LITTORAL PHYSICS TEACHERS' ASSOCIATION (LIPTA)

REGIONAL MOCK EXAMINATION

GENERAL CERTIFICATE OF EDUCATION

0780 PHYSICS 2

APRIL 2021 **ADVANCED LEVEL**

Subject Title	PHYSICS
Paper No	Paper 2
Subject Code	0780

Two and a half Hours

Answer ALL questions

Section I is designed to be answered in 1 hour, Section II in 30 minutes and Section III in 1 hour.

You are advised to divide your time accordingly.

For your guidance, the approximate mark for each part of a question is indicated in the brackets.

You are reminded of the necessity for good English and Orderly presentation in your answers.

In calculations you must show all the steps in your working, giving your answer at each stage.

Calculators and formulae booklets are allowed.

SECTION I (One hour)

Answer all questions in this section

1. A physical quantity, X, is defined by the following physical equation.

$$X = \frac{\varepsilon_0 LV}{t}$$

Where ε_0 is the permittivity of free space, L is length, V is electrical potential difference and t is time. The above *equation is dimensionally homogenous*.

a) What do you understand by the phrase in *italics*?
b) What are the base units of the X?
c) What does the physical quantity X represent?

(7 marks)

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2. a) Distinguish between thermionic emission and photoelectric effect.
b) A metal has a work function of 2.25×10^{-19} J.
(i) Explain what is meant by the work function of a metal.
(ii) An electromagnetic radiation of wavelength 560 nm falls on this metal surface. Determine, by calculation, whether or not electrons will be emitted from this metal surface.

(6 marks)

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3. The graph in *figure 1* shows how the electric potential of a charged sphere varies with distance from the centre of the sphere.

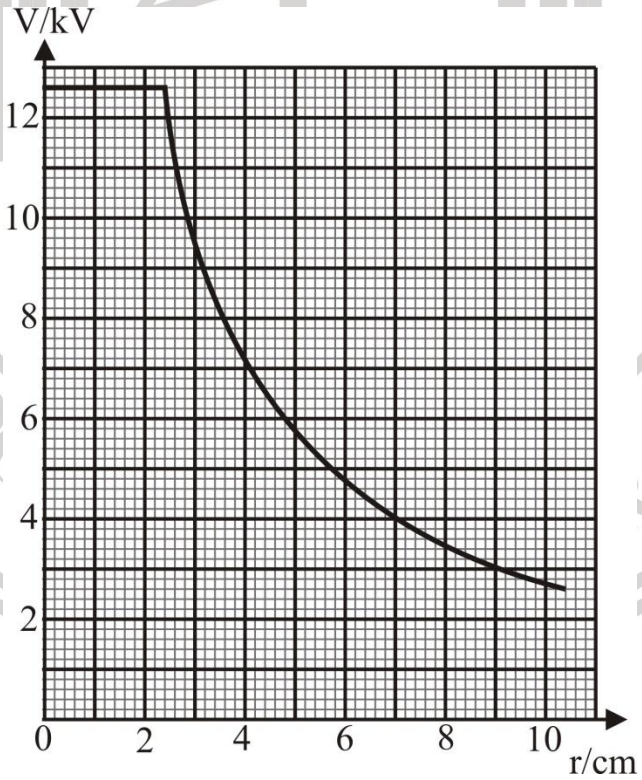

Figure 1

Use the graph to answer the following questions.

a) Write down the radius of the sphere and the electric potential on the surface of the sphere.

b) Is the sphere positively charged or negatively charged? Explain.
c) What is the electric field intensity at a point 7.0 cm from the centre of the sphere?
d) Sketch a graph to show how the intensity of the sphere's electric field varies with distance from the centre of the sphere.

(7 marks)

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4. a) Explain the meaning of Doppler effect.
An ambulance travelling at 25.0 m s^{-1} approaches a stationary observer. To the observer, the frequency of the sound from the horn of the ambulance is 1720 Hz.
b) What is the true frequency of the sound from the ambulance?
c) Determine the frequency of the sound heard by the stationary observer as the ambulance moves away from him at the same speed.

(5 marks)

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5. a) What is a vector quantity?
b) *Figure 2* shows two forces (vectors) acting on object.

Figure 2

(i) What is the angle between the two vectors?
(ii) What do you understand by the *resultant of two vectors*?
(iii) Determine the resultant of the two forces on the diagram.
(iv) Is the object in equilibrium? Explain your answer.

(5 marks)

ANSWER EITHER 6 a), b) and c) or d), e) and f)

EITHER 6 a), b) and c)

6. a) (i) What do you understand by the specific heat capacity of a substance?
(ii) Describe an experiment to determine the specific heat capacity of copper. Your description should include a diagram of the set-up, procedure, observations, calculations, precautions and a conclusion.

(10 marks)

b) Two parallel plate capacitors X and Y, have the same area of plates and same separation between them. They are connected in series as shown in *figure 3*.

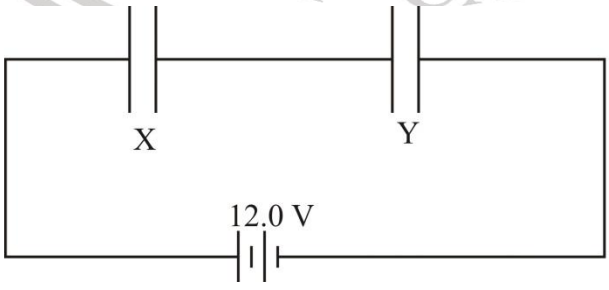

Figure 3

The dielectric constant of the medium between the plates of Y is 4 times that of the medium between the plates of X.

(i) What is a capacitor?

(ii) Determine the capacitance of each capacitor if the equivalent capacitance of the combination is 4 μF.

(iii) What is the potential difference between the plates of X?

(7 marks)

c) (i) What is resonance?

(ii) Distinguish between damped oscillations and free oscillations.

(3 marks)

OR 6 d), e), f) and g)

6. d) (i) State the law of conservation of linear momentum.

(ii) Describe an experiment to verify the law of conservation of linear momentum. Your description should include a diagram, procedure, observations, calculations, precaution and conclusion.

(10 marks)

e) The steel wire of the crane shown in *figure 4* has a length of 18.0 m and a diameter of 25.0 mm. Steel has a Young modulus of 2.0×10^{11} Pa.

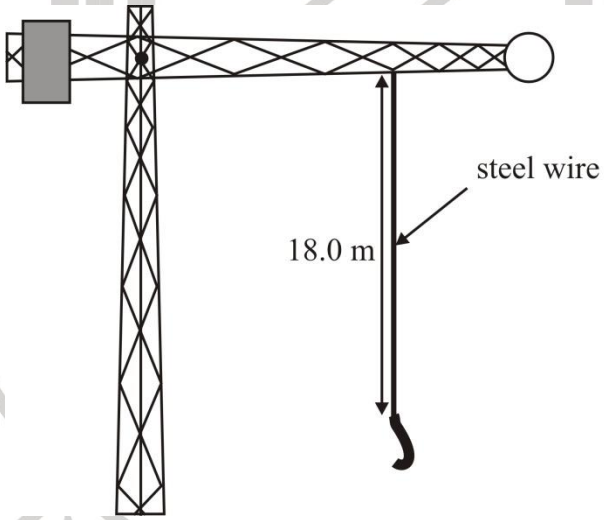

Figure 4

(i) Explain what is meant by the *Young modulus of a material*.

(ii) State two differences between the elastic properties of rubber and steel.

If the maximum stress that the above steel wire can withstand before breaking is 1.2×10^{7} Pa, determine:

(iii) the maximum load (in newtons) that the above wire can carry

(iv) the extension of the wire when the wire supports the load in e)(iii) above.

(7 marks)

f) (i) State Kirchhoff's Second Law of electric circuits

(ii) Explain how Kirchhoff's Second Law is a statement of the law of conservation of energy.

(3 marks)

SECTION II (30 Minutes)

DATA ANALYSIS

7. When the bob of the simple pendulum shown in *figure 5* is displaced horizontally through a small distance and released, its motion is approximately simple harmonic.

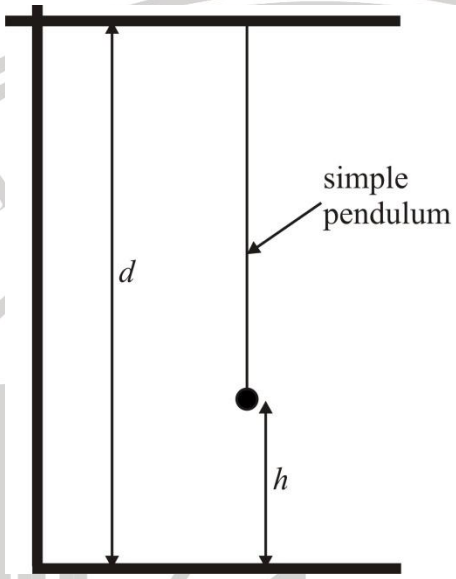

Figure 5

By changing the length of the pendulum without altering *d*, a student measures the period (*T*) of oscillation of the bob at different values of *h* (the height of the bob above the ground). The results obtained are shown on the following table.

h/cm	*T*/s
25.0	2.02
35.0	1.92
45.0	1.80
55.0	1.70
65.0	1.56
75.0	1.42
85.0	1.30
95.0	1.10

Theory suggests that *T* is related to *h* by the equation:

$$T = 2\pi\sqrt{\frac{d-h}{k}}$$

Where *k* is a constant.

a) Plot a suitable graph that can be used to determine the values of *k* and *d*.

(10 marks)

b) Use the graph to obtain the values of *k* and *d*.

(8 marks)

c) What does the physical quantity *k* represent?

(2 marks)

SECTION III (1 HOUR)

OPTIONS

ANSWER ANY TWO OF THE FOUR OPTIONS

OPTION 1: ENERGY RESOURCES AND ENVIRONMENTAL PHYSICS

8. a) A tidal power station of area 100 km^2 has water raised to a height of 1.5 m above the lower tide level behind a tidal barrage.
   (i) What is the mean power output of the station if its efficiency is 45 % and there are two tides per day?
   (ii) Explain why most countries with coastlines do not depend on tides as a source of energy for the generation of electricity.

   (6 marks)

   b) The greenhouse effect is a natural phenomenon but its effects have been enhanced by human activity over the past 200 years.
   (i) State two human activities that have greatly affected the natural greenhouse effect.
   (ii) Explain how any one of the human activities named above has led to global warming.

   (4 marks)

   c) Fossil fuels and biomass have the sun as their ultimate energy source.
   (i) Explain how fossil fuel and biomass energy originate from the sun.
   (ii) State two advantages of fossil fuels over biomass in electrical energy generation.
   (iii) Describe the energy changes in a fossil thermal power plant for the generation of electricity.

   (5 marks)

OPTION 2: COMMUNICATION

9. a) *Figure 6* shows the CRO trace of a radio wave that is carrying an information signal.

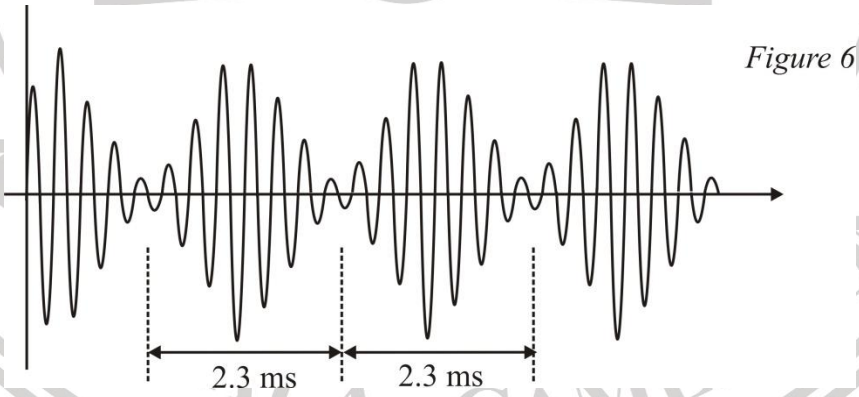

Figure 6

Between each maximum there are 2.1×10^5 complete oscillations of the carrier wave.
   (i) Explain why the above wave is said to be amplitude modulated.
   (ii) Determine the frequency of the signal wave and of the carrier wave.
   (iii) Explain why a signal is modulated before being transmitted along a communication channel.

   (5 marks)

   b) An LED provides input power of 1.26 mW to an optic fibre of length 60 m. The output at the other end of the fibre is 1.12 mW.
   (i) What is meant by *signal attenuation*?

(ii) Calculate the attenuation per unit length in the optic fibre.
(iii) State the cause of signal attenuation in an optic fibre and how it can be minimized.

(4 marks)

c) A base station in a cell phone communication system uses 16 channels and each channel allows 8 telephone conversations to take place at the same time.
(i) What is a base station?
(ii) State the type of multiplex system this cellular system uses.
(iii) State two different techniques that can be used to improve coverage and capacity in this cellular system.
(iv) What is the full meaning of the acronym 'PIN' as used in cell phone communication?

(6 marks)

OPTION 3: ELECTRONICS

10. a) Distinguish between
(i) An intrinsic semiconductor and an extrinsic semiconductor
(ii) An ordinary p-n junction diode and a Zener diode

(4 marks)

b) *Figure 7* shows a simple circuit used to control the number of people entering into the room.

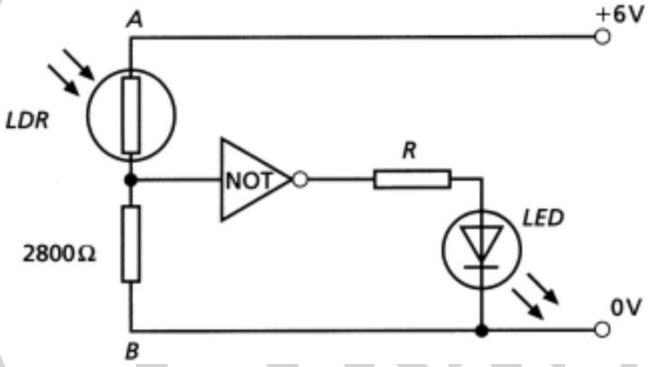

Figure 7

The LED is at the entrance into the room and when it is on, people are let into the room. When the bulb in the room is on, the resistance of the LDR is 200 Ω.
(i) Establish the truth table of a NOT gate.
(ii) The input of the NOT gate is 'high' when the voltage across the 2800 Ω is greater than 5.0 V. Determine, by calculation, whether or not the LED will come on when the bulb in the room is on.

(5 marks)

c) A transistor in the common-emitter mode has a d.c. gain of 80 and a current of 50 μA flowing through the base when the transistor is in the quiescent mode.
(i) Explain the meaning of the underlined phrase.
(ii) What is the current flowing through the emitter of the transistor?
(iii) Draw a simple circuit diagram to show how a transistor in the common-emitter mode can be used as a voltage amplifier.

(6 marks)

OPTION 4: MEDICAL PHYSICS

11. a) (i) State the value of the threshold intensity of hearing of the human ear.
(ii) The human ear can be divided into three main parts: the outer ear, the middle ear and the inner ear. State the main function of each of these parts.

(4 marks)

b) When an ultrasound pulse reflects from the front and back edges of a bone, it produces two peaks on an A-scan. The time interval between these two peaks is 13 μs. The speed of the ultrasound in bone is 4000 m s^{-1}.
(i) Calculate the thickness of the bone.
(ii) Describe how a B-scan differs from an A-scan.

(4 marks)

c) *Figure 8* shows the ECG waveform produced when electrodes are attached to the chest of a healthy person.

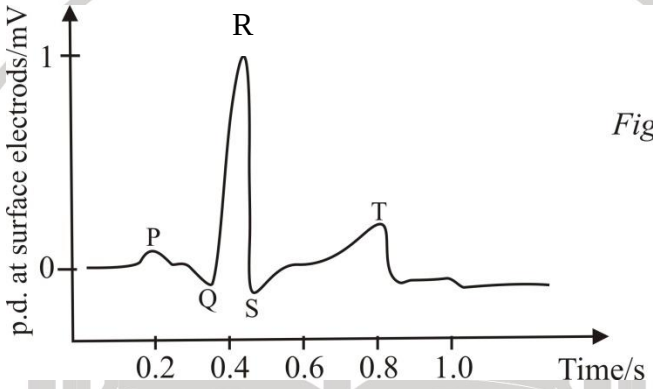

Figure 8

(i) State how the action of the atria and ventricles correspond to the waveform PQRST shown in the figure.
(ii) State the cause of a p.d setup at any two points on the body surface.

(4 marks)

d) (i) State two advantages of an MRI scan compared with a CT scan.
(ii) Explain why it is sometimes useful to produce a combined image from a CT scan and an MRI scan.

(3 marks)

END