Physicsaholics

Exercise

Thermo-1

Elasticity, Calorimetry,

Thermal Expansion, Heat Transfer

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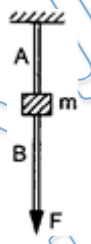
Exercise-3

(Objective Type: Multi Correct)

Q 1. Select the correct alternative(s):
(A) Elastic forces are always conservative
(B) Elastic forces are not always conservative
(C) Elastic forces are conservative only when Hooke's law is obeyed
(D) Elastic forces may be conservative even when Hooke's law is not obeyed

Q 2. A wire is suspended from the ceiling and stretched under the action of a weight F suspended from its other end. The force exerted by the ceiling on it is equal and opposite to the weight.
(A) Tensile stress at any cross section A of the wire is F/A.
(B) Tensile stress at any cross section is zero.
(C) Tensile stress at any cross section A of the wire is 2F/A.
(D) Tension at any cross section A of the wire is F.

Q 3. The wires A and B shown in the figure are made of the same material, and have radii r_A and r_B respectively. The block between them has a mass m. When the force F is mg/3, one of the wires breaks.



(A) A will break before B if $r_A = r_B$.
(B) A will break before B if $r_A < 2r_B$.
(C) Either A or B may break if $r_A = 2r_B$.
(D) The lengths of A and B must be known to predict which wire will break.

Q 4. A copper and a steel wire of the same diameter are connected end to end. A deforming force F is applied to this composite wire which causes a total elongation of 1cm. The two wires will have
(A) the same stress. (B) different stress. (C) the same strain. (D) different strain.

Q 5. A metal wire of length L, area of cross-section A and Young modulus Y is stretched by a variable force F such that F is always slightly greater than the elastic forces of resistance in the wire. When the elongation of the wire is *l*,
(A) the work done by F is $\frac{YAl^2}{2L}$
(B) the work done by F is $\frac{YAl^2}{L}$

(C) the elastic potential energy stored in the wire is $\frac{YAl^2}{2L}$

(D) no heat is produced during the elongation

Q 6. A body of mass M is attached to the lower end of a metal wire, whose upper end is fixed. The elongation of the wire is *l*.

(A) Loss in gravitational potential energy of M is Mg*l*

(B) The elastic potential energy stored in the wire is Mg*l*

(C) The elastic potential energy stored in the wire is 1/2 Mg*l*

(D) Heat produced is 1/2 Mg*l*.

Q 7. A body of mass M is attached to the lower end of a metal wire, whose upper end is fixed. The elongation of the wire is *l*.

(A) Loss in gravitational potential energy of M is Mg*l*.

(B) The elastic potential energy stored in the wire is Mg*l*.

(C) The elastic potential energy stored in the wire is ½ Mg*l*.

(D) Heat produced is 1/2 Mg*l*.

Q 8. Mark the CORRECT options:

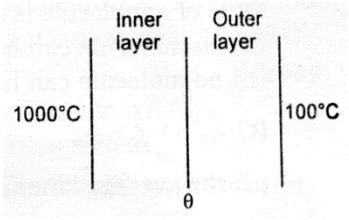
(A) A system X is in thermal equilibrium with Y but not with Z. System Y and Z may be in thermal equilibrium with each other.

(B) A system X in the thermal equilibrium with Y but not with Z. Systems Y and Z are not in thermal equilibrium with each other.

(C) A system X is neither in thermal equilibrium with Y nor with Z. The system Y and Z must be in thermal equilibrium with each other.

(D) A system X is neither in thermal equilibrium with Y nor with Z. The system Y and Z may be in thermal equilibrium with each other.

Q 9. The temperature drops through a two layer furnace wall is 900°C. Each layer is of equal area of cross section. Which of the following actions will result in lowering the temperature θ of the interface?



(A) by increasing the thermal conductivity of outer layer

(B) by increasing thermal conductivity of inner layer

(C) by increasing thickness of outer layer

(D) by increasing thickness of inner layer.

Q 10. When the temperature of a copper coin is raised by 80°C, its diameter increases by 0.2%.

(A) Percentage rise in the area of a face is 0.4 %

(B) Percentage rise in the thickness is 0.4 %

(C) Percentage rise in the volume is 0.6 %

(D) Coefficient of linear expansion of copper is 0.25×10^{-4} $C°^{-1}$.

Q 11. A spherical black body of radius r radiates power P, and its rate of cooling is R.

(A) $P \propto r$ (B) $P \propto r^2$ (C) $R \propto r^2$ (D) $R \propto \frac{1}{r}$

Q 12. Choose the correct statement(s) of the following.

(A) Thermal expansion is consequence of atomic vibrations.

(B) Thermal expansion is due to asymmetry in potential function.

(C) Thermal expansion is not due to asymmetry in potential function.

(D) All solids expands on heating.

Q 13. Pendulum clock looses 5 sec per day at $35^0 C$ and gains 10 sec per day at $14^0 C$

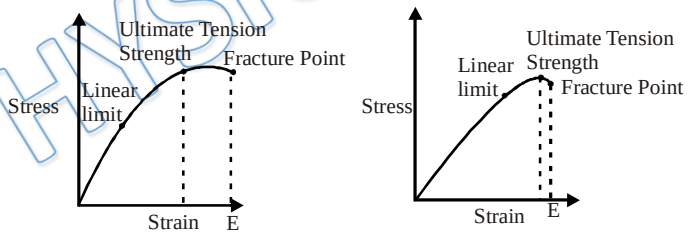
(A) The pendulum shows correct time at $18^0 C$

(B) The pendulum shows correct time at $28^0 C$

(C) The temperature coefficient of linear expansion of the pendulum rod is 1.65×10^{-5} $^0C^{-1}$

(D) The temperature coefficient of linear expansion of the pendulum rod is 1.65×10^{-6} $^0C^{-1}$

Q 14. The stress-strain graphs for two materials are shown in figure (assume same scale).



(A) Material (ii) is more elastic than material (i) and hence material (ii) is more brittle.

(B) Material (i) and (ii) have the same elasticity and the same brittleness.

(C) Material (ii) is elastic over a larger region of strain as compared to (i).

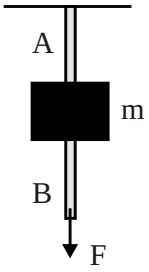
(D) Material (ii) is more brittle than material (i).

Q 15. A composite rod consists of a steel rod of length 25 cm and area 2A and a copper rod of length 50cm and area A. The composite rod is subjected to an axial load F. If the Young's modulus of steel and copper are in the ratio 2 : 1.

(A) the extension produced in copper rod will be more.

(B) the extension in copper and steel parts will be in the ratio 2 : 1.
(C) the stress applied to the copper rod will be more.
(D) no extension will be produced in the steel rod.

Q 16. The wires A and B shown in the figure are made of the same material and have radii r_A and r_B respectively. The block between them has a mass m. When the force F is mg/3, one of the wires breaks.



(A) A breaks if $r_A = r_B$
(B) A breaks if $r_A < 2r_B$
(C) Either A or B may break if $r_A = 2r_B$
(D) The lengths of A and B must be known to predict which wire will break

Q 17. 50 gm ice at – 10°C is mixed with 20 gm steam at 100°C. When the mixture finally reaches its steady state inside a calorimeter of water equivalent 1.5 gm then: [Assume calorimeter was initially at 0°C,Take latent heat of vaporization of water = 540 cal/gm, Latent heat of fusion of water = 80 cal/gm, specific heat capacity of water = 1 cal/gm-°C, specific heat capacity of ice = 0.5 cal/gm°C]
(A) Mass of water remaining is : 67.4 gm(B) Mass of steam remaining is : 2.6 gm
(C) Mass of water remaining is : 67.87 gm (D) Mass of steam remaining is : 2.13 gm

Q 18. Two metallic sphere A and B are made of same material and have got identical surface finish. The mass of sphere A is four times that of B. Both the spheres are heated to the same temperature and placed in a room having lower temperature but thermally insulated from each other.
(A) The ratio of heat loss of A to that of B is $2^{4/3}$.
(B) The ratio of heat loss of A to that of B is $2^{2/3}$.
(C) The ratio of the initial rate of cooling of A to that of B is $2^{-2/3}$.
(D) The ratio of the initial rate of cooling of A to that of B is $2^{-4/3}$

Q 19. Two bodies A and B have thermal emissivities of 0.01 and 0.81 respectively. The outer surface areas of the two bodies are the same. The two bodies radiate energy at the same rate. The wavelength λ_B, corresponding to the maximum spectral radiancy in the radiation from B, is shifted from the wavelength corresponding to the maximum spectral radiancy in the radiation from A by 1.00 μm. If the temperature of A is 5802 K,
(A) the temperature of B is 1934 K (B) λ_B =1.5 μm
(C) the temperature of B is 11604 K (D) the temperature of B is 2901 K

Q 20. A bimetallic strip is formed out of two identical strips one of copper and the other of brass. The coefficient of linear expansion of the two metals are α_C and α_B. On heating, the temperature of the strip goes up by ΔT and the strip bends to form an arc of radius of curvature R. Then R is
(A) proportional at ΔT (B) inversely proportional to ΔT
(C) proportional to $|\alpha_B - \alpha_C|$ (D) inversely proportional to $|\alpha_B - \alpha_C|$

Answer Key

Q.1) B,D	Q.2) A,D	Q.3) A,B,C	Q.4) A,D	Q.5) A,C,D
Q.6) A,C,D	Q.7) A,C,D	Q.8) B,D	Q.9) A,D	Q.10) A,C,D
Q.11) B,D	Q.12) A,B	Q.13) B,C	Q.14) C,D	Q.15) A,C
Q.16) A,B,C	Q.17) A,B	Q.18) A,C	Q.19) A,B	Q.20) B,D