

اجب عن اسئلة الحرارة في نصف منفصل من كراسة الاجابة و خواص المادة في النصف الأخر.

ملاحظة هامة جدا: اسئلة الامتحان في ثلاث صفحات.

Question one: heat

1-Heat-a- Define: Absolute zero, thermal efficiency, Forced convection and adiabatic process. (5 marks)

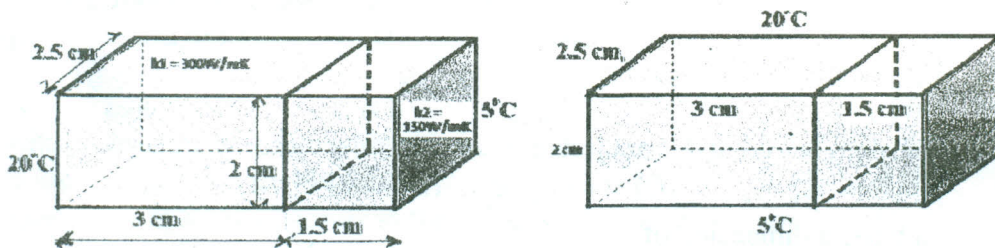
1-Heat-b- Two rods of the same length ($L=50\text{ cm}$) and same diameter ($d=8\text{ cm}$) are made from different materials ($\alpha_c = 17 \times 10^{-6}\text{ K}^{-1}$, $E_c = 2 \times 10^{11}\text{ Pa}$, $\alpha_s = 11 \times 10^{-6}\text{ K}^{-1}$, $E_s = 12 \times 10^{11}\text{ Pa}$) Fig. 1Heat-b. The rods are to connect two rigid walls, if the temperature increased by $30\text{ }^\circ\text{C}$. (i) Find the stress and the length in each rod, (ii) What is the type of the stress? (iii) Determine the change in the volume for each rod. (8 marks)

1-Heat-c- What mass of steam initially at $110\text{ }^\circ\text{C}$ is required to warm 20 g of ice in 130 g glass container from $-5\text{ }^\circ\text{C}$ to $35\text{ }^\circ\text{C}$? $C_{\text{glass}} = 837\text{ J/kg }^\circ\text{C}$, $C_w = 4200\text{ J/kg }^\circ\text{C}$, $C_{\text{ice}} = 2100\text{ J/kg }^\circ\text{C}$, $C_{\text{st}} = 2010\text{ J/kg }^\circ\text{C}$, $L_f = 3.3 \times 10^5\text{ J/kg}$, $L_v = 2.2 \times 10^6\text{ J/kg}$. (8 marks)

Question two: heat

2-Heat-a- Draw: Thermocouple thermometer, and heating curve of water. (5 marks)

2-Heat- b- For the systems shown, how much energy is transferred by conduction between the walls each second? $K_1 = 300\text{ W/mK}$, $k_2 = 150\text{ W/mK}$. (8 marks)



2-Heat-c- The sun delivers 1000 W to each square meter of a black top asphalt road. What is the equilibrium temperature of the hot asphalt? $\epsilon_{\text{asphalt}} = 1$, $\sigma = 5.67 \times 10^{-8}\text{ W/m}^2\text{ K}^4$. (4marks)

Question three: heat

3-heat-a- A gas is taken through the cyclic process described in Fig P.3-a. (a) Find the net energy transferred to the system by heat during one complete cycle. (b) If the cycle is reversed—that is, the process follows the path $ACBA$ —what is the net energy input per cycle by heat? (6 marks)

3-Heat-b- Over one cycle, a Carnot engine absorbs 25 MJ of heat along an isothermal at $150\text{ }^\circ\text{C}$ and rejects heat along a $20\text{ }^\circ\text{C}$ isothermal. Find the amount of heat rejected and the Carnot efficiency. (6 marks)

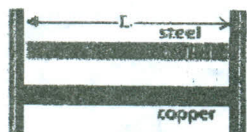


Fig. P.1-Heat-b-

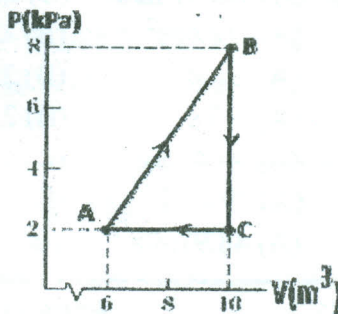


Fig. P.3-heat-a-

اسئلة أسئلة الحرارة
دراسة الجداول

Mechanical properties of matter and waves

لا بد من كتابة الجملة كاملة ووضع خط تحت الإختيار الصحيح

Question 4 [18 marks]

(1) The frequency f of vibration of mass m suspended from a spring of force constant k is given by the relation

$f=C m^x k^y$, where C is dimensionless constant. Choose the correct answer (4 marks)

- (a) The spring force constant k has a dimension of
(A) $[M][T]$ (B) $[M][T^2]$ (C) $[M][T^{-2}]$ (D) $[M][T^{-1}]$
- (b) The frequency f has a dimension of
(A) $[T]$ (B) $[T^{-1}]$ (C) $[S^{-1}]$ (D) $[L][T^{-1}]$
- (c) The values of x and y are equal to
(A) $x=0.5, y=0.5$ (B) $x=-0.5, y=-0.5$ (C) $x=0.5, y=-0.5$ (D) $x=-0.5, y=0.5$

(2) An aluminum alloy with modulus of elasticity 11400 ksi is subjected to a tension stress test. The specimen used for the test has a gauge length of 2 in and a diameter of 0.5 in. When a load of 9 kilo pound is applied, the new diameter of the specimen is 0.49935 in. Choose the correct answer (8 marks)

- (a) The longitudinal stress is equal to (A) 140 ksi (B) 400 ksi (C) 750 ksi (D) 45.84 ksi
- (b) The longitudinal strain is equal to (A) 0.00204 (B) 0.204 (C) 0.00402 (D) 0.0402
- (c) The lateral strain is found to be (A) 0.13 (B) -0.013 (C) -0.0013 (D) 0.00013
- (d) The shear modulus is equal to (A) 4307.14 ksi (B) 3408.51 ksi (C) 2308.7 ksi (D) 8302 ksi

(3) Choose the correct answer for the following questions (6 marks)

- (a) The ratio of the stress to the strain is called
(A) modulus of elasticity (B) Young's modulus (C) both (A) and (B) (D) neither (A) nor (B)
- (b) The region in the stress-strain curve extending from origin to proportional limit is called
(A) plastic region (B) elastic region (C) semi plastic region (D) permanent region
- (c) Which of these factors doesn't affect the stress of a wire?
(A) diameter (B) original length (C) load (D) cross sectional area
- (d) A bar of steel is placed along x axis and is subjected to an axial tension force. Poisson's ratio is equal to
(A) $\nu = -\epsilon_x / \epsilon_z$ (B) $\nu = -\epsilon_z / \epsilon_x$ (C) $\nu = -\epsilon_z / \epsilon_y$ (D) $\nu = -\epsilon_y / \epsilon_z$
- (e) The damping constant b has a dimension of
(A) ML^2/T^3 (B) M/T^3 (C) M/T (D) ML/T^2
- (f) The intensity of waves radiating isotropically from a point source is inversely proportional to
(A) the distance from the source. (B) the square of the distance from the source.
(C) the triple of the distance from the source. (D) the power of the source.

Question 5 [16 marks]

(1) A body of mass 0.5 kg oscillates simple harmonic motion according to the equation $x=6 \cos(3\pi t + \pi/3)$ meter. Choose the correct answer for the following questions: (8 marks)

- (a) The displacement at $t=2$ sec (A) 3.0 m (B) 4.0 m (C) 2.0 m (D) 1.0 m
- (b) The velocity at $t=2$ sec (A) -48.97 m/s (B) 28.97 m/s (C) -48.97 cm/s (D) -28.97 cm/s
- (c) The acceleration at $t=2$ sec (A) -7π m/s² (B) $-27\pi^2$ m/s² (C) $27\pi^2$ cm/s² (D) 7π m/s²
- (d) The phase constant (A) π rad (B) $2\pi/3$ rad (C) $\pi/3$ rad (D) 3π rad
- (e) The frequency (A) 1.5 s⁻¹ (B) 2.5 s⁻¹ (C) 0.5 s⁻¹ (D) 0.66 s⁻¹
- (f) The spring constant k (A) 44.41 kg (B) 44.41 N m (C) 44.41 kg m (D) 44.41 N/m
- (g) The maximum kinetic energy (A) 799.4 J (B) 680 J (C) 594 J (D) 977.83 J
- (h) The velocity at $x=A/2$ (A) 48.97 m/s (B) 28.68 m/s (C) 25.76 m/s (D) 97.83 m/s



(2) The displacement $y(x, t)$ of a particular travelling wave has the form $y(x, t) = (0.01\text{m}) \sin(x + \pi t/2)$.

Choose the correct answer for the following questions:

(5 marks)

- (a) What is the wavelength of this wave? (A) $1/2\pi$ m (B) $1/\pi$ m (C) π m (D) 2π m
(b) What is the frequency of this wave? (A) $1/2$ Hz (B) 4 Hz (C) $1/4$ Hz (D) 2 Hz
(c) What is the speed of this wave, ignoring its direction? (A) $\pi/2$ m/s (B) 2π m/s (C) 4 m/s (D) 8π m/s
(d) If a similar wave is travelling in the opposite direction, the amplitude of the resultant wave at $x=1.0$ m
(A) 0.0168 m (B) 0.168 m (C) 0.00035 m (D) 0.0035 m
(e) If a similar wave is travelling in the opposite direction, the distance between antinode and adjacent node is equal to (A) $\pi/2$ m (B) $\pi/3$ m (C) $\pi/4$ m (D) $\pi/6$ m

(3) Choose the correct answer for the following questions

(3 marks)

- (a) The total energy of a particle executing simple harmonic motion of amplitude A is proportional to
(A) A^2 (B) A^{-2} (C) A (D) $1/A$
(b) A mass m hanging from a spring of force constant k oscillates with a period T . If the same mass were hung from a spring with force constant $3k$, what would be its period of oscillation?
(A) $3T$ (B) $\sqrt{3}T$ (C) T (D) $T/\sqrt{3}$
(c) A string under tension carries transverse waves travelling at speed v . If the tension in the string is halved and the linear density of the string is doubled, the wave speed will be
(A) the same v (B) $v/2$ (C) $4v$ (D) $0.71 v$

Question 6 [16 marks]

(1) The sound level of a dog's bark is 50 dB. The intensity of a concert is 10000 times that of the dog's bark.

(6 marks)

- (a) The intensity of the dog's bark is equal to (A) 10^{-7}W/m^2 (B) 10^{-17}W/m^2 (C) 10^{-12}W/m^2 (D) 10^{-5}W/m^2
(b) What is the sound level of the rock concert? (A) 10,050 dB (B) 500,000 dB (C) 90 dB (D) 2000 dB
(c) If another dog with the same intensity is placed beside the first one, the sound level will be
(A) 100.73 dB (B) 53.01 dB (C) 70.05 dB (D) 120.2 dB

(2) A truck moving at 36 m/s and a police car moving 45 m/s are headed in the opposite direction. The frequency of the siren is 500 Hz relative to the police car. (The speed of sound in air is 343 m/s.)

(6 marks)

- (a) The frequency heard by an observer in the truck is (A) 635.9 Hz (B) 300 Hz (C) 395.6 Hz (D) 240 Hz
(b) The frequency heard by an observer in the truck as the two vehicles pass each other
(A) 635.9 Hz (B) 363.4 Hz (C) 395.6 Hz (D) 240.3 Hz
(c) The change in frequency (in Hz) heard by an observer in the truck as the two vehicles pass each other is
(A) 636 Hz (B) 395.9 Hz (C) 360 Hz (D) 240.3 Hz

(3) A specimen is originally 12 in long, has a diameter of 0.5 in., and is subjected to a force of 500 lb. When the force is increased from 500 lb to 1800 lb, the specimen elongates 0.009 in.

(4 marks)

- (a) The change in the applied stress is equal to
(A) 2.432 ksi (B) 6.621 ksi (C) 5.467 ksi (D) 8.345 ksi
(b) The modulus of elasticity for the material if it remains linear elastic is equal to
(A) 8828 ksi (B) 1260 ksi (C) 7090 ksi (D) 4324 ksi