Markscheme

May 2018

Physics

Standard level

Paper 2

10 pages

Question			Answers	Notes	Total
1.	a		use of conservation of energy ***OR*** $v^2 = u^2 + 2as$ ✓ $v = «\sqrt{2 \times 60.0 \times 9.81}» = 34.3 «\text{ms}^{-1}»$ ✓		2
1.	b	i	use of impulse $F_{ave} \times \Delta t = \Delta p$ ***OR*** use of $F = ma$ with average acceleration ***OR*** $F = \frac{80.0 \times 34.3}{0.759}$ ✓ 3620 «N» ✓	*Allow ECF from (a).*	2
1.	b	ii	upwards ✓ clearly longer than weight ✓	*For second marking point allow ECF from (b)(i) providing line is upwards.*	2
1.	b	iii	$3620 + 80.0 \times 9.81$ ✓ 4400 «N» ✓	*Allow ECF from (b)(i).*	2

(continued…)

(Question 1 continued)

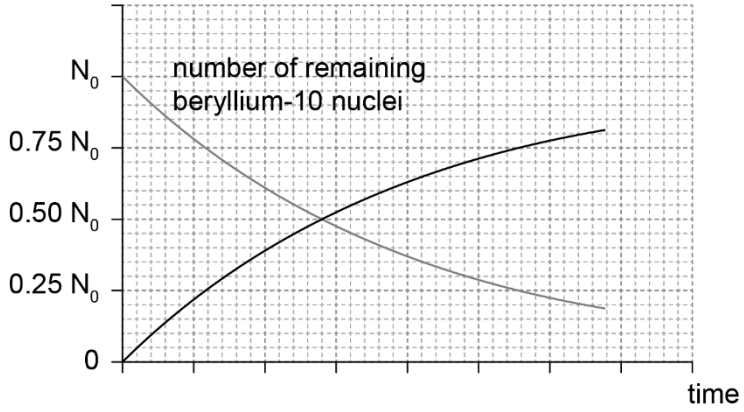
1.	**c**	**i**	(loss in) gravitational potential energy (of block) into kinetic energy (of block) ✓	*Must see names of energy (gravitational potential energy and kinetic energy) – Allow for reasonable variations of terminology (eg energy of motion for KE).*	**1**
1.	**c**	**ii**	(loss in) gravitational potential and kinetic energy of block into elastic potential energy of rope ✓	*See note for 1(c)(i) for naming convention.* *Must see either the block or the rope (or both) mentioned in connection with the appropriate energies.*	**1**
1.	**d**		k can be determined using $EPE = \frac{1}{2}kx^2$ ✓ correct statement or equation showing GPE at A = EPE at C ***OR*** (GPE + KE) at B = EPE at C ✓	*Candidate must clearly indicate the energy associated with either position A or B for MP2.*	**2**

2.	**a**		«$\frac{3.0 \times 8.31 \times 290}{0.15}$» 48 «kPa» ✓		**1**
2.	**b**	**i**	mass = «$\frac{860}{3100 \times 23}$ =» 0.012 «kg» ✓	*Award **[1]** for a bald correct answer.*	**1**
2.	**b**	**ii**	$\frac{3}{2} 1.38 \times 10^{-23} \times 313 = 6.5 \times 10^{-21}$ «J» ✓		**1**
2.	**c**		larger temperature implies larger (average) speed/larger (average) KE of molecules/particles/atoms ✓ increased force/momentum transferred to walls (per collision) / more frequent collisions with walls ✓ increased force leads to increased pressure because P=F/A (as area remains constant) ✓	*Ignore any mention of PV=nRT.*	**3**

3.	**a**	**i**	superposition of light from each slit / interference of light from both slits ✓ with path/phase difference of any half-odd multiple of wavelength/any odd multiple of π (in words or symbols) ✓ producing destructive interference ✓	*Ignore any reference to crests and troughs.*	**3**
3.	**a**	**ii**	evidence of solving for D **«**$D = \frac{sd}{\lambda}$**»** ✓ **«**$\frac{4.50 \times 10^{-3} \times 0.300 \times 10^{-3}}{633.0 \times 10^{-9}} \times 2$**»** $= 4.27$**«**m**»** ✓	*Award **[1]** max for 2.13 m.*	**2**
3.	**b**	**i**	$\frac{633.0}{1.33} = 476$**«**nm**»** ✓		**1**
3.	**b**	**ii**	distance between peaks decreases ✓ intensity decreases ✓		**2**

4.	**a**		$1.7\times10^{-8}\times\frac{0.10}{(0.02\times10^{-2})^2}$ ✓ 0.043 **«Ω»** ✓		**2**
4.	**b**		v **«**$=\frac{I}{neA}$**»** $=\frac{2}{8.5\times10^{22}\times1.60\times10^{-19}\times0.02^2}$ ✓ 0.368 **«**cm s^{-1}**»** ✓ 0.37 **«**cm s^{-1}**»** ✓	*Award **[2 max]** if answer is not expressed to 2 sf.*	**3**

5.	**a**		out of the page plane / ⊙ ✓	*Do not accept just "up" or "outwards".*	**1**
5.	**b**		$1.60\times10^{-19}\times6.8\times10^{5}\times8.5=9.2\times10^{-13}$ **«**N**»** ✓		**1**
5.	**c**	**i**	the magnetic force does not do work on the electron hence does not change the electron's kinetic energy ***OR*** the magnetic force/acceleration is at right angles to velocity ✓		**1**
5.	**c**	**ii**	the velocity of the electron is at right angles to the magnetic field ✓ (therefore) there is a centripetal acceleration / force acting on the charge ✓	*OWTTE*	**2**

6.	**a**		$^{10}_{4}\text{Be} \rightarrow {}^{10}_{5}\text{B} + b + \overline{\nu}_e$ conservation of mass number ***AND*** charge $^{10}_{5}\text{B}$, $^{10}_{4}\text{Be}$ ✓	*Correct identification of both missing values required for **[1]**.*	**1**
6.	**b**	**i**	correct shape *ie* increasing from 0 to about $0.80N_0$ ✓ crosses given line at $0.50N_0$ ✓ number of nuclei  		**2**

(continued…)

(Question 6b continued)

6.	**b**	**ii**	***ALTERNATIVE 1*** fraction of Be $= \frac{1}{8}$, 12.5%, or 0.125 ✓ therefore 3 half lives have elapsed ✓ $t_{\frac{1}{2}} = \frac{4.3 \times 10^6}{3} = 1.43 \times 10^6$ **«**$\approx 1.4 \times 10^6$**»«**y**»** ✓ ***ALTERNATIVE 2*** fraction of Be $= \frac{1}{8}$, 12.5%, or 0.125 ✓ $\frac{1}{8} = e^{-\lambda}\left(4.3 \times 10^6\right)$ leading to $\lambda = 4.836 \times 10^{-7}$**«**y**»**$^{-1}$ ✓ $\frac{ln2}{\lambda} = 1.43 \times 10^6$**«**y**»** ✓	*Must see at least one extra sig fig in final answer.*	**3**
6.	**b**	**iii**	1.9×10^{11} ✓		**1**

(continued…)

(Question 6 continued)

6.	**c**	**i**	emission of (infrared) electromagnetic/infrared energy/waves/radiation. ✓		**1**
6.	**c**	**ii**	the (peak) wavelength of emitted em waves depends on temperature of emitter/reference to Wein's Law ✓ so frequency/color depends on temperature ✓		**2**
6.	**c**	**iii**	$\lambda = \frac{2.90 \times 10^{-3}}{253}$ ✓ $= 1.1 \times 10^{-5}$ **«**m**»** ✓	*Allow ECF from MP1 (incorrect temperature).*	**2**
6.	**c**	**iv**	correct units for Intensity (allow *W, Nms^{-1} OR Js^{-1} in numerator)* ✓ rearrangement into proper SI units = kgs^{-3} ✓	*Allow ECF for MP2 if final answer is in fundamental units.*	**2**