Mansoura University   Exam. Of Physics   Date : 23 - 1 – 2011
Faculty of Engineering   For Preparatory year   Time : 3 hrs
Engineering Mathematics and Physics Department   Full mark : 100

اجب عن أسئلة خواص المادة فى نصف منفصل من كراسة الاجابة ، والحرارة فى النصف الآخر

## Mechanical properties of matter and waves

Question 1

a- When an object falls through air, there is a drag force that depends on the product of the cross sectional area (A) of the object and the square of its velocity (v^2), that is, $F_{air} = C A v^2$, where C is a constant. Determine the dimensions of C.   (4 marks)

b- The stress-strain curve for quartzite is shown in the Fig. What are   i) the Young's modulus , ii) the approximate yield strength for this material, iii) the percent elongation, and   v) the type of this material.   (8 marks)
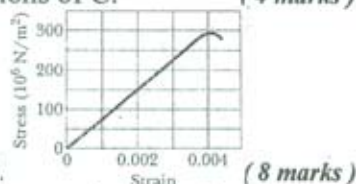
c- A 3.0 kg object on a frictionless horizontal surface oscillates at the end of a spring with an amplitude of 4.5 cm.Its total mechanical energy is 1.4 J. What are i) the force constant of the spring, ii) the periodic time, and iii) the maximum velocity. (6 marks)

Question 2

a- A 50 g block is attached to a vertical spring whose stiffness constant is 4 N/m. The block is released at the position where the spring is unextended (بدون استطالة).
i) Write the displacement equation. ii) What is the maximum extension of the spring ?   (4 marks)

b- Two waves arriving at a point are described by $Y = (6 m) \sin [(\pi/15)X – (\pi/.005)t]$ (X and Y in (m) and t in (s)) and differ in phase by 60°. Write the equation of the resultant wave at this point.   (4 marks)

c- State : i) Superposition principle,   and   ii) Hook's law   (6 marks)

Question 3

a- A car moving at 40 m/s and a truck moving at 15 m/s travel along the same straight road. The car's horn has a natural frequency of 400 Hz. What is the frequency observed by the truck driver as the car passes the truck, assuming that the car and truck are traveling in opposite directions.   (6 marks)

b- A man strikes one end of a thin rod with a hammer. A woman, at the other end with her ear close to the rod, hears the sound of the blow twice (مرتين), with a 0.12s intervals between them. What is the length of the rod? (**The speed of sound in air = 340 m/s, and the speed of the sound in the rod is 15 times the speed in air**). ·   (6 marks)

c- A point source emits 30 W of sound isotropically. A small microphone, 200 m from the source intercepts (يستقبل)the sound in an area of 0.75 cm^2.
Calculate i) the sound intensity there, and ii) the power intercepted by the microphone.   (6 marks)

ثانيا: الحرارة أبدا الأجابة من الجهة الأخرى. و كل سؤال فى صفحة. ممنوع الكتابة أو الرسم فى الرسم البيانى

$E_{cop} = 2 \times 10^{11}$ Pa $\alpha_{cop} = 12 \times 10^{-6}$ °C^{-1}, $C_{cop} = 380$ J/kg °C, (R = 8.31 J/mol.K).
$C_w = 4200$ J/kg °C, $C_{ice} = 2100$J/kg °C, $L_f = 3.3 \times 10^5$J/kg, $L_v = 2.2 \times 10^6$J/kg, $C_s = 2000$ J/kg °C

Qusation 4-a- **Plot** the temperature versus energy added when 1 g of ice, initially at -30°C, is converted to steam at 120°C. ارسم بمقياس رسم مناسب *(5 marks)*

4-b- A copper telephone wire has essentially no sag between poles 50 m apart on a day when the temperature is 20°C. **What** is the length of the wire on a summer day when $T=$ 45°C? **What** is the length of the wire on a winter day when $T= 0.0$°C? **Calculate** the type and the magnitude of the stress at each case. *(5 marks)*

4-c- **Find** the change in volume of a copper cube of 5-cm side when it is heated from 20°C to 150° C. *(5 marks)*

Qusation 5-a- i-How does a bimetal thermometer work?
ii-What does Absolute Zero mean?
iii-What is the difference between temperature and amount of heat energy?
iv-How did Fahrenheit determine 100 degrees? *(5 marks)*

5-b- A heavy copper pot of mass 2 kg is at a temperature of 110°C. You pour 0.2 kg of ice at -15°C into the pot. **Find** the final temperature of the pot and its contents. *(10 marks)*

5-c- Two rods of the same length ($L=40$ cm) and same diameter ($d=8$ cm) are made from different materials ($k_1 = 50$ W/mK, $k_2 = 200$ W/mK). The rods are to connect two regions of different temperature ($T_h = 70$ °C, $T_c = 30$°C). They can be connected in series, or in parallel. **In which case** is the rate of energy transfer by heat larger, when the rods are in series or when they are in parallel? وضح برسم الدائرة المناظرة فى كل حالة *(5 marks)*

Quastion 6-a-Define: Good reflector, Heat convection, First law of thermodynamics, Third law of thermodynamics. *(5 marks)*

6-b- Three moles of helium are initially at 30°C, and a pressure of 1 atm. **What** is the work done by the gas if the volume is *doubled* **(i)** at constant pressure, **(ii)** isothermally? *(5 marks)*

6-c- A Carnot engine takes in 2000 J of heat and produces 800 J of work during each cycle. If the temperature of its cold reservoir is 0.0°C, **what** is the temperature of its hot reservoir? **What** is the efficiency of this engine? *(5 marks)*

Figure Pr. 5-c

(ضع النتائج النهائية لكل مطلوب فى مستطيل)
انتهت الأسئلة