REVIEW QUESTIONS

11.1. Name the two basic categories of casting processes.

11.2. There are various types of patterns used in sand

casting. What is the difference between a split

pattern and a match-plate pattern?

11.3. What is a chaplet?

11.4. What properties determine the quality of a sand

mold for sand casting?

11.5. What is the Antioch process?

11.6. What is the difference between vacuum permanent-

mold casting and vacuum molding?

11.7. What are the most common metals used in die

casting?

11.8. Which die casting machines usually have a higher

production rate, cold-chamber or hot-chamber,

and why?

11.9. What is flash in die casting?

11.10. What is the difference between true centrifugal

casting and semicentrifugal casting?

11.11. What is a cupola?

11.12. What are some of the operations required in sand

casting after the casting is removed from the

mold?

11.13. What are some of the general defects encountered

in casting processes? Name and briefly describe

three.

11.14. (Video) What is the composition of green sand in

the green-sand molding process?

11.15. (Video) What are the advantages and disadvantages

of sand casting over investment casting?

11.16. (Video) Explain the difference between horizontal

and vertical die casting machines. Which is more

popular?

11.17. (Video) Why are aluminum and copper alloys

unsuitable for use in hot-chamber die casting?

11.18. (Video) According to the die casting video, what

materials are most common for die casting dies?

MULTIPLE CHOICE QUIZ

There are 27 correct answers in the following multiple choice questions (some questions have multiple answers that are

correct). To attain a perfect score on the quiz, all correct answers must be given. Each correct answer is worth 1 point. Each

omitted answer or wrong answer reduces the score by 1 point, and each additional answer beyond the correct number of

answers reduces the score by 1 point. Percentage score on the quiz is based on the total number of correct answers.

11.1. Which one of the following casting processes is the

most widely used: (a) centrifugal casting, (b) die

casting, (c) investment casting, (d) sand casting, or

(e) shell casting?

11.2. In sand casting, the volumetric size of the pattern is

(a) bigger than, (b) same size as, or (c) smaller than

the cast part?

11.3. Silica sand has which one of the following compositions:

(a) Al2O3, (b) SiO, (c) SiO2, or (d)

SiSO4?

11.4. For which one of the following reasons is a green

mold named: (a) green is the color of the mold,

(b) moisture is contained in the mold, (c) mold is

cured, or (d) mold is dry?

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11.5. Given that Wm ¼ weight of the molten metal

displaced by a core and Wc ¼ weight of the core,

the buoyancy force is which one of the following:

(a) downward force ¼ Wm þ Wc, (b) downward

force ¼Wm \_Wc, (c) upward force ¼Wm þWc, or

(d) upward force ¼ Wm \_ Wc?

11.6. Which of the following casting processes are

expendable-mold operations (four correct

answers): (a) centrifugal casting, (b) die casting,

(c) investment casting, (d) low pressure casting,

(e) sand casting, (f) shell molding, (g) slush casting,

and (h) vacuum molding?

11.7. Shell molding is best described by which one of the

following: (a) casting operation in which the molten

metal has been poured out after a thin shell has been

solidified in the mold, (b) casting process in which

the mold is a thin shell of sand bonded by a thermosetting

resin, (c) sand casting operation in which the

pattern is a shell rather than a solid form, or (d)

casting operation used to make artificial sea shells?

11.8. Investment casting is also known by which one of

the following names: (a) fast-payback molding,

(b) full-mold process, (c) lost-foam process,

(d) lost-pattern process, or (e) lost-wax process?

11.9. In plaster-mold casting, the mold is made of which

one of the following materials: (a) Al2O3,

(b) CaSO4-H2O, (c) SiC, or (d) SiO2?

11.10. Which of the following qualifies as a precisioncasting

process (two correct answers): (a) ingot

casting, (b) investment casting, (c) plaster-mold

casting, (d) sand casting, and (e) shell molding?

11.11. Which of the following casting processes are permanent-

mold operations (three correct answers):

(a) centrifugal casting, (b) die casting, (c) expanded

polystyrene process, (d) sand casting, (e) shell molding,

(f) slush casting, and (g) vacuum molding.

11.12. Which of the following metals would typically be

used in die casting (three best answers): (a) aluminum,

(b) cast iron, (c) steel, (d) tin, (e) tungsten,

and (f) zinc?

11.13. Which of the following are advantages of die casting

over sand casting (four best answers): (a) better

surface finish, (b) closer tolerances, (c) higher

melting temperature metals, (d) higher production

rates, (e) larger parts can be cast, and (f) mold can

be reused?

11.14. Cupolas are furnaces used to melt which of the

following metals (one best answer): (a) aluminum,

(b) cast iron, (c) steel, or (d) zinc?

11.15. A misrun is which one of the following defects in

casting: (a) globules of metal becoming entrapped

in the casting, (b) metal is not properly poured

into the downsprue, (c) metal solidifies before

filling the cavity, (d) microporosity, and (e) ‘‘pipe’’

formation?

11.16. Which one of the following casting metals is most

important commercially: (a) aluminum and its

alloys, (b) bronze, (c) cast iron, (d) cast steel, or

(e) zinc alloys?

PROBLEMS

Buoyancy Force

11.1. An 92% aluminum-8% copper alloy casting is

made in a sand mold using a sand core that weighs

20 kg. Determine the buoyancy force in Newtons

tending to lift the core during pouring.

11.2. A sand core located inside a mold cavity has a

volume of 157.0 in3. It is used in the casting of a cast

iron pump housing. Determine the buoyancy force

that will tend to lift the core during pouring.

11.3. Caplets are used to support a sand core inside a

sand mold cavity. The design of the caplets and the

manner in which they are placed in the mold cavity

surface allows each caplet to sustain a force of 10 lb.

Several caplets are located beneath the core to

support it before pouring; and several other caplets

are placed above the core to resist the buoyancy

force during pouring. If the volume of the core ¼

325 in3, and the metal poured is brass, determine

the minimum number of caplets that should be

placed (a) beneath the core, and (b) above the core.

11.4. A sand core used to form the internal surfaces of a

steel casting experiences a buoyancy force of 23 kg.

The volume of the mold cavity forming the outside

surface of the casting ¼ 5000 cm3. What is the

weight of the final casting? Ignore considerations

of shrinkage.

Centrifugal Casting

11.5. A horizontal true centrifugal casting operation

will be used to make copper tubing. The lengths

will be 1.5 m with outside diameter ¼ 15.0 cm, and

inside diameter ¼ 12.5 cm. If the rotational speed

of the pipe ¼ 1000 rev/min, determine the Gfactor.

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11.6. A true centrifugal casting operation is to be performed

in a horizontal configuration to make cast

iron pipe sections. The sections will have a length ¼

42.0 in, outside diameter ¼ 8.0 in, and wall thickness

¼ 0.50 in. If the rotational speed of the pipe ¼

500 rev/min, determine the G-factor. Is the operation

likely to be successful?

11.7. A horizontal true centrifugal casting process is

used to make brass bushings with the following

dimensions: length ¼ 10 cm, outside diameter ¼ 15

cm, and inside diameter ¼ 12 cm. (a) Determine

the required rotational speed in order to obtain a

G-factor of 70. (b) When operating at this speed,

what is the centrifugal force per square meter (Pa)

imposed by the molten metal on the inside wall of

the mold?

11.8. True centrifugal casting is performed horizontally

to make large diameter copper tube sections. The

tubes have a length¼1.0 m, diameter¼0.25 m, and

wall thickness ¼ 15 mm. (a) If the rotational speed

of the pipe ¼ 700 rev/min, determine the G-factor

on the molten metal. (b) Is the rotational speed

sufficient to avoid ‘‘rain?’’ (c) What volume of

molten metal must be poured into the mold to

make the casting if solidification shrinkage and

contraction after solidification are considered?

Solidification shrinkage for copper ¼ 4.5%, and

solid thermal contraction ¼ 7.5%.

11.9. If a true centrifugal casting operation were to be

performed in a space station circling the Earth,

how would weightlessness affect the process?

11.10. A horizontal true centrifugal casting process is used

to make aluminum rings with the following dimensions:

length ¼ 5 cm, outside diameter ¼ 65 cm, and

inside diameter¼60 cm. (a)Determine the rotational

speed that will provide a G-factor ¼ 60. (b) Suppose

that the ring were made out of steel instead of

aluminum. If the rotational speed computed in part

(a) were used in the steel casting operation, determine

theG-factor and (c) centrifugal force per square

meter (Pa)onthemoldwall. (d)Wouldthis rotational

speed result in a successful operation?

11.11. For the steel ring of preceding Problem 11.10(b),

determine the volume of molten metal that must be

poured into the mold, given that the liquid shrinkage

is 0.5%, solidification shrinkage ¼ 3%, and

solid contraction after freezing ¼ 7.2%.

11.12. A horizontal, true centrifugal casting process is

used to make lead pipe for chemical plants. The

pipe has length ¼ 0.5 m, outside diameter ¼ 70 mm,

and wall thickness ¼ 6.0 mm. Determine the rotational

speed that will provide a G-factor ¼ 60.

11.13. A vertical, true centrifugal casting process is used

to make tube sections with length ¼ 10.0 in and

outside diameter ¼ 6.0 in. The inside diameter of

the tube ¼ 5.5 in at the top and 5.0 in at the bottom.

At what speed must the tube be rotated during the

operation in order to achieve these specifications?

11.14. A vertical, true centrifugal casting process is used

to produce bushings that are 200 mm long and 200

mm in outside diameter. If the rotational speed

during solidification is 500 rev/min, determine the

inside diameter at the top of the bushing if the

inside diameter at the bottom is 150 mm.

11.15. Avertical, true centrifugal casting process is used to

cast brass tubing that is 15.0 in long and whose

outside diameter ¼ 8.0 in. If the speed of rotation

during solidification is 1000 rev/min, determine the

inside diameters at the top and bottom of the tubing

if the total weight of the final casting ¼ 75.0 lbs.

Defects and Design Considerations

11.16. The housing for a certain machinery product is

made of two components, both aluminum castings.

The larger component has the shape of a dish sink,

and the second component is a flat cover that is

attached to the first component to create an

enclosed space for the machinery parts. Sand casting

is used to produce the two castings, both of

which are plagued by defects in the form of misruns

and cold shuts. The foreman complains that the

parts are too thin, and that is the reason for the

defects. However, it is known that the same components

are cast successfully in other foundries.

What other explanation can be given for the

defects?

11.17. A large, steel sand casting shows the characteristic

signs of penetration defect: a surface consisting of a

mixture of sand and metal. (a) What steps can be

taken to correct the defect? (b) What other possible

defects might result from taking each of these

steps?

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