answer sheet, Write correct Answers (True or False) in column G for questions 21 -25 of Section C.

Question 21

In a plane mirror the angle of incidence is equal to the angle of reflection? ***True or False***

Question 22

Another name for the first law of motion Is "Law of Inertia? ***True or False***

Question 23

To every action there is equal and opposite reaction is Newton's second Law? ***True or False***

Question 24

Charles Law states that [PV = nRT] ? ***True or False***

Question 25

Specific heat(c) – is defined as the amount of heat energy required to raise the temperature of 1 kg of substance by 1° C. ***True or False***

Section D Long answer (5 questions 10 marks each) 50 marks

Question 26 (10 marks)

a. A sinusoidal wave train is described by the equation

$$y = (3.0\,m)\sin(2x - 30\,t)$$

Where *x* and *y* are in meters and *t* is in seconds. Determine for this wave the

I. Amplitude (1 Mark)

II. direction of motion (1 Mark)

III. angular frequency (2 Mark)

IV. angular wave number (2 Mark)

V. wavelength (2 Mark)

VI. wave speed (2Mark)

Question 27 (10 marks)

a) Heat is transferred mainly in three distinct ways. Describe any TWO methods of heat transfer. (2 marks)

b) The temperature of 0.050 kg ingot of metal is raised to 200.0ºC and the ingot is then dropped into a light, insulated beaker containing 0.400 kg of water initially at 20.0 ºC. If the final equilibrium temperature of the mixed system is 22.4 ºC, find the specific heat of the metal. (4 marks)

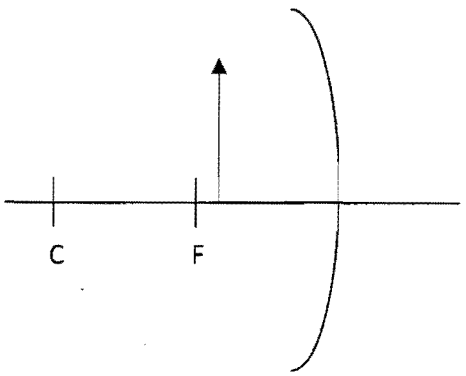
c) Find the amount of heat required to change 1 g cube of ice at -30ºC to steam at 120ºC. (4 marks)

Question 28 (10 marks)

a) What are the two types of reflection and what is the difference between them, explain with the aid of diagrams (2 marks)

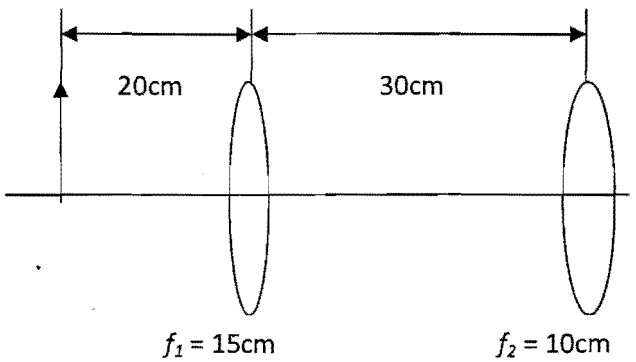
b) An object is placed in front of a concave mirror as shown below in **Figure 3.0**. Determine the image position of the object with the properties of the image. (4 marks)

(Figure 3.0)



c) Two thin converging lenses of focal length f_1 = 15cm and f_2 = 10cm are separated by 30cm, as shown below in *figure 5*. An object is placed 20cm to the left of lens 1. Find the position of the final image and the magnification of the system. **(Figure 4.0)** (4 marks)

(Figure 4.0)

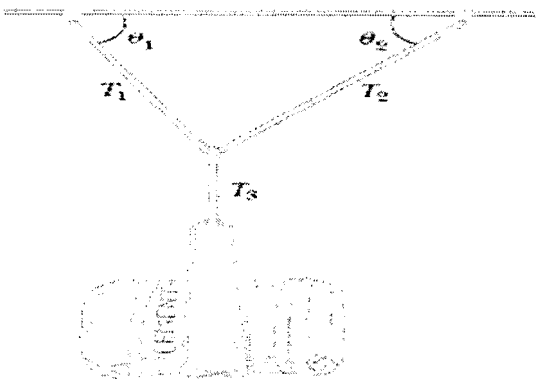


Question 29 (10 marks)

a. A bag of cement of weight F_g hangs from three wires as shown. Two of the wires makes angle θ_1 and θ_2 with the horizontal. If the system is in equilibrium, show that the tension in the left-hand wire is:

Figure 5.0 (2 marks)

$$T_1 = \frac{F_g \cos\theta_2}{\sin(\theta_1 + \theta_2)}$$



If the bag of cement of weight 300 N hangs from three wires as shown in **Figure 5.0 above**. Two of the wires make angles θ_1=60.0° and θ_2=25.0° with the horizontal. If the system is in equilibrium, find the tensions (3 marks)

a) T_1 = ?

b) T_2 = ?

c) T_3 = ?

d) A certain 600-watt light bulb emits a total luminous flux of 600lm distributed uniformly over a semi-circle. Find the illumination at a distance of 1 meter. (5 marks)

Question 30 (10 marks)

As a passenger train passes a platform at a constant speed of 40.0 m s^{-1} it sounds its horn at frequency of 320 Hz. ? ***(Given speed of sound =345m/s)***

(a) What overall change in frequency is detected by a person on the platform as the train moves from approaching to receding?

(b) What wavelength is detected by a person standing on the platform as the train approaches? (10 marks)

" Good Luck "

Common Formulae

$$\rho = \frac{m}{V} \qquad F = ma \qquad E_k = \frac{1}{2} m\ v^2$$

$$E_p = mgh \qquad W = F_r\ d \qquad p = mv$$

$$H = m\ c\ \Delta T \qquad H = m\ L \qquad v_f = v_i + a\ t$$

$$E = \frac{1}{2} k\ x^2 \qquad F_c = \frac{mv^2}{r} \qquad \tau = F\ d_\perp$$

$$S = v_i\ t + \frac{1}{2} a\ t^2 \qquad v_f^2 = v_i^2 + 2\ a\ s \qquad F_g = \frac{G m_1 m_2}{r^2}$$

$$PV = nRT$$

Data

Acceleration due to gravity, g	$9.80\ \text{m s}^{-2}$
Specific heat of water, c_w	$4.19 \times 10^3\ \text{J kg}^{-1}\ \text{K}^{-1}$
Latent heat of vaporization, L_v	$2.26 \times 10^6\ \text{J kg}^{-1}$
Density of water, ρ_w	$1000\ \text{kg m}^{-3}$
Charge of electron, q	$1.60 \times 10^{-19}\ \text{C}$
Speed of light, c	$3.00 \times 10^8\ \text{m s}^{-1}$
Electron volt, 1 eV	$1.60 \times 10^{-19}\ \text{J}$
Unified mass unit, 1 u	$1.66 \times 10^{-27}\ \text{kg} = 931.5\ \text{MeV c}^{-2}$
Mass of Earth, M_E	$5.98 \times 10^{24}\ \text{kg}$
Radius of Earth, R_E	$6.37 \times 10^6\ \text{m}$
Universal Gravitational Constant, G	$6.67 \times 10^{-11}\ \text{N m}^2\ \text{kg}^{-2}$

More Useful Formulae

$$Q = mc\Delta T \qquad \frac{Q}{t} = \frac{kA\Delta T}{L}$$

$$E = hf \qquad f = \frac{c}{\lambda} \qquad KE = \frac{1}{2} mv^2$$

$$E = \Phi + KE$$

$$f' = f\left(\frac{v + v_o}{v}\right) \qquad f' = \left(\frac{v}{v - v_s}\right) f \qquad f' = f\left(\frac{v + v_o}{v - v_s}\right)$$