Rewarding Learning

General Certificate of Secondary Education
2012

Science: Physics

Paper 1
Higher Tier

[G7604]

FRIDAY 15 JUNE, AFTERNOON

MARK SCHEME

Subject-specific instructions

1 In numerical problems, the marks for intermediate steps shown in the mark scheme are for the benefit of candidates who do not obtain the correct final answer. A correct answer and unit, if obtained from a valid starting-point, gets full credit, even if all the intermediate steps are not shown. It is not necessary to quote units for intermediate numerical quantities.

Note that this "correct answer" rule does not apply to formal proofs and derivations, which must be valid in all the stages shown in the mark scheme to obtain full credit.

2 Do not reward wrong physics. No credit is given for substitution of numerical data, or subsequent arithmetic, in a physically incorrect equation.

However, answers to later parts of questions that are consistent with an earlier incorrect numerical answer, and are based on a physically correct equation, must gain full credit. Annotate this by writing **ECF** (Error Carried Forward) by your text marks.

3 The normal penalty for an arithmetical and/or unit error is to lose the mark(s) for the answer/unit line. Substitution errors lose both the substitution and answer mark, but 10^n errors (e.g. writing 550 nm as 550×10^{-6} m) count only as arithmetical slips and lose the answer/unit mark.

1 (a) (i) Output electrical energy = 1200 (J) [1]

(ii) Efficiency = useful output energy/total input energy [1]
= 1200/6000 = 0.2 (20%) ecf from **(i)** [1] [2]

(iii) Conversion of 1200 W to 1.2 kW ecf from **(i)** [1]
1.2 kW × 10 hrs
= 12 (kWh) [1] [2]

(iv) The solar panel is a little short of their energy demands they would supplement this with other resources
If the calculation in **(iii)** gives 15 kWh or greater then allow an answer consistent with this.
Accept, that if the energy provided is more than enough/use smaller solar panel [1]
The use of another/larger solar panel would solve the problem [1]
Advantages – free after the initial cost/non polluting [1]
Disadvantages – produces d.c. but appliances require a.c. or
less sunlight in the winter when most energy is needed
Expensive to install [1] [4]

Quality of written communication [2]

Response	Mark
Candidates describe in detail using good spelling, punctuation and grammar all of the main points shown above. The form and style is of a high standard and specialist terms are used appropriately at all times	**2**
Candidates make some reference to the same main points shown above using satisfactory spelling, punctuation and grammar. The form and style is of a satisfactory standard and they have made some reference to specialist terms.	**1**
Response not worthy of credit	**0**

(b) (i) Work = force × distance moved Give [1] if no further credit possible
Possible combinations
200 N 1.5 m
150 N 2.0 m
300 N 1.0 m [3]

(ii) Total work in 30 seconds = 300 × 10 = 3000 [1]
Power = work/time worth [1] on its own
= 3000/30 **or** = 300/3 [1]
= 100 = 100 [1]
W **or** J/s W **or** J/s [1] [4]

(c) (i) ACM = CM [1]
[1] F × 2.0 = 500 × 1.2 [1] [2]
F = 300 (N) [1] [4]

(ii) To the left or away from him/towards the pivot
500 N has a smaller moment
because its distance from pivot is less [3]

AVAILABLE MARKS

25

2 **(i)** 80 km = 80 000 m Give [1] if no further credit possible
1 hr = 60 × 60 = 3600 s Give [1] if no further credit possible

80 km/h = 80 000/3600 = (22.2 m/s) This line is worth [3] [3]

(ii) (Thinking) distance = speed × time Give [1] if no further credit possible
15 = 22.2 × time Give [2] if no further credit possible
Time = 15/22.2 Give [3] if this line present
= 0.675 (s) Method is not required for full marks
Accept 0.67 to 0.68
No ecf for the speed or the distance [4]

(iii) 75/4 or 96/4 [1] no further marks
21/4 or 5.25 [2]
round up to 6 car lengths [1] [3]

(iv) $v^2 = u^2 + 2as$ [2] giving $0 = 31.1^2 + 2a \times 75$ [3] ([1] per substitution)
giving $a = 6.4$ (m/s^2) [1]
or [1] [1]
$s = \frac{1}{2}(u + v) \times t$ [1] giving $75 = \frac{1}{2} \times 31.1 \times t$ [2] giving $t = 4.82$ [1]
then $v = u + at$ [1] giving $0 = 31.1 \times 4.8\ a$ $a = 6.4$ (m/s^2) [1]
Accept a = 6.4 to 6.5
Ignore any minus sign [6]

(v) F = ma give [1] if no further credit
or F = 1500 × 6.4 = 9600 N [3] Allow ecf for deceleration
Unit mark [1] [4]

(vi) P = F/A [1]
= 9600/(8 × 40) **or** $\frac{2400}{2 \times 40}$ allow ecf for force from **(v)** [3]
= 30 (N/cm^2) [1] [5]

AVAILABLE MARKS

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AVAILABLE MARKS

3 **(a)**

Wave	Direction of vibrations	Type of wave
Light wave	Perpendicular to the direction of energy transfer	Transverse
Sound wave	Parallel to the direction of energy transfer	Longitudinal
Water wave	Perpendicular to the direction of energy transfer	Transverse

[4]

(b) **(i)** 4 [1]

(ii) 8 [1]

(iii) The time between one wave and the next (**or** the period) is constant [1]

(iv) 50 waves/wavelengths/vibrations pass in 1 second [1]

(v) $\lambda = v/f \quad v = f\lambda$ [1]
$= 4500/50$ [1]
$= 90$ (m) [1] [3]

(c) **(i)** 14 (mm) (Allow 13–15 mm) [1]

(ii) Energy [1]

(iii) **Arrow** at 45° to horizontal/barrier [1]
With 3 wavefronts crossing the arrow [1]
Perpendicular to arrow [1]
Wavefronts parallel and equally spaced [1]
Reflected wavefront spacing = wavelength of incident waves [1] [5]

(iv) Equal to [1]

(d) **(i)** They can travel through a vacuum/space [1]

(ii) Time = distance/speed (**or** equivalent) [1]
Distance to satellite and back = 72 000 km [1]
Time for microwaves to travel from A to B via satellite
$= 72000/300000$ [1]
$= 0.24$ (s) [1] [4]

(iii) Fibre optic link/optical fibre [1]

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						AVAILABLE MARKS
4	**(a)**	**(i)**	Voltmeter in parallel with the lamp		[1]	
		(ii)	Correct location of + sign		[1]	
		(iii)	R = V/I	[1]		
			R = 12/2	[1]		
			R = 6	[1]		
			ohms or Ω	[1]	[4]	
		(iv)	R = 6 + 6 [1] = 12 ohms [1] ecf from **(iii)** $R = R_1 + R_2$ [1] if no further no unit mark		[2]	
		(v)	$R_{comb} = R/2$ [1] = 3 ohms [1] ecf from **(iii)** no unit mark		[2]	
	(b)	**(i)**	P = IV	[1]		
			[1] 8000 = I × 240 [1]	[2]		
			I = 33.3 (A)	[1]	[4]	
			[1] [1]			
		(ii)	Number of kWh = 8 × 0.25 = 2	[2]		
			Cost = 2 × 13.5 = 27 (pence)	[1]	[3]	
	(c)	**(i)**	The coulomb		[1]	
		(ii)	Q = It **or** t = Q/I	[1]		
			5 = 40 000 t **or** t = 5/40 000	[2]		
			t = 0.000125 s **or** $t = 1.25 \times 10^{-4}$ s	[1]	[4]	
		(iii)	E = QV **or** E = VIt **or** V = E/Q **or** V = E/It	[1]		
			$700 \times 10^6 = 5$ V **or** $700 \times 10^6 = 40\,000 \times 0.000125$ V			
			or $V = 700 \times 10^6/5$	[1]		
			$V = 140 \times 10^6$ (volts) Allow ecf from **(ii)** for time	[1]	[3]	25

		AVAILABLE MARKS
5	**(a)** Protons 6 [1] Neutrons 8 [1] Name of particle [1] Numbers correct [1] each [4]	
	(b) **(i)** X and Z both needed [1]	
	(ii) Both have same number of protons/atomic number [1]	
	(c) True accept T or ✓ False accept F or ✗ False False False True [$\frac{1}{2}$] each, round up Maximum [3] [3]	
	(d) Fusion Fission 5 3 6 7 1 2 4 8 [$\frac{1}{2}$] each, round down [4]	
	(e) **(i)** $^{0}_{-1}\beta$ and $^{60}_{28}\mathrm{Ni}$ [1] each [4]	
	(ii) 120/15 = 8 [1]; $8 = 2^3$ **or** 3 half lives **or** $t_{\frac{1}{2}} = 15/3$ [1] $t_{\frac{1}{2}} = 5$ years [1] [3]	
	(iii) sterilisation of medical supplies, radiotherapy, radiography, food irradiation Any **two** [1] each [2]	
	(iv) Alpha radiation is stopped by paper (so gloves stop it) [1]	
	(v) Keep a large distance away/Keep exposure time very short/ Use a weak source Any acceptable alternative(s), e.g. as small a source as possible Any **two** [1] each [2]	25
	Total	**125**