EN4105 Integrated Environmental Management AY15/16 SEM1 NOV2015

1a.treat of global warming and climate change could impact the local catchment water resource development (4m)

Potential impacts of global warming on future water resource development:

- Higher temperature increasing crop water demand
- Significant changes in rainfall patterns, extreme weather conditions could cause floods and droughts
- Coastal areas experience permanent inundation as ocean water levels rise, affecting coastal groundwater resources
- Flooding of wastewater plants and septic tanks in low-lying areas causing severe pollution of water sources

1b. List 4 WSUD design features used in Singapore for storm water quality AND quantity management. (4m)

SUDS control techniques include: Good housekeeping at individual premises, green roofs, rainwater harvesting, pervious pavements, infiltration systems, detention ponds, wetlands, bioswales, bio-retention swales, filter strips, etc..

1c. Discuss measures to achieve 140L per day per capita of domestic water consumption by 2030. (4m)

To reduce water demand [refer to Dr Shue notes]

Measures to reduce UFW could include:

- Leakage control through use of better quality pipes and fittings, e.g. stainless steel, copper pipes, replacing old cast iron mains and galvanized iron connections, leak detection and quick response and rectification of leaks, checking connections and distribution mains, strict legislation on illegal draw offs
- Accurate metering through 100% metering and good quality meters with accurate output to help in proper accounting of water used

Water Conservation measures include:

- Public Education and Publicity Program
- Mandatory Installation of Water Saving Devices, examples:
- Self-closing delayed action taps
- Constant flow regulators
- Low capacity flushing cistern
- Fiscal Policy: Pricing water to encourage conservation

1d. Discuss potential problems associated with usage of reclaimed wastewater. (4m)

NEWater Cons:

- Potential long-term adverse health effects
- Psychological effect
- Higher treatment cost
- Separate water reticulation system
- Smell and odour
- Colour
- Corrosion of pipes and fittings
- Indirect potable use

2a. Define "Sustainable development" in a sentence. How does EIA process help to achieve sustainable development? (4m)

Sustainable Development can be defined as development that meets the needs of the present generation without compromising the ability of future generations to meet their needs

EIA process allows better management of the use, renewal and conservation of all natural resources, and hence in the long term sustainable development.

2b. Briefly describe how environmental impacts can be characterized (4m)

- Direct impacts: Impacts caused directly by the activity itself
- Indirect impacts: Secondary impacts which could occur remote in distance or time from the project
- Cumulative impacts: Individual projects may not have significant effects, but when combined with other projects or actions, the incremental contributions of individual projects may cause overall adverse cumulative effects

2c. EIA process considers alternative processes, techniques or sites, give examples of projects which are site specific, others which are not.

Site specific: harbor, mines, powerplant, WWTP

Not site specific: hospital, shopping mall etc

2d. List 4 EIA methods which can be used for impact identification?

- Ad-hoc methods
- Checklists methods
- Matrices methods
- Network methods
- Overlays methods
- Environmental index using factor analysis
- Cost/benefit analysis
- Predictive or simulation methods

2e. common types of simulation models which can be used by engineers for impact assessment?

- Physical Models
- Small scale models of the environmental system in which experiments can be carried out to predict future changes
- Experimental models
- For example, in-situ tracer experiments to monitor movement of releases into the environment.
- Mathematical models
- Use mathematical equations to simulate behavior of environmental systems
- Can be deterministic or stochastic, stationary or dynamic, empirical or internally descriptive, homogeneous or non-homogenous, generalized or site-specific

3a. State the goal or objective of Hazcom, list down measures to implement and apply them to the case of lead soldering paste

Hazcom

- **To communicate information about dangers of hazardous materials used to all affected personnel**
  - ◦Labelling
  - ◦Posting of signage
  - ◦Maintaining safety data sheet (SDS)
  - ◦Training
- **MSDS**
  - ◦Physical and chemical properties
  - ◦Physical and health hazards
  - ◦Routes of exposure
  - ◦Precautions for safe handling and use
  - ◦Emergency and first-aid procedures
  - ◦Control measures

Lead = chemical poisoning, chemical vapour, risk assessment done, medical checks before and after employment (lead poisoning)

Solder= hotwork, hot work permit, training for hotwork, presence of hotwork watcher, first aid/ emergency procedures

3bi. Define the term hazard and risk

- **Hazards**
  - ◦Source of situation with a potential for harm in terms of human injury or ill health, damage to workplace environment, or a combination of these
- **Risk**
  - ◦Combination of the likelihood and consequence(s) of a specified hazardous event occurring

3bii. State processes carried out in Risk analysis and relate them based on the maintenance job of cleaning a metal storage vessel (containing flammable and volatile petroleum, need to climb into tank for cleaning, washing takes 30-50min)

Risk assessment = Hazard identification, Risk evaluation, Risk control
Flammable = fire triangle
Volatile= gas mask+ safety accessor must do checks before entry
Petroleum = slip and fall, Safety data sheet
Climbing into tank = confined space= emergency procedure, training, first aid team
30-50min = toxic limits, LHL

4 [PLEASE CHECK]***

4ai. New cost of generating electricity by fuel, with carbon tax of $30

1ton = 1000kg= 1000000g

	cents/kwh	gCO2/kwh	tax($30 per 1,000,000g CO2)		final cost after tax	
coal	5	1000	30*1000/1000000	0.03	0.03+0.05	0.08
wind	8	200	30*200/1000000	0.006	0.006+0.08	0.086
nuclear	15	50	30*50/1000000	0.0015	0.0015+0.15	0.1515

4aii. Does suggested carbon tax make wind and nuclear energy cost competitive in generating electricity?

No, coal is still cheapest. Thus wind nad nuclear are not cost competitive

4aiii. What amount of tax is needed to make both wind and nuclear energy cost competitive?

Let Y= carbon tax
For wind: 8+(Y*200/10^6) = 5+(Y*1000/10^6)
For nuclear: 15+(Y*50/10^6) = 5+(Y*1000/10^6)
Solve for Y, choose the higher value of Y

4bi. Elaborate on the possible reasons that made the 2015 haze issue worse than previous years.

El nino = prolonged dry season
Usually is haze from Sumatra, but unfavorable winds = both Sumatra and Kalimantan haze both blow past Singapore

4bii. What are potential health impacts of Haze?

PM10= nose irritation, eye issues
PM2.5= goes deep into lungs, asthma

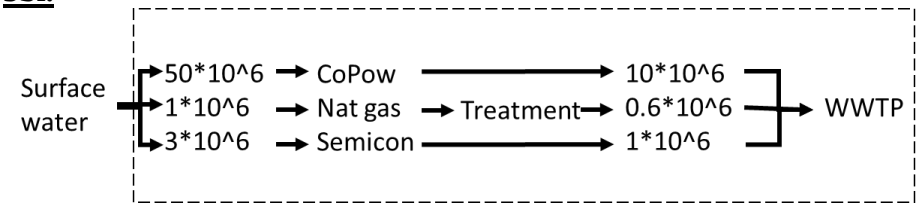
4biii. Propose 2 potential strategies that can help to reduce personal exposure to haze episode

Personal= N95+Air purifier+ stay indoors

5ai.	D [dual stream recycling = highly quality or recovered AND lower level of downstream contamination]
5aii.	D [prevention minimization recycling energy recovery disposal]
5aiii.	A [not taught]
5aiv.	A [IEM first step = identify system limits, geological boundaries, history of resource]
5av.	E [case study, dependent on notes]
5avi.	D
5avii.	D [Reference dose = lowest tested dose which observed adverse effect is noted]
5aviii.	C [please check!]

5 [PLEASE CHECK]***

5bi.



5bii.

Total flow = (10*+0.6+1)*10^6 = 11.6*10^6 m3/yr
CoPow efficiency= (50-10)*10^6
Nattygas efficiency = (1-0.6)*10^6
Semicon efficiency = (3-1)*10^6

5biii.

	Convert to litres		extraction cost in cents	
CoPow	50*10^6 *1000	50000000000	50000000000*0.02	1000000000
Nat gas	1*10^6 * 1000	1000000000	1000000000*0.02	20000000
Semicon	3*10^6* 1000	3000000000	3000000000*0.02	60000000

	Convert to litres		Pretreatment in cents	
CoPow	10*10^6 * 1000	10000000000	0	0
Nat gas	0.6*10^6 * 1000	600000000	600000000*6	3600000000
Semicon	1*10^6 * 1000	1000000000	0	0

	wastewater disposal in cents		total in cents	total in dollars
CoPow	10000000000*0.5	5000000000	6000000000	104800000
Nat gas	600000000*0.5	300000000	3920000000	
Semicon	1000000000*0.5	500000000	560000000	

5biv.

0.05cents/L → 0.15cents/L over 3 years
Let Y be percentage
0.15= 0.05* Y^5
Y=1.2457 → annual increase should be 24.57%