Good example of essay on logo of institution

Technology, Development

Answers to Questions

Block 1: Problems, Challenges and Opportunities (Parts 1 and 2)

T207 Engineering: Mechanics, Materials, Design

Answer 1(a)

The three categories of Engineering Solutions are Innovation by Context, Innovation by Development and finally Routine Solutions. Innovation by Context will have inventions in their ranks, which relies on a new technology to bring about a solution to a problem. The ball point pen(deviating away from the liquid ink), the Gore-Tex® Fabric which is not a fabric but layers of artificial organic material making it breathable, waterproof one-way, durable, etc. and the Dyson™ Vacuum Cleaner which uses cyclonic vacuum technology will fall into this category.

Among Contact lenses, Tablet Computers and Blu-Ray Discs, the similarity is that they were invented or designed before but needed improvements to make them practical in a modern world, will fall into Innovation by Development. The boundary is tough to discern but these are improvements in material, compactness and storage capacity prevent them from falling into the first category make them Innovation by development examples.

There appears to be no routine solutions among the artifacts given.

(b)The historical development of the washing machine mainly consists of incremental steps as well as a few sudden changes. The change from the scrub-board to a hand powered washing machine in a drum like structure, the James King invention, may be called an example of innovation by context(in 1851). After that stage, Blackstone and others come into the picture lowering manual energy required, adding the wringer to the washer are steps of innovation by development. Routine solutions were also there as the machine made too much noise, the casing material was changed. However, proper documentation of the routine solutions will be in correcting these mistakes which were contrary to the planned results. The next innovation by context examples were the electrical operation and the microchip programmed computer controlled today’s front loading fully automatic, front loading washing machines. In between there was innovation by development of the rotary motion introducer, moving the water and not the clothes, top loading semi-automatic washing machines all electrically controlled. Then the fully automatic microchip controlled washing machine was an innovation by context. From then, till now, innovations of development are going on (or ‘ value additions’) like child-proof locking. Routine solutions continue taking place, changing the knobs to plastic, making them standard sized, etc. but are not documented as well in history books.

(c) We will assume that the main need is to decrease the power consumption. However, if possible the management also wants to reduce the vibration. First of all, the design team sits together, brainstorms and tries to find out the solutions

They get three solutions which they feel will serve their need.

- Motor is mounted in a slanting position which makes balancing difficult. They will now approach it from the reverse side. They will first finalize motor shaft and finalize a more efficient motor to cut down power.
- As above but the load will be made also a little light so that a lower rating

motor will do the job. This can be done by a hollow shaft motor . They will also make the shape a little futuristic looking just for attraction.

- They will do the above and also incorporate power factor improvers to make the motoe further efficient.

The next step is the modeling here. There is no question of mathematical modeling as the team outsources the motor. They will go in for the more efficient at a slight price increase. This will be compensated by the hollow shaft and the hollow extension which will reduce metal costs. The change in looks will be done. However, the modeling is done by costing models. The power factor idea is dropped as costs will be uncompetitive.

Solution 2 is adopted as the most commercially competitive solution.

On checking, the decision is supported because with the new motor, their power consumption will be at par. Power factor improvement will decrease power costs still further but costing will go up in higher proportion.

This is how the modeling will be done, in case of this particular need. Higher efficiency is good but after a certain level ceases to have meaning especially for white good products.

Answer 2 (a)

Mercury in glass thermometer is used to measure the temperature of the ambient area in touch with the thermometer bulb. There is no connection with time here (or none needs to be considered), the mercury rise in the stem becoming stable at thermal equilibrium, thereby making the process simple. Therefore, say a reading is taken in a hospital of a patient by inserting the thermometer in the man’s mouth. Due to the gradual change, any delay between the time taken to remove the thermometer and looking at it , one can be sure that due to gradual change, the mercury stem will still show the correct temperature. However, for sudden or accelerating changes, the same thermometer may show different results after a few minutes have passed.

2 (b) The equation for thermal expansion is

$L1= L0 (1 + \alpha \Delta T)$ where the unexpanded value before heating is L0, the post expansion value is L1, the coefficient of expansion is α and the temperature difference is ΔT.

Therefore, $L1 = L0 + L0 \alpha \Delta T$

Or, $L1 - L0 = L0 \alpha \Delta T$

Or, $\Delta L = L0 \alpha \Delta T$ (here ΔL is the difference in dimension pre and post thermal expansion)

We have proved what was required.

2 (c)

Let l be the glass bottle length after thermal expansion

The temperature difference is here 50 degrees Kelvin.

Original length of glass bottle is 0. 25 mts

The co-efficient of thermal expansion for glass is 9 x 10-6 K-1 (

Therefore, from answer 2b,

Change in length = 0. 25*9 x 10-6x50= 1012. 5 x 10-6 mts= 0. 0010125 mts

The answer is 0. 0010125mm

Answer 2(d) :

Let l be the length of a side of the square after thermal expansion

The temperature difference is here 67 degrees Kelvin.

If the area is 1. 5 square meters, then l = 1. 50. 5

Original length of glass bottle is 1. 225 mts (approx.)

The co-efficient of thermal expansion for copper is 17 x 10-6 K-1 (T207 text, 2009, p. 90)

Therefore, from answer 2b,

Change in length = 1. 225* 17 x 10-6x67= 1395. 275 x 10-6 mts= 1.

395275x10-3mts

Increase in area =(1. 225+0. 001395275)/1. 225 * 100%= 0. 001%

The answer is 0. 001%

Answer 3(a)

The Arrhenius model for creep strain follows an equation of the form:

ε = A exp (–Ea / RT)

Here, ε is the strain rate, T is the absolute temperature, A is a constant, and

R is the universal gas constant = 8. 314 J K-1 mole-1.

We will take the natural logarithm of both sides and adjust the constant A

Ln ε= (-Ea/R)ln (1/T) +constant

This is in the form of the equation y= mx+C

And therefore can be expressed as a straight line.

Therefore Ea= 0. 22 KJ/mole

Diffusion is most likely to occur at the lattice energy level.

We are required to find out the strain rate at 84 deg Celsius

Changing into Kelvin, T= 357 deg K

Therefore 1/T= 0. 0028

Ln ε =-12

Hence, The strain rate will be given by the antilog of (-12)

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