THE PNG UNIVERSITY OF TECHNOLOGY

ENTRANCE EXAMINATION - 2020

SUBJECT: PHYSICS

TIME ALLOWED: THREE (3) HOURS

INFORMATION FOR STUDENTS

1. You have TEN (10) MINUTES to read this question paper. Do not begin writing this time.

2. There are fifteen (15) questions altogether. Answer ALL Questions.

3. There are total of 100 Marks from this examination paper.

4. All answers must be written in the answer book supplied. Show all your working in the answer book. COMPLETE THE DETAILS REQUIRED ON THE FRONT COVER OF THE ANSWER BOOK.
    DO THIS NOW.

5. Text books, note books and mobile phones are NOT permitted.

6. Calculators are allowed.

7. TURN OFF YOUR MOBILE PHONES NOW.

SURNAME _____

GIVEN NAME _____

DATE _____

LOCATION _____

STUDENT SIGNATURE: _____

INTENDING COURSE: _____

DO NOT WRITE UNTIL YOU ARE TOLD TO START.

Question 1 (8 Marks)

a) Express the following into scientific notation. (2 Marks)

    i)   6287000m   ii)   0.0000000025s

b) Convert the following measurements. (2 Marks)

    i)   450 Tbytes to bytes   ii)   52.6 Ms to µs

c) Solve the following addition problem and get the final answer to three significant figures. (4 Marks)

    i)   205 kg + 32.75 kg + 235.40 kg

   ii)   24.5mm + 0.0045m + 400µm

Question 2 (10 Marks)

a) A vector of magnitude 3N due East is added to a vector of magnitude 4 N due North. What is the magnitude of the resultant? (5 Marks)

b) Two objects are hanging from a retort stand. The mass of Object A is 420 g and the mass of Object B is 730 g as shown in the diagram below. (2 and 3 Marks)
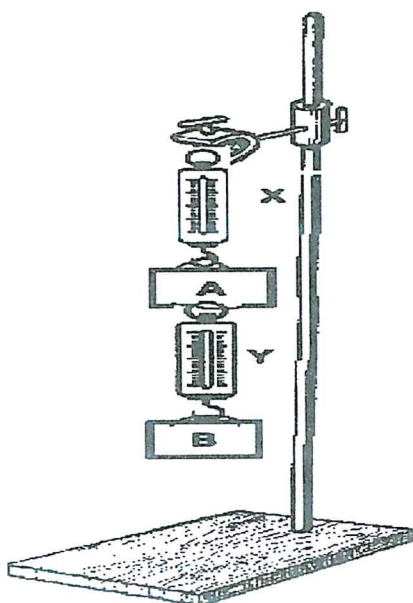
What will be the reading in Newton on the Spring Balance Y and X?

Question 3 (4 Marks)

a) The graph shows the Temperature vs Energy Added for various materials; A B, C and D. The materials have the same mass, warmed in identical conditions and they change phase from solid to liquid.
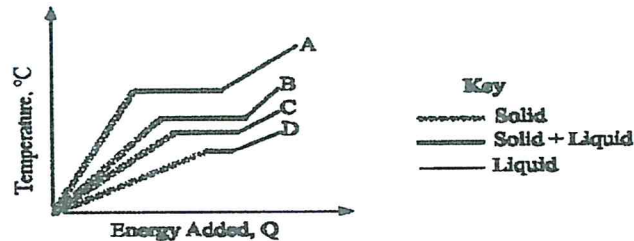
Which material has the highest specific heat capacity as a solid? (2 Marks)

b) Which one of the graphs below correctly represents the relationship between the Velocity (m/s) of a tennis ball that is thrown vertically up and falls down and its time (t)? (2 Marks)
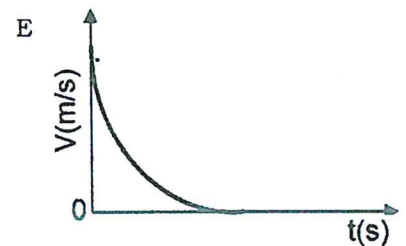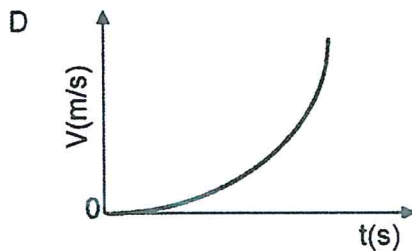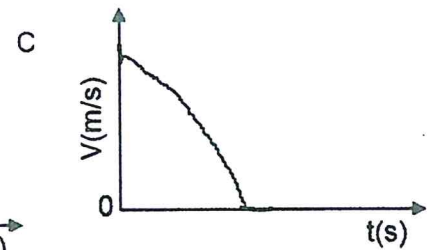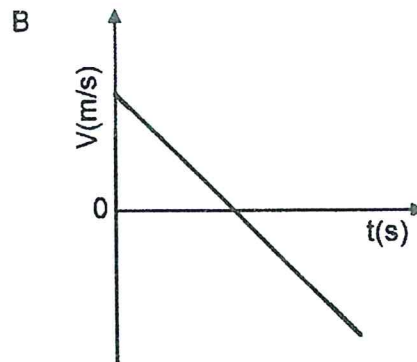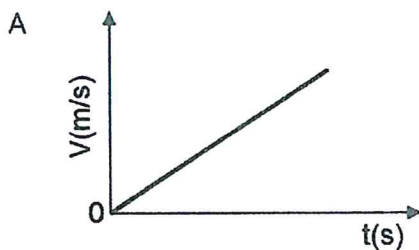
## Question 4 (5 marks)

A tennis ball is projected upwards vertically into the air with an initial speed of 30m/s from a point 1.0 m above the ground.

a) How high does it climb (maximum height) from the ground? (2 marks)

b) How long does it climb to maximum height and return to its point of projection? (3 marks)

Question 5 (5 marks)

The electrical circuit below has all values of resistance equal to 4Ω.
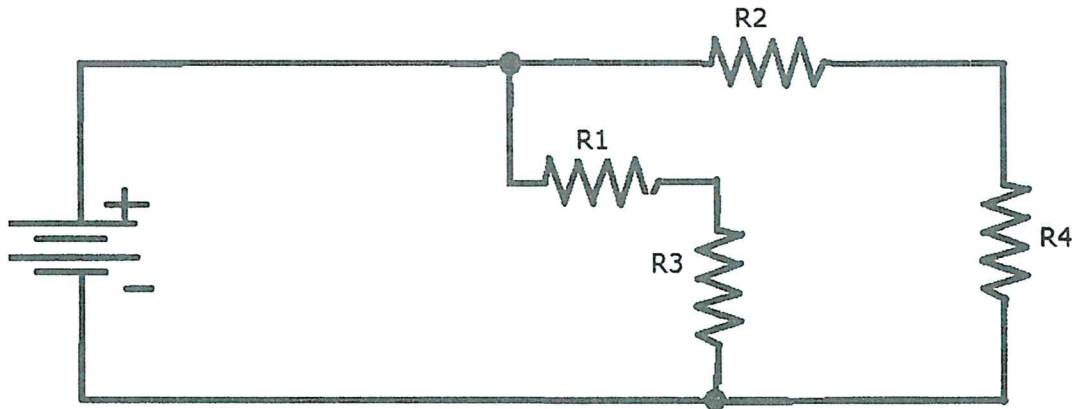
(a) Calculate the total resistance in the circuit. (2 marks)
(b) The current through the circuit if the Battery is 10 volts. (2 marks)
(c) What is the total power supplied by the battery? (1 mark)

Question 6 (6 marks)

A car starts from rest and accelerated with a uniform acceleration of 4.0 ms^{-2} for 10 seconds and then moves with a constant velocity for another 10 seconds and finally decelerates uniformly to rest in 2 seconds.

i) Sketch a velocity – time graph which represent the above information. (3 marks)

ii) How far did the travelled from the starting point until it came to a stop? (3 marks)

Question 7 (6 marks)

(a) The logic gate below is a two input OR gate. Draw the truth table for the OR gate. (3 marks)

(b) Using the truth table in part(a) draw an electric circuit representing the gate using switches, resistors, light bulb and dry cells to represent OR gate.
(3 marks)

Question 8 (5 marks)

(a) A storage tank 12.0 m deep is filled with water. The top of the tank is open to the air. What is the absolute pressure at the bottom of the tank? (3 marks)

(b) Refer to part (a) above calculate the gauge pressure? (2 marks)

Question 9 (8 marks)

(a) A block of lead of mass 0.4 kg at a temperature of 95°C is dropped in 2 kg of water originally at 20°C contained in a container. Calculate the equilibrium temperature if no heat is lost to the container and the environment? (Specific heat of lead is 128 J/kg °C and for the water is 4184 J/kg °C). (4 marks)

(b) An electric kettle with a power rating of 1.5 kW is used to evaporate 2.0 kg of water which is at 100^0 C into steam at 120^0 C. Calculate the mass of water left after ten (10) minutes have elapsed? (4 marks)

Question 10 (8 marks)

a) The half-life of sodium radionuclide $^{22}_{11}Na$ is 2.6 years. How much will be left of a 1.0 µg sample of $^{22}_{11}Na$ after 5.2 years. (4 marks)

b) A ship uses a sonar system to detect underwater objects as shown in figure below. The system emits underwater sound waves and measures the time interval for the reflected wave (echo) to return to the detector. Determine the speed of sound waves in water using equation given in formula sheet and find the wavelength of a 262-Hz wave.
(4 marks)
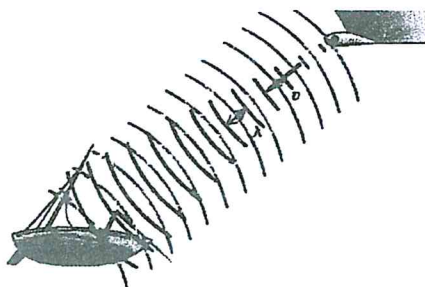
Question 11 (8 Marks)

An house hold electric heater is rated at 500W

a) How much energy is delivered to the heater in one and half hours? (4 Marks)

b) At the rate of K0.07 per kWh, how much does it cost to run the heater 12.0 hours per day for 30 days? (4 Marks)

Question 12 (6 Marks)

A beam of light strikes the flat, glass side of water – filled aquarium at an angle of 40^0 to the normal. For glass, n = 1.5, for air n=1.0, and for water n= 1.31.

a) At what angle does the beam enter the glass? (3 Marks)

b) At what angle does the beam enter the water? (3 Marks)

Question 13 (7 Marks)

A car moving at 10 ms^{-1} crashes into a barrier and stops in 0.05 s. There is a 25 kg child in the car. Assume that a child's velocity is changed by the same amount as the car's in the same time period.

a) What is the change in momentum of the child? (3 marks)

b) What is the impulse of the child needed to come to a complete stop? (2 Marks)

c) Calculate the average force of the child? (2 Marks)

Question 14 (6 Marks)

A positive charge of 8.0 x 10^{-3} C is placed 25 cm away from another negative charge of -5 x 10^{-3} C. Calculate;

a) The force that exists between them. (3 Marks)

b) The electric field in the middle of the charges. (3 Marks)

Question 15 (8 Marks)

A 2 kg block of a material slides down a 30^0 and 2 m inclined plane with a constant acceleration. The block starts from rest at the top and gained its velocity of 5 ms^{-1}.

    a) What is the acceleration of the block? (5 Marks)

    b) What is the coefficient of the friction? (3 Marks)

THE END!

Data and Formula Sheet

1. $c_{water} = 4184 \text{J/kg}°\text{C}$

2. $L_{f(ice)} = 3.34 \times 10^5 \text{ J/kg}$

3. $L_{v(water)} = 2.26 \times 10^6 \text{ J/kg}$

4. $C_{ice} = 2100 \text{ J/Kg}°\text{C}$

5. Density of water $= 1000 \text{ kg/m}^3$

6. $P = \rho g h$

8. $P = \dfrac{F}{A}$

8. $\rho = \dfrac{m}{V}$

9. $V = IR$

10. $P = I^2 R = IV = V^2/R$

11. $E = P \times t$

12. $Q = mC\Delta T$

13. $Q = C\Delta T$

14. $Q = mL_f$

15. $k = \dfrac{1}{4\pi \varepsilon_0} = 9 \times 10^9$

16. $\Delta L = L_0 \alpha \Delta T$

17. Snell's law: $n_1 \sin\theta_1 = n_2 \sin\theta_2$

18. $B = \dfrac{\mu_0 I}{2\pi d} = \dfrac{kI}{d}, k = 2 \times 10^{-7}$ magnetic field in a conductor

19. Bernoulli's equation: $P_1 + \dfrac{1}{2}\rho v_1 + \rho g h_1 = P_2 + \dfrac{1}{2}\rho v_2 + \rho g h_2$

20. Acceleration due to gravity (g) = 10 ms^{-2}

21. $E = \Delta m C^2$, mass energy conversion equation.

22. $m = \dfrac{m_0}{2^n}$, mass remaining in a nuclear decay, where n is the number of half-lives.

23. Velocity of sound through water, $v = \sqrt{\dfrac{B}{\rho}}$, ρ = density of water, B = bulk modulus.

24. $T_{1/2} = \dfrac{0.693}{\lambda}$

25. $N = N_0 e^{-\lambda t}$

26. $\beta_w = 0.21 \times 10^{10}$ Pa

27. $n_1 \sin\theta_1 = n_2 \sin\theta_2$