

# Engineering Questions by Topic

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Higher Level

Question 1

Section B

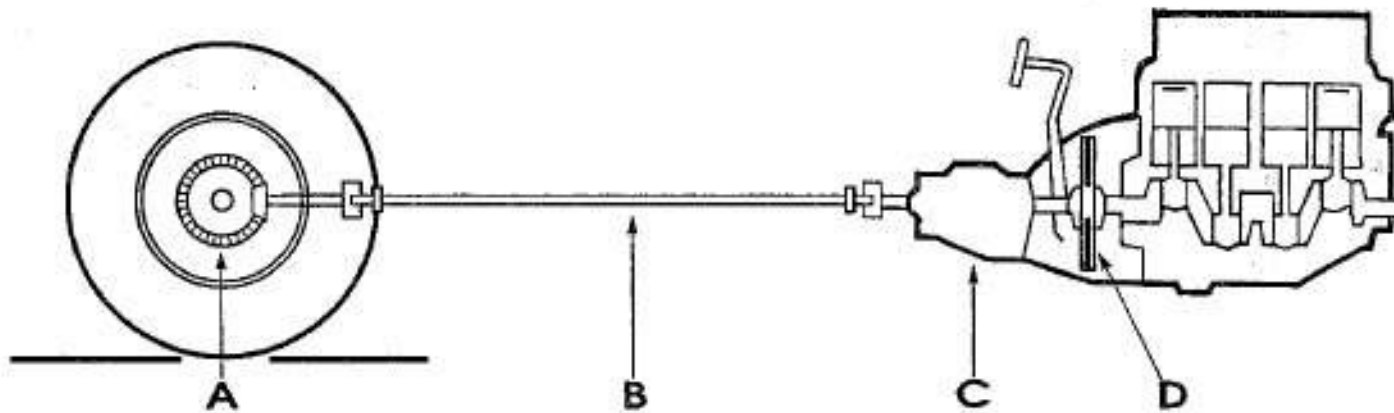
Special Topic

50 Marks

# 1996 Question 1 Section B

Answer all of the following:

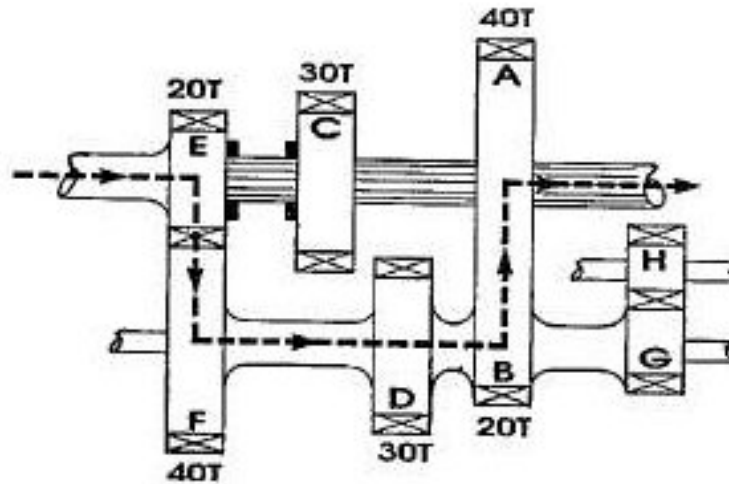
- (n) Identify and state the function of each of the components marked A, B, C and D.



- (o) Name two types of transmission system and explain the principle of any one of the types you have selected.
- (p) What is an overdrive transmission? State two advantages of this system.

# 1996 Question 1 Section B cont.

- (q) Explain the basic difference between a manual and an automatic transmission system.  
A first gear selection in a transmission system is shown. What is the first gear ratio and state its significance.

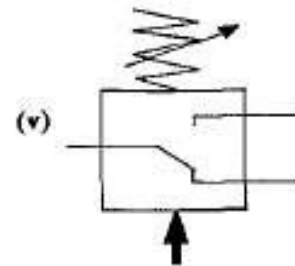
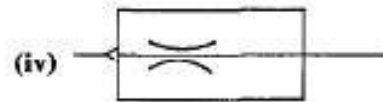
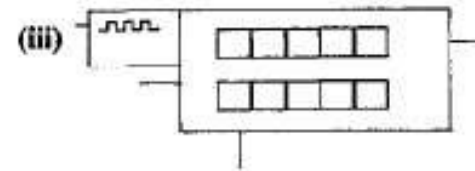
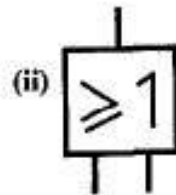
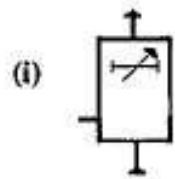


- (r) List three functions served by fitting a gearbox in a transmission system.

# 1997 Question 1 Section B

Answer all of the following:

- (n) Explain why time delays are vital in the safe operation of an automated pneumatic system?
- (o) Identify any three of the pneumatic symbols shown and state a specific function for each one.





# 1998 Question 1 Section B

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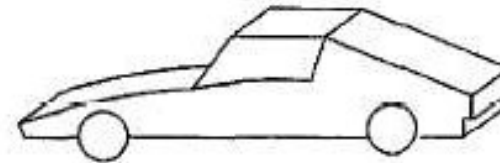
Answer all of the following:

(n) Compare the aerodynamic characteristics of the following design models:

(i)



(ii)



Briefly describe the function and operation of a wind tunnel.

(o) Select and compare any two of the following modelling categories:

(i) Sales models;

(ii) Test models;

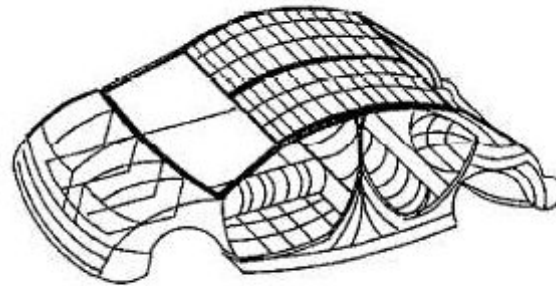
(iii) Layout models;

(iv) Aesthetic/Ergonomic models.

# 1998 Question 1 Section B cont.

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- (p) State two advantages of using 3D computer aided design in modelling as shown.



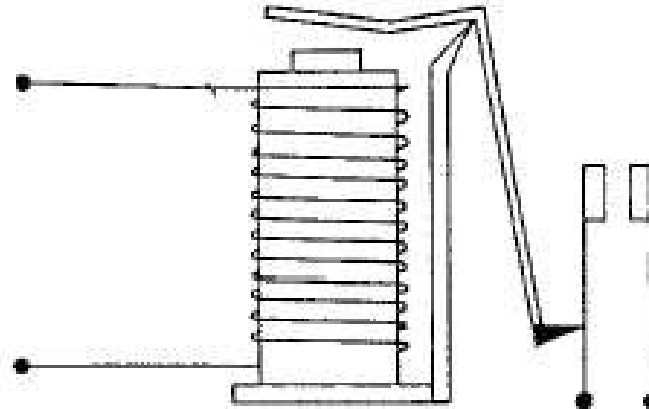
- (q) Distinguish between Qualitative and Quantitative types of test model.
- (r) Select any three terms below relating to the development and testing of prototypes and models and explain their meaning:
- (i) Development Hacks;
  - (ii) Ultraviolet ray exposure;
  - (iii) Endurance tests;
  - (iv) Deflection tests;
  - (v) Rolling road tests;
  - (vi) Simulated assembly;
  - (vii) Clay models or Balsa wood.

# 1999 Question 1 Section B

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Answer all of the following:

- (n) Describe the energy conversion that takes place in an electromagnet.
- (o) Using the electromagnetic relay shown, identify;
  - (i) the armature; (ii) the solenoid; (iii) the contactors.

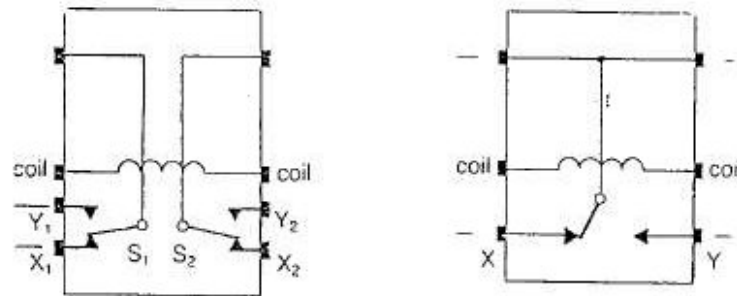


- (p) Distinguish between a normally open (NO) and a normally closed (NC) type of relay.

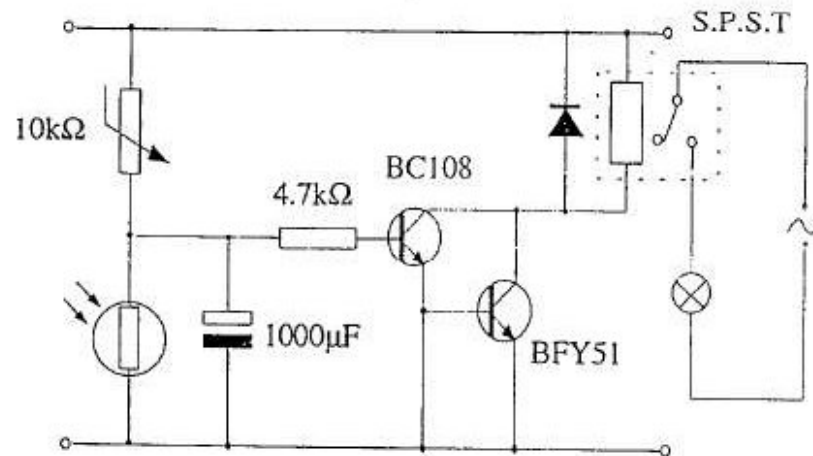


# 1999 Question 1 Section B cont.

- (q) Using the diagrams given below, distinguish between a double pole double throw (DPDT) and a single pole double throw (SPDT) relay.



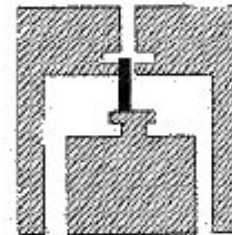
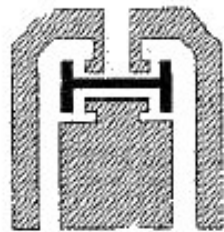
- (r) The circuit diagram shows a relay controlled mains lamp. Outline the operation of the circuit and describe the purpose of the diode positioned near the relay.



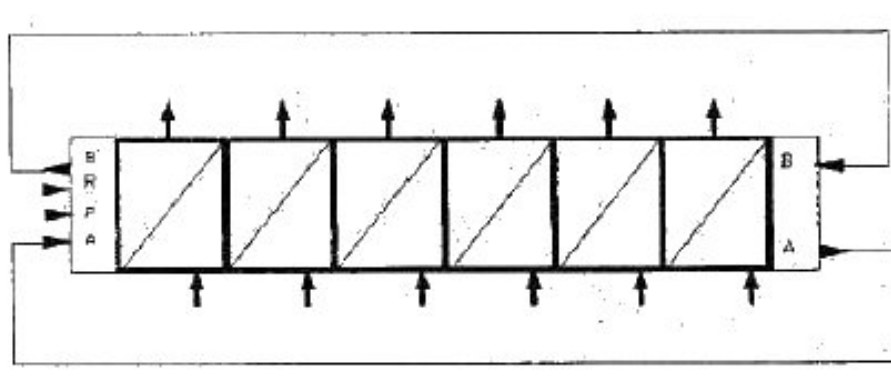
# 2000 Question 1 Section B

Answer **all** of the following:

- (n) Outline the advantages of using modular pneumatic sequencers.
- (o) Using the diagrams below, outline the operation of the “AND” logic block **and** the “OR” block.



- (p) Name the three main parts of the pneumatic sequencer shown below.

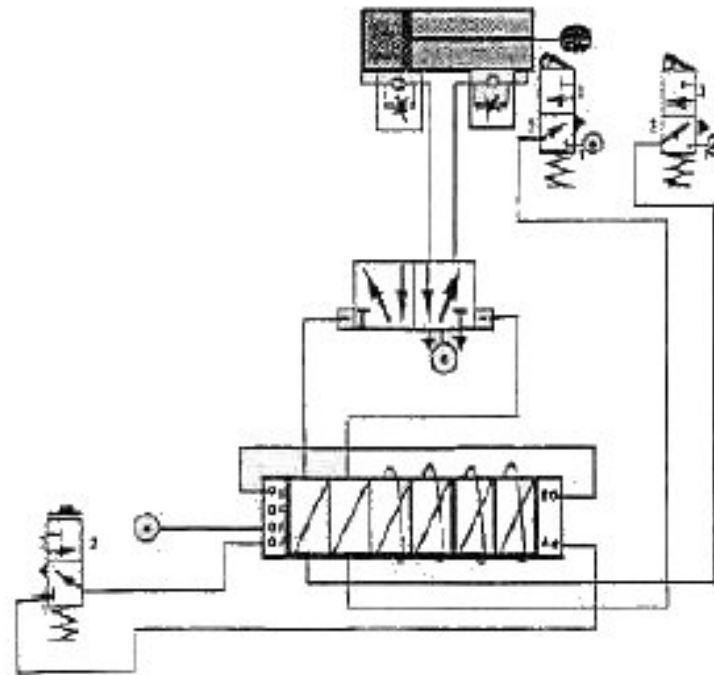


# 2000 Question 1 Section B cont.

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(q) Describe the operation of the simplified circuit shown.

(r) Using the same circuit, identify the input, control and output stages of the circuit.

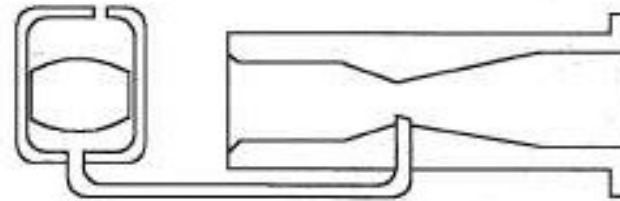


# 2001 Question 1 Section B

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Answer **all** of the following.

- (n) (i) Outline the principle of carburation using the sketch opposite.
- (ii) Describe **two** main functions of the carburettor?

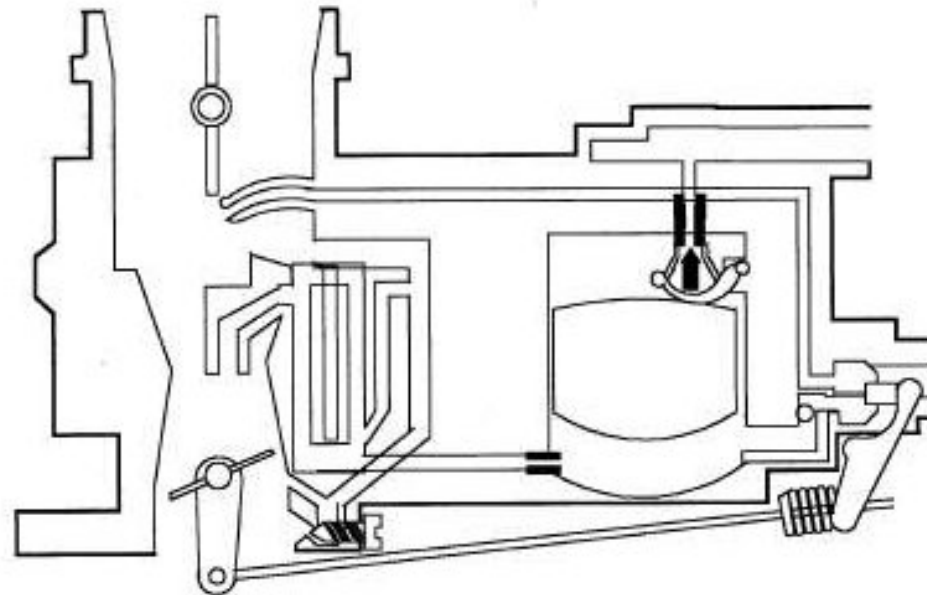


- (o) (i) Explain the difference between Down Draught and Side Draught carburettors.
- (ii) Describe **one** design consideration governing the use of a Side Draught carburettor.
- (p) What is meant by the term mixture strength and why is it necessary to provide a variety of strengths.
- (q) Describe the operation and function of the float chamber in the diagram given below.

# 2001 Question 1 Section B cont.

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- (r) Utilising the given diagram describe the purpose of any three of the following.
- (i) Throttle lever;
  - (ii) Throttle butterfly;
  - (iii) The choke control lever;
  - (iv) Venturi;
  - (v) Emulsifying tube;
  - (vi) Idling adjustment screw.

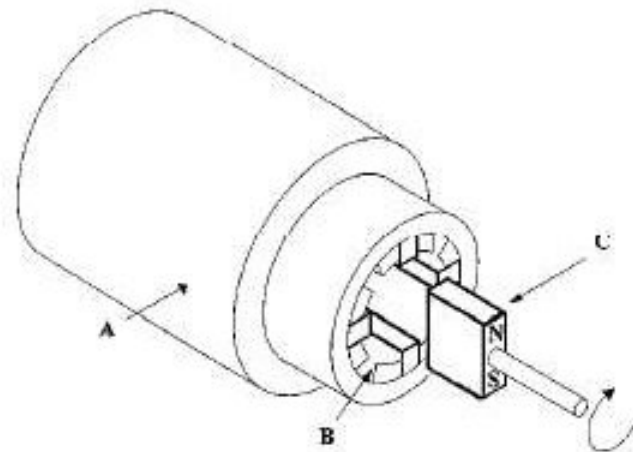


# 2002 Question 1 Section B

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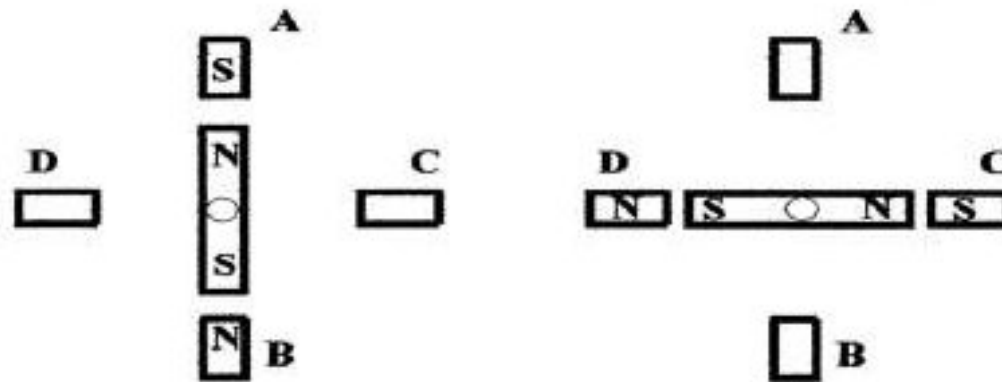
Answer all of the following:

- (n) (i) What characteristics of magnets make them suitable to the operation of a stepper motor.
- (ii) Explain electromagnetism as it applies to the operation of a stepper motor in terms of current flow and polarity of magnets.
- (o) Identify the components A, B and C shown below.



# 2002 Question 1 Section B cont.

- (p) Utilising the given diagrams describe how ninety degrees of movement is achieved.

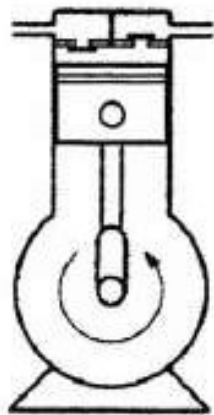


- (q) (i) What is meant by holding torque?  
(ii) What is the relationship between stator coils and rotor segments?
- (r) (i) Name two types of stepper motor.  
(ii) List three advantages and three disadvantages in the use of stepper motors.

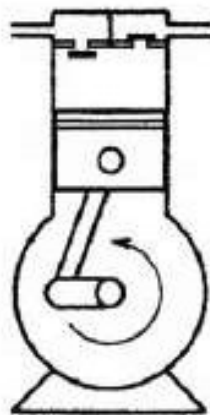
# 2003 Question 1 Section B

Answer all of the following:

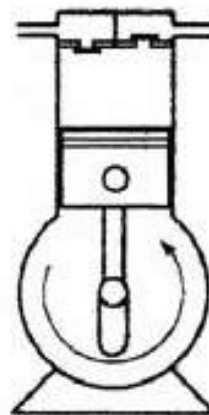
- (n) Outline the function of a compressor in a refrigeration system.
- (o) Name three types of compressors commonly used in refrigeration.
- (p) (i) Identify the compressor system shown in the diagrams below.  
(ii) Utilising the diagrams, describe the principle of operation of this compressor system.



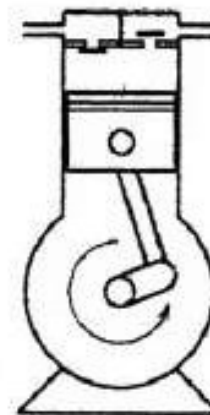
(a)



(b)



(c)



(d)





# 2003 Question 1 Section B cont.

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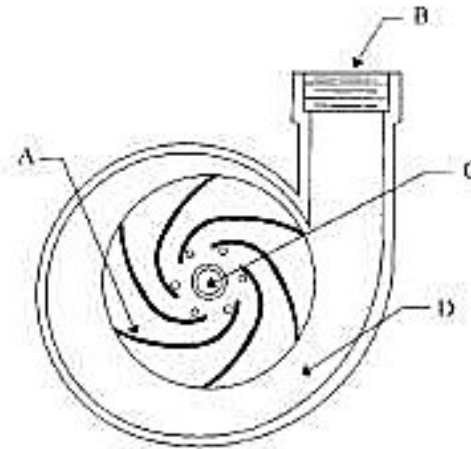
- (q) Explain the meaning of non-positive displacement in a compressor system.
- (r) With reference to compression cycle refrigerators:
  - (i) Name two parts located in the low pressure side.
  - (ii) Name two parts located in the high pressure side.

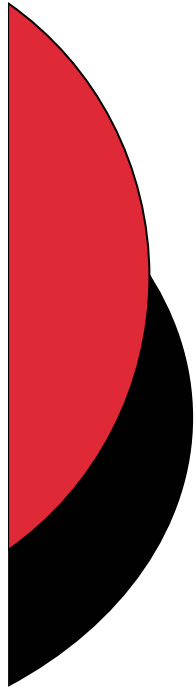
# 2004 Question 1 Section B

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Answer all of the following:

- (n) Outline the principle of operation of a centrifugal pump.
  
- (o) With reference to the diagram shown below:
  - (i) Name the components A, B, C and D.
  - (ii) Describe the function of **any two** components named.





## 2004 Question 1 Section B cont.

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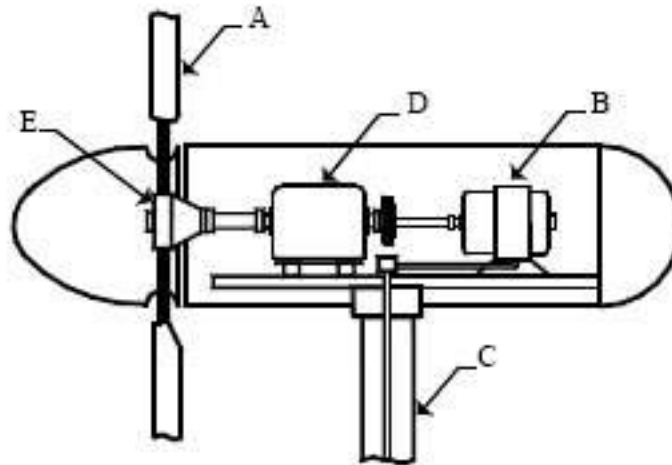
- (p) Describe the energy conversion that occurs during the operation of a centrifugal pump.
  
- (q) Differentiate between any two of the following:
  - (i) Radial flow and axial flow;
  - (ii) Single suction and double suction;
  - (iii) Open impeller and closed impeller;
  - (iv) Volute casing and circular casing.
  
- (r)
  - (i) State two advantages of using centrifugal pumps.
  - (ii) Give two suitable applications for centrifugal pumps.

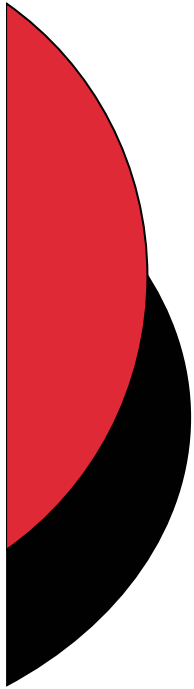
# 2005 Question 1 Section B

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Answer **all** of the following:

- (n) Describe the principle of operation of an aero-generator.
- (o) With reference to the diagram shown below:
  - (i) Name the components A, B, C, D and E;
  - (ii) Describe the function of any **three** components named.





# 2005 Question 1 Section B cont.

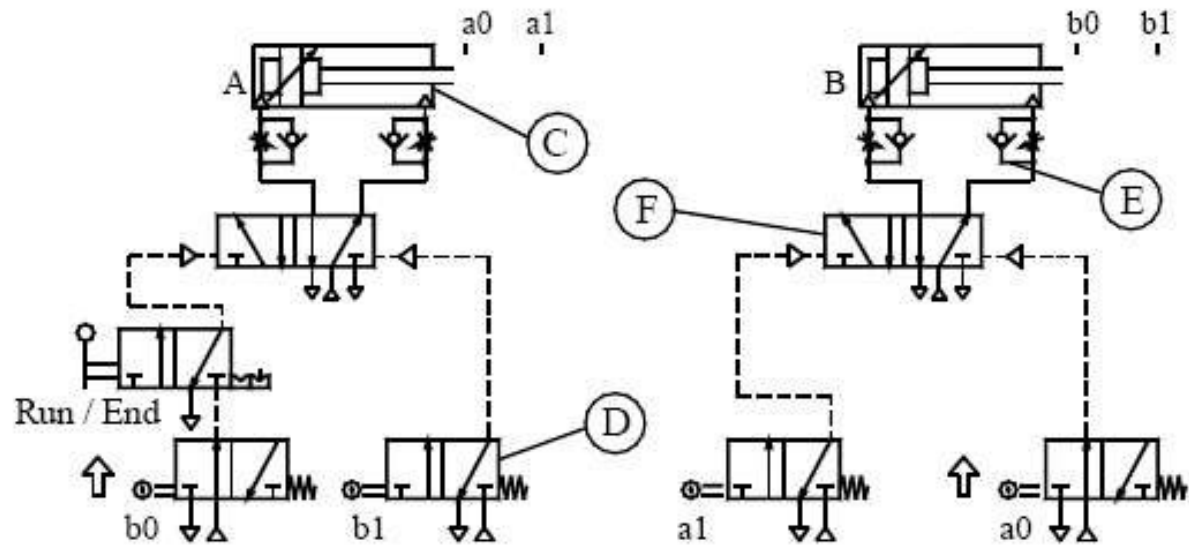
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- (p) Answer **any two** of the following:
- (i) Explain **one** method employed to ensure the safety of an aero-generator in extreme weather conditions;
  - (ii) Distinguish between pitch controlled and stall controlled wind turbines;
  - (iii) What is the function of the nacelle in an aero-generator ?
- (q) (i) State **one** appropriate reason for installing large wind turbines.
- (ii) List **two** advantages of wind-generated electricity.
- (r) Define **any two** of the following terms:
- (i) Stall;
  - (ii) Lift;
  - (iii) Wind farm;
  - (iv) Anemometer.

# 2006 Question 1 Section B

Answer all of the following:

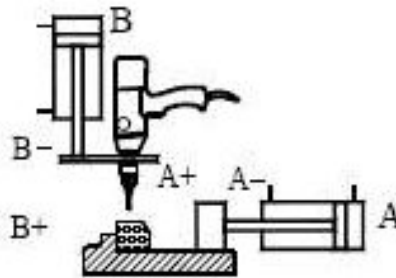
- (n) Outline **three** advantages of using pneumatic sequential control in industry.
- (o) With reference to the pneumatic sequential control circuit shown:
  - (i) Name the components C, D, E and F;
  - (ii) Describe the function of **any two** components named.



# 2006 Question 1 Section B cont.

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- (p) With reference to pneumatic sequential control describe **any two** of the following:
- (i) Cascade circuit,      (ii) PLC,      (iii) FRL.
- (q) (i) State **two** industrial applications where pneumatic sequential control is used.
- (ii) What are the benefits of using compressed air systems in industry?
- (r) Utilising the diagram shown below, describe the sequence of operations which will ensure that the component is drilled safely.



# 2007 Question 1 Section B

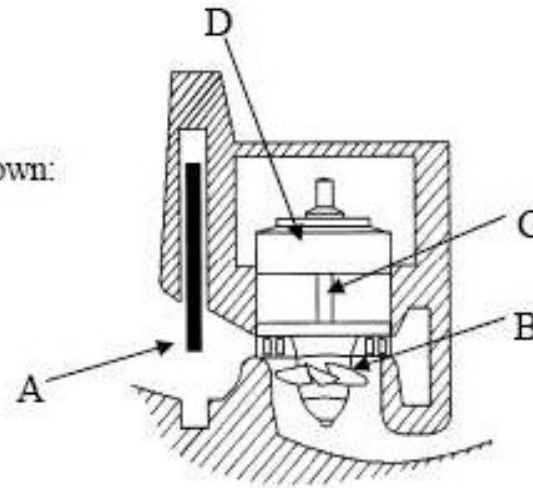
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Answer **all** of the following:

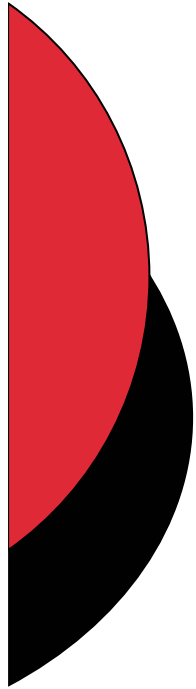
- (n) *Solar power may be used to generate electricity through photovoltaic (solar) cells or by thermal electric generators, which produce steam to drive turbines.*

Identify **three** other energy sources, used in the generation of electricity, that may drive a turbine-based system.

- (o) With reference to the diagram of the turbine shown:
- Name the turbine;
  - Describe the principle of operation;
  - Identify any **three** of the components labelled A, B, C and D.







## 2007 Question 1 Section B cont.

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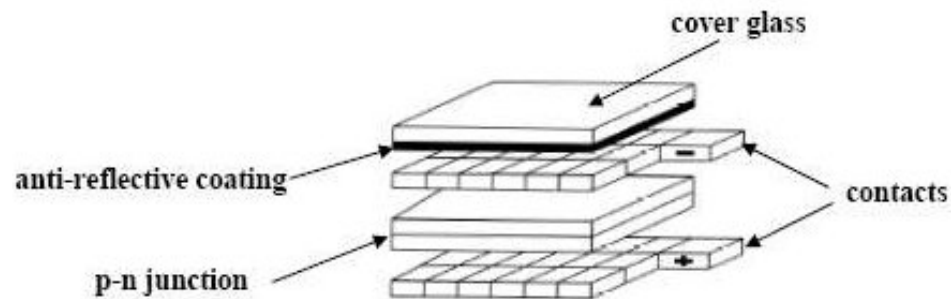
- (p) Describe, with the aid of suitable diagrams, the essential differences between *Impulse* turbines and *Reaction* turbines.
- (q) (i) Distinguish between *pitch control* and *stall control* to avoid damage to a wind turbine.  
(ii) Explain “rated wind speed”.
- (r) Explain any two of the following:
- (i) The use of idlers in a multi-level steam turbine;
  - (ii) The main features of a Pelton turbine;
  - (iii) The environmental impact of using renewable sources of energy for electricity generation.

# 2008 Question 1 Section B

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Answer all of the following:

- (n) Identify any **three** applications where the photovoltaic cell is commonly used.
- (o) (i) Distinguish between an electrical *conductor* and an electrical *semiconductor*.  
  
(ii) Explain the advantages of using photovoltaic systems in developing economies.
- (p) The basic structure of a photovoltaic cell is illustrated below:



- (i) Describe the process of current flow at the junction of the P-type and N-type silicon layers.
- (ii) Explain the function of the anti-reflective coating.



# 2008 Question 1 Section B cont.

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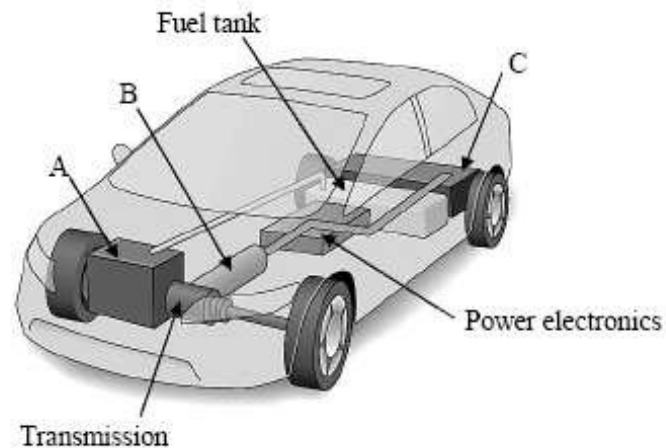
- (q) Outline **any two** reasons for the necessity of using supplemental fuels, such as oil or gas, with solar generating stations.
- (r) Explain **any two** of the following:
- (i) The environmental impact of using solar cells;
  - (ii) Photovoltaic module;
  - (iii) The difference between *on-grid* and *off-grid* use of solar power.

# 2009 Question 1 Section B

Answer all of the following:

An increased awareness of both sustainable design and social responsibility has encouraged car manufacturers to develop the more environmentally friendly hybrid vehicle.

(n) A hybrid vehicle is illustrated in the diagram below:



- (i) Identify the parts labelled A, B and C.
- (ii) Describe the principle of operation of this hybrid vehicle.
- (o) Identify **three** common power sources that may be used to power a hybrid vehicle.



# 2009 Question 1 Section B cont.

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- (p) Describe, in detail, **any three** environmental consequences associated with the use of hybrid vehicles.
- (q) Explain how the running costs of a hybrid vehicle are reduced by the following design elements in hybrid vehicle technology:
  - (i) regenerative braking;
  - (ii) battery capacity;
  - (iii) fuel-engine shut down.
- (r) Describe **any two** of the following:
  - (i) PHEV;
  - (ii) the incentives to consumers to encourage the use of hybrid vehicle technology;
  - (iii) the difference between *series* hybrid vehicles and *parallel* hybrid vehicles.

# 2010 Question 1 Section B

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Answer all of the following:

- (n) Outline the benefits for using accelerometer technology in each of the following applications:

- (i) mobile phone;
- (ii) car safety.



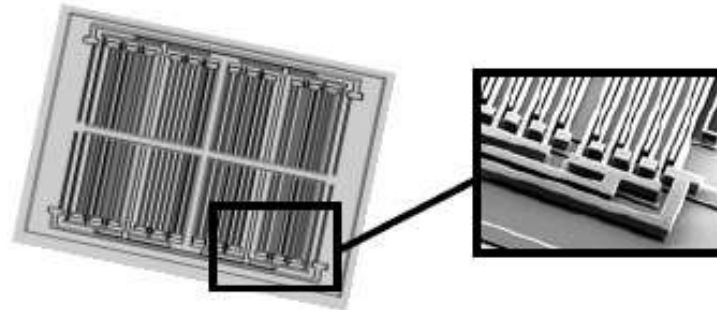
- (o) Explain, with the aid of suitable diagrams, any three of the following types of movement used in an accelerometer:

- (i) Acceleration;
- (ii) Vibration;
- (iii) Shock;
- (iv) Tilt;
- (v) Rotation.

# 2010 Question 1 Section B cont.

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- (p) A micro electro-mechanical systems (MEMS) accelerometer is illustrated in the diagram below. Describe the principle of operation of this type of accelerometer.



- (q) Explain any two of the following:
- The factors to be considered when selecting an accelerometer for use in protecting a laptop computer;
  - Piezoelectric accelerometer;
  - How the distribution of hot gas may be used as a sensing element in an accelerometer.
- (r) The accelerometer will measure both static and dynamic forces on items such as the computer game controller shown. Distinguish clearly between *static* and *dynamic* forces.





# 2011 Question 1 Section B

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Answer all of the following:

- (n) The iconic design of the Spittelau incineration plant in Vienna as shown, is widely regarded as being both innovative and visually interesting.

The following are some of the pollution concerns that need to be addressed in relation to incineration technology:

- (i) Volume of waste for landfill;
- (ii) Hazard of 'fly' ash;
- (iii) Impact on recycling rates.



Briefly describe each of these pollution concerns.

- (o) Dioxins are a group of 200 or so chlorinated organic compounds and are a by-product of incineration and backyard burning of domestic waste.
- (i) Outline two ways that dioxins may affect the health of residents who live close to incineration plants.
  - (ii) Explain how the production of dioxins can be minimised.

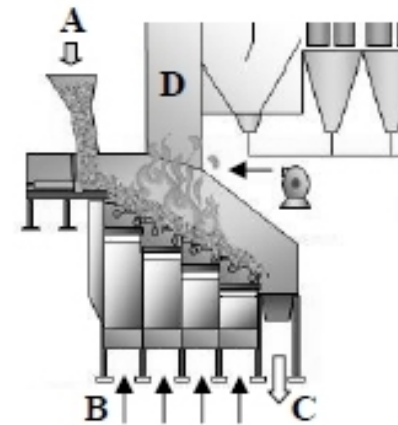


# 2011 Question 1 Section B cont.

- (p) Waste incineration technology uses the combustion process under controlled conditions to convert waste materials to inert gases and ash. Describe any **three** of the combustion elements outlined below:

- Temperature
- Fuel
- Time
- Oxygen.

- (q) Describe the principles of operation of the moving grate incinerator, as shown in the diagram. Make reference to waste input and the processing of incinerator products.



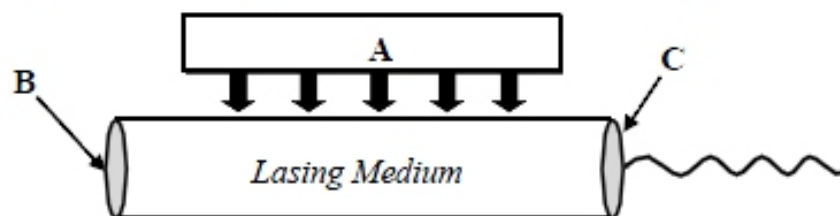
- (r) Explain any **two** of the following:
- (i) The benefits of waste-to-energy (WtE/W2E) technologies;
  - (ii) Some of the issues involved when locating incinerator plants;
  - (iii) Incineration by the *rotary kiln* method.

# 2012 Question 1 Section B

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Answer **all** of the following:

- (n) Laser (*Light Amplification by Stimulated Emission of Radiation*) technologies are commonplace in modern society. Outline **one** specific example where laser technology is used in **each** of the following:
- Entertainment;
  - Industry.
- (o) The principle of a simple laser is illustrated in the diagram below.



- Name parts A, B and C.
- Describe the principle of operation of this laser.
- List **any two** sources of energy for this laser.



# 2012 Question 1 Section B cont.

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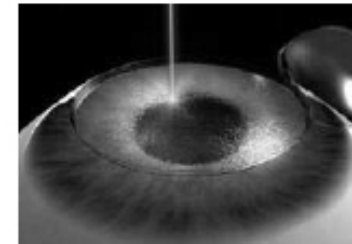
- (p) Laser light is different from normal light and has the following properties, it is:
- Monochromatic
  - Coherent
  - Directional.

Explain any two of these properties.

- (q) *Lasik* is a laser technology used in correcting a range of sight problems by altering the shape of the eye, as shown.

(i) Describe two properties that make laser technology suitable for this application.

(ii) Discuss the advantages of using laser technology for medical purposes.



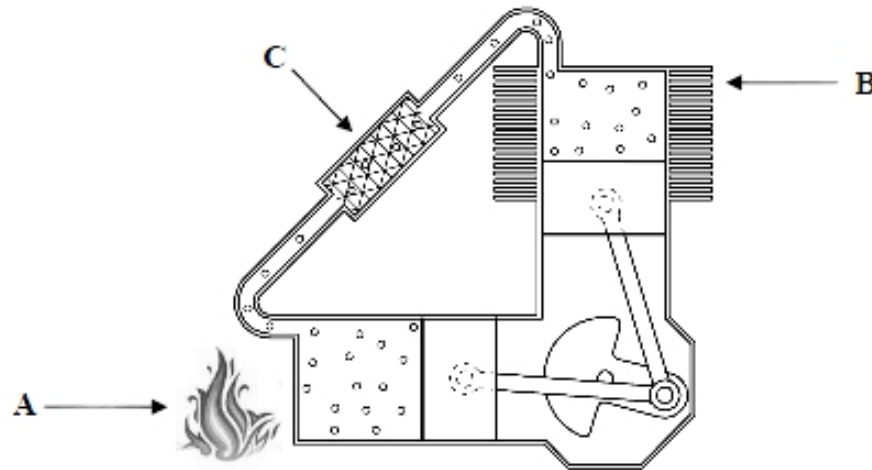
- (r) Explain any two of the following:
- The applications of *laser vaporisation cutting* and *laser fusion cutting*;
  - The safety hazards associated with industrial Class IV laser technology;
  - Photon.

# 2013 Question 1 Section B

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Answer all of the following:

- (n) A key element of the Stirling engine is an effective heat source.  
Identify **three** heat sources that can be used to run a Stirling engine.
  
- (o) A simplified Stirling engine is shown.
  - (i) Identify the zones A, B and C.
  - (ii) Describe the principle of operation of this engine.



# 2013 Question 1 Section B cont.

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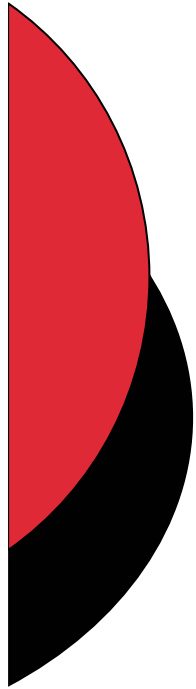
- (p) Outline the main advantages and disadvantages of the Stirling engine with reference to:
- engine efficiency
  - range of applications.

- (q) A miniature Stirling engine can be used in the electronic circuit of a computer.

Explain the function of the Stirling engine in this application.



- (r) Describe any two of the following:
- Beta Stirling engine;
  - One reason for using an internal combustion engine rather than a Stirling engine in motor car design;
  - The role of the *displacer* in a Stirling engine.



# Topic Summary

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Year	Topic
1996	Transmission Systems
1997	Pneumatics
1998	Prototype Design
1999	Electromagnetic Switches
2000	Pneumatics
2001	Carburettor
2002	Stepper Motor
2003	Compressor
2004	Centrifugal Pump
2005	Wind Generator
2006	Pneumatics
2007	Turbines
2008	Photovoltaic Cell
2009	Hybrid Engine
2010	Accelerometer
2011	Incineration
2012	Lasers
2013	Stirling Engines