Name of the Student:_____
Max. Marks : 17 Marks **Time : 17 Minutes**

Mark Schemes

Q1.

Question Number	Answer	Mark
	There is a red shift [accept Doppler shift] (1) The galaxy is receding **Or** the galaxy is moving away from us (1) [Do not accept "the universe is expanding"]	2
	Total for question	2

Q2.

Question number	Acceptable answers	Additional guidance	Mark
	• Force on object = mg (local g) **(1)** • Force is proportional to displacement **(1)** • Force acts in the opposite direction to the displacement **(1)** • Therefore we can say $F = -kx$, so the condition for SHM is met and the prediction is correct **(1)**		4

Q3.

Question Number	Answer		Mark
(a)(i)	(A standard candle is) an object of known luminosity	**(1)**	**1**
(a)(ii)	Flux/brightness/intensity of standard candle is measured Inverse square law used (to calculate distance to standard candle) [Reference to measurement of apparent magnitude of star, m, and distance calculated using $m - M = 5\log(d/10\text{ pc})$ can score 2 marks]	**(1)** **(1)**	**2**
(b)(i)	An increase in the wavelength (of radiation) received from a receding source [accept in terms of a decrease in the frequency]	**(1)**	**1**
(b)(ii)	Use of $z = v/c$ and $v = H_0 d$ $[z = H_0 d/c]$ $d = 1.7 \times 10^{25}$ m Example of calculation: $v = zc = 0.12 \times 3 \times 10^8$ m s^{-1} $= 3.6 \times 10^7$ m s^{-1} $d = v/H = 3.6 \times 10^7$ m s^{-1} $/ 2.1 \times 10^{-18}$ s^{-1} $= 1.71 \times 10^{25}$ m	**(1)** **(1)**	**2**
***(c)**	(QWC – Work must be clear and organised in a logical manner using technical wording where appropriate) **Max 3** Dark matter has mass but does not emit e-m radiation [accept light] (Dark matter proposed when) observations of galaxies indicated that they must contain more matter than could be seen. The existence of dark matter will increase the (average) density of the universe This may make it more likely that the universe is closed [accept will contract **Or** end with a "Big Crunch"] **Or** Idea that this may make the ultimate fate of the Universe less certain	**(1)** **(1)** **(1)** **(1)**	**3**
(d)	**Max 2** The universe started from a small initial point [accept Big Bang] Idea that universe has a finite age Idea that (observable universe is finite because) we can only see as far as (speed of light) × (age of universe) **Or** light reaching us must have travelled a finite distance since the Big Bang **Or** some parts of the universe are so distant, light has not had time to reach us yet	**(1)** **(1)** **(1)**	**2**
	Total for question		**11**