

# GCSE PHYSICS

Topic Paper: 8.2 Red-shift & The Big Bang theory  
Part 1 & 2 Mark Scheme

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## MARK SCHEME



**63 Marks**



- M1.**
- (a) (i) origin of the Universe  
*accept (why) the Universe is expanding*  
*do **not** accept origin of the Earth* 1
- (ii) provided more evidence to support the 'Big Bang' theory 1
- (b) (i) red-shift  
*accept Doppler (shift)* 1
- (ii) (at the point in time shown the observed spectrum from) star A (shows it) is moving away from the Earth  
*accept star A is moving away*  
*star A shows red-shift is insufficient* 1
- light from star B shows a decrease in wavelength  
*accept light from star B shows blue-shift*  
*accept light from star B shows an increase in frequency* 1
- so star B is moving towards Earth 1
- [6]**

- M2.**
- (a) (i) gamma  
*accept correct symbol* 1
- (ii) any **one** from:  
 (ultraviolet has a) higher frequency  
*ultraviolet cannot be seen is insufficient*  
 (ultraviolet has a) greater energy  
 (ultraviolet has a) shorter wavelength  
*ignore ultraviolet causes cancer etc* 1
- (b)  $1.2 \times 10^7 / 12\ 000\ 000$   
*allow 1 mark for correct substitution, ie  $3 \times 10^8 = f \times 25$*  2
- hertz / Hz / kHz / MHz  
*do **not** accept hz or HZ*  
*answers 12 000 kHz or 12 MHz gain 3 marks*  
*for full credit the numerical answer and unit must be consistent* 1



- (c) (i) away (from each other)  
*accept away (from the Earth)*  
*accept receding* 1
  - (ii) distance (from the Earth)  
*accept how far away (it is)* 1
  - speed galaxy is moving 1
  - (iii) (Universe is) expanding 1
- [9]**

**M3.** (a) change in (observed) wavelength / frequency  
*accept specific change eg increase*  
*accept pitch for frequency provided the source is sound* 1

when source of waves / observer moves (relative to each other)  
*accept specific example of source*  
*accept specific example of movement*  
*for both marks a specific change in wavelength / frequency must be linked to a correct specific movement of source / observer* 1

(b) (observed) increase in wavelength of light (from distant galaxies)  
*accept a correct description eg wavelength(s) of light*  
*(from distant galaxies) moves towards red end of spectrum*

**or**  
(observed) decrease in the frequency of light (from distant galaxies)  
*(pattern) of (black) lines in (visible) spectrum move towards red end*  
*galaxy looks red negates this first mark point* 1

because the galaxy is moving away from the Earth / us 1

the bigger the red-shift the faster the galaxy is moving  
*accept bigger the red-shift the further the galaxy is from the Earth* 1

**[5]**

**M4.** (i) an enormous explosion causing matter to spread from one point 1



(ii) it is increasing **or** expanding 1 [2]

**M5.** (a) longer wavelength waves **or** light moved towards red end of spectrum 1

(galaxy) moving away from the Earth **or** space is expanding **or**  
the galaxy and Earth are moving apart

*accept us for Earth*  
*do **not** accept galaxies expanding*

1

(b) big bang 1 [3]

**M6.** (a) wavelength increases 1  
*accept the crests are further apart*  
*ignore waves are further apart*

frequency decreases

*accept pitch decreases*  
*ignore references to amplitude*

1

(b) stars / galaxies / sources emit all / different types of electromagnetic waves / radiation 1  
*accept two or more named electromagnetic waves*  
*accept answers in terms of frequencies / wavelengths*

(c) (i) wavelength (of light) increases 1  
*accept frequency decreases*  
**or**  
light moves to red end of spectrum  
*accept redder but do **not** accept red alone*

(ii) it is the star (detected) furthest from the Earth 1  
*accept galaxy for stars*  
**or**  
it is moving away the fastest  
*ignore reference to universe expanding*

1



- (d) (i) all matter compressed to / starts at / comes from a single point  
*do **not** accept increasing gravitational pull*  
*accept everything / the universe for all matter* 1
- (massive) explosion sends matter outwards  
*accept explosion causes universe to expand*  
*ignore explosion creates the universe **or** further reference to star / Earth formation* 1
- (ii) check validity / reliability of the evidence  
**or**  
 change the theory to match the new evidence  
*accept comparison of new and old evidence* 1

[8]

- M7.** (a) any **three** from:
- red-shift shows galaxies are moving away (from each other / the Earth)  
 more distant galaxies show bigger red-shift
- or**
- more distant galaxies show a greater increase in wavelength  
*accept correct reference to frequency in place of wavelength*
- (in all directions) more distant galaxies are moving away faster  
*accept (suggests) universe is expanding*
- suggests single point of origin (of the universe) 3
- (b) (i) (radiation produced shortly after) 'Big Bang'  
*accept beginning of time / beginning of the universe for 'Big Bang'* 1
- (ii) any **one** from:
- can only be explained by 'Big Bang'  
 existence predicted by 'Big Bang'  
 provides (further) evidence for 'Big Bang'  
*ignore proves 'Big Bang' (theory)*  
*ignore reference to red-shift* 1
- (iii) increase  
*accept becomes radio waves* 1



universe continues to accelerate outwards  
*accept as universe continues to expand*

**or**

greater red-shift

1

[7]

**M8.** (a) wavelength (of light appears to) increase

*accept frequency (appears to) decrease*

*accept light moves to the red end of the spectrum*

*do not accept it moves to the red end of the spectrum*

*do not accept light becomes redder*

1

(b) (i) **M** is closer (to the Earth) than **N**

1

**M** is moving (away from the Earth) slower than **N**

1

(ii) 520

*an answer between 510 and 530 inclusive gains 1 mark*

2

(iii) more recent

*no mark for this but must be given to gain reason mark*

data more reliable

*accept data is more accurate*

**or**

improved equipment / techniques

*more technology is insufficient*

**or**

data obtained from more (distant) galaxies

*accept a wider range of data*

*accept data closer to the line of best fit*

*or data less scattered*

*accept no anomalous result(s)*

*accept all data fits the pattern*

1

(c) wavelength is decreased

1

frequency is increased

1

[8]



**M9.** (a) clearer / more detailed / sharper / less distorted image  
*image is better is insufficient* 1  
*ignore image is bigger*

any **one** from:

no light pollution  
*accept no clouds to prevent observations*

light is not scattered by the atmosphere  
*accept air for atmosphere*  
*accept (image) not distorted by the atmosphere*  
*accept (light) does not have to pass through the atmosphere*  
*do **not** accept in terms of distance* 1

(b) (i) bigger the red-shift, further the galaxy is from the Earth  
*accept red-shift and distance are directly proportional*  
*accept there is a positive correlation* 1

(ii) origin / start / beginning / creation  
*accept expansion* 1

[4]

**M10.** (a) the observed wavelength of the dark line from the distant galaxy has increased 1

therefore the distant galaxy must be moving away from the Earth 1

suggesting the Universe is expanding outwards from a small initial point 1

(b) existence of cosmic microwave background radiation  
*accept existence of CMBR* 1

[4]

**M11.** (a) (i) Universe began at a (very) small (initial) point  
*'it' refers to Universe* 1



'explosion' sent matter outwards

**or**

'explosion' causing Universe to expand

*accept gas / dust for matter*

*accept rapid expansion for explosion*

1

(ii) light shows a red shift

*owtte*

*the term red shift on its own does not score a mark*

1

galaxies moving away (from the Earth)

*'it' refers to light*

*'they' refers to galaxies*

*accept star for galaxy*

*do **not** accept planet for galaxy*

1

(b) check reliability / validity of data

*accept check data*

*accept collect more data*

1

amend theory

**or**

discount the data

*accept replace old theory with new theory*

1

(c) answer involves (religious) belief

**or**

no / insufficient evidence

*accept it cannot be tested*

1

[7]