Engineering Questions by Topic

Higher Level

Question 7

Cutting of Materials

50 Marks

1996 Question 7

(a) State **three** factors which affect the amount of heat generated during a cutting operation.

(b) (i) Explain the basic metal cutting theory of chip formation.

(ii) What conditions influence the formation of a continuous chip?

1996 Question 7 cont.

(c) Answer any **two** of the following:

(i) With the aid of diagrams, differentiate between gang and straddle milling;

(ii) Explain the principle of the quick return mechanism of the shaping machine;

(iii) In relation to the grinding wheel specification shown, explain any three codes

39 C 60 J 5 V

OR

(i) In relation to a CNC machine, list **three** safety features incorporated in its design.

(ii) Explain what is represented by the lines 200, 210 and 220 in the part CNC program shown in the table.

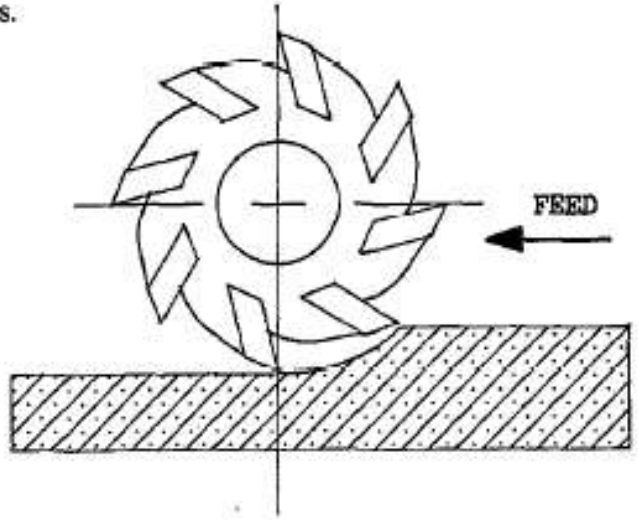
N	G	M	X	Z	I	K	S
200	00	05	30	10			
210		06			11		
220	00	04	22	−11.6			2500

1997 Question 7

(a) List the positive effects of using cutting fluids.

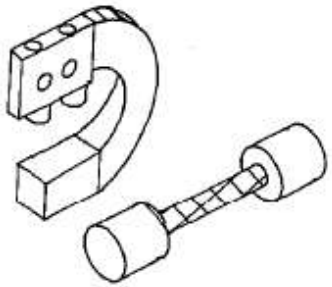
Define the terms: (i) Rancidity; (ii) Irritant.

(b) Compare Upcut and Downcut milling.
Identify the example shown.



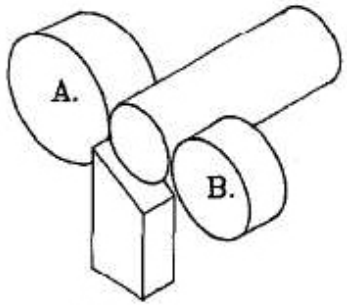
1997 Question 7 cont.

(c) Answer any **two** of the following:



(i) What are the functions of the two gauges shown and briefly compare direct and comparative measurement.

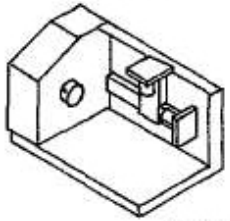
(ii) Explain the surface symbol shown.



(iii) Identify and briefly describe the grinding process shown. Name parts A and B.

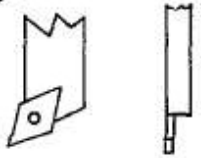
OR

(c) With reference to CNC machining, answer **each** of the following:



(i) Explain the function of a stepper motor;

(ii) Distinguish between an M99 and a G91 code;



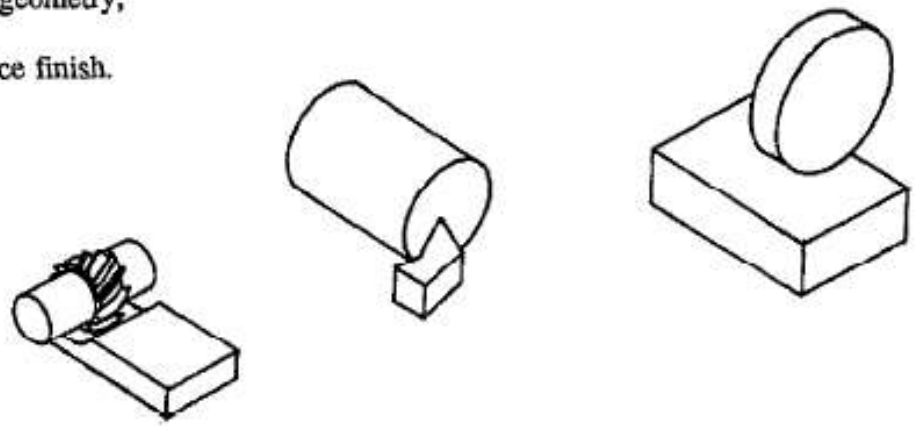
(iii) Identify the two tools shown and discuss the advantages of carbide inserts.

1998 Question 7

(a) Flat surface machining may be carried out by any one of the methods shown. Compare <u>any two</u> using the following headings;

(i) Tool geometry;

(ii) Surface finish.

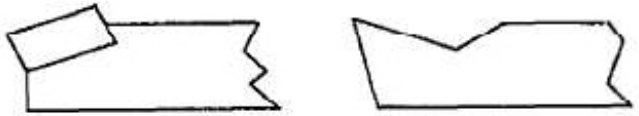


1998 Question 7 cont.

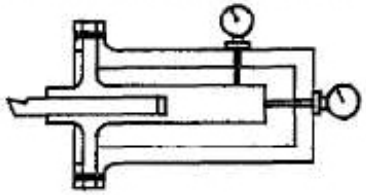
(b) Answer **any two** of the following:

(i) Describe **one function** for each gauge shown:

(ii) Compare the effects of negative rake tool geometry with positive rake angles, as shown, when cutting;



(iii) Explain the function and operation of the simplified Dynamometer shown.



1998 Question 7 cont.

(c) Distinguish clearly between forming and generating.

OR

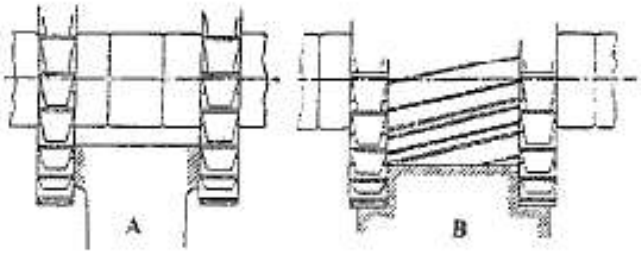
(c) Compare conventional machining with computer numerical controlled machining.

1999 Question 7

(a) Describe the positive effects of using cutting fluids on metal cutting operations.

(b) Answer **any two** of the following:

(i) Distinguish between the two milling operations shown at A and B;

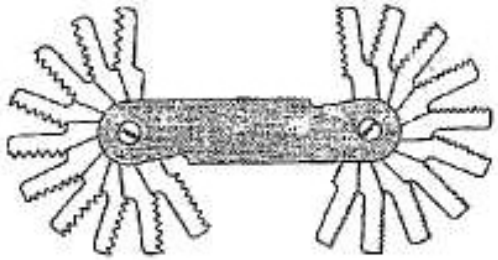


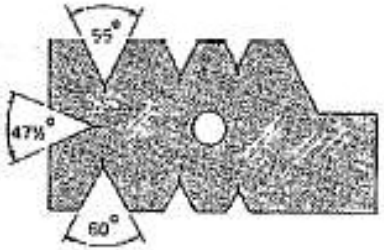
(ii) Outline a use for the lathe accessory shown.

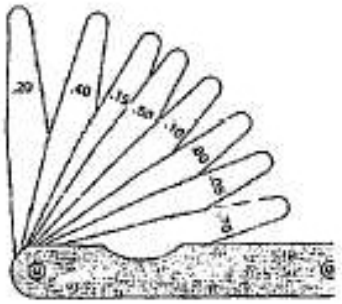
(iii) Explain the terms *loading* and *glazing* of a grinding wheel.

1999 Question 7 cont.

(c) Select **any two** gauges shown and describe their use.







OR

(c) With reference to a CNC lathe, explain **any three** of the following terms:

(i) Canned cycle;

(ii) Stepper motor;

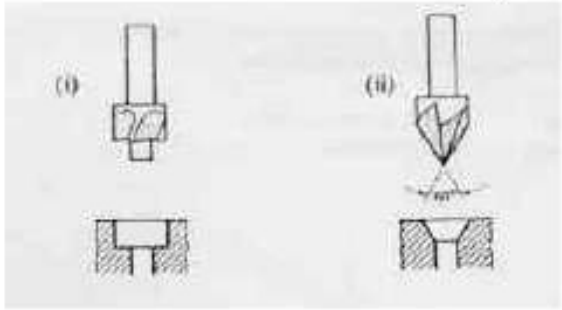
(iii) X-axis;

(iv) Z-axis;

(v) G codes.

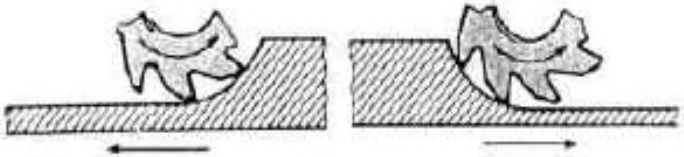
2000 Question 7

(a) Distinguish between the drilling operations shown at (i) and (ii) and outline an application for **each**.

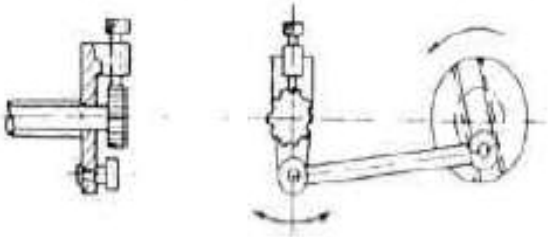


(b) Answer **any two** of the following:

(i) Compare the milling operations shown opposite;



(ii) Identify and briefly explain the operation of the feed mechanism shown opposite;



(iii) Compare gauging with direct measurement;

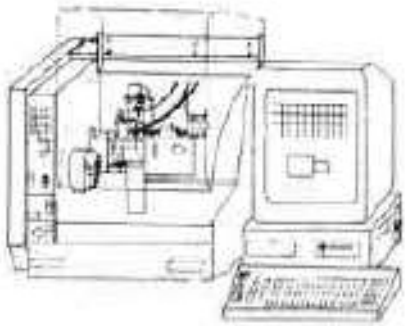
(iv) Name **three** types of cutting chip formed in machining.

2000 Question 7 cont.

(c) Explain how surfaces are machined by (i) forming and (ii) generating.

OR

(c) With reference to CNC machine shown, answer **three** of the following:



(i) Outline any **five** safety precautions incorporated in a CNC lathe;

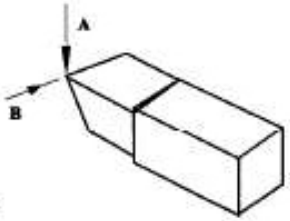
(ii) Explain, with the aid of a diagram, the difference between incremental dimensioning and absolute dimensioning;

(iii) What is the meaning of simulation in CNC machining?

(iv) How is the position of the cutting tool determined in CNC machining?

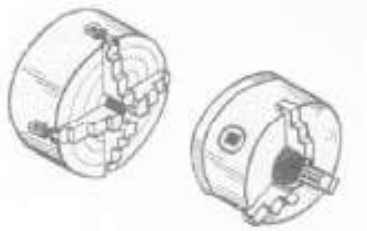
2001 Question 7

(a) Answer **any three** of the following.



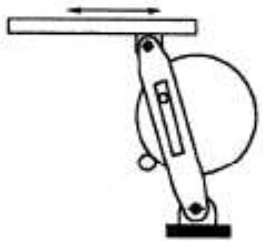
(i) Identify the forces A and B acting on the cutting tool shown.
(ii) Distinguish between Orthogonal and Oblique cutting forces.
(iii) Describe an instrument for measuring cutting forces.
(iv) Suggest how altering the rake angle would affect the shear plane angle.

(b) Answer **any two** of the following.



(i) Distinguish between the two chucks shown and describe their applications.

(ii) Name and outline the principles of operation of the grinding process shown.



(iii) Describe the principles of operation of the quick-return mechanism shown.

2001 Question 7 cont.

(c) With reference to metrology, explain **any four** of the following terms.

(i) Optical Projector;
(ii) Sine Bar;
(iii) Slip Gauges;
(iv) Precision Balls;
(v) Comparator.

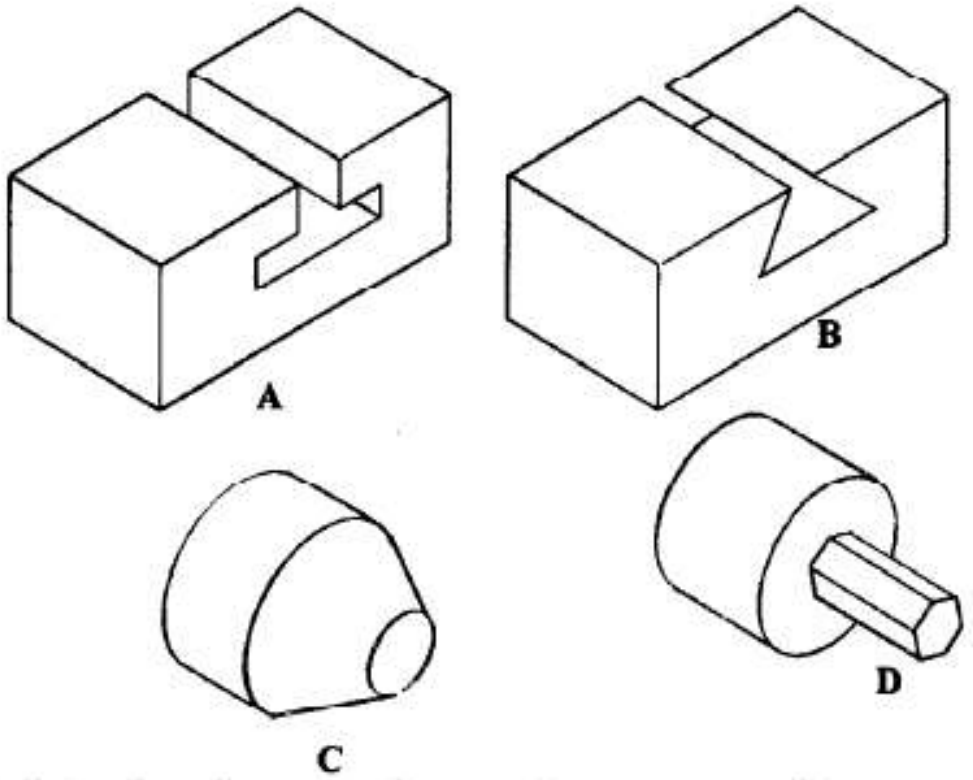
OR

(c) With reference to CNC lathework, indicate the code used for **any four** of the following functions.

(i) Tool change;
(ii) Absolute dimensions;
(iii) Spindle start/reverse;
(iv) Continuation code;
(v) Linear interpolation.

2002 Question 7

(a) Outline a suitable machining process for **each** of the following sections:



2002 Question 7 cont.

(b) Answer **any three** of the following:

(i) With reference to grinding distinguish between loading and glazing;
(ii) Outline the difference between generating and forming;
(iii) Describe the types of material that result in a continuous and discontinuous chip being formed;
(iv) Explain the terms gang milling and straddle milling;
(v) What are the essential differences between direct and comparative measurements?

(c) Outline the effects of altering the rake angle on the shear plane.

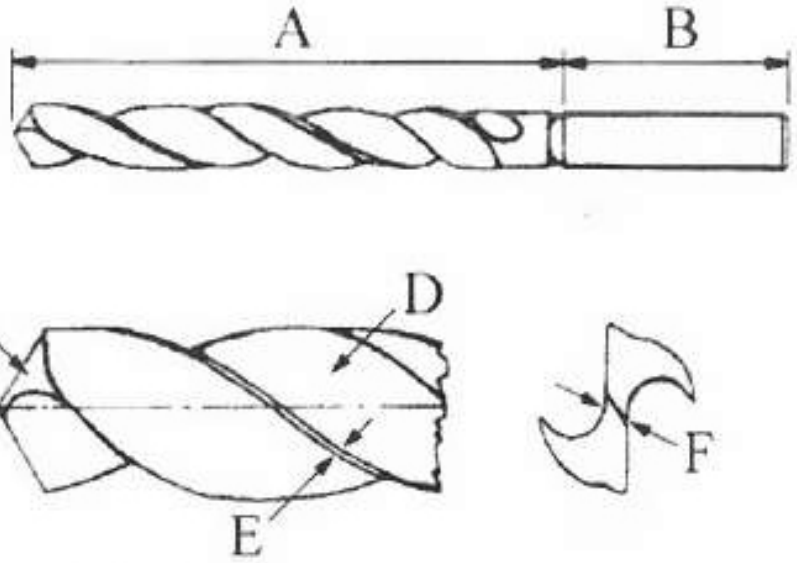
OR

(c) Explain each line in the part CNC program shown in the table.

N	G	M	X	Z	I	K	F	S
200	00		15	1				
210	01			-20			75	
220	01		25	-25			75	
230	00	05	30	10				
240		02						

2003 Question 7

(a) With reference to the drill shown below, describe **any three** of the parts A, B, C, D, E and F.



(b) Answer **any three** of the following:

(i) Outline the benefits of using cutting fluids when machining;
(ii) Describe the purpose of a sine bar;
(iii) Suggest **two** different ways of mounting cutters on a milling machine;
(iv) Describe **one** use of the dividing head.

2003 Question 7 cont.

(c) Compare **three** different types of machine tool for machining flat surfaces using the following guidelines:

(i) Names;
(ii) Methods of operation;
(iii) Applications.

OR

(c) With reference to CNC machining, describe the meaning of **any three** of the following terms:

(i) Linear interpolation;
(ii) Canned cycle;
(iii) Rapid traverse;
(iv) Continuation code;
(v) Stepper motor.

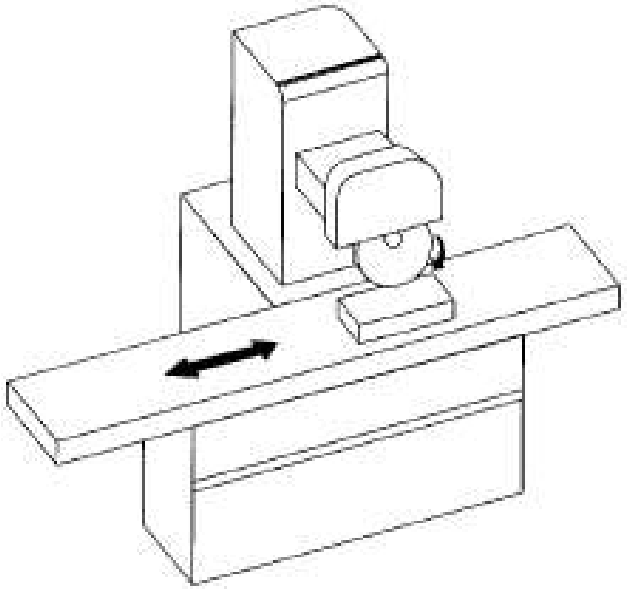
2004 Question 7

(a) With reference to the diagram shown below:

(i) Name and describe the machining process;

(ii) Explain a method of workholding;

(iii) Give **one** suitable application.



2004 Question 7 cont.

(b) Answer **any three** of the following:

(i) Outline the difference between drilling and reaming;

(ii) Distinguish between a clearance fit and an interference fit;

(iii) Describe the purpose of a plug gauge;

(iv) Name **three** types of chip formed in metal cutting.

(c) Describe, with the aid of a suitable diagram, the main features of peripheral milling **or** face milling.

OR

(c) With reference to CNC machining, describe the meaning of **any three** of the following:

(i) Incremental dimensioning;

(ii) Time dwell;

(iii) Canned cycle;

(iv) CAM.

2005 Question 7

(a) Answer **any three** of the following:

(i) Distinguish between countersinking and counterboring when drilling;

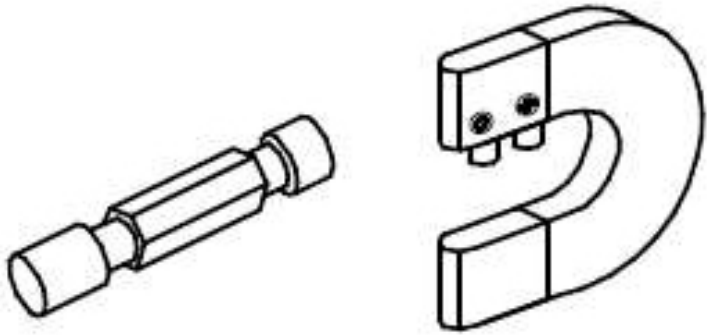
(ii) Identify **two** safety hazards associated with the use of cutting fluids;

(iii) State **two** factors which influence the surface finish during parallel turning;

(iv) Explain the function of the bond in a grinding wheel;

(v) Differentiate between orthogonal cutting and oblique cutting.

(b) **(i)** Name and state the function of **one** of the gauges shown below.



(ii) Identify **two** reasons why precise measurements could be inaccurately taken.

2005 Question 7 cont.

(c) Outline the difference between the items in **any one** of the following:

(i) Up-cut and down-cut milling;

(ii) Peripheral milling and face milling.

OR

(c) With reference to CNC machining answer **any two** of the following:

(i) State **two** safety features incorporated in a CNC lathe;

(ii) Distinguish between a G-code and an M-code;

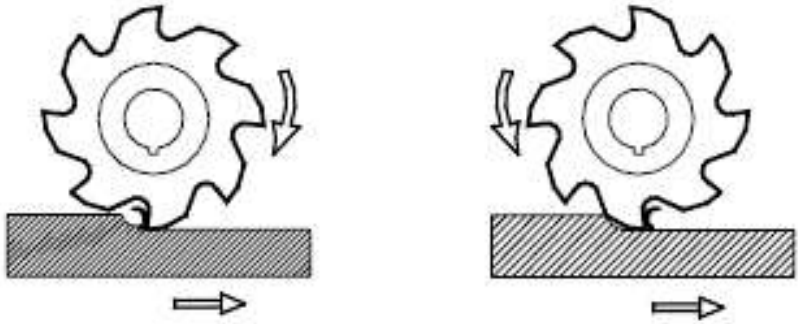
(iii) Compare conventional machining with computer numerical control machining.

2006 Question 7

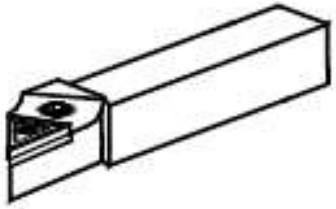
(a) Answer **any two** of the following:

(i) Identify **three** machining processes used to produce a cylindrical surface;

(ii) Differentiate between the milling operations shown below;



(iii) State **three** advantages of using the cutting tool shown below in a turning operation.



2006 Question 7 cont.

(b) Distinguish clearly between **any three** of the following:

(i) Loading and glazing;

(ii) Feeler gauge and drill gauge;

(iii) Rake angle and clearance angle;

(iv) Gang milling and straddle milling.

(c) Identify **two** safety hazards associated with **each** of the following:

(i) Using cutting fluids;

(ii) Machining mild steel.

OR

(c) With reference to CNC machining answer **any two** of the following:

(i) Differentiate between incremental and absolute dimensioning;

(ii) Explain the operation of a stepper motor;

(iii) State **one** advantage of using a canned cycle when programming for machining.

2007 Question 7

(a) Answer **any three** of the following:

(i) Identify **three** safety features that should be incorporated into a centre lathe;

(ii) List **three** reasons for using a cutting fluid when machining;

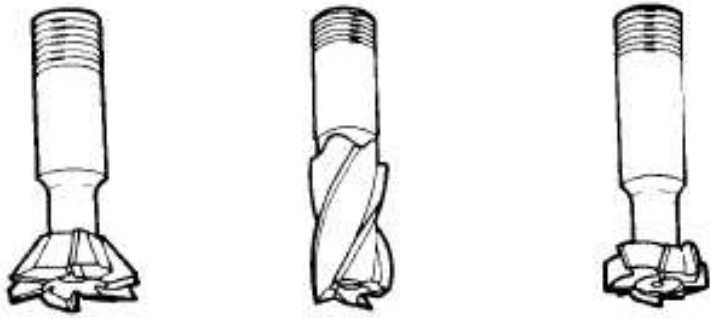
(iii) Explain, with reference to metrology, the use of slip gauges;

(iv) Distinguish between orthogonal and oblique cutting forces;

(v) Describe how surfaces are machined by forming and generating.

(b) The milling machine is capable of producing a range of cutting operations. Three milling cutters are illustrated below:

Identify a use for **any two** of the milling cutters shown.



(i) **(ii)** **(iii)**

2007 Question 7 cont.

(c) Describe, with the aid of a diagram, **any one** of the following:

(i) Surface grinding;

(ii) Cylindrical grinding.

OR

(c) With reference to CNC machining, describe **any three** of the following:

(i) Safety features on the machine;

(ii) Canned cycle;

(iii) G00;

(iv) Tool park position.

2008 Question 7

(a) Answer **any three** of the following:

(i) Name **three** types of chip formed in metal cutting;

(ii) Describe the function of a *reamer*;

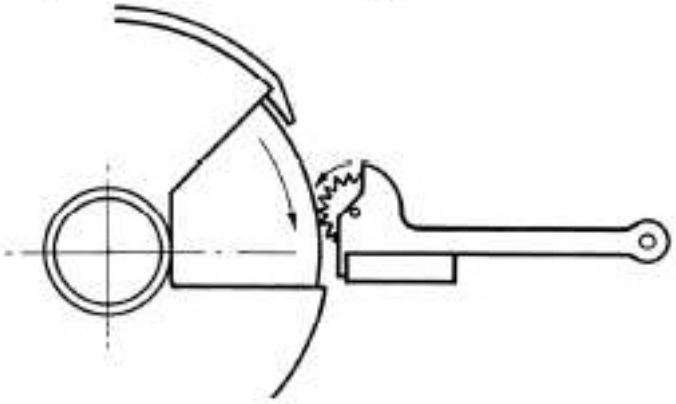
(iii) Outline **two** factors that influence the amount of heat generated in a machining operation;

(iv) Identify **two** safety issues associated with machining mild steel;

(v) Distinguish between a *clearance* fit and an *interference* fit.

2008 Question 7 cont.

(b) The process of grinding wheel dressing is illustrated below:



(i) Outline the reasons for wheel dressing a grinding wheel;

(ii) Differentiate between the *loading* and *glazing* of a grinding wheel.

2008 Question 7 cont.

(c) Describe, with the aid of suitable diagrams, the differences between *up-cut* milling and *down-cut* milling.

OR

(c) With reference to CNC machining describe **any two** of the following:

(i) **Two** features that reduce machining cycle time;

(ii) The contrast between CNC machining and conventional lathework;

(iii) The factors that make CNC machining safe.

2009 Question 7

(a) Answer **any three** of the following:

(i) Identify **one** use for the milling cutter shown;

(ii) Describe the process of knurling;

(iii) Identify **two** safety features incorporated into a pedestal grinding machine;

(iv) Outline **two** advantages of using a height gauge;

(v) Distinguish between direct and comparative measurements.

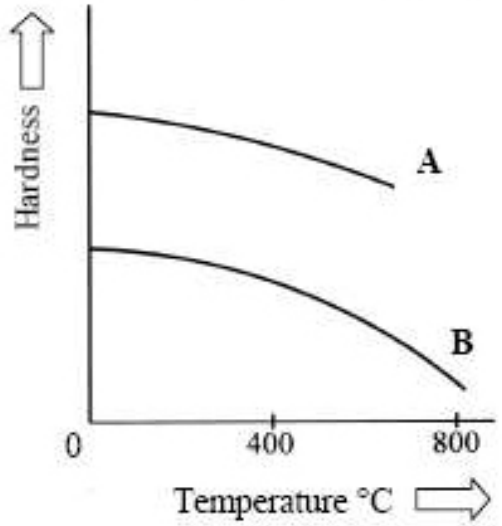
2009 Question 7 cont.

(b) Cutting tool materials include high carbon steel, high speed steel and tungsten carbide.

The effect of increased machining temperatures on the hardness of cutting tool materials **A** and **B** is shown below.

(i) Suggest a suitable cutting tool material for **A** and a suitable cutting tool material **B**.

(ii) Outline **two** methods of prolonging cutting tool life.



2009 Question 7 cont.

(c) Describe, with the aid of suitable diagrams, the essential features of the horizontal milling machine or the vertical milling machine.

OR

(c) (i) Distinguish between CAD and CAM.

(ii) Outline the main safety features of a modern CNC machine.

2010 Question 7

(a) Answer **any three** of the following:

(i) Identify **two** cutting tool materials used on a centre lathe;

(ii) Describe the process of up-cut milling;

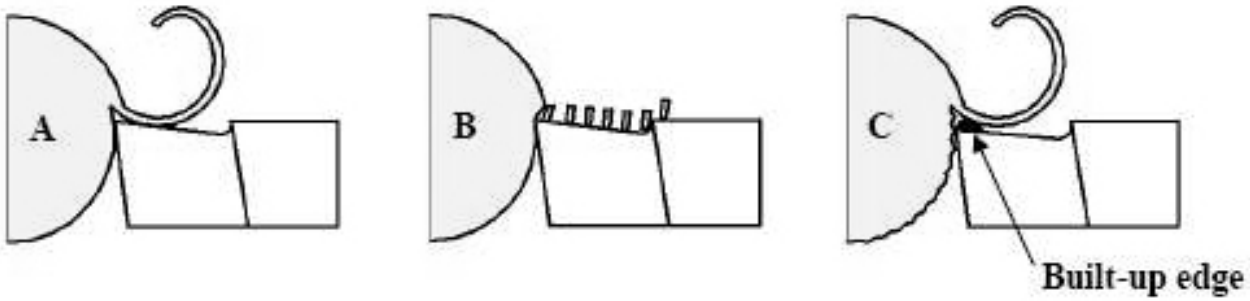
(iii) Explain the differences between forming and generating;

(iv) Outline **two** reasons for wheel dressing a grinding wheel;

(v) Distinguish between a clearance fit and an interference fit.

2010 Question 7 cont.

(b) The main types of material chip formed in metal cutting are illustrated below.



(i) Identify the type of chip formed at **A** and the type of chip formed at **B**.

(ii) Describe the type of material that results in the chip formed at **A** and the type of material that results in the chip formed at **B**.

(iii) Suggest **three** safety precautions that would minimise the formation of a built-up edge as shown in **C**.

2010 Question 7 cont.

(c) Describe, with the aid of suitable diagrams, the essential features of **one** of the following:

(i) Magnetic chuck;

(ii) Four-jaw chuck.

OR

(c) **(i)** Explain the term CNC.

(ii) Describe the use of CNC technologies with reference to each of the following:

- Efficiency
- Accuracy
- Cost.

2011 Question 7

(a) Answer **any three** of the following:

(i) Identify **two** safety precautions that reduce the formation of a *built-up edge* while turning on a centre lathe;

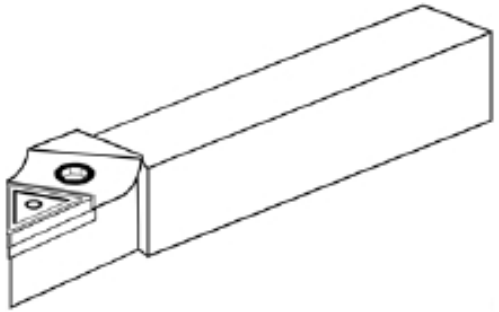
(ii) Distinguish between oblique cutting and orthogonal cutting;

(iii) Explain **one** main function of a feeler gauge;

(iv) Describe the main features of a Morse taper sleeve;

(v) State the function of a reamer.

(b) During the production of tungsten carbide cutting-tool inserts, cobalt and tungsten powder are mixed with cemented carbide and pressed into shape.

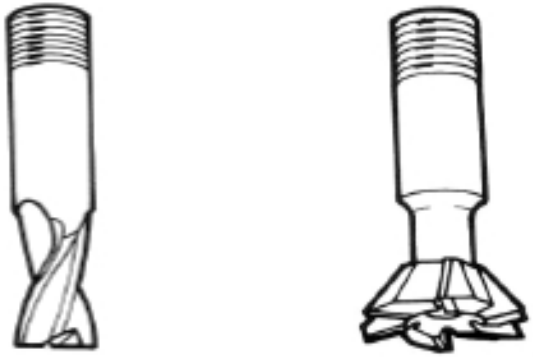


(i) Outline **two** reasons for using tungsten carbide cutting tools rather than high-speed steel cutting tools.

(ii) Explain **one** advantage of using interchangeable tool inserts.

2011 Question 7 cont.

(c) Describe, with the aid of diagrams, a suitable cutting operation for **each** of the milling cutters shown.



(i) **(ii)**

OR

(c) **(i)** Describe **three** safety features integrated into the design of a CNC lathe or a CNC milling machine.

(ii) Explain the role of simulation in CNC machining.

2012 Question 7

(a) Answer **any three** of the following:

(i) Identify **two** benefits of the use of cutting fluids in machining;

(ii) Describe the function of a *dividing head* on a milling machine;

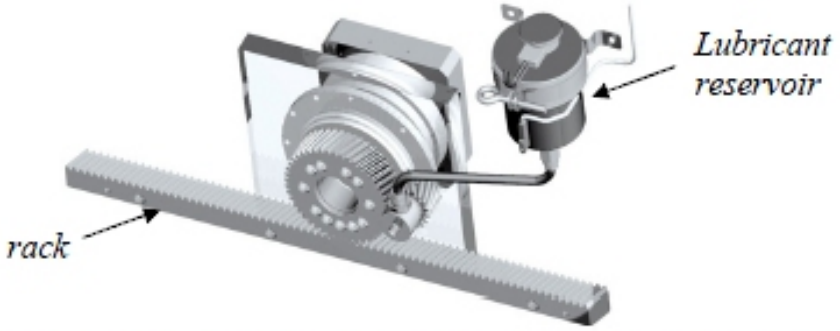
(iii) Explain the term *tolerance* in engineering measurement systems;

(iv) Describe the main factors that influence metal surface finish when parallel turning on the lathe;

(v) State **one** advantage and **one** disadvantage of using magnetic chucks on a grinding machine.

2012 Question 7 cont.

(b) Lubrication is vital to the efficient working of machine parts, such as in the engineering system shown.



(i) Outline **two** reasons why lubrication is important in machining processes.

(ii) Identify **any two** lubricating materials commonly used in engineering machines.

2012 Question 7 cont.

(c) Outline, with the aid of diagrams, the essential differences between the machining terms in **each** of the following:

(i) Loading and glazing of grinding wheels;

(ii) Forming and generating on the lathe.

OR

(c) Industrial engineering was one of the earliest areas to use computer technology. Describe **any one** use of computer technology in **each** of the following areas:

(i) Research;

(ii) Product design;

(iii) Production techniques.

2013 Question 7

(a) Answer **any three** of the following:

(i) Identify **three** safety features incorporated in the design of a centre lathe.

(ii) Describe the purpose of a plug gauge.

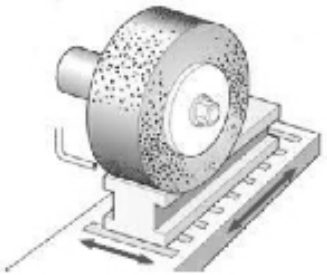
(iii) Distinguish between **any two** types of chip formed when machining.

(iv) Outline **three** methods of machining flat surfaces on metals.

(v) Identify **one** advantage and **one** disadvantage of using carbide tipped cutting tools when machining.

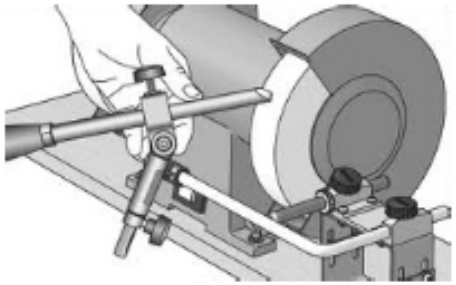
2013 Question 7 cont.

(b) Two common grinding processes are illustrated at **A** and **B**.



A

Surface grinding a steel machine slide.



B

Sharpening a cutting tool on a bench grinder.

(i) Outline the main features of a surface grinding machine.

(ii) Describe **three** hazards associated with using a bench grinder.

2013 Question 7 cont.

(c) Describe, with the aid of suitable diagrams, the differences between *gang milling* and *straddle milling*.

OR

(c) CNC machining is used in a variety of industrial engineering applications.

(i) Describe **two** features that reduce CNC machining cycle time.

(ii) Outline the advantages of using stepper motors in CNC machines.