Diploma Programme
Programme du diplôme
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Markscheme

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Physics

Standard level

Paper 2

9 pages

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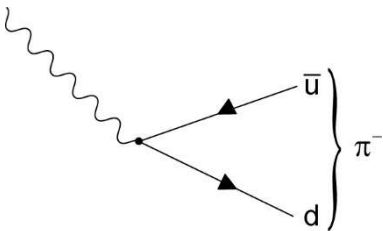| Question			Answers	Notes	Total
1	**a**	**i**	$\dfrac{1}{2}v^2 = 0.24\,gh$ ✓ $v = 11.9$ «$m\,s^{-1}$» ✓	*Award GPE lost* $= 65 \times 9.81 \times 30 = $ «*19130 J* ». *Must see the 11.9 value for MP2, not simply 12.* *Allow g = 9.8 ms^{-2}.*	**2**
	a	**ii**	internal energy is the total KE «and PE» of the molecules/particles/atoms in an object ✓ temperature is a measure of the average KE of the molecules/particles/atoms ✓	*Award [1 max] if there is no mention of molecules/particles/atoms.*	**2**
	b	**i**	arrow vertically downwards from dot labelled weight/W/mg/gravitational force/F_g/$F_{gravitational}$ **AND** arrow vertically upwards from dot labelled reaction force/R/normal contact force/N/F_N ✓ W > R ✓	*Do not allow gravity.* *Do not award MP1 if additional 'centripetal' force arrow is added.* *Arrows must connect to dot.* *Ignore any horizontal arrow labelled friction.* *Judge by eye for MP2. Arrows do not have to be correctly labelled or connect to dot for MP2.*	**2**

Question			Answers	Notes	Total
1	**b**	**ii**	**ALTERNATIVE 1** recognition that centripetal force is required / $\dfrac{mv^2}{r}$ seen ✔ = 468 «N» ✔ W/640 N (weight) is larger than the centripetal force required, so the skier does not lose contact with the ground ✔ **ALTERNATIVE 2** recognition that centripetal acceleration is required / $\dfrac{v^2}{r}$ seen ✔ a = 7.2 «m s^{-2}» ✔ g is larger than the centripetal acceleration required, so the skier does not lose contact with the ground ✔ **ALTERNATIVE 3** recognition that to lose contact with the ground centripetal force ≥ weight ✔ calculation that v ≥ 14 «ms^{-1}» ✔ comment that 12 «ms^{-1}» is less than 14 «ms^{-1}» so the skier does not lose contact with the ground ✔ **ALTERNATIVE 4** recognition that centripetal force is required / $\dfrac{mv^2}{r}$ seen ✔ calculation that reaction force = 172 «N» ✔ reaction force > 0 so the skier does not lose contact with the ground ✔	*Do not award a mark for the bald statement that the skier does not lose contact with the ground.*	**3**

Question			Answers	Notes	Total
1	**c**		**ALTERNATIVE 1** $0 = 8.2^2 + 2 \times a \times 24$ therefore $a = $«$-$»$1.40$ «$\mathrm{m\,s^{-2}}$» ✔ friction force $= ma = 65 \times 1.4 = 91$ «N» ✔ coefficient of friction $= \dfrac{91}{65 \times 9.81} = 0.14$ ✔ **ALTERNATIVE 2** $KE = \dfrac{1}{2}mv^2 = 0.5 \times 65 \times 8.2^2 = 2185$ «J» ✔ friction force = KE/distance = 2185/24 = 91«N» ✔ coefficient of friction $= \dfrac{91}{65 \times 9.81} = 0.14$ ✔	*Allow ECF from MP1.*	**3**
	d	**i**	«76×9.6» $= 730$ ✔ Ns **OR** $\mathrm{kg\,m\,s^{-1}}$ ✔		**2**
	d	**ii**	safety net extends stopping time ✔ $F = \dfrac{\Delta p}{\Delta t}$ therefore F is smaller «with safety net» **OR** force is proportional to rate of change of momentum therefore F is smaller «with safety net» ✔	*Accept reverse argument.*	**2**

Question			Answers	Notes	Total
2	**a**		when 2 waves meet the resultant displacement ✔ is the «vector» sum of their individual displacements ✔	*Displacement should be mentioned at least once in MP 1 or 2.*	**2**
	b		$\lambda = \dfrac{4.7 \times 10^{-3} \times 0.35 \times 10^{-3}}{2.4}$ ✔ $= 6.9 \times 10^{-7}$ «m» ✔ answer to 2 SF ✔	*Allow missed powers of 10 for MP1.*	**3**
	c		green wavelength smaller than red ✔ fringe separation / distance between maxima decreases ✔	*Allow ECF from MP1.*	**2**
	d		bright central maximum ✔ subsidiary maxima «on either side» ✔ the width of the central fringe is twice / larger than the width of the subsidiary/secondary fringes/maxima **OR** intensity of pattern is decreased ✔	*Allow marks from a suitably labelled intensity graph for single slit diffraction.*	**2 max**

Question			Answers	Notes	Total
3	a		solar heating panel converts solar/radiation/photon/light energy into thermal **energy** *AND* photovoltaic cell converts solar/radiation/photon/light energy into electrical **energy** ✔	*Accept internal* **energy** *of water.*	1
	b		power received $= 240 \times 25000 = $ «6.0 MW» ✔ efficiency «$= \dfrac{1.6}{6.0}$» $= 0.27 \,/\, 27\%$ ✔		2
	c	i	area $= \pi \times 17^2$ «$= 908 \, m^2$» ✔ power $= \dfrac{1}{2} \times 908 \times 1.3 \times 7.5^3$ «$= 0.249 \, MW$» ✔ number of turbines «$= \dfrac{1.6}{0.249} = 6.4$» $= 7$ ✔	*Only allow integer value for MP3.* *Award* **[2 max]** *for* **25 turbines** *(ECF from incorrect power)* *Award* **[2 max]** *for* **26 turbines** *(ECF from incorrect radius)*	3
		ii	«efficiency is less than 100 % as» not all KE of air can be converted to KE of blades **OR** air needs to retain KE to escape ✔ thermal energy is lost due to friction in turbine/dynamo/generator ✔	*Allow velocity of air after turbine is not zero.*	2

Question			Answers	Notes	Total
4	**a**	**i**	$I \text{«}= \dfrac{8.5 \times 10^3}{240}\text{»} = 35\text{«A»}$ ✔		**1**
	a	**ii**	$R = \dfrac{1.7 \times 10^{-8} \times 10}{6.0 \times 10^{-6}}$ ✔ $= 0.028 \text{«}\Omega\text{»}$ ✔	*Allow missed powers of 10 for MP1.*	**2**
	b		«as temperature increases» there is greater vibration of the metal atoms/lattice/lattice ions **OR** increased collisions of electrons ✔ drift velocity decreases «so current decreases» ✔ «as V constant so» R increases ✔	*Award **[0]** for suggestions that the speed of electrons increases so resistance decreases.*	**3**
	c		recognition that power = flow rate $\times c\Delta T$ ✔ flow rate $\text{«}= \dfrac{\text{power}}{c\Delta T}\text{»} = \dfrac{8.5 \times 10^3}{4200 \times 35}$ ✔ $= 0.058 \text{«kg s}^{-1}\text{»}$ ✔ kg s^{-1} / g s^{-1} / l s^{-1} / ml s^{-1} / m^3 s^{-1} ✔	*Allow MP4 if a bald flow rate unit is stated. Do not allow imperial units.*	**4**

Question			Answers	Notes	Total
5	**a**		*Meson:* quark-antiquark pair ✔ *Baryon:* 3 quarks ✔		**2**
	b	**i**	**Alternative 1** strange quark changes «flavour» to an up quark ✔ changes in quarks/strangeness happen only by the weak interaction ✔ **Alternative 2** Strangeness is not conserved in this decay «because the strange quark changes to an up quark» ✔ Strangeness is not conserved during the weak interaction ✔	*Do not allow a bald answer of weak interaction.*	**2**
		ii	arrows drawn in the direction shown ✔ 	*Both needed for [1] mark.*	**1**
		iii	W^- ✔	*Do not allow W or W^+.*	**1**
	c		it lowers the cost to individual nations, as the costs are shared ✔ international co-operation leads to international understanding **OR** historical example of co-operation **OR** co-operation always allows science to proceed ✔ large quantities of data are produced that are more than one institution/research group can handle ✔ co-operation allows effective analysis ✔	*Any one.*	**1 max**