

1) Refsum's disease is a severe disorder that results in the accumulation of high levels of phytanic acids and its unsaturated fatty acid leading to myelin problems around nerves. Normally, the phytanic acid is broken down in the peroxisome, but in patients with Refsum's, α -oxidation does not function and there are different reasons why α -oxidation is affected. The two most probable are likely due to the lack of a key enzyme responsible for the breakdown of phytanic acid, or the absence of a functional transport protein prevents the import of the enzyme into the peroxisome. How many of the following statements are true?

✓ *catalase is present in the peroxisome; peroxisomes are membrane-bound organelles; the melting point of fatty acids decreases as the length of the chain decreases; oleic acid is considered a unsaturated fatty acid because it contains one double bond; Western blot analysis would discriminate between a normal person and one suffering from Refsum's*

- A) One of the above.
- B) Two of the above.
- ☒ C) Four of the above.
- D) Five of the above.
- E) None of the above.

2) Which of the following is required for normal striated muscle function?

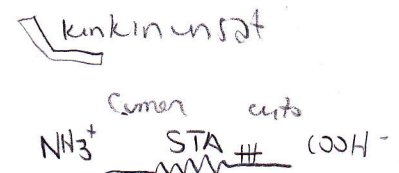
- ☒ A) calcium pumps
- B) depolymerization of T-tubule membranes
- C) thick filament shortening
- D) troponin hydrolysis
- E) spindle pole shortening

3) A pure lipid bilayer will not allow _____ molecules to pass, while adding _____ to the bilayer would ascribe much more functional and biochemical properties to the _____ and therefore the cell. Pick the best answers to complete the sentences above.

- A) charged; GPI links; pumps
- B) large; fatty acids; membrane
- C) large; pumps; cytoskeleton
- ☒ D) charged; proteins; membrane
- E) hydrophobic; cholesterol; polar heads

4) The lipid tails in a typical cell membrane contain both saturated and unsaturated fatty acids. What would the result be if all of the fatty acids in the membrane were to become saturated?

- ☒ A) The melting point of the lipid bilayer would decrease. *W unsat*
- B) Myristic acid could not be present.
- C) Stearic acid could not be present.
- ☒ D) The polar heads would form micelles.
- E) None of above.



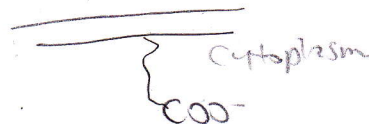
5) Integrin is a type one transmembrane protein. From this we know that:

- ☒ A) its SA domain becomes the trans-membrane domain.
- B) its N-terminal domain can bind to KDEL. *endocytosis*
- C) its C-terminal domain can interact with the cytoskeleton.
- D) it is secreted into the ECM.
- ☒ E) it is glycosylated on its STA domain.

R6D

Type I Sig seq, STA, N in lumen
 III SA, N in lumen
 II SA, C in lumen
 IV could be either

STA → cyto
 SA → lumen

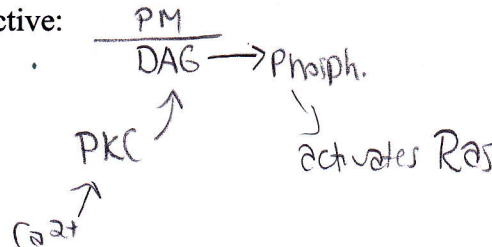


6) You are studying the poisoning effects caused by Amanita phalloides and you plan to use a number of cell biological techniques along with human mature red blood cells. First off, a microarray analysis reveals that c-fos mRNA levels in control, untreated cells are lower in those cells grown in the presence of the mushroom toxin. Secondly, you use confocal microscopy with an actin monoclonal antibody and notice that _____. Given this information, pick the best answers to complete the sentences above.

- A) higher than in; most of the actin is in the globular form
- B) lower than in; there is significantly more filamentous actin
- C) higher than in; there are no differences in the actin forms
- D) lower than in; most of the actin is in the globular form
- E) identical compared to; most of the actin is in the filamentous form

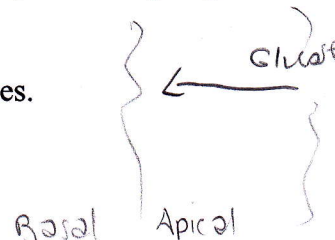
7) Many phorbol esters, which are plant-derived organic compounds, promote tumour formation in animal cells because they mimic DAG and cannot be regulated because of their foreign nature. From the example that was discussed in lecture, and in the presence of free cytosolic Ca^{2+} , phorbol ester-treated cells would have an active:

- A) MAPK pathway
- B) CREB pathway
- C) Wnt pathway
- D) PKG pathway
- E) None of the above



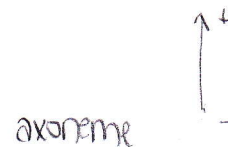
8) The intestinal epithelium is a complex arrangement of cells, junctions, pumps and other transport components. One function of this epithelial arrangement is to

- A) maintain high Na^+ levels in the blood.
- B) transport glucose across the apical and basal membranes.
- C) maintain low Na^+ levels in the blood.
- D) transport glucose into the intestinal lumen.
- E) pump glucose into cells.



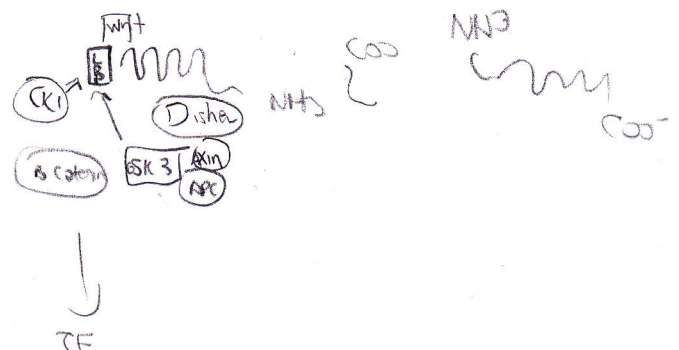
9) Centrioles are pivotal cellular components whose distinct structure is well characterized. During mitosis centrioles replicate and then become components of the mitotic apparatus. A difference between a centriole found in a mitotic versus a non-mitotic cell is that:

- A) in non-mitotic cells centrioles are not associated with an MTOC.
- B) centrioles are made of triplet microtubules only in mitotic cells.
- C) in non-mitotic cells centrioles are basal-body linked.
- D) centrioles drive cell migration in non-mitotic cells.
- E) None of the above are differences.



10) The GPCR-like protein Frizzled has seven transmembrane domains. Accordingly we know that Frizzled:

- A) is an ABC transporter.
- B) has cytosolic domains that bind Wnt ligands.
- C) has 6 extracellular domains.
- D) is a type IV transmembrane protein.
- E) Two of the above.



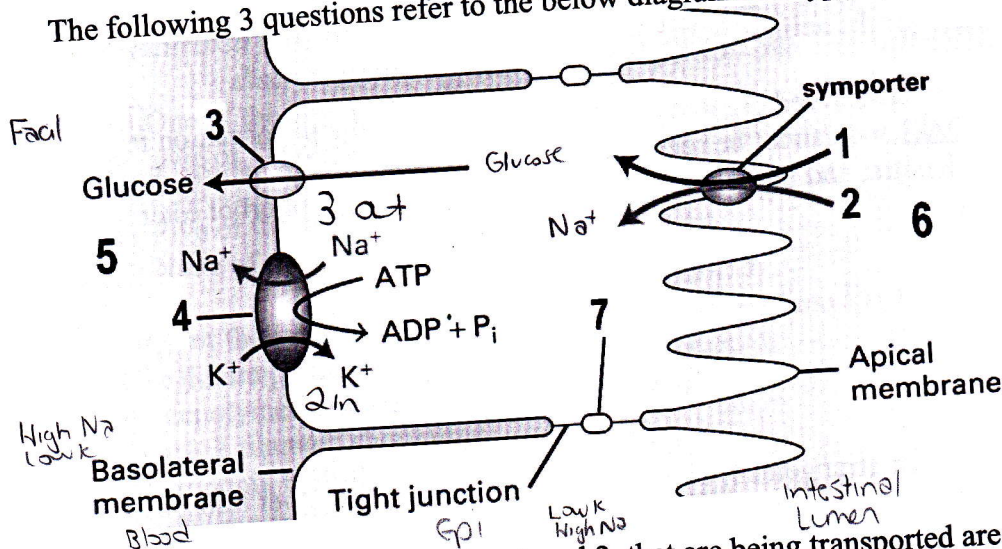
11) Given what you know about collagen processing, secretion and function, in how many of the following locations would you expect to find collagen? *Scurvy, Vit C*

ER; cis-Golgi; cell surface; mitochondria; trans-Golgi; peroxisomes
Essential Protein

- A) 2
- B) 3
- C) 4
- D) 5
- E) 6

X1 B1
not cyclops

The following 3 questions refer to the below diagram of a typical epithelial cell.



12) The molecules, designated as 1 and 2, that are being transported are:

- A) K⁺ and Na⁺
- B) Na⁺ and glucose
- C) ADP and ATP
- D) K⁺ and glucose
- E) ATP and H⁺

13) The type of transport designated by 3 is:

- A) Passive diffusion
- B) Facilitated transport
- C) Active transport
- D) Secondary transport
- E) Primary active transport

14) Labels 5 and 6 each represent, respectively:

- A) body tissues and intestinal lumen
- B) intestinal lumen and lung air space
- C) body tissues and lung air space
- D) body tissues and blood supply
- E) intestinal lumen and blood supply

15) *c-Fos* is considered a proto-oncogene because as a transcription factor, its unregulated expression occurs in response to abnormal growth factor signaling associated with the proliferation of various cancers. How many of the following directly relate to the *c-Fos* protein?
 it contains an activation domain; EMSA could be used to prove/disprove *c-Fos* binds to the promoter of the *p27Kip1* gene; it contains a GPI-anchor; immunofluorescence and confocal microscopy would show it travels through the cis-Golgi

- A) one
- ☒ B) two
- C) three
- D) four
- E) none of the above

16) To complete the characterization of *c-Fos*, you found using a yeast-two hybrid assay that it dimerizes non-covalently into an AP-1 complex with the *c-Jun* protein. Which one of the following would you have to use to convince your audience that this occurs naturally in living cells?

- ☒ A) EMSA
- ☒ B) FRET
- ☒ C) KDEL → endocytosis
- ☒ D) CAAX destruct
- ☒ E) NCAM 16 superfamily → independent of Ca^{2+} homophilic

17) Many people from the Swedish province of Norrbotten have a genetic disease called Gaucher's type III, which is due to a single mutation in exon 10 of the glucocerebrosidase gene, leading to a proline to leucine substitution. The result is an accumulation of glucocerebroside in certain white blood cells that contribute to an enlarged liver and spleen. Your task is to select the proper technique a hospital lab would need in order to screen a population of individuals for this disease. The best method to detect this mutated enzyme is:

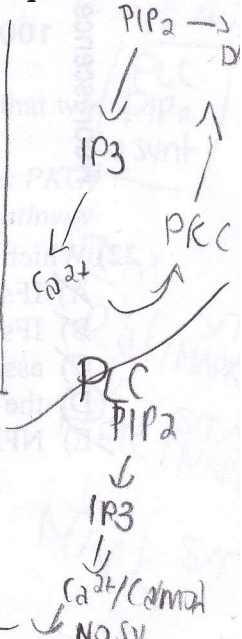
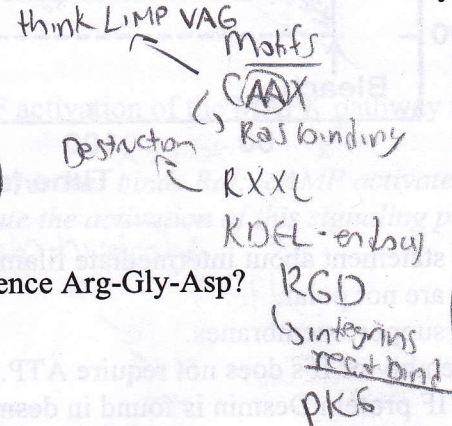
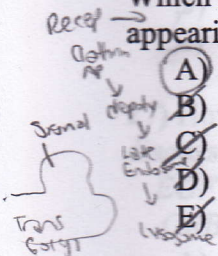
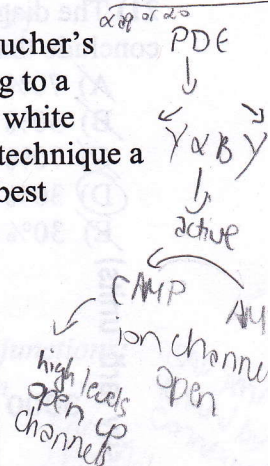
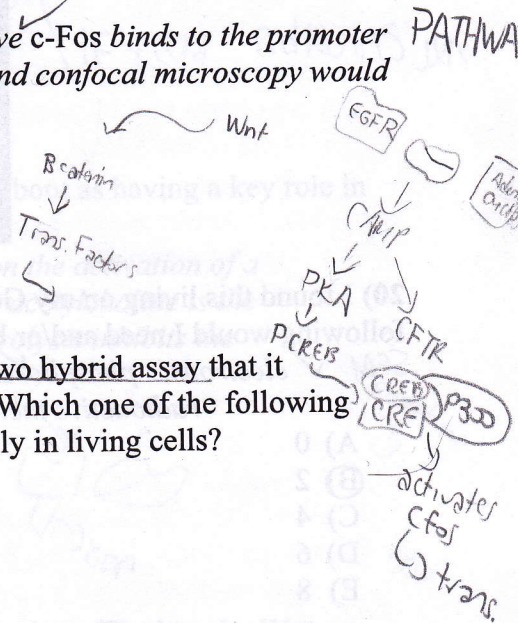
- ☒ A) EMSA
- ☒ B) autoradiography
- ☒ C) 2D PAGE charge (K_F) → 20 charged
- ☒ D) FRET analysis
- ☒ E) equilibrium density gradient centrifugation - density

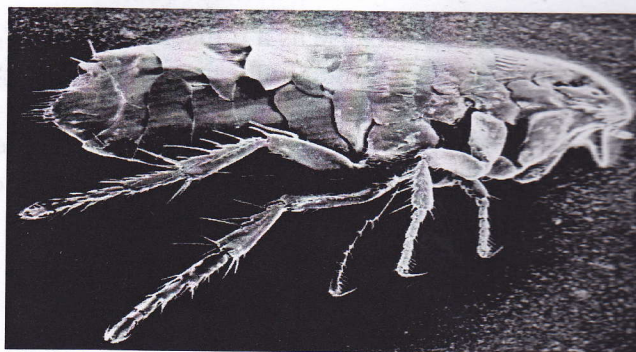
18) Gaucher's disease is also considered to be the most common of the lysosomal storage diseases. Which one of the following is the best hypothesis you can think of that would contribute to symptoms appearing related to a problem with the lysosome?

- ☒ A) the absence of glucose-6-phosphate receptors
- ☒ B) no peroxisomes
- ☒ C) hyperactive adenylyl cyclase → high (AMP)
- ☒ D) absence of COPII vesicles ER → Golgi (antag)
- ☒ E) dominant Wee1 cell cycle

19) Which secreted protein(s) contains the tripeptide sequence Arg-Gly-Asp?

- ☒ A) integrin
- ☒ B) fibronectin
- ☒ C) lamin
- ☒ D) plectin
- ☒ E) all of the above.





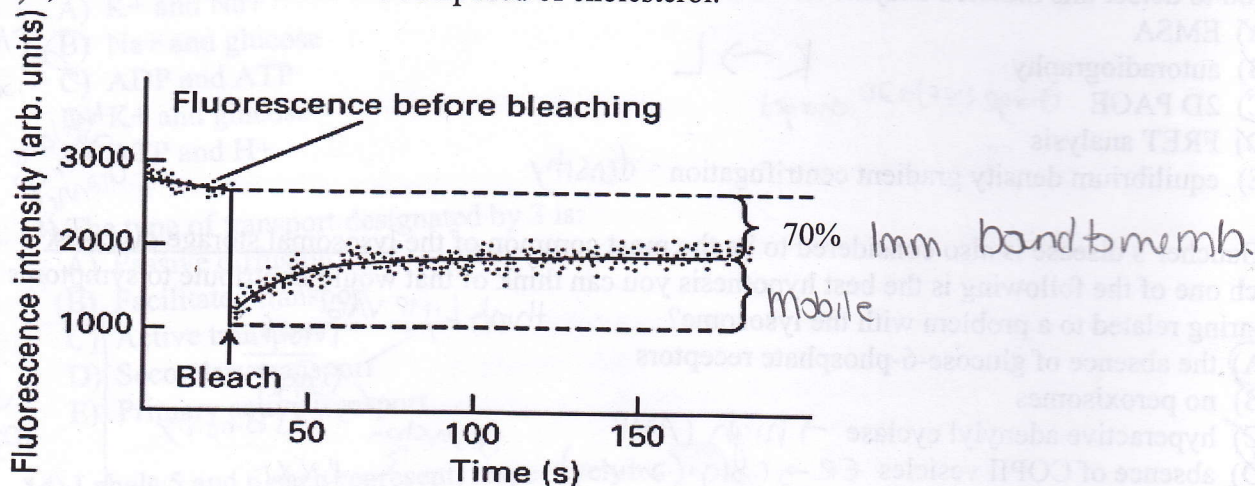
20) I found this living on my Golden Retriever and had to take a picture of it. How many of the following would I need and/or be required to generate this micrograph?

SEM ✓ electrons; phosphorescent screen; a vacuum; rhodamine-phalloidin; ricin; UV-light; radioactive methionine; X-ray film; monoclonal antibodies; barrier filter

- A) 0
 B) 2
 C) 4
 D) 6
 E) 8

21) The diagram below illustrates the results of a FRAP experiment. Based on these data, one could conclude that

- A) 70% of the membrane is mobile.
 B) 30% of the membrane is composed of lipids.
 C) 70% of the membrane is composed of protein.
 D) 30% of the membrane is mobile.
 E) 30% of the membrane is composed of cholesterol.



22) Which statement about intermediate filaments (IFs) is false?

- A) IFs are not polar.
 B) IFs support membranes.
 C) assembly of IFs does not require ATP.
 D) the IF protein Desmin is found in desmosomes.
 E) NFL is found in nerves.

IF
 not polar
 no motor tracks
 Structure
 7-9 nm

Friday April 23rd 2010

Code 333

23) Cadherins:

- ☐ A) bind fibronectin.
- ☒ B) are linked to the cytoskeleton.
- ☐ C) bind intracellular calcium.
- ☐ D) bind with their integrin partners.
- ☐ E) are cleaved to remove the anchor peptide.

24) How many of the following applies to the K^+ channel that we talked about as having a key role in heart rate regulation?

it is activated directly by the γ and β subunits; signaling relies on the activation of a \times nicotinic-GPCR; K^+ flows out of the cell following stimulation; acetylcholine is the ligand responsible for initiating the signaling event; GTP hydrolysis inhibits the initial stimulation

- ☐ A) One of the above.
- ☐ B) Two of the above.
- ☒ C) Three of the above.
- ☐ D) Four of the above.
- ☐ E) Five of the above.

25) Proteasome degradation is a mechanism that ensures the Wnt pathway is "off" when the Wnt ligand is not present. In this case, B catenin is phosphorylated by CKI prior to its degradation in the proteasome.

- ☐ A) Cyclin, MAPK
- ☐ B) CREB, PKA
- ☐ C) Raf, PKC
- ☐ D) β -catenin, MEK
- ☒ E) None of the above

26) How many of the following are functions performed by the extracellular matrix?

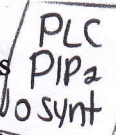
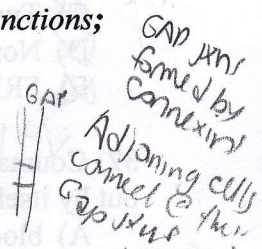
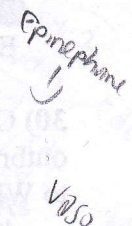
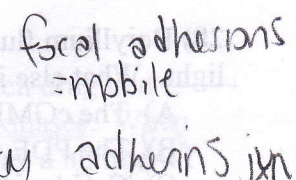
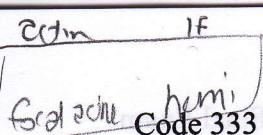
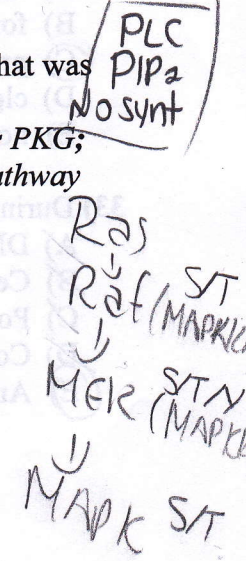
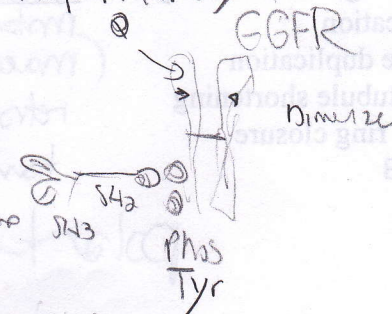
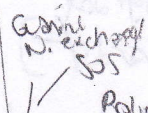
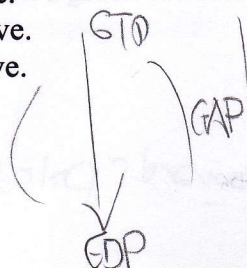
facilitating ligand/receptor binding; holding organelles within cells; modulating gap junctions; driving membrane extension; inhibiting cell migration; aiding cell migration

- ☒ A) 2
- ☐ B) 3
- ☐ C) 4
- ☐ D) 5
- ☐ E) 6

27) How many of the following are true regarding the EGF activation of the MAPK pathway that was discussed in lectures?

EGF receptors can dimerize in the absence of EGF; Active Ras binds Raf; cAMP activates PKG; GRB2 binds the SH2 domains on SOS; GAPs accelerate the activation of this signaling pathway

- ☐ A) All of the above.
- ☐ B) One of the above.
- ☐ C) Two of the above.
- ☐ D) Three of the above.
- ☒ E) None of the above.



28) Beryllium fluoride is a chemical that activates transducin, even in the total absence of GTP or light. What else is expected to occur, following beryllium fluoride exposure?

- POE active
- ☐ A) The cGMP-gated cation channel would be open.
 - ☒ B) The PDE would be active.
 - ☐ C) Ca^{2+} levels would be higher inside rather than outside the rod cell.
 - ☐ D) The brain would perceive this situation as a dark situation.
 - ☐ E) None of the above.

29) V and F pumps share the following feature(s).

- ☒ A) Are asymmetric.
- ☒ B) Are transmembrane proteins.
- ☐ C) They pump K^+ H
- ☒ D) 2 of the above.
- ☐ E) None of the above.

30) On April 13th of this year the San Diego County Health and Human Services Agency reported an outbreak of Whooping Cough in schools in and around San Diego. Which of the following pertaining to Whooping Cough is correct?

- Gα I / Gα S → pot sis
- ☒ A) The toxin is called botox.
 - ☒ B) The toxin targets the Gαq subunit. PDE
 - ☒ C) The toxin would cause a decrease in intracellular ATP levels.
 - ☒ D) The toxin keeps phospholipase C in a permanent "on" condition. Adenyl Cyclase
 - ☐ E) The toxin acts directly on microtubules, preventing them from disassembling.

31) If you were a clinician and had received tissue samples from those children displaying symptoms of a Whooping Cough infection, which one of the following techniques would be the most informative to support your claim that they had in fact been infected by this bacteria?

- ☒ A) Confocal microscopy and immunofluorescence with an antibody to adenylyl cyclase (effector)
- ☒ B) SDS-PAGE and Western blot analysis to measure the GDP state of Gαi
- ☒ C) Two-Hybrid analysis to measure cyclin/cdk interactions cell cycle
- ☒ D) Northern blot analysis to measure p53 levels cell
- ☒ E) FRET analysis to measure SNARE/botox interactions

32) Coumarin, contributes to that wonderful aroma you smell when passing a field of fresh cut clover, but by itself it is especially dangerous at high concentrations because it specifically acts to:

- ☐ A) block the synthesis of new mRNA
- ☐ B) force the transition of G to F-actin
- ☒ C) promote blood clotting
- ☐ D) cleave a docking complex required for neurotransmission
- ☐ E) none of the above

33) During which stage of the cell cycle is dynein function critical?

- ☒ A) DNA replication
- ☒ B) Centrosome duplication
- ☒ C) Pole microtubule shortening
- ☒ D) Contractile ring closure
- ☒ E) Anaphase B

motors (movement) retrograde towards (-)
polar tubules towards poles in Ana B

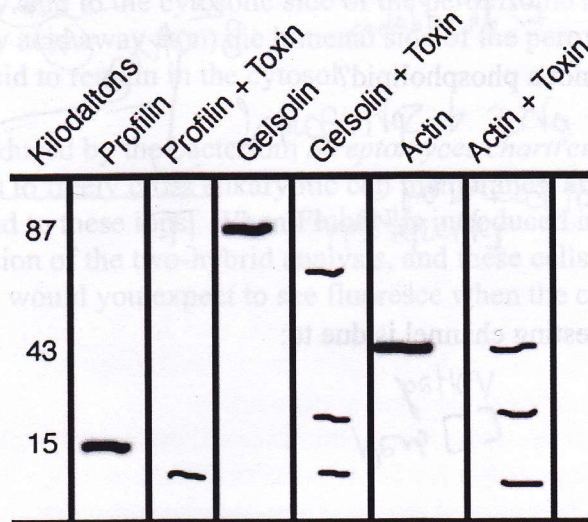
34) Any drugs that target the cell cycle are of particular interest as they could serve as chemotherapeutic agents against cancer. *Seliciclib*, also called *R-roscovitine*, is one such drug that is currently in clinical trials because it appears to act as an inhibitor of cyclin-dependent kinases. When non-small cell lung cancer cells are treated with *R-roscovitine* they stop growing, display a number of characteristic features and then undergo apoptosis. Using the right assays, how many of the following would you expect to see following the treatment of these cells with *R-roscovitine* and before they complete apoptosis?

- ☒ COPII vesicles; ☒ lamins; ☒ blebs; ☒ p34^{cdc2}; ☒ ubiquitin; ☒ p53; ☒ SRP receptor; ☒ gelsolin;
☒ ER-Golgi; ☒ bind ECM; ☒ α-tubulin; ☒ histone H1; ☒ cell free sys.; ☒ CDK

- (A) Two of the above
 (B) Three of the above
 (C) Five of the above
 (D) Nine of the above
 (E) All of the above

35) Years ago it was very popular to study the effects of toxins on cytoskeletal and cytoskeletal-associated proteins. Using a cell free system with all the components needed for translation, S³⁵ methionine, and mRNAs specific for profilin, actin and gelsolin, researchers translated these mRNAs in the presence of a toxin and then used SDS-PAGE and autoradiography to analyze the products. The products were electrophoresed alongside control samples of mRNAs translated without the toxin. In one case, the scientist did not tell her colleague what toxin was used, and when the gel was run and exposed to X-ray film, the autoradiogram looked like this:

Pro-promote poly charging Gpp



Based on the toxins that were discussed in class, the one responsible for the data above is:

- A) Ackee - fruit, poisonous, blocks
 B) TTX - tetra - puffer fish - lethal
 C) cholera - CAMP
 D) phalloidin - stab
 (E) cannot be determined given the evidence

36) What cellular event is not associated with ricin poisoning?

- A) Coenzyme A signalling.
 B) Receptor mediated endocytosis.
 C) Retrograde transport.
 D) Dynein transport.
 E) Recognition by chaperons. *chaperones*

*rec chap
chaperone*

37) Resolution for a Brightfield Microscope is defined as being equal to:

A) $\frac{0.61\lambda}{n \cos \alpha}$

B) $\frac{0.61\lambda}{\alpha}$

C) $\frac{0.61\lambda}{\sin \alpha}$

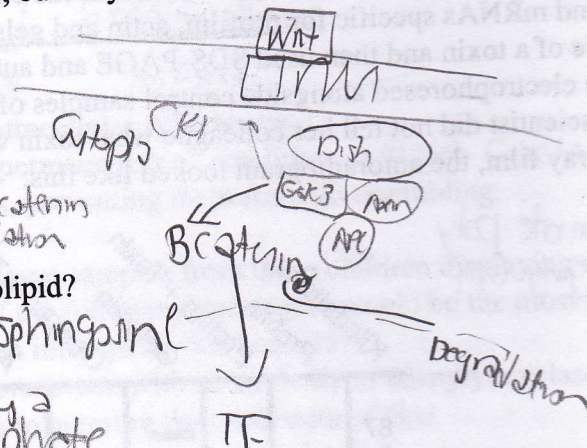
D) $\frac{0.61\lambda}{n \sin \alpha}$

E) $\frac{0.61 \cos \lambda}{n \arctan \alpha}$

38) Activation of the Wnt pathway in 80% of prostate cancers leads to metastasis, the migration of tumour cells into bone. Investigators are trying to prevent this from happening by using the protein Dickkopf (Dkk-1) which, at micromolar concentrations, very effectively binds Wnt and prevents it from interacting with its receptor. When you apply these same concentrations of Dkk1 to LNCaP prostate cancer cells, they change their shape, but they do not migrate. Using a variety of techniques you find:

- A) no Dishevelled protein
 B) β -catenin is in the nucleus
 C) Rho bound to GDP
 D) GSK-3 is not associated with Axin
 E) none of the above

*it is phos. β -catenin
for degradation*



39) Which of the following is not a phospholipid?

- A) SM *bind by 2 phos + sphinganol*
 B) PE
 C) GlcCer, *sugar, not bound by a phosphate*
 D) PS
 E) PI

40) The selectivity of the K⁺ resting channel is due to:

- A) size-based exclusion.
 B) gap-junction pore size.
 C) pump selectivity.
 D) the GTP state of K⁺.
 E) hydrophobic attraction.

*voltage
[] grad*

cdc42

41) How many of the following are G proteins?

Gai; transducin; MAPK; β -catenin; Ras; Rho; Rac; cdc42

- A) 4
 B) 5
 C) 6
 D) 7
 E) 8

42) Brefeldin A is a substance that when added to cells interferes with transport from the endoplasmic reticulum to the Golgi apparatus. This specific interference is associated with:

- ☐ A) spectrin coated membranes.
- ☐ B) anterograde transport.
- ☒ C) interference of RGD signals.
- ☐ D) clathrin coated membranes.
- ☐ E) intermediate filament depolymerization.

ER → Golgi
cop II
Arter

43) Which of the following molecules are common to BOTH desmosomes and adherens junctions?

- ☐ A) Cadherins.
- ☐ B) Microtubules.
- ☐ C) Microfilaments.
- ☐ D) Intermediate filaments.
- ☒ E) Two of the above.

44) The importance of protein asymmetry is exemplified by chloroplast membranes where the directional movement of ions is crucial to photosynthesis. While they do not have as complex a membrane structure as chloroplasts, peroxisomes membranes and their proteins play key roles in the metabolism of fatty acids. PMP70 is a peroxisomal membrane protein one of whose functions is to transport such fatty acids into the peroxisome. In doing so it is:

- ☒ A) transporting the fatty acid to the expolasmic side of the peroxisome membrane.
- ☐ B) allowing for the passive diffusion of the fatty acid across the peroxisome membrane.
- ☐ C) transporting the fatty acid to the cytosolic side of the peroxisome membrane.
- ☐ D) transporting the fatty acid away from the luminal side of the peroxisome membrane.
- ☐ E) allowing the fatty acid to remain in the cytosol.

ABC pump
↓
Cytosol

45) Calcein, a toxin produced by the bacterium *Streptomyces chartreusensis*, acts as a mobile ion-carrier that allows Ca^{2+} ions to freely cross eukaryotic cell membranes, and indicators like Fluo5N give off fluorescence when bound to these ions. When Fluo5N is introduced into the same kind of yeast cells we used in our discussion of the two-hybrid analysis, and these cells are then treated with Calcein, what organelle would you expect to see fluoresce when the cells are examined by confocal microscopy?

- ☐ A) Mitochondria
- ☐ B) Lysosome
- ☐ C) Proteasome
- ☐ D) RER
- ☒ E) None of the above.

↓
can't see fluorescence

46) In a culture dish containing a pure population of endothelial cells, Calcein stimulates nitric oxide (NO) production by a calmodulin-dependent nitric oxide synthase. Which one of the following is expected to coincide with the increase in NO levels?

- ☒ A) Increase in cAMP production.
- ☐ B) Increase in the concentration of GTP.
- ☐ C) Increase in PKG activity. → activates
- ☐ D) Decrease in citrulline production.
- ☐ E) None of the above

Arg + O_2 → Citrulline + NO

47) You learned a great deal from the Calcimycin experiments, but when you turn your attention to studying smooth muscle relaxation of blood vessels in a living mouse model system, you stumble on a real cell biology puzzle. To begin with, you test the ability of these endothelial cells to respond to muscarine, and they respond in the appropriate manner, IP₃ is released and using Fluo5N, you detect the almost immediate increase in Ca²⁺ into the cytosol. Immunoblot analysis indicates that calmodulin levels are normal, but there is one noticeably absent protein that confirms your suspicions as to why muscarine stimulation fails to cause vasodilation of the blood vessels. The missing protein at the root of this problem is:

- ☐ A) Phospholipase C
- ☒ B) Guanylyl cyclase
- ☐ C) Protein kinase C
- ☐ D) Acetylcholine GPCR
- ☐ E) All of the above.

48) FGFR is a type III transmembrane protein that participates in signal transduction events along with proteoglycan low affinity receptors. These proteoglycans:

- ☐ A) bind to the FGFR STA domain.
- ☒ B) cleave the FGFR signal sequence.
- ☐ C) cleave the FGF N-terminal signal sequence.
- ☒ D) associates with the FGFR N-terminal domain.
- ☐ E) aid with FGF-RGD binding.

I
Type III } STA
II } N_{in}exo, SA

49) BiP is a key player in the Wnt signaling pathway and, although it was not discussed in lectures, I can tell you that it is resident RER protein. Having said that you would expect to find that BiP contains a _____ motif.

- ☐ A) mannose-6-phosphate → degradation
- ☒ B) KDEL sequence
- ☐ C) ubiquitin ligase
- ☐ D) RxxL → deubiquitin
- ☐ E) CaaX → Ras

↑ Golgi
KDEL

50) A result of a cell having both Na⁺ K⁺ ATPase pumps, and the K⁺ resting channels is that:

- ☐ A) the depolymerized membrane can be triggered by a nerve impulse.
- ☐ B) the ion and charge gradients can be used to do work.
- ☐ C) passive diffusion of glucose across the membrane will be faster.
- ☒ D) the K⁺ gradient makes it possible for faster passive diffusion of K⁺ back into the cell.
- ☐ E) membrane thickness will be altered due to increased charges on the polar heads.

51) Which is not associated with carbohydrates?

- ☐ A) Acylation NAG (glucose = carb)
- ☒ B) Exoplasmic leaflet
- ☐ C) ECM
- ☐ D) GPI linked proteins
- ☐ E) The Golgi

52) Mutations in the human phosphatidylinositol-binding clathrin assembly protein (*PICALM*) gene specifically affect adaptor protein complex-dependent clathrin-mediated endocytosis. How many of the following would you expect to see in hepatocytes (liver cells) expressing a mutated *PICALM* gene?

no LDL receptors; increased rate of mitosis; stabilized microtubules; symptoms of hypercholesterolemia; no KDEL-containing proteins; excess ergosterol; no keratin

- A) one
- B) three
- C) five
- D) seven
- E) none of the above

internalize cholesterol

sterol like cholesterol

no endocytosis

mannose 6 phos + rec → clath & AP1

53) Which of the following contributes to the stability of microtubules?

- A) Colchicine
- B) Phalloidin
- C) EB1
- D) MAPs
- E) Kinesin

colchicine - depol

Tau2 / 7 stable

54) In mice, the G-protein $\gamma 3$ subunit binds a β subunit and as a result, neurons throughout the gut are stimulated. At present it is not known how the $\beta\gamma$ complex is activated and therefore we need you to pick out the technique from the list below that is best suited to identify which one of the β subunit family can bind $\gamma 3$.

- A) Gel filtration chromatography.
- B) Autoradiography.
- C) Yeast two-hybrid analysis.
- D) DNA microarray analysis.
- E) Monoclonal antibody production.

55) In your analysis from above you find there are two β subunits, 1 and 3 that each bound to $\gamma 3$ and although excited by the findings, you are skeptical that this may not be an event that occurs in cells in the mouse. To convince your audience you decide to follow up with a technique and that technique confirms your suspicions that in mouse intestinal cells, $\gamma 3$ only binds $\beta 3$. The technique you chose was:

- A) Ion exchange chromatography.
- B) DNA microarray analysis.
- C) Atomic force microscopy.
- D) FRET analysis.
- E) Scanning electron microscopy.

56) According to your text (Lodish et al.), which one of the following is an aliphatic amino acid required for proper signaling involving the Ras G-protein?

- A) Proline ✓
- B) Isoleucine ✓
- C) Histidine
- D) Tyrosine
- E) Threonine

LIMP VAG

57) Ras that lacks its C-terminal domain would interfere with EGF signalling because it:

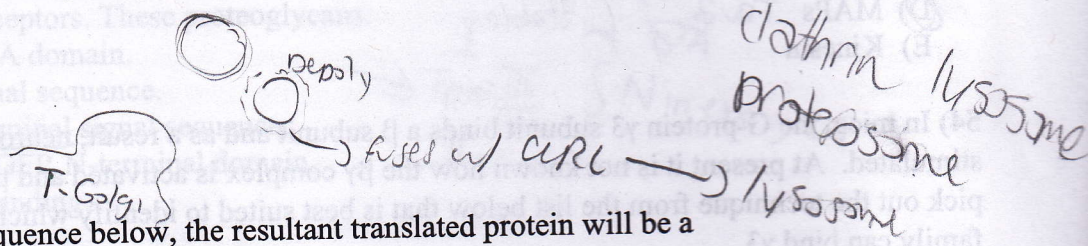
- ☒ A) could not act as the EGFR ligand. *not ligand*
 - ☐ B) could not de-phosphorylate MAPK.
 - ☐ C) would be retained in the RER.
 - ☐ D) could not be secreted.
 - ☐ E) None of the above.
- Diagram: A box labeled 'No' with 'cleaved' written next to it, pointing to a protein structure. A label 'G protein' points to a protein structure.*

58) In Addition to DAG, the other second messenger that forms from the cleavage of PIP₂ by PLC is:

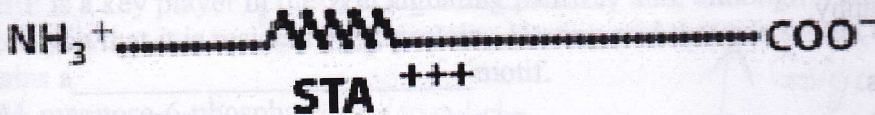
- ☐ A) cAMP
- ☐ B) IP₂
- ☐ C) PI3K
- ☒ D) IP₃
- ☐ E) NO

59) Clathrin, a key player in receptor-mediated endocytosis, is a major component of the:

- ☒ A) RER
- ☐ B) nuclear envelope
- ☐ C) lysosomes
- ☐ D) proteasome
- ☐ E) endocytotic pit



60) Given the topogenic sequence below, the resultant translated protein will be a



- ☐ A) secreted protein.
- ☐ B) type II transmembrane protein.
- ☐ C) type III transmembrane protein.
- ☐ D) cytosolic protein.
- ☒ E) None of the above.

Question	Answer	Weight	Alternate	Alternate	Alternate	Alternate
1	D	1.0				
2	A	1.0				
3	B	1.0				
4	B	1.0				
5	B	1.0				
6	C	1.0				
7	A	1.0				
8	A	1.0				
9	C	1.0				
10	E	1.0				
11	B	1.0				
12	E	1.0				
13	C	1.0				
14	D	1.0				
15	A	1.0				
16	A	1.0				
17	C	1.0				
18	B	1.0				
19	E	1.0				
20	B	1.0				
21	E	1.0				
22	A	1.0				
23	C	1.0				
24	C	1.0				
25	A	1.0				
26	C.	1.0				
27	D	1.0	C(1)			
28	E	1.0				
29	D	1.0				
30	D	1.0				
31	C	1.0				
32	E	1.0				
33	A	1.0				
34	C	1.0				
35	A	1.0				
36	A	1.0	B(1)	C(1)	D(1)	E(1)
37	C	1.0				
38	D	1.0				
39	D	1.0				
40	D	1.0				
41	D	1.0				
42	B	1.0	E(1)			
43	B	1.0				
44	A	1.0				
45	C	1.0				
46	E	1.0				
47	A	1.0				
48	A	1.0				
49	B	1.0				
50	E	1.0				
51	C	1.0				
52	A	1.0				
53	C	1.0				
54	A	1.0				
55	C	1.0				
56	A	1.0				
57	C	1.0				
58	E	1.0				
59	B	1.0				
60	A	1.0				