

**CORK INSTITUTE OF TECHNOLOGY**  
**INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ**

**Autumn Examinations 2012**

**Module Title:     Molecular Biology**

**Module Code:**         GENE 7002

**School:**                Science & Informatics

**Programme Title:**

BSc in Applied Bioscience with Biotechnology – Stage 3

BSc (Hons) in Pharmaceutical Biotechnology – Stage 3

**Programme Code:**    **SBIBI\_7\_Y3**  
                              **SPHBI\_8\_Y3**

**External Examiner(s):**     Dr Don Faller / Dr Jerry Bird

**Internal Examiner(s):**     Dr Brigid Lucey

**Instructions:** This exam booklet is your answer book. Please hand it up at the end of the exam to the invigilator.

*Answer all questions. Each question carries equal marks. Circle the letter (A,B,C, etc.) under the question number. If you want to make a correction, cross the letter out completely and write the correct letter beside it. Only one answer is correct; marking more than one per question cancels the question.*

**Duration:**         2 Hours

**Sitting:**             Autumn 2012

**Requirements for this examination:**

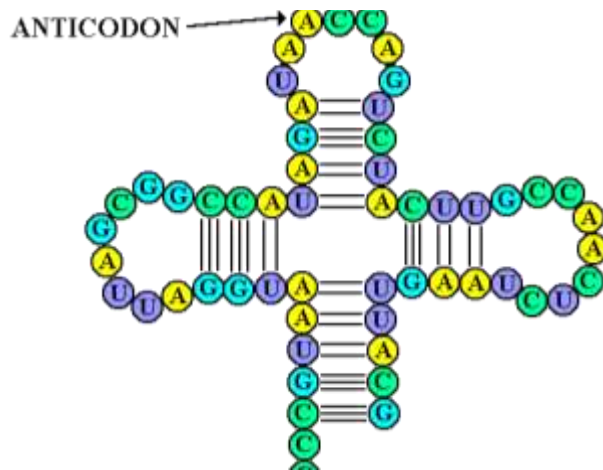
**Note to Candidates:** Please check the Programme Title and the Module Title to ensure that you have received the correct examination paper.  
If in doubt please contact an Invigilator.

1. What is the function of DMSO in the PCR reaction?
  - A. To prevent the mixture from sticking to the sides of the tube
  - B. To denature the DNA
  - C. To prevent self-complementarity
  - D. To chelate calcium
  - E. To act as a buffer
  
2. The function of Bovine Serum Albumin in the PCR mixture is:
  - A. To prevent the mixture from sticking to the sides of the tube
  - B. To denature the DNA
  - C. To prevent self-complementarity
  - D. To chelate calcium
  - E. To act as a buffer
  
3. When DNA is being isolated from blood, the best fraction to use is
  - A. The plasma
  - B. The buffy coat
  - C. The red blood cells
  - D. The fibrin
  - E. None of the above
  
4. When DNA is being isolated from blood, why is EDTA used?
  - A. It binds calcium
  - B. It binds protein
  - C. It binds RNA
  - D. It binds fibrin
  - E. It binds white blood cells
  
5. How much of the eukaryotic genome codes for proteins?
  - A. 2%
  - B. 12%
  - C. 25%
  - D. 50%
  - E. 95%
  
6. At what temperature does DNA extension optimally occur during the polymerase chain reaction (PCR)?
  - A. 95°C
  - B. 72°C
  - C. 65 °C
  - D. 60°C
  - E. 50°C

7. Which of the following statements is NOT one of the uses of PCR?
- A. Detection of a specific gene
  - B. Detection of a mutation in a gene
  - C. Epidemiological typing of a collection of microbes
  - D. Amplification of a protein
  - E. Detection of a pathogen in food
8. For a PCR total volume of 50  $\mu\text{l}$  how much 25mM  $\text{MgCl}_2$  stock solution would you add to the mix to achieve a final concentration of 4mM  $\text{MgCl}_2$ ?
- A. 4.0  $\mu\text{l}$
  - B. 5.0  $\mu\text{l}$
  - C. 5.0  $\mu\text{l}$
  - D. 6.0  $\mu\text{l}$
  - E. 8.0  $\mu\text{l}$
9. For a PCR total volume of 100 $\mu\text{l}$ , how much 10X buffer would you add to achieve a working concentration of 1X?
- A. 1  $\mu\text{l}$
  - B. 4  $\mu\text{l}$
  - C. 5  $\mu\text{l}$
  - D. 10  $\mu\text{l}$
  - E. 50  $\mu\text{l}$
10. For a RAPD PCR, when provided with a stock primer concentration of 25 pmol/ $\mu\text{l}$ , how many microlitres of primer would you need to add in a total PCR volume of 100  $\mu\text{l}$  to achieve a concentration of 25 pmoles?
- A. 1  $\mu\text{l}$
  - B. 10  $\mu\text{l}$
  - C. 4  $\mu\text{l}$
  - D. 1,000  $\mu\text{l}$
  - E. 2,500  $\mu\text{l}$
11. When calculating the  $T_m$  or melting temperature for the primer 5'**GCCGGCGACTACTTGATCAGT** 3', which of the following is correct?
- A. 60°C
  - B. 42°C
  - C. 66°C
  - D. 68°C
  - E. 70°C

12. In a PCR reaction the annealing temperature should be
- A. 5°C higher than the  $T_m$
  - B. 5°C lower than the  $T_m$
  - C. 10°C higher than the  $T_m$
  - D. 10°C lower than the  $T_m$
  - E. None of the above
13. Which of the following is the most accurate: The promoters of *E. coli* may have a frequency of initiation of up to
- A. A ten-fold range
  - B. A 100-fold range
  - C. A 1,000-fold range
  - D. A 10,000-fold range
  - E. They are all the same
14. What is the purpose of the heated lid on the thermocycler?
- A. To decrease ramping times
  - B. To increase ramping times
  - C. To prevent evaporation
  - D. To allow even heating over all wells
  - E. None of the above
15. Which of the following is not part of the *lac* operon of *E. coli*?
- A. Genes for the repressor, a regulatory protein
  - B. Genes for inducible enzymes of lactose metabolism
  - C. A gene for RNA polymerase
  - D. A promoter, the RNA polymerase binding site
  - E. The operator, the repressor binding site
16. In bacterial promoters, which of the following describes the Pribnow box?
- A. The 5' untranslated region
  - B. The -10 region
  - C. The -35 region
  - D. The -50 region
  - E. The termination sequence
17. How many different transfer RNAs are there?
- A. 20
  - B. About 30
  - C. About 45
  - D. 61
  - E. 64

18. Which of the following is true of RNA transcription?
- A. RNA synthesis is always in the 5' to 3' direction
  - B. RNA polymerase needs a primer to initiate synthesis
  - C. In transcription U is inserted opposite T
  - D. New nucleotides are added on to the 2' OH of the ribose sugar
  - E. RNA synthesis is always in the 3' to 5' direction
19. The anticodon ACC shown below this question will bind to which mRNA sequence?
- A. TGG
  - B. ACC
  - C. GGT
  - D. GGU
  - E. UGG



20. An example of disease caused by lysogeny is found in
- A. *Vibrio cholerae*
  - B. *Shigella dysenteriae*
  - C. *Streptococcus pyogenes*
  - D. All of the above
  - E. None of the above
21. Svedberg units may most accurately defined as measuring
- A. Migration rates
  - B. Density
  - C. Sedimentation rates
  - D. All of the above
  - E. None of the above

22. Conditions that can stimulate termination of the lysogenic state include
- A. Dessication
  - B. Mutagens
  - C. UV radiation
  - D. All of the above
  - E. None of the above
23. Which one of the following statements is true of prokaryotes?
- A. One mRNA = one protein
  - B. Prokaryotic DNA contains large stretches of repetitive DNA
  - C. DNA in prokaryotes is found complexed with histones
  - D. In prokaryotes one mRNA can be polycistronic
  - E. Prokaryotic genes are usually split into introns and exons
24. In *E. coli* the sigma factor of RNA polymerase is
- A. Required for specificity of transcription
  - B. Required for translation
  - C. Required for production of the other subunits of RNA polymerase
  - D. Required to bind to an amino acid
  - E. Required for none of the above suggestions
25. The -35 region of the promoter region of prokaryotic organisms
- A. Affects the binding of DNA polymerase
  - B. Affects the binding of RNA polymerase
  - C. Affects the binding of chromosomal plasmids
  - D. Repels DNA polymerase
  - E. Repels RNA polymerase
26. A strong promoter is one which
- A. Selects for a low rate of transcription
  - B. Differs greatly from the consensus sequence
  - C. Differs little from the consensus sequence
  - D. Is more useful than a weak promoter to the bacterial cell
  - E. Can only promote the translation of a single gene
27. The optimal temperature for *Taq* DNA polymerase activity is
- A. 37°C
  - B. 40°C
  - C. 45°C
  - D. Between 40 and 60°C
  - E. Between 70 and 80°C

28. Which of the following statements is NOT true?  
The function of  $MgCl_2$  in the PCR reaction is to:
- A. Acts as a co-factor for *Taq* DNA polymerase activity
  - B. Stabilises dsDNA
  - C. Affects the end product of PCR
  - D. Works best at a 15 mmolar concentration
  - E. Helps in the binding of primer
29. In molecular biology elution refers to
- A. The removal of RNA from the DNA preparation
  - B. The freeing of DNA from the extraction column
  - C. The lysis of bacterial cells
  - D. The homogenisation of DNA in solution
  - E. The removal of protein from the lysed cells
30. Random Amplified Polymorphic DNA analysis:
- A. Does not require prior knowledge of the genome sequence
  - B. Typically uses primers that are 22 or more bases in length
  - C. Uses pairs of primers
  - D. Is not reproducible
  - E. Needs an annealing temperature of  $>50^{\circ}C$
31. Degenerate primers are
- A. Primers that have degraded
  - B. Primers that require a high annealing temperature to work
  - C. Primers that require no prior knowledge of the template sequence
  - D. Mixtures of primers that are similar but not identical
  - E. None of the above
32. A mRNA base sequence for the amino acid leucine is UUA. The complementary DNA base sequence is:
- A. TTA
  - B. AAT
  - C. TTT
  - D. AAA
  - E. UUA

33. Regarding the use of software programmes for analysis of PCR fingerprints, which of the following statements is NOT true?
- A. Gel capture is part of the process
  - B. Normalisation of the gel is necessary
  - C. The programme is based on a binary system whereby presence or absence of a band is denoted by 1 and 0, respectively
  - D. Human intervention is not possible
  - E. Inter-gel variation can be corrected for comparative purposes
34. Streptavidin/Biotin hybridisation assays of PCR products work because:
- A. Streptavidin and biotin have an extraordinary affinity for one another
  - B. Streptavidin has a high affinity for DNA
  - C. Biotin has a high affinity for DNA
  - D. Biotin has a high affinity for alkaline phosphate
  - E. None of the above
35. Which of the following measures is NOT useful in preventing PCR contamination (false positives)?
- A. Keeping pre- and post-PCR areas separate
  - B. Using separate pipettes for pre- and post-PCR steps
  - C. Using UTP and the enzyme Uracil N-glycosylase (UNG)
  - D. Use of disinfectant
  - E. Using barrier pipette tips
36. Which statement is NOT true about nucleic acid hybridisation?
- A. A protein can hybridise with a DNA strand
  - B. It depends on complementary base pairing
  - C. A DNA strand can hybridise with another DNA strand
  - D. Double stranded DNA can be denatured chemically
  - E. Double stranded DNA denatures at high temperatures
37. Prokaryotic ribosomes consist of
- A. Two subunits: 40S and 30S
  - B. Two subunits: 50S and 30S
  - C. No subunits
  - D. Two subunits: 50S and 40S
  - E. Two subunits: 40S and 40S
38. In the standard genetic code which of the following is NOT a stop codon
- A. AUU
  - B. UGA
  - C. UAA
  - D. UAG
  - E. They are all stop codons



39. In the standard genetic code which of the following is the start codon?
- A. AUA
  - B. AAA
  - C. AUU
  - D. UUU
  - E. AUG
40. In real time PCR the term Cycle Threshold (CT) refers to:
- A. The start of the plateau phase
  - B. The baseline at which fluorescence is detected
  - C. The end of the exponential phase
  - D. The threshold of detection of fluorescence above background
  - E. The point at which 45 cycles have been reached
41. In real time PCR the test is invalid if:
- A. The internal control is not positive
  - B. The internal control is negative for a positive test
  - C. The negative control is negative
  - D. The internal control is negative for a negative test
  - E. None of the above
42. SYBR Green dye binds to
- A. Any single-stranded DNA
  - B. Any double-stranded DNA
  - C. All RNA
  - D. mRNA
  - E. rRNA
43. Fluorescence describes the attributes of some chromophores to emit light with a longer wavelength when excited by light. The wavelength spectrum for this is most correctly described as:
- A. 100-300 nm
  - B. 300-500 nm
  - C. 500-700 nm
  - D. 700-800 nm
  - E. 300-800 nm
44. When using multiple fluorophores simultaneously in a real time PCR assay, in order to be detectable simultaneously the different fluorophores should be separated by
- A. <10 nm
  - B. <20 nm
  - C. 15-50 nm
  - D. >75 nm
  - E. 100-200 nm

45. In real time PCR colour compensation refers to
- A. The process that is necessary to compensate for bleeding of fluorescence into channels other than the optimal one selected
  - B. The means to artificially raise the level of fluorescence
  - C. The signal to re-calibrate the instrument
  - D. The means to decide which is the optimal channel to use for a new dye
  - E. None of the above
46. In prokaryotes introns are found
- A. In mRNA only
  - B. In tRNA and rRNA
  - C. In tRNA only
  - D. In rRNA only
  - E. In all forms of RNA
47. Ramping is a term used in molecular biology to indicate
- A. The changing from one temperature to another
  - B. The optimisation of DNA concentration
  - C. Determination of the correct wavelength to use
  - D. Measurement of DNA concentration
  - E. None of the above
48. RNA polymerase actually covers a region of DNA that is:
- A. 10 bases long
  - B. 20 bases long
  - C. 35 bases long
  - D. 50 bases long
  - E. 75 bases long
49. Different forms of RNA polymerase
- A. Recognise different promoters
  - B. Don't exist
  - C. Recognise only one promoter between them
  - D. Must be complexed to histone proteins
  - E. None of the above
50. In molecular biology chromatograms
- A. Show protein concentrations
  - B. Show nucleotide sequences
  - C. Show DNA concentration
  - D. Generate fingerprints
  - E. Show nucleotide concentration