OPERATIVE

1. Indirect composite materials have physical characteristics that include which of the following?

1. **Some of the polymerization shrinkage occurs outside of the mouth, but the most of the polymerization occurs inside the tooth upon delivery.**
2. **One potential advantage is a slightly higher degree of polymerization is attained.**
3. **Laboratory processing may employ heat and pressure.**
4. **These resins have greater color stability than light-activated resins.**
5. **Bond failures and induced stresses are reduced**

a. 1, 2, 3
b. 1, 2, 3, 4
c. 2, 3, 4, 5
d. 2, 4, 5
e. all of the above

The polymerization shrinkage occurs outside of the mouth, not in the tooth, which improves the physical properties and resistance to wear. The polymerization shrinkage does not occur in the tooth. This reduces induced stresses and bond failures. This will theoretically reduce the potential for leakage. These resins are also repairable in the mouth and are not as abrasive to opposing tooth structure as ceramic inlays.

Laboratory processing may employ heat (140 C) and pressure (0.6 MPa for 10 minutes). This polymerization under heat and pressure is used for a homogeneous microfilled resin that is claimed to have a higher filler content, less porosity and greater color stability than light-activated resins. In addition, a slightly higher degree of polymerization (degree of conversion) is attained.

The following are additional physical properties of laboratory composites:
Flexural strength is high-90-150 MPa
Flexural modulus is variable-4.7-15 GPa
Compressive strength is 210-280 MPa
Handling characteristics and properties:
Advantages-best anatomy and contacts, lower wear
Disadvantages-lab cost, special equipment, requires resin cement

1. Is incorrect as noted above. The polymerization occurs completely outside of the mouth.

The correct answer is c. (2, 3, 4, 5.)

Extra notes to recall about all composites (direct) regarding repair: A restoration that has just been cured and polished may have up to 50%of unreacted methacrylate groups to copolymerize with the newly added material. As the restoration ages, fewer and fewer unreacted methacrylate groups resin, and greater cross-linking reduces the ability for fresh monomer to penetrate into the matrix. Then strength of the bond between the original material and the added composite resin decreases in direct proportion to the time that has elapsed between the original polymerization and the addition of new composite. In addition, it should be noted that the polishing step would expose filler particles that are free from silane coating, which will inhibit a chemical bond to the new composite. The strength of the repair composite is less than ½ of the original material.

References:
Anusavice K: Philips' Science of Dental Materials, 10th Ed. WB Saunders, 1996.

Craig RG and Powers JM: Restorative Dental Materials, 11th Ed. Mosby, 2002.

2. The following statements are problems with bonding agents and solutions in various environments or clinical situations. Choose which of these combinations are correct.

1. **Problem: Debonding of a composite core build-up occurred during removal of an impression.**
   Solution: Compatible composite core material should be used. Certain self-cured composite cores are incompatible with certain light cured bonding agents. Choose a dual cured bonding agent or used a light –cured composite core material.
2. **Problem: A dentist etched tooth structure prior to using a 6th generation bonding agent.**
   Solution: Sixth generation bonding agents bond effectively to enamel and dentin without prior etching with phosphoric acid. The additional etching could result in over etching of dentin and may lead to nanoleakage.
3. **Problem: After etching, a dentist over dried the tooth.**
   Solution: Most modern bonding agents bond best to a moist tooth surface. Dentin should be rehydrated by applying a moist cotton pellet until the dentin surface glistens before applying the primer of the bonding agent.
4. **Problem: A ceramic restorative surface has fractured on your patient with a 3-unit anterior FPDPFM, exposing only the fractured porcelain.**
   Solution: The fractured surface should be isolated, prepared and then micro-etched with 50 um aluminum oxide particles; it is then treated with 5-9% hydrofluoric acid for 4 minutes; ; it is then treated with silane to wet the surface and act as a chemical coupling agent; then the bonding system is applied and light cured; and finally, the composite material is applied incrementally and light cured.
5. **Problem: A dentist uses a standard unfilled bonding agent to bond a laboratory composite restoration.**
   Solution: Bonding requires agents for both the tooth structure and the undersurfaces of the indirect restoration.

   a. **1. is correct**
   b. **1 and 2 are correct**
   c. **1, 2, and 3 are correct**
   d. **1, 2, 3, and 4 are correct**
   e. **all of the above**

Correct answer is e. all of the above.

Answers for # 1-4 contain self-explanatory responses.
Answer for #5 can be best explained as follows:
Resin composite cements are used to fill the space between the laboratory composite and the tooth surface. Bonding to the indirect composite surface is difficult. The goal is to swell the outer surfaces of the resin matrix and allow new monomers from the bonding agent to penetrate spaces among existing polymer chains. At the time of curing, the new polymer chains become micromechanically intertwined with the existing polymer chains, producing relatively strong bonding. Bonding can be enhanced by micro etching with aluminum oxide (50um) etching with hydrofluoric acid, or treating with primers. Sandblasting roughens the surface. Etching removes smear layers and partially dissolves glass filler particles. Primers provide good wetting and potential chemical bonding to exposed glass filler particle surfaces. Commercial primers foe laboratory composites contain silane, unfilled resin monomers, or silane-monomer combinations. Bonding composite cements to laboratory composites can produce bond strengths in the range of 20-35 MPa.

The formation of an optimally bonded interface has the following:

1) the surface of the substrate be clean;
2) the adhesive wets the substrate well and has a low contact angle;
3) adapts to the substrate to produce intimate approximation of the materials without entrapped air or other intervening materials;
4) the interface include the sufficient physical, chemical and or mechanical strength to resist intraoral forces of debonding; and

5) the adhesive be well cured in the "environment" or conditions for which they are to be used.

References:
Craig RG and Powers JM: Restorative Dental Materials, 11th Ed. Mosby, 2002.

3. Regarding environment and biocompatibility (toxicity), which one of the following is not true?

1. **The term biocompatible is defined in Dorland's Illustrated Medical Dictionary as being harmonious with life and not having toxic or injurious effects on biologic function.**
2. **Biocompatibility is measured on the basis of localized cytotoxicity.**
3. **Naturally occurring mercury can be found in large cold water fish with concentrations that often exceed FDA limits.**
4. **Ten percent of the female population is allergic to nickel, compared with only about 1% of the male population.**
5. **Berylliosis is a disease resulting from contact dermatitis of some RPD alloys.**

a. 1.
b. 2.
c. 3.
d. 4.
e. 5.

1. Is a true statement.
2. Is true. Biocompatibility is measured on the basis of localized cytotoxicity (such as pulp and mucosal response), systemic responses, allergenicity, and carcinogenicity.
3. Is true. Methylated mercury accumulates in the food chain and is derived from areas of undersea volcanic acidity and hydrothermal waters. Virtually 100% of methyl mercury is absorbed in the gut. Thus, conversion of elemental mercury to methyl mercury would greatly increase absorption via the gastrointestinal route. All of the mercury in seafood is methyl mercury and all is absorbed. The average contribution of one seafood meal per week to blood mercury levels of methyl mercury is many times that of the aberage contribution of elemental mercury from the presence of 8-10 amalgam restorations in the mouth.
4. Is true. Ten percent of the female population if allergic to nickel, compared with only about 1% of the male population. This disparity is attributed to the greater exposure of females to nickel. Almost all gold plated jewelry is made with a nickel undercoat beneath the gold plating Only about 30% of those patients with a known nickel allergy develop a reaction to an intraoral nickel-chromium dental alloy.
5. Is false. Berylliosis is an inflammatory lung disease resulting from the inhalation of beryllium dust or fumes. Beryllium containing alloy should be ground with adequate ventilation.

The correct answer is e. (5 is a false statement).

References:
Anusavice K: Philips' Science of Dental Materials, 10th Ed. WB Saunders, 1996.

4. Onlay preparation design for porcelain includes all but which of the following?

a. **Cuspal onlay preparations should have a 2.5 to 3.0 mm reduction in vertical height of the cusps and all occluding areas.**
b. **Preparation should have finish lines on any supporting cusps that are hollow ground chamfers, generally with no bevel.**
c. **Well-rounded angles on the cuspal preparation.**
d. **The typical well-defined internal line and point angles of cast-metal restorations are rounded for porcelain and the pulpal floor should be indented.**
e. **Slightly more divergent axial walls than for conventional cast metal inlay.**

a. **Is the correct answer** -It is a false statement: the reduction should incorporate a 1.5- to 2.0 mm reduction in vertical height and all occluding areas. The adhesive nature of the bonded restoration makes the traditional approach of additional preparation to protect unsupported cusps or to develop additional resistance form unnecessary. Removal of additional tooth structure to onlay cusp is contraindicated.
b. Is a true statement The hollow ground chamfer is used to expose and increased number of enamel rods for increased bond strength, increased marginal seal, and a transition for better esthetic color blend. A bevel could lead to fracture of porcelain due to the friability of the thin edge of porcelain.
c. Is a true statement: There should be well-rounded angles on the Cuspal preparation, to prevent propagation of porcelain fracture from these sharp stress points.
d. Is a true statement: GV Black's original concepts for restorations demanded sharp, definitive line angles. These are contraindicated in any form of porcelain restoration. All line and point angles are of necessity rounded. This facilitates the laboratory fabrication and decreases the propagation of fractures within the restoration. The cavity preparation should be indented in the pulpal floor to develop even thickness of porcelain in the restoration in the central fossa region to parallel the cuspal inclines. This allows for a thickness of porcelain in the center that is similar to that on the lateral aspects of the restoration.
e. Is a true statement: The axial walls of the cavity preparation should be slightly more divergent from the pulpal floor toward the enamel surface than would be prepared for a conventional cast-metal inlay, where the 6-10 degree taper is commonly favored to develop retention. Increased taper of the axial walls allows easier placement and removal of the restoration during the true-in phase, but the taper should not be exaggerated so as to unnecessarily remove additional tooth structure.

Reference: Porcelain and Composite Inlays and Onlays. Garber DA and Goldstein RE

5. Glass Ionomer differ from a compomer (polyacid modified resin)in which ways.

1. **Compomers contain both composite and glass inomer**
2. **Glass ionomer releases less fluoride than compomers**
3. **Glass inomers use polyacrylic acid**
4. **Compomers have improved physical properties over glass ionomers**

Answers:

a. **2, 3, and 4**
b. **2 and 4**
c. **1 and 2**
d. **1, 3, and 4**

The answer is D.

Answer 2 is not correct. Conventional glass ionomers release fluoride into the surrounding tooth at a greater amount that compomers. This gives them a higher anticariogenic effect. Glass ionomer have low wear resistance, and relatively low strength compared to composite or amalgam. Compomers have improved strength and wear resistance with the combination of composite and glass ionomer.

Roberson T.M., Heymann H.O., and Swift E.J. Studervant's Art & Science of Operative Dentistry, Fourth Edition, Mosby Inc. 477-478.

6. Which of the following statement(s) distinguishes a flowable composite from a regular composite.

1. **Flowable composite have equal filler content but just smaller particles when compared to regular composites.**
2. **Flowable composite have lower filler content**
3. **Flowable composites have favorable wettability**
4. **Flowable composite have lower wear resistance and increased strength.**

A. 1, 3, and 4
B. 1 and 4
C. 2 and 3
D. 3 and 4

Answer 1. is incorrect since flowable composite achieves its ability to flow by decreasing the amount of filler particles.

Answer 4. is not correct since flowable composite has decreased strength.

Flowable composites have lower filler content which make it have inferior physical properties such as lower wear resistance and decreased strength. It does have increased wettability. Indications are limited to Class 1 restorations, pit and fissure sealants, cavity liners and margin repair materials.

The answer is C.

Roberson T.M., Heymann H.O., and Swift E.J. Studervant's Art & Science of Operative Dentistry, Fourth Edition, Mosby Inc. 477-478.

7. Which of the statements concerning veneer designs are acceptable veneer designs?

1. **A facial veneer that does not include the incisal edge is acceptable.**
2. **An incisal lapping veneer preparation is contraindicated in most situations.**
3. **The incisal lapping preparation is ideal to lengthen the tooth.**
4. **The margins should always be subgingival**

Answers:

A. 1 and 2
B. 1
C. 1, 3 and 4
D. 1 and 3

Veneers can be made of composite; lab processed composite, porcelain or pressed ceramics. The gingival margin should be supraginigival unless the defect, discoloration, or caries extends below the gingival margin. An acceptable design involves the incisal edge that can extend to the lingual surface. This is useful to lengthen the tooth and cover stain or defects on the incisal edge. The incisal lapping preparation is not contraindicated with porcelain and may be used in most situations. There is a potential increase in wear of the opposing dentition with the incisal edge lapping design. A veneer preparation does not have to include the incisal edge.

The answer is D.

Roberson T.M., Heymann H.O., and Swift E.J. Studervant's Art & Science of Operative Dentistry, Fourth Edition, Mosby Inc. 615-618.

8. Which gives the best results for caries prevention?

a) **Low dose/high frequency fluoride**

b) **High dose/low frequency fluoride**

c) **High dose/high frequency fluoride**

d) **Low dose/low frequency fluoride**

Answer is a) Low dose/high frequency fluoride

According to Featherstone, primary benefits of are had with a continuous low level of exposure of aqueous fluoride in contact with enamel in the presence of calcium and phosphate ions.

Chronic excessive fluoride intake during tooth development may bring about fluorosis. 1ppm fluoride in drinking water is the optimal amount needed for caries prevention before any signs of fluorosis appears.

Remineralization-demineralization balance theory indicates 0.2 to 1.0ppm Fluoride lowers the solubility of enamel.

In vitro experiments have shown that concentrations of Fluoride in range of 100ppm reduce sensitive bacteria population. Sublethal concentrations alter carbohydrate metabolism by reducing acidogenicity, altering the production of extra cellular insoluble polysaccharides, and possibly reducing adhesion.

Fluoride concentration in saliva rarely exceeds a few ppm. Effect of additional Fluoride on plaque metabolism is insignificant except for individuals with reduced saliva flow < 0.5ml/min.

Featherstone, JDB, The science and practice of caries prevention. JADA 2000; 121:887-899
Phillips Science of Dental Materials 11th ed., Anusavice, K.J. P447-9

9. What is role of Indium in amalgam?

a) **To reduce Hg release during mastication**
b) **To reduce Hg release during abrasion of set amalgams**
c) **To reduce Gamma two phase**
d) **To reduce Gamma phase**

Answer: a) To reduce Hg release during mastication

Composition of amalgam:

Alloy type:	%Silver	%Tin	%Copper	%Zinc
Conventional low copper	65-70	21-29	2-4	0-2
High copper	40-60	26-30	6-28	0-2

Indium (5-15% wt.) is added to reduce the release of Hg during mastication, and during and after setting.
Zinc is a deoxidizer (oxygen scavenger) during manufacturing. It decreases brittleness. It may decrease corrosion and improve marginal integrity.
Higher copper alloys have high early strength, low creep, good corrosion resistance, and good resistance to marginal fracture. High copper alloys reduce gamma two phase (weaker).
Silver and tin are the major components of amalgam, combining with Mercury to produce an amalgam with varying working properties.
Palladium is added to enhance mechanical properties and corrosion resistance.

Chemistry of amalgam:
Mercury + Ag_3Sn (gamma phase) = Ag_3Sn (unreacted) + Ag_2Hg_3 (gamma one) +
Sn_7Hg_8(gamma two)

Gamma one and two are inferior in properties than gamma phase.
Gamma two is weaker and more prone to corrosion than gamma phase.

In high copper alloys (>6% wt.), gamma two reacts with cilver-copper eutectic to eliminate the gamma two phase.

Sn_7Hg_8 (gamma two) + AgCu = Ag_2Hg_3 (gamma one) + Cu_6Sn_5

In high copper alloys the reaction is this:

Ag_3Sn (gamma phase) + Hg = Ag_3Sn (unreacted) + Cu_6Sn_5

Vaporization of Hg from Hg-in amalgams during setting and after abrasion. Ferracane, Materials in Dentistry, Stannard, J.G. 1986 Denali Publishing
Dental Materials and Their Selection 2nd Ed., O'Brien WJ, 1997 page 189
Restorative Dental Materials 10th Ed., Craig, R.G. 1997 page 210

10. Which is not desired in a Class I amalgam preparation design?

a) **Shallow preparation <1.5mm**
b) **Preservation of well supported enamel**
c) **Parallelism of opposing walls**
d) **Smooth cavosurface outline form**

Answer : a) Shallow preparation <1.5mm

Class I Amalgam tooth preparation
Elimination of caries, preservation of tooth structure, remove enamel that is undermined by caries.
Routine extension in non carious fissures and pits is no longer justified.
Occlusal cavosurface bevel is contraindicated in these preparations.
Outline should include only faulty and defective occlusal pits and fissures.
Avoid sharp angles in marginal outline.
Need 90-100 degree cavosurface angle.
Opposing walls need to be parallel or converge slightly to the occlusal table for retention form.
Keep facial and lingual margin extensions as minimal as possible between the central groove and the cusp tips.
Sufficient depth (>1.5mm) to give adequate thickness of the restoration.
Parallelism or slight occlusal convergence of external walls.
Preparations (faciolingually) exceeding the intercuspal distance should have remaining cusps evaluated for restoration.

Conservative Class I Composite tooth (adhesive) preparation
Limit removal of tooth structure to amount needed to remove caries and severely thinned enamel.
Preparation tends to be shallower than in amalgam preparations.
Retention is provided by bonding, no need to penetrate enamel if caries does not.
Preserve as much enamel as possible to improve bonding, preparation can be shallower.
Preparation should be narrower to limit occlusal wear and reduce polymerization shrinkage.
Rounded internal line angles which enhances resin adaptation.
No extension for prevention. Occlusal pits only include if there is caries, they can be treated with sealants.
An axial and/or pulpal wall of varying depth (not uniform) is allowed.
Enamel does not have to be fully supported by dentin.

Ref:
Sturdevant, C.M., Sturdevant's Art and Science of Operative Dentistry 4th Ed. 2002 Mosby. Page 539, Page 671.
Summit, Robbins, & Schwartz, 2nd Ed, Fundamentals of Operative Dentistry 2001 Ch 10,11.

11. Bevel margins are indicated in:

1. **Gold castings**
2. **Dentin margins on composite restorations**
3. **Enamel margins on composite restorations**
4. **Glass Ionomer restorations**
5. **Resin-modified glass Ionomer restorations**
6. **Porcelain restorations**

a) 1, 2, 4, 6
b) 1, 3, 5, 6
c) 1, 3
d) 1, 3, 5
e) None of the above

Answer: (c)

- The bevels for cast metal *may slightly* improve retention form when they are opposing bevels.
- The bevels for cast metal are primarily to afford a better junctional relationship between the metal and the tooth.
- Enamel margins of composite restoration have a beveled or flared configuration to increase both the surface area of etchable enamel.
- Enamel margin of composite restoration is to maximize the effectiveness of the bond by etching more enamel rods ends.
- The porcelain, resin-modified glass ionomer restorations and glass ionomer restorations require butt-joint (bulk of material at the margin) due to the brittleness and low tensile strength.

Sturdevant's Art and Science of Operative dentistry 4th Edition. P-298

12. Which of the following is *not* the indication of miniflaps?

a) **Class V lesions with difficult moisture control.**
b) **Restorative margin is significantly deep gingivally.**
c) **Limited access and visibility.**
d) **Gingival margin of the restoration is at the crest of the bone.**

Answer: (d) When carious lesion extends gingivally enough that a soft tissue flap is necessary for adequate access and visibility. Proper surgical procedures must be followed including sterile technique, careful soft tissue management and complete debridement of the operating site prior to wound closure. When the gingival margin of the restoration violates the biologic width (Gingival margin of the restoration is less than 3mm from the crest of the bone) osseous crown lengthening may be necessary.

The design of the "mini-flap" is: intersulcular incision around the tooth (or the surface that you need access for restoration), full-thickness flap with small vertical releasing incisions not extending beyond the mucogingival junction. Flap is repositioned at the previous coronal height (note: not apically positioned) and suture may be necessary.

Sturdevant's Art and Science of Operative dentistry 4th Edition. P- 744

13. Which of the following statement(s) on the mercury hazard is(are) *false*?

1. **Mercury in the environment is bioaccumulative.**
2. **Mercury in the form of dental amalgam is very stable, but when incinerated mercury may be released to the environment.**
3. **Amalgam sludge is the mixture of liquid and solid material collected within vacuum pump filters or other amalgam capture devices.**
4. **Mercury can be recovered from amalgam waste through a distillation process and reuse in new products.**
5. **ADA recommends recycling as a best management practice for dental offices.**

a) 1
b) 2
c) 3
d) All of the above
e) None of the above

Answer: (e)

- Majority (87%) of mercury released to the environment comes from combustion of fuel and waste. Dentistry contributes less than 1%.
- Mercury is present in numerous chemical forms. Methylated mercury compounds and Elemental mercury are toxic. Elemental or inorganic forms can be transformed into organic forms by biological systems.
- Some mercury released into the air eventually collects in waterways and then enters the food chain. Amalgam in environment is bioaccumulative, which means that it can build up in fish and cause health problems in any animals that eat fish.
- Dental Amalgam is a solid intermetallic compound, quite different from elemental, cationic and organic mercury. Dental amalgam is very stable.

REF: ADA BMP, 2003.

14. How do dentinal tubules change as you approach the pulp?

1. Tomes fibers are absent as you approach the pulp.

2. There are 45,000-60,000/mm^2 near the pulp.

3. The lumen diameter decreases to .5 to .9 um near the pulp.

4. The tubules are straighter in the incisal ridges, cusps and root areas.

a. 1 and 2 are true
b. 1,2,3 are true
c. 2, 4 are true
d. All the above are true

Thus the answer is C.

Each dentinal tubule contains cytoplasmic cell processes (Tomes fibers) of an odontoblast. There is no mention of them being absent as you approach the pulp. There are 15,000-20,000/mm^2 at the DEJ and this INCREASES to 45,000-60,000/mm^2 at the pulp. The lumen in the coronal dentin is .5 to .9 um then INCREASES to 2-3 um at the pulp. The tubules have a slight S-curve to them in the crown, but are straighter in the incisal ridges, cusps and root areas.

SOURCE: STURDEVANTS ART AND SCIENCE OF OPERATIVE DENTISTRY 4TH EDITION. page 23.

15. What makes a glass ionomer a true glass ionomer?

1. It must have an acid-base reaction (i.e. metal + acid= salt). You must mix materials together to have a true glass ionomer.

2. Calcium ions are gradually replaced by Aluminum ions to produce a more cross linked, more mechanically stronger material.

3. Glass ionomers are materials consisting of ion-cross linked polymer matrices surrounding glass-reinforcing filler particles.

4. Fluoride is an integral part of the matrix formation.

5. Polyacrylic acid may be freeze dried-(anhydrous) and combined with aluminosilicate powder.

6. Water is a key ingredient for the setting reaction.

A. All the above are true
B. none are true
C. 1,2,4 are true
D. 1,2,3,5,6 are true
E. 4,5,6 are true

Answer is D
SOURCE: CAPT Cook's lecture on Glass Ionomers, page 5,6.
SOURCE: STURDEVANTS ART AND SCIENCE OF OPERATIVE DENTISTRY 4TH EDITION. Page 207-211.
It must have an acid-base reaction (i.e. metal + acid= salt). You must mix materials together to have a true glass ionomer. Calcium initially and the later aluminum replaces the hydrogen ions on the carboxyl groups resulting in the post set hardening stage. Glass ionomers are materials consisting of ion-cross linked polymer matrices surrounding glass-reinforcing filler particles. Fluoride is NOT an integral part of the matrix formation, therefore it is available for release without compromising the structural integrity of the restoration. Polyacrylic acid may be freeze dried and combined with aluminosilicate powder. The freeze dried form is called anhydrous, there also is a semi-hydrous form available. Water is a key ingredient for the setting reaction, it is critical for the reaction to occur. The water hydrates the salts and allows them to crosslink. Too much water results in an opaque weakened restoration, if water is lost during setting crazing will occur.

16. Which of the following advantages for the curing lights are true?

1. **Quartz-Tungsten-halogen curing lites- 90% of the light produced is suitable for curing. Output ranges from 400-800 mW/cm^2.**

2. **Plasma arc curing units-PAC- curing times can be as low as 3-10 seconds. This produces a much more rapid polymerization resulting in decreased polymerization stresses and stronger bond strengths.**

3. **Laser curing lights-curing times can be as low as 3-10 seconds.**

4. **Light emitting diode (LED) lights-Allows one to generate the appropriate wavelength in a narrow spectrum and curing cycle.**

5. **Stepped cure lights-may allow the newly formed polymer network to stress-relax and eliminate strains before completion of the curing cycle.**

a. 1,2,3 are true
b. 2,3,4 are true
c. All the above are true
d. All the above are false
e. 3,4,5 are true

The answer is E.
The quartz bulbs only produce 0.5% of light suitable for curing. Most is converted into heat. UV and infrared filters eliminate unnecessary light . Output is in the range of 400-800 mW/cm^2. Curing times for Lasers and PAC lights are advertised as 3-10 seconds. The fast cure can however cause INCREASED polymerization stress and DECREASED bond strengths. LED's are advertised as allowing one to generate the appropriate wavelength and curing cycle for the many products on the market. Camphoroquinone is the photoinitiator most used in composites. Stepped cure lights (Elipar 1997) used 100 mW/cm^2 for 10 seconds, then 600 mW/cm^2 for 30 seconds this shows some promise in decreasing polymerization stresses.
SOURCE: STURDEVANTS ART AND SCIENCE OF OPERATIVE DENTISTRY 4TH EDITION. page 198-202.

17. Indicate the optimum restorative material to restore a G.V. Black Class V cavity prep restoring a suspected abfraction lesion on a maxillary anterior.

a. **Amalgam**
b. **Hybrid Composite Resin**
c. **Compomer**
d. **Glass Ionomer**
e. **Glass Ionomer / Microfill Composite Resin**

The common theory accepted for the causative agent of abfraction lesion is of an occlusion orgin. Excessive flexion of the tooth causes compression and relaxation at below the CEJ which forces a fluid exchange to occur. This exchange of fluid also carries with it elements of the tooth structure matrix.

In restoring these types of lesions one must take into account several factors. The majority of the margins will exist on dentin/cementum. Enamel may only be present at the occlusal margin. The material chosen should be able to withstand the flexion forces experienced by the tooth, lesion's position in the esthetic zone, and patient's caries risk status.

It is accepted that Glass ionomers have the more favorable, low flexural strength and low modulus of elasticity to withstand these forces. As well, they have a chemical bond to tooth structure, and a coefficient of thermal expansion close to that of natural tooth structure. But their wear resistance is low and esthetics fair. For these reasons this restorative procedure would call for a Sandwich Technique where the prep is restored with a GI on all dentin margins, then a veneer of Resin on the enamel margins to esthetically cover some of the GI leaving the GI/dentin margins exposed.

The correct answer is e. Glass Ionomer / Microfill Composite Resin

-Amalgam would not serve the esthetic needs and has a very high modulus of elasticity.
-Hybrid Composite is esthetic but flexural strength is high and no true chemical bond to tooth structure, only micro-mechanical can be made to tooth structure.
-Compomers are an option because they are a blend between a GI and Resin. You get a bit of the chemical dentin bond, better wear resistance, some fluoride release, and a bit more flexion.
-Glass Ionomer alone has the bond and flex needed and also supplies optimum fluoride release if it is needed, great bond to dentin, flexural strength and thermal expansion similar to tooth structure, but poorer esthetics an low wear restsiance.

Craig, R.G and Powers, J.M., Restorative Dental Materials 11th Edition, Mosby 2002, page 214-217, 244, 599, 627

18. Which is the correct sequence of reaction stages of Glass Ionomers?

a. Decomposition, gelation, maturation, migration, post-set hardening
b. Migration, decomposition, maturation, gelation, post-set hardening
c. Decomposition, migration, gelation, post set hardening, maturation
d. Migration, gelation, decomposition, post set hardening, maturation

Glass Ionomers are supplied as powders of various shades and a liquid component. The powder is an ion-leachable calcium fluoro-alumino-silicate glass, and the liquid is a water solution of polymers and co-polymers of acrylic acid.
(Although polyacrylic acid is the original, Currently the acid is in the form of a copolymer with Itaconic, Maleic, or Tri-Carboxylic acid. Tartaric acid is also present as it improves the handling characteristics and increases the working time)

The material sets through an acid-base reaction in the presence of water. As a result, metallic salt bridges form between the Al++ and Ca++ ions leached from the glass and the acid groups on the polymers. The resulting glass ionomer matrix will bind both the glass particles and water into a cement structure that will contain up to 24% water. Water in a glass ionomer ensures effective 'wetting' of moist tooth surfaces for strong adhesion. Water bound in a mature glass ionomer facilitates continuous fluoride release and uptake, benefiting adjacent tooth surfaces. The reaction goes to completion slowly, with the formation of a cross-linked gel matrix in the initial set and an aluminum ion exchange strengthening the cross-linking in the final set.

A chelation effect takes place with the calcium in the apatite on the exposed tooth surface, creating an ionic adhesive bond. The surface on the new restoration should be protected from saliva during initial set with a varnish or light cured bonding agent.

Types based on their formulation and potential uses:
Type I: Luting agents
Type II: Restorative material
Type III: Liner and bases

The correct answer is c. Decomposition, migration, gelation, post set hardening, maturation

Decomposition - acid reacts with glass, release of metal ions
Migration – ions migrate into aqueous solution
Gelation – metal ions gel and initiate cross-links,
Created 1st are Calcium polysalts, 2nd are Aluminum polysalts
Post-Set Hardening – ions become bound, cross-links continue
Maturation – increased cross-linking, decreased free water, improved physical properties.
This phase can comtinue for several months.

Craig, R.G and Powers, J.M., Restorative Dental Materials 11th Edition, Mosby 2002, page 211-213

Cook, N.B., CAPT, DC, USN, Chair Operative Dentistry, National Naval Dental Center, NPDS Course 225 Operative Dentistry, Lecture #12, 21 Aug 02, page

19. Place the following types of G.V. Black cavity preps in order of increasing C-Factor: Class 1, Class 2, Class 4

- **a. 1, 2, 4**
- **b. 2, 4, 1**
- **c. 4, 2, 1**
- **d. 2, 1, 4**

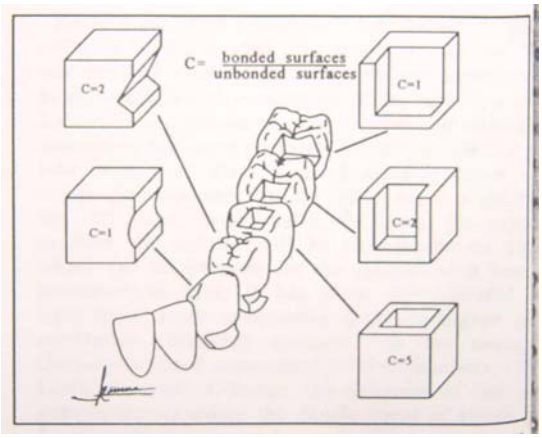
During polymerization the organic matrix of a composite resin can undergo volumetric shrinkage on the order of 2% ~ 7%. This contraction crates stresses at the hybrid layer upwards 18 MPa. These forces can severely strain the bond between composite and tooth structure. This leads to Marginal gap formation, microleakage, stress cracking of composite, or enamel fractures along the margins.

The degree of stress development can be controlled to an extent by the cavity design, expressed in C-Factors, uses of bases, the size, shape, and position of increments, light or chemical curing. Most important and easily controlled in respects to stress relief can be accomplished by maintaining the C-Factor as low as possible.

The calculation of C-Factor is the number of bonded surfaces verses non-bonded surfaces. The higher number of tooth structure walls that will be bonded to yields a higher C-Factor. Conversely the fewer number of tooth structure walls the lower the C-Factor. Thus a ***standard*** cavity preps represent the following: Class 1 preps have 5 bonded to 1 non-bonded for a C-Factor of 5. Two surface Class 2 preps have 4 bonded to 2 non-bonded for a C-Factor of 2. Class 3 preps have 4 bonded to 2 non-bonded for a C-Factor of 2. Class 4 preps have 1 to 4, C-Factor 1. Class 5 varies according to depth and can range from 1 to 5. Of course multi-surface Class 2 (MOD, MODB, ETC), 3 (MFL, DFL), and 4 (MIFL, MIDFL) have lower C-Factors than the standard preps in that there are more non-bonded surfaces than bonded.

Answer is c. 4, 2, 1

To compensate for this contraction the following should be factored in to the procedure: All enamel margins, incremental fill, highly filled material (less matrix = less shrinkage, don't bridge cusps, clear matrix.



Carvalho, R.M. et al. A Review of Polymerization Contraction : The Influence of Stress Development verses Stress Relief. Oper Dent 1996 (21): 17-24 *{source of photo}*

20. What are the predominate microbes are involved in root caries?

a. ***Fusobacterium***
b. ***Actinomyces***
c. ***S. mutans***
d. ***Lactobacillus***
e. ***Fusobacterium***

A: b. The predominate microbes involved in root caries are Actinomyces according to the cited text here. The NIH publication on *Diagnosis and Management of Dental Caries Throughout Life* claims that convincing data on the source of infection by cariogenic bacteria almost entirely pertain to mutans streptococci. Caries originating on the root is alarming because: (1) it has a comparatively rapid progression, (2) it is often assymptomatic, (3) it is closer to the pulp and (4) it is more difficult to restore

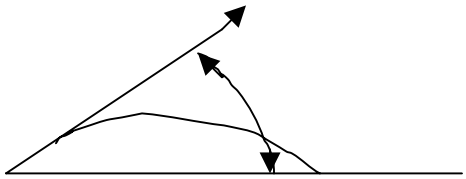
OPERATIVE DENTISTRY, 3rd ed. Sturdevant

21: Primers have excellent ability to wet a surface when they form a high contact angle. A liquid with a relatively low surface tension coefficient will have improved surface wetting properties.

a. **The first statement is true, the second is false.**
b. **The first statement is false, the second is true**
c. **Both statements are true**
d. **Both statements are false.**

A: b◄

The contact angle is a measurement formed by the balance of energies between the liquid and solid. A higher contact angle means more "bubble-like" and hence poorer wetability.



Surface tension is measured in terms of force (dynes) per centimeter of the surface of liquid. The higher the surface tension, the less the wetability. Some examples at 20° C follow:

1-benzene 29 dynes
2-water 72.8
3-mercury 465

These values are influenced by temperature and purity. Higher temperatures and impurities, especially detergents, decrease surface tension. Just remember:

HIGH SURFACE TENSION OR HIGH CONTACT ANGLE = POOR WETABILITY.

Restorative Dental Materials,11th ed. Craig and Powers

22. Which of the following statements regarding the prep design and characteristics of Glass Ionomer and RMGI are true?

a. **A 2mm 45° bevel should be evident at the enamel margins to enhance bonding.**
b. **All margins should be 90°**
c. **Occlusal depths should be at least 3mm deep to allow for thickness of material for strength.**
d. **Internal line angles should be rounded**

A: b,d

A beveled margin would allow for a thin layer of restorative material, more prone to fracture than a 90° cavosurface margin. GI restorative material should not be used in occlusal load areas due to poor wear resistance. Sharp line angles will allow voids under the restorative material since the material lacks adequate flow characteristics. Polyacrylic acid is the agent of choice to remove the smear layer.

Fundamentals of Operative Dentistry 2ND Edition Summit, Robbins, Schwartz 2001 PG 396-7