

**Physics 1 – Summer 2015**  
**Higher Tier**

| Question Number |    |             |       |  | Mark | Answer                                                                                                                                                                                                                                 | Accept                                                                                                                  | Neutral answer     | Do not accept                                                                 |
|-----------------|----|-------------|-------|--|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------------------------------------------------------------------|
| FT              | HT | Sub-section |       |  |      |                                                                                                                                                                                                                                        |                                                                                                                         |                    |                                                                               |
|                 | 1  | (a)         | (i)   |  | 2    | One quarter / 25% (1)<br>× 20 = 5 [cpm] (1)                                                                                                                                                                                            | Alternative routes to get an answer of 5                                                                                |                    |                                                                               |
|                 |    |             | (ii)  |  | 2    | Repeat the test / counts per minute / take more readings (1)<br>and find the mean (1)<br><b>OR</b> <u>count</u> / <u>reading</u> / <u>measure</u> over longer period of time (1)<br>and divide by that number of minutes (1)           |                                                                                                                         |                    |                                                                               |
|                 |    |             | (iii) |  | 1    | Radon <b>OR</b> buildings / soil                                                                                                                                                                                                       | Ground / earth                                                                                                          |                    | Named rocks / uranium                                                         |
|                 |    | (b)         | (i)   |  | 2    | 350 – 20 (1 - for <u>subtraction of 20 from any value</u> )<br>= 330 [cpm] (1)                                                                                                                                                         |                                                                                                                         |                    |                                                                               |
|                 |    |             | (ii)  |  | 2    | Alpha (1)<br>Because the reading is reduced [to background level] by thin card / can't penetrate thin card (1)<br><b>The 2<sup>nd</sup> mark can only be awarded if it is linked to the 1<sup>st</sup> mark.</b>                       | <b>Alternative for the 2<sup>nd</sup> mark:</b><br>If it was beta or gamma the reading wouldn't be reduced by thin card |                    | Alpha with beta or gamma<br>Alpha absorbed by card and gamma absorbed by lead |
|                 |    |             | (iii) |  | 1    | Range of alpha is only a few [about 30] cm in air / can't penetrate the skin or clothes / not very penetrating                                                                                                                         | Short range in air<br>can't reach them                                                                                  |                    | Only harmful inside the body                                                  |
|                 |    |             | (iv)  |  | 2    | Aluminium has no effect on the count rate (1)<br>because only gamma passes through aluminium / beta can't pass through aluminium (1)<br><b>The 2<sup>nd</sup> mark can only be awarded if it is linked to the 1<sup>st</sup> mark.</b> | There's still a [small] count rate [beyond lead] (1) only gamma goes through lead (1)                                   | Reference to alpha |                                                                               |
|                 |    |             | (v)   |  | 1    | Background count <u>varies over time</u> / random                                                                                                                                                                                      |                                                                                                                         |                    |                                                                               |
|                 |    | Total Mark  |       |  | 13   |                                                                                                                                                                                                                                        |                                                                                                                         |                    |                                                                               |

| Question Number |    |             |      |  |      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                              |                             |                                               |
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| FT              | HT | Sub-section |      |  | Mark | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Accept                                                                                                       | Neutral answer              | Do not accept                                 |
|                 | 2  | (a)         |      |  | 2    | Increases or steps up the voltage / reduces the current (1) to reduce energy / heat losses [in the cables] (1)<br><b>The 2<sup>nd</sup> mark can only be awarded if it is linked to the 1<sup>st</sup> mark.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                              | Improves efficiency (given) | Reduces the power<br>No heat loss             |
|                 |    | (b)         | (i)  |  | 1    | 950 000 000 [W]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | $950 \times 10^6$                                                                                            |                             | 950 MW                                        |
|                 |    |             | (ii) |  | 2    | $I = \frac{P}{V}$<br>$I = \frac{950\,000\,000}{475\,000}$ (manip & subst- 1) <b>ecf</b> from (b)(i)<br>$I = 2\,000$ [A] (1)<br><b>Alternative:</b><br>Calculations with matching units e.g. mega or kilo                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | An answer of $2 \times 10^n$ [A] other than $2 \times 10^3$ award 1 mark only unless <b>ecf</b> rule applies |                             | $\frac{475\,000}{950\,000\,000}$<br>$= 2$ [A] |
|                 |    | (c)         |      |  | 2    | Reduce the voltage (1) to a <u>safer</u> value [for use in the home] / because high voltages are more dangerous (1)<br><b>The 2<sup>nd</sup> mark can only be awarded if it is linked to the 1<sup>st</sup> mark.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Step-down the voltage                                                                                        | Increase the current        |                                               |
|                 |    | (d)         |      |  | 6    | <b>Indicative content:</b><br>Some types of power station continue working for 24 hours a day and for 365 days a year. These include nuclear, coal and oil powered stations which take a long time to shut down and to start up again. Through the day, however, demand changes, the demand being small at night while most of the population is sleeping but during the daytime there are peaks of demand, notably at breakfast time and again in early evening. To meet this demand some power stations are needed which can be brought on stream at very short notice. This is where hydroelectric power stations are very useful because they can start up within seconds by just opening a valve to let the water flow. They, along with reserve oil and gas powered stations can also be used to maintain supply during maintenance or breakdown times of other stations.<br><br><b>5 – 6 marks</b><br>The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology |                                                                                                              |                             |                                               |

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|                 | 2  | (d)         |  |  |      | <p><b>3 – 4 marks</b></p> <p>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p><b>1 – 2 marks</b></p> <p>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p><b>0 marks</b></p> <p>The candidate does not make any attempt or give a relevant answer worthy of credit.</p> |        |                |               |
|                 |    | Total Mark  |  |  | 13   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |        |                |               |

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|                 | 3  | (a)         | (i)  |  | 1    | 20 [J/m <sup>2</sup> ]                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                               |                              |                                                                   |
|                 |    |             | (ii) |  | 4    | 20% × 700 (1 - for use of 700)<br>= 140 [W/m <sup>2</sup> ] (1)<br>1 000(conversion-1)<br>÷ 140 <b>ecf</b> = 7.14 (ans-1) [m <sup>2</sup> ]<br><b>Alternative solution:</b><br>20% × 1 400 (1 - for use of 1 400)<br>= 280 [W/m <sup>2</sup> ] (1)<br>1 000(conversion-1)<br>÷ 280 <b>ecf</b> = 3.57 (ans-1) [m <sup>2</sup> ]<br>Incorrect rounding loses answer mark. | 1 000 [J/s] (1)<br>So need 5 000 [J/s] (1)<br>$\text{Area} = \frac{5\,000}{700} (1)$<br>Area = 7.14 (ans-1) [m <sup>2</sup> ] |                              |                                                                   |
|                 |    | (b)         |      |  | 3    | Radiation [IR / visible] from the Sun is absorbed by the surface of the Earth (1)<br>The ground [gets heated and] emits radiation [IR] with an <u>increased wavelength</u> (1)<br>which is absorbed by / trapped in the atmosphere (1)                                                                                                                                  |                                                                                                                               | Other em regions referred to | Different wavelength<br>Blocked by the atmosphere<br>Bounces back |
|                 |    | Total Mark  |      |  | 8    |                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                               |                              |                                                                   |

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|                 | 4  | (a)         | (i)  |  | 3    | Scale on $x$ -axis from 0 – 4.0 present with intervals of 0.5 <b>and</b> scale on $y$ -axis from 0 – 6.0 present with intervals of 1.0 (1)<br>Points plotted within $\pm \frac{1}{2}$ small square division (1)<br>don't penalise for point (0,0) not being present<br>Smooth curve of best fit from origin $\pm 1$ small square division on each point (1) | If scale transposed or incorrect don't award the scale mark but if correct the plots and curve marks can be awarded |                                   | Thick, wobbly, disjointed, wispy curves                                            |
|                 |    |             | (ii) |  | 2    | As the depth increases the wave speed increases (1)<br>At a decreasing rate (1)<br>No <b>ecf</b> from graph                                                                                                                                                                                                                                                 | Positive correlation (for the 1 <sup>st</sup> mark)<br>Slower rate                                                  | Non-linear                        | For a straight line graph they are proportional<br>Answer for incorrect wave speed |
|                 |    | (b)         | (i)  |  | 3    | 5.3 (1) =<br>$f \times 8.1$ (1)<br>$f = 0.65$ [Hz](1)<br>N.B. <b>Speed value must be taken from candidate's graph</b><br>N.B. If speed is:<br>5.0 then $f = 0.617$ [Hz]<br>5.1 then $f = 0.630$ [Hz]<br>5.2 then $f = 0.642$ [Hz]<br>5.4 then $f = 0.666$ [Hz]<br>5.5 then $f = 0.679$ [Hz]                                                                 |                                                                                                                     |                                   |                                                                                    |
|                 |    |             | (ii) |  | 2    | Waves have decreasing wavelength [from A to B] (1)<br>because speed decreases [but $f$ remains constant] (1)<br><b>The 2<sup>nd</sup> mark can only be awarded if it is linked to the 1<sup>st</sup> mark.</b>                                                                                                                                              |                                                                                                                     | Any reference to amplitude change |                                                                                    |
|                 |    | Total Mark  |      |  | 10   |                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                     |                                   |                                                                                    |

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|                 | 5  | (a)         |      |  | 2    | $\text{Time} = \frac{3\,900}{3} \text{ (1)}$ $= 1\,300$ $\frac{1300}{52} \text{ (ecf)} = 25 \text{ [hours]}(1)$ <p><b>Alternative solution:</b></p> $\text{Time} = = \frac{3\,900}{52} \text{ (1)}$ $= 75$ $\frac{75}{3} \text{ (ecf)} = 25 \text{ [hours]}(1)$          |                                                                                                                  |                |                 |
|                 |    | (b)         | (i)  |  | 4    | $3\,900 \times 30 \text{ p (1)}$ $=117\,000 \text{ p (1)}$ $\text{conversion to } [\pounds]1170 \text{ (1)}$ $\frac{7\,500}{1170} \text{ (ecf)} = 6.41 \text{ [years]} \text{ (1)}$ <p>Incorrect rounding loses answer mark.</p> <p><b>Accept alternative routes</b></p> | If 16 p used, time<br>= 12.02 [years]<br>award 3 marks<br>If 14 p used, time<br>= 13.74 [years]<br>award 3 marks |                |                 |
|                 |    |             | (ii) |  | 2    | Money saved <u>each year</u> would increase (1)<br>reducing the pay-back time (1)<br><b>The 2<sup>nd</sup> mark can only be awarded if it is linked to the 1<sup>st</sup> mark.</b>                                                                                      |                                                                                                                  |                |                 |
|                 |    | (c)         |      |  | 2    | Units saved = $3\,900 \times 25 = 97\,500$ (1)<br>$\text{CO}_2$ saving = $97\,500 \text{ (ecf)} \times 0.5 = 48\,750$ [kg] (1)                                                                                                                                           |                                                                                                                  |                | $25 \times 0.5$ |
|                 |    | Total Mark  |      |  | 10   |                                                                                                                                                                                                                                                                          |                                                                                                                  |                |                 |

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|                 | 6  | (a)         |  | 6    | <p><b>Indicative content:</b><br/>Absorption spectra from distant galaxies consist of coloured light crossed with black lines. The wavelengths of the black lines are shifted to the red end of the spectrum when compared with light from similar sources in the laboratory. The black lines from more distant galaxies are more red shifted due to the expansion of space itself. This suggests that the Universe began its existence at a single point and has expended outwards ever since. CMBR on the other hand initially existed as gamma radiation of very small wavelength but an expanding Universe has caused the wavelength to increase into the microwave region of the em spectrum.</p> <p><b>5 – 6 marks</b><br/>The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p><b>3 – 4 marks</b><br/>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p><b>1 – 2 marks</b><br/>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p><b>0 marks</b><br/>The candidate does not make any attempt or give a relevant answer worthy of credit.</p> |        |                |               |  |
|                 |    | Total Mark  |  | 6    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |        |                |               |  |