1. (c) Initial diameter of tyre = (1000 – 6) *mm* = 994 *mm*, so initial radius of tyre 

and change in diameter Δ*D* = 6 *mm* so 

After increasing temperature by Δ*θ* tyre will fit onto wheel

Increment in the length (circumference) of the iron tyre

Δ*L* = *L* × *α* × Δ*θ*  [As 

⇒

⇒

1. (a) With temperature rise (same 25°*C* for both), steel scale and copper wire both expand. Hence length of copper wire *w.r.t.* steel scale or apparent length of copper wire after rise in temperature



⇒ 

 = 80.0096 *cm*

1. (b) Loss of weight at 27º*C* is

= 46 – 30 = 16 = *V*1 × 1.24 *ρl* × *g* …(i)

Loss of weight at 42º*C* is

= 46 – 30.5 = 15.5 = *V*2× 1.2 *ρ l* × *g* …(ii)

Now dividing (i) by (ii), we get  = 

But  = 1 + 3*α* (*t*2 – *t*1) =  = 1.001042

⇒ 3*α* (42º – 27º) = 0.001042 ⇒ *α* = 2.316 × 10–5/º*C*.

1. (a) Heat is lost by steam in two stages (i) for change of state from steam at 100º*C* to water at 100º*C* is *m* × 540   
   (ii) to change water at 100º*C* to water at 80º*C* is   
   *m* × 1 × (100 – 80), where *m* is the mass of steam condensed.

Total heat lost by steam is m × 540 + *m* × 20 = 560 *m* (*cals*) Heat gained by calorimeter and its contents is

= (1.1 + 0.02) × (80 – 15) = 1.12 × 65 *cals*.

using Principle of calorimetery, Heat gained = heat lost

∴ 560 *m* = 1.12 × 65, *m* = 0.130 *gm*

1. (b) Initially ice will absorb heat to raise it's temperature to 0o*C* then it's melting takes place

If *mi* = Initial mass of ice, *mi*' = Mass of ice that melts and *mW* = Initial mass of water

By Law of mixture Heat gained by ice = Heat lost by water ⇒  = 

⇒  =  ⇒ = 1*kg*

So final mass of water = Initial mass of water + Mass of ice that melts = 5 + 1= 6 *kg*.

1. (a) Heat gained by the water = (Heat supplied by the coil) – (Heat dissipated to environment)

⇒ 

⇒ 

⇒ 

1. (a) If mass of the bullet is *m* *gm*,

then total heat required for bullet to just melt down

*Q*1 = *m c* Δ*θ* + *m L* = *m* × 0.03 (327 – 27) + *m* × 6

= 15 *m cal* 

Now when bullet is stopped by the obstacle, the loss in its mechanical energy 

(As )

As 25% of this energy is absorbed by the obstacle,

The energy absorbed by the bullet



Now the bullet will melt if 

*i.e.* ⇒ 

1. (b) Suppose *m* *kg* steam required per hour

Heat released by steam in following three steps

(i) When 150°*C* steam  steam

*Q*1 = *mcSteam* Δ*θ* = *m* × 1 (150 – 100) = 50 *m cal*

(ii) When 150°*C* steam  water

*Q*2 = *mLV* = *m* × 540 = 540 *m cal*

(iii) When 100°*C* water  water

*Q*3 = *mcW* Δ*θ* = *m* × 1 × (100 – 90) = 10 *m cal*

Hence total heat given by the steam *Q* = *Q*1 +*Q*2 + *Q*3 = 600 *mcal* ... (i)

Heat taken by 10 *kg* water



Hence *Q* = *Q*′ ⇒ 600 *m* = 600 × 103

⇒ *m* = 103 *gm* = 1*kg*.

1. (d) 





Neglecting  and 



1. (c) Heat given by water 

Heat taken by ice to melt

*Q*2 = 10 × 0.5 × [0 – (– 20)] + 10 × 80 = 900 *cal*

As  so ice will not completely melt and final temperature = 0°*C*.

As heat given by water in cooling up to 0°*C* is only just sufficient to increase the temperature of ice from – 20°*C* to 0°*C*, hence mixture in equilibrium will consist of 10 *gm* ice and 10 *gm* water at 0°*C*.

1. (b) 

Rod *A* : 0.075 = 20 × *αA* × 100 ⇒ 

rod *B* : 0.045 = 20 × *αB* × 100 ⇒ 

For composite rod : *x* *cm* of *A* and (20 – *x*) *cm* of *B* we have

(20 – *x*)

*B*

*αB*

*A*

*αA*

20*cm*

x

0.060 = *x αA* × 100 + (20 – *x*) *αB* × 100



On solving we get *x* = 10 *cm*.

1. (d) ⇒

⇒ ⇒  ⇒ 

1. (c) Both the cylinders are in parallel, for the heat flow from one end as shown.

*R*

2*R*

*K*2

*K*1

Hence ; where *A*1 = Area of cross-section of inner cylinder = *πR*2 and Area of cross-section of cylindrical shell 

⇒ 

1. (b) Let the temperature of junction be *θ*. Since roads *B* and *C* are parallel to each other (because both having the same temperature difference). Hence given figure can be redrawn as follows



*R*

*R*

*R*

0°

*θ*

90°

90°

*R*

*R*/2

0°

90°

*θ*

*C*

*A*

*B*

*Q*

*l*

*l*

 and 

⇒  ⇒  ⇒

1. (a)  ⇒ 

⇒ *t* = 8.9 × 103 *sec* = 2.47 *hr*.

1. (b) Let the temperature of junction be *θ* then according to following figure.

2*K*

*K*

3*K*

100°

*θ*

50°

20°

*H*

*H*1

*H*2

*H* = *H*1 + *H*2

⇒ 

⇒ 300 – 3*θ* = 3*θ* – 120 ⇒ *θ* = 70°*C*

1. (c) Initially the rods are placed in vessels as shown below



*l*

*R*

*R*

100°*C*

0°*C*

100°*C*

0°*C*

⇒ ... (i)

Finally when rods are joined end to end as shown

*l*

*R*

*R*

100°*C*

0°*C*

*l*

*Req* = 2*R*

⇒  ... (ii)

From equation (i) and (ii), 

1. (c) The given arrangement of rods can be redrawn as follows

*H*

*H*

*H*1

*H*1

*H*2



*l*

*l*

*K*1

*K*2

*K*3

It is given that *H*1 = *H*2

⇒ ⇒ 

*dr*

*H*

*r*1

*r*2

*r*

1. (a) Consider a concentric spherical shell of radius *r* and thickness *dr* as shown in fig.

The radial rate of flow of heat through this shell in steady state will be 

⇒ 

Which on integration and simplification gives

⇒ 

1. (c)

Temperature difference between *C* and *D* is zero.



*C*

*R*

*R*

*B*

*T*

*R*

*D*

*R*

*A*

1. (a) Work done = Area enclosed by triangle *ABC*
2. (a) Initial and final states are same in all the process.

Hence Δ *U* = 0; in each case.

By FLOT; Δ*Q* = Δ*W* = Area enclosed by curve with volume axis.

 (Area)1 < (Area)2 < (Area)1 ⇒ *Q*1 < *Q*2 < *Q*3­ .

1. (a) By adjoining graph  and



∴ 

Now, 

From FLOT 

⇒  ⇒ 

1. (a) For cyclic process. Total work done 

Δ*WAB* = *P*Δ*V* = 10(2 – 1) = 10*J* and Δ*WBC* =0

(as *V* = constant)

From FLOT, Δ*Q* = Δ*U* + Δ*W*

Δ*U* = 0 (Process *ABCA* is cyclic)

⇒ Δ*Q* = Δ*WAB* + Δ*WBC* + Δ*WCA*

⇒ 5 = 10 + 0 + Δ*WCA* ⇒ Δ*WCA* = – 5 *J*

1. (b) The cyclic process 1 is clockwise where as process 2 is anticlockwise. Clockwise area represents positive work and anticlockwise area represents negative work. Since negative area (2) > positive area (1), hence net work done is negative
2. (d)  Δ*U* does not depend upon path.

  ⇒ 

1. (d) Work done = Area under curve = 9 *P*1*V*1
2. (d) Work done 
3. (c) In a cyclic, Δ*U* = 0

From FLOT, Δ *Q* = Δ*U* + Δ*W* = 0 + Δ*W* = Area of closed curve ⇒ Δ*Q* = *πr*2 



1. (d) *W* = Area bonded by the indicator diagram with *V*-axis)



1. c) Processes *A* to *B* and *C* to *D* are parts of straight line graphs of the form *y* = *mx*

Also  (*μ* = 6)

*P*2

*T*

*D*

*A*

*C*

*B*

*P*

*P*2

*VA*

*VD*

*VC*

*VB*

*P*1

*TB* =800 *K*

*TC* = 2200 *K*

*TA* =600 *K*

*TD* =1200 *K*

⇒ *P* ∝ *T*. So volume remains constant for the graphs *AB* and *CD*

So no work is done during processes for *A* to *B* and *C* to *D* *i.e.*, *WAB* = *WCD* = 0 and *WBC* = *P*2(*VC* – *VB*­) = *μR* (*TC* – *TB*)

= 6*R* (2200 – 800) = 6*R* × 1400 *J*

Also *WDA* = *P*1 (*VA* – *VD*) = *μR*(*TA* – *TB*)

= 6*R* (600 – 1200)= – 6*R* × 600 *J*

Hence work done in complete cycle

*W* = *WAB* + *WBC* + *WCD* + *WDA*

= 0 + 6*R* × 1400 + 0 – 6*R* × 600

= 6*R* × 900 = 6 × 8.3 × 800 ≈ 40 *kJ*