Hong Kong Olympiad in Informatics 2014
Heat Event (Junior Group)
Official Solution

Statistics (N = 182)
Full mark = 45. Maximum = 44. Median = 21. Advance to Final = 24 marks or above.

Section A

Q	A	Explanation
1	F	The high data transfer speed with optic fiber is due to multiplexing and less signal loss. In fact, the speed of EM wave (light) in optic fiber is approximately 62% (1/1.62) of speed of light in vacuum while the speed (electric signal propagation speed) in coaxial cable is approximately 66%, which is higher.
2	T	The ASCII code of "A" is 65 while that of "a" is 97.
3	T	The range of `short int` is -32,768 to 32,767
4	F	The first character of an identifier (variable name) cannot be a number
5	F	Instructions take different amount time to execute. For example, dividing two numbers is slower than adding them.
6	B	Place 7 bishops in row 4 to achieve the goal.
7	C	The program will simply output every multiple of 3 from 1 to 10
8	B	There is one branch with statements for both cases. There are also no loops.
9	D	Neither integer*string not string*integer is valid.
10	A	The symbol represents the logical operator "OR". OR is associative, meaning that the expression can become (NOT U OR U) OR V, which is TRUE OR V, which is TRUE.
11	D	We can draw a graph like this: Tryndamere ↔ Taric ↔ Xin Zhao ↔ Jarvan IV Master Yi ↔ Wukong Lee Sin ↔ Garen Number of pairs of friends = 4C2 + 1 + 1 = 6 + 2 = 8
12	C	The `a[k+1] = j` at the end of the loop body inserts the new number in the correct position, which shows that the program implements insertion sort.
13	A	Multiplication, division and modulo are all left-associative. This means that the expression should be evaluated as ((72 / 12) / 6) % 4
14	D	From the third sentence we know that he got full marks in the exam, which means he had a nice meal based on the second sentence. From the first sentence we know that he must have studied hard the night before exam. For the fourth sentence, it is equivalent to saying that Tom will play computer games if and only if he is happy.

Q	A	Explanation
15	B	12 = 1100(2), 4 = 0100(2), 12 `&` 4 = 0100(2). 10 = 01010(2), 21 = 10101(2), 10 `|` 21 = 11111(2) Hint: If the operands are positive, the result of `&` would not be larger than the smaller operand. The result of `|` would not be smaller than the larger operand.
16	B	Only ordinal data types such as `int`, `char`, `bool` can be used. Hint: floating point operations are not performed in the ALU.
17	B	Let's simulate the queue: Enqueue(3): [3] Enqueue(4): [3 4] Enqueue(5): [3 4 5] Enqueue(6): [3 4 5 6] Dequeue(): [4 5 6] Dequeue(): [5 6] Enqueue(Dequeue()): [6 5] Enqueue(7): [6 5 7] Dequeue(): [5 7] The next Dequeue() then returns 5.
18	D	The number of ways to form $*x* is the sum of number of ways to form $*x*-1 and $*x*-2. $1: 1 way. $2: 2 ways. $3: 1 + 2 = 3 ways. $4: 2 + 3 = 5 ways. $5: 3 + 5 = 8 ways. $6: 5 + 8 = 13 ways.
19	B	Let's track the value of `x`: 3 -> 2 -> 5 -> 4 -> 7 -> 6 -> 9
20	A	Let's track the value of `j`: 1 -> 0 -> 2 -> 3 -> 7 -> 4 -> 5 -> 8 Finally, the output is `a[8]`, which is 2
21	A	Let's track the value of `a[j]`: 2 -> 3 -> 7 -> 4 -> 5 -> 8 -> 2 -> … (repeats) The cycle length is 6 and the loop is executed 10008 times. $10008 \equiv 0 \pmod 6$
22	A	x*x*2 = 2^{31} which exceeds the maximum range of integer. The left hand side would be negative so the output is false.
23	C	We can safely store a 16-bit integer into a 32-bit integer without losing information.
24	C	Notice the triple `3`s, [K] must be M (the loop that repeats 3 times).
25	A	The output number is smallest when it has the fewest digits. Number of digits for A: 2 * 3 * (4 + 1) = 30 B: 3 * 4 * (2 + 1) = 36 C: 4 * 2 * (3 + 1) = 32 D: 4 * 3 * (2 + 1) = 36

Section B

Answer and Explanation		
A	52 Try all possible options: 0, 1, 2, 3, 4, 5 packs of cabbage.	
B1	`n=1`	`n==1`
B2	`f:=2`	`return 2`
C	`n*2+1` The first fourth prime numbers are 2, 3, 5, 7. Except the first one, others can be calculated by formula n*2-1	
D	4.875 Just calculate the sum of the positive numbers and divide the sum by 8	
E	Any answer that satisfies: $(x + y) - 4294967296 = -170,\ x \leq 2147483647,\ y \leq 2147483647$ Example: 2147483647 2147483479 Notice that $100 + 200 + x + y = 32.5 \times 4$. Therefore $x + y = -170$. The trick is to make use of overflow to achieve negative number.	
F	Logic	
G	21	59
H	`halt end`	`return 0;}`
	Originally, when n is a triangular number, both lines will be printed. We need to stop the program in the body of the if statement.	
I	`swap(p,p+1)`	
J1	`p>0`	
J2	`p:=p-1`	`p=p-1`
K	`p:=p+1`	`p=p+1`
	Alternative answer for J2: `p=0` The program implements insertion sort. A new element will be swapped into correct place before moving on to the next element.	
L	`a[j]:=a[i]-a[j]`	`a[j]=a[i]-a[j]`
	This is one of the many ways to swap two elements without using a temporary variable.	