**EEE124 Tutorial Questions and answers GW**

**Q1**

*Which of the following statements best describes the global 'greenhouse effect'? Select one only.*

a. Heat generated inside the earth warms the atmosphere above.

b. Light from the sun is reflected by the earth, thus making the atmosphere hotter.

c. The sun warms the earth, so the earth gets hotter.

d. Light from the sun is absorbed by the earth and is then reradiated at a longer wavelength, which warms the atmosphere.

e. Radiant energy from the sun is absorbed by the atmosphere, thus making the atmosphere hotter.

D

**Q2**

*Which of the following arrangements is most suitable for a large 3-phase electrical generator? Select one only.*

a. Rotor: permanent magnets. Stator: electromagnets.

b. Rotor: permanent magnets. Stator: permanent magnets.

c. Rotor: electromagnets. Stator: permanent magnets.

d. Rotor: electromagnets. Stator: electromagnets.

e. Rotor: iron core. Stator: electromagnets.

d.

**Q3**

*Which of the follow statements best describes nuclear fission? Select one only.*

a. Daughter products join together to release high energy neutrons

b. A uranium atom captures a neutron and then decays to daughter products and high energy neutrons

c. Two hydrogen atoms join to produce high energy helium

d. Uranium burns in an oxygen furnace to release energy

e. High energy protons bombard uranium, which then release energy

b

**Q4**

*Which energy source is the odd one out from this list (select one only):*

a. Hydro

b. Natural gas

c. Geothermal

d. Nuclear fusion

e. Solar

b

**Q5**

*Which of the following statements best describes the global 'greenhouse effect'? Note: There is one 'best' answer (full marks) and a second 'ok' answer (half marks).*

a. Heat generated inside the earth warms the atmosphere above.

b. Light from the sun is reflected by the earth, thus making the atmosphere hotter.

c. Radiant energy from the sun is absorbed by the atmosphere, thus making the atmosphere hotter.

d. The sun warms the earth, so the earth gets hotter.

e. Light from the sun is absorbed by the earth and is then reradiated at a longer wavelength, which warms the atmosphere.

= Q1, but with graded answers e(100), b(50)

**Q6**

*Which of the following systems are subject to the second law of thermodynamics? Select all that apply.*

a. Internal combustion engine

b. Microwave oven

c. Coal-fire steam train

d. Nuclear power station

e. Photovoltaic solar cell

a, c, d

**Q7**

*Approximately what proportion of UK domestic energy is used to heat air? Answer one only.*

a. 5 %

b. 80 %

c. 60 %

d. 20 %

e. 40 %

c (see L7)

**Q8**

*Which of the following correctly describe the voltage induced in a wire coil rotating at constant angular velocity in a uniform magnetic field? Select all that apply.*

a. DC

b. Square wave

c. Constant voltage

d. Sine wave

e. AC

**(See L4S9) d e**

**Q9**

*Which of the following statements describes the global 'greenhouse effect'? Select all that apply.*

a. Light from the sun is reflected by the earth, thus making the atmosphere hotter.

b. The sun warms the earth, so the earth gets hotter.

c. Heat generated inside the earth warms the atmosphere above.

d. Radiant energy from the sun is absorbed by the atmosphere, thus making the atmosphere hotter.

e. Light from the sun is absorbed by the earth and is then reradiated at a longer wavelength, which warms the atmosphere.

**A E**

**Q10**

*Which of these electric motor types is the cheapest to manufacture? Select one only.*

a. series DC motor with field windings

b. induction motor

c. brushless AC motor

d. universal machine

e. shunt DC motor

(see L9S14) b

**Q11**

*Which of the following parameters would affect the energy efficiency rating of a domestic property? Select all that apply.*

a. Loft insulation

b. Draft proofing

c. Number of occupants

d. Wood-burning stove

e. Carbon monoxide sensor

**(see L10 S23) a b d**

**Q12**

*How many 40 W light bulbs could be powered for one day (24 h) by burning 1 litre of paraffin? (Energy density paraffin = 43 MJ/l). Show your working and assumptions made.*

$E_1$ = 40 W x 60 x60x24 = 3.456 MJ

Assume heat engine that burns paraffin has ~ 50% efficiency, hence electrical energy available = 43 x 0.5 = 21.5 MJ

Hence number of light bulbs = 21.5 / 3.456 = 6.2 = 6

**Q13**

*Discuss two methods by which the efficiency of a gas turbine be improved. (Two paragraphs max).*

**(see L4**

Use hot exhaust gas from gas turbine to generate steam to drive steam turbine

Use hot exhaust from Steam turbine for direct heating

**Q14**

*At the current production level, how long will global oil and gas reserves satisfy current demand?*

a. 20-40 years

b. 40-60 years

c. 60-100 years

d. 100-500 years

e. > 500 years

**(See L1 S21) b**

**Q15**

*Which of these factors are advantages of hydro-electricity generation? Select all that apply.*

a. Rapid response

b. Infinite resource

c. Can be easily modified to act as energy storage mechanism

d. Provides secondary heat source

e. Zero $CO_2$ emissions

a c e

**Q16**

*Which of the following statements best describes the global 'greenhouse effect'? Select one answer only. Note: some particularly wrong answers may invoke a negative mark of up to -50%. The question must be attempted.*

a. Heat generated inside the earth warms the atmosphere above.

b. Radiant energy from the sun is absorbed by the atmosphere, thus making the atmosphere hotter.

c. Light from the sun is reflected by the earth, thus making the atmosphere hotter.

d. The sun warms the earth, so the earth gets hotter.

e. Light from the sun is absorbed by the earth and is then reradiated at a longer wavelength, which warms the atmosphere.

**a (-50) b (0) c(+50) d (0) e (+100)**

**Q17**

*Which of the following strategies could be used to markedly reduce domestic energy consumption? Select all that apply. Note: some particularly wrong answers may invoke a negative mark of up to -50%. The question must be attempted.*

a. Install cavity wall insulation

b. Install extra radiators

c. Turn TV off at mains, when not in use

d. Move freezer into garage

e. Add air vents to all external doors

**a(+50) b (-25) c (0) d(+50) e (-25)**

**Q18**

*The input to a turbine is steam at 600 °C. The output steam is at 390 °C. What is the efficiency? Note: some particularly wrong answers may invoke a negative mark of up to -50%. The question must be attempted.*

a. 1.65

b. 0.65

c. 1.24

d. 0.75

e. 0.24

See L3 S4

Efficiency = $1 - (T_{out} / T_{in}) = 1-(390+273)/(600+273) = 0.24$ hence: e

(temperatures in Kelvin).

**Q19**

*Fill in the blank:*

'The SI unit of power is the _____Watt_____'

**Q20**

*Fill in the blank:*

'Photosynthesis requires light, carbon dioxide and _____water_____'

**Q21**

*Fill in the blank:*

'The working fluid in a coal-fired power station is ____high-pressure steam_____'

Not water!

**Q22**

*How much energy is released by the burning of 1 tonne of coal? (Heat value = 30 MJ/kg)*

Answer 30 x $10^6$ x 1000 = 3 x $10^{10}$

Units Joules

**Q23**

*What is the name given to the property that describes the flow of heat from warm to cold?*

Answer entropy

**Q24**

*Explain the reasons for the difference in the energy density between coal and natural gas (maximum one paragraph).*

*Natural gas – pure methane, 100% combustion, higher C-H bond content*

*Coal – hydrocarbons plus ash plus water < 100% combustion*

**Q25**

*Ignoring all losses, how much energy (kJ) is required to move 6 people from D-floor to F-floor in the Mappin Building lift? Show your working.*

Mass ~ 60 kg x 6

Height ~ 10 m

E = mgh = 6 x 60 x 9.8 x 10 = 35280 J = 35.28 kJ

Note: mass of actual lift ignored, since it has counterweights – take a look!

**Q26**

*How much energy is required to accelerate a car from rest to 100 km/h? Show your working.*

*M ~ 800 kg*

*V = 100 km/h = 100 x 1000 / (60 x 60) = 27.8 m/s*

*E = ½ $mv^2$ = 0.5 x 800 x $27.8^2$ = 0.3 MJ*

**Q27**

*Place the following items in order of increasing energy density (as a fuel for humans).*

*a. Beer*

*b. Butter*

*c. Bread*

*d. Sugar*

*e. Water*

e a c d b

Note: 100 % alcohol has high energy density, but beer is ~ 95% water.

**Q28**

*Why is it cheaper to heat your home using natural gas rather than electricity? (One paragraph max).*

Inefficiency of heat engines and distribution losses

**Q29**

*Describe the operation of a fridge (one paragraph max).*

**(see L9 S4)**

**Q30**

*The power emitted by a light bulb can be measured in watts by using a power meter. Why is this not an appropriate unit with which to compare different light bulbs? What unit is used instead? (one paragraph max).*

*Use lumens (L8 S 6)*

**Q31**

Briefly explain Faraday's law of induction.

(See L4 S8)

**Q32**

Part a) How much energy is needed to heat a swimming pool (25x10x2m) to 30 °C? State any assumptions you make. Assume $C_{water}$=4.2 kJ/litre°C.

Part b) Why will this amount of energy be insufficient to keep the pool warm all day?

V = 25x10x2 = 500 $m^3$ = 500 x $10^3$ litres

Assume $T_{input}$ = 10 °C

E = 5x$10^5$ x 4.2 x (30-10) = 42 MJ

Losses make this figure unrealistic.

**Q33**

Rubbish question. Ignore!