Q16 $\boxed{\text{A,C,E}}$ Put $t = 0$ into Eq.51 of Unit 2 to give

$$y(x,0) = \sum_{n=1}^{\infty} B_n \sin k_n x \quad \text{where } k_n = n\pi/L.$$

The coefficients B_n are found by using Eq.50 of Unit 2 with $y(x,0)$ equal to the function given in the CMA and carrying out the integrations. A quicker way to the answer is to expand the given function using the trig. identities

$$\cos^2 X = \frac{1+\cos 2X}{2} \quad \text{and}$$

$$\sin A \cos B = \frac{1}{2}[\sin(A+B) + \sin(A-B)].$$

Using these, the given function can be expressed as

$$y(x,0) = 0.04L\left[\frac{1}{2}\sin(3\pi x/L) + \frac{1}{4}\sin(5\pi x/L) + \frac{1}{4}\sin(\pi x/L)\right].$$

Hence the non-vanishing coefficients are B_3, B_5 and B_1.

Q17 $\boxed{\text{A,E}}$ Looking at the answer to Q16 you can see that the non-vanishing coefficients are $B_3 = 0.02L, B_5 = 0.01L$ and $B_1 = 0.01L$.

Q18 $\boxed{\text{D}}$ The phase velocity is given by Eq.28 of Unit 2, $v_p = \omega/k$. Here it is

$$v_p = \frac{v}{k}\left[k^2 + k^4/k_0^2\right]^{1/2} = v\left[1 + k^2/k_0^2\right]^{1/2}.$$

For $k = 0.75k_0$, this yields $v\left[1 + (0.75)^2\right]^{1/2} = 1.25v$.

Q19 $\boxed{\text{F}}$ The group velocity is given by Eq.36 of Unit 2. Differentiating with respect to k gives

$$\frac{d\omega}{dk} = \frac{v}{2}\left(k^2 + k^4/k_0^2\right)^{-1/2}\left(2k + 4k^3/k_0^2\right).$$

Evaluating this at $k = 0.75k_0$ yields $1.7v$.
(Note that the symbol k_0 is defined differently in the CMA and in Unit 2 Eq.36. In Unit 2 $k_0 = 2\pi/\lambda_0$ is the local wavenumber of a wave packet, while in the CMA the local wavenumber is $0.75k_0$.)

Q20 $\boxed{\text{B}}$ Factorise the exponent and obtain

$$y(x,t) = \exp[-(x-4t)^2]$$

(i.e. $y(x,t) = f(x-4t)$. See d'Alembert's general solution on p14 of Unit 2.) Thus the solution is a pulse with a pulse shape e^{-x^2} at $t = 0$. This shape is maintained on the pulse propagates from left to right.