General Certificate of Secondary Education
2012

Science: Physics

Paper 2
Higher Tier

[G7605]

MONDAY 25 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 $550\,\text{nm}$ as $550 \times 10^{-6}\,\text{m}$) count only as arithmetical slips and lose the answer/unit mark.

1 (a) (i) Largest = 16 N [1]
both arrows in same direction [1]
Smallest force = 4 N [1]   Ignore signs. Insist on 2 arrows
arrows in opposite direction [1]   [4]

(ii) Object accelerating or decelerating or change in speed/velocity
or moves [1]
change of direction/topples
change of shape [1]
Any **two**   [2]

(b) (i) Time (to fall) **or** distance (between the gates)   [1]
Time to reach ground [0], time to pass through gates [0]

(ii) The answer here **must be consistent** with the answer to **(b)(i)**

If time then v = u + at   } Give [1] if answer to **(b)(i)** wrong
If distance then v² = u² + 2as } $\frac{v - u}{t}$ [1] $\frac{\text{change in } velocity}{\text{time}}$ [1]   [2]

(c) (i) (Uniform) acceleration for 5 secs [1] or velocity increases
Constant speed (velocity) for next 10 secs [1]
(Uniform) deceleration for next 5 secs [1] or decelerates
At rest for 5 secs **or** speed/vel = 0 [1]   constant speed [0]   [4]
Deduct [½] for each missing time, round **down**

(ii) Height = area between graph and time axis (or shaded) [1]
$\frac{1}{2} \times 5 \times 4 \ + 10 \times 4 + \frac{1}{2} \times 5 \times 4$ [3]
    [1]   [1]   [1]
= 60 (m) [1]   [5]
or
$\frac{1}{2} (20 + 10) \times 4 = 60$ (m)
      [3]   [1]

(iii) Average velocity = 60/20 [1]   allow **ecf** for distance
                = 3 (m/s)   no ecf for time

$\frac{\text{total displacement}}{\text{time}}$ [1] if no further working shown   [2]

(iv) Positive – $\frac{\text{up}}{\text{ascending}}$ Negative – $\frac{\text{down}}{\text{descending}}$
or travelling in opposite directions **or** change of direction
velocity is a vector **or** is now moving down   [1]

(v) Deceleration = velocity change/time taken [1]
                = 20/1 [2]
                = 20 [1]
                m/s² [1]   Ignore **minus** sign   [5]

(vi) Momentum = mass × velocity [1]   mass × speed [0]
                [1]   [1]
                = 2500 × 20 [2]
                = 50 000 (kg m/s) [1]   [4]

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2 (a) (i) Unlimited supply/suitable alternative/never runs out/replaced in a
lifetime [1]
but **exclude** can be used over again   **accept** sustainable

(ii) It uses electricity [1]
which is not a renewable energy resource [1] [2]
or reference to use of fossil/non-renewable [2]

(iii) PE = mgh [1]
= 1 × 10 × 70 [2]   [2] or [0]   Formula mark only given
= 700 (J) [1]   if second line is correct [4]

(iv) Converted to heat or sound – or non-useful forms [1]
Changed   other forms

(v) KE= 595 **or** $\frac{1}{2}$ mv^2 = 595 [1]   **or** $\frac{85}{100} \times 700$
$\frac{1}{2}1$ v^2 = 595 [2] or = $\frac{85}{100} \times 700$
v^2 = 1190 [1]   100% v = 37.4 ← [3] if 100% of energy used
v = 34.5 (m/s) [1]   v = 31.8 ← [3] if 85% of v taken
allow **ecf for PE** from **(iii)**   CREDIT [5]

(vi) Efficiency = (useful) energy output/(total) energy input [1]
$\frac{output}{input}$ = [0] $\frac{out}{in}$ = [0] $\frac{E_{OUT}}{E_{IN}}$ [1]
= 500/700 [1]
= 0.71 (71%) [1]   **Accept** 0.7 – 0.71

Allow e.c.f. from **(iii)** provided the answer does not give an
efficiency >1   max. [1] (eqn) [3]

(vii) The demand for extra electricity can be met very quickly [1]
It is faster than fossil **or** fossil slower

(b) (i) It should **bend** upward/towards contact [1]
move up [0]

(ii) The metal with greater (rate of) expansion should be further from the
contacts or on the bottom [1]
outside [0]   inside [0]

(c) **(i)** Heat is conducted (from the processor) by the metal [1]
Air is heated by **convection** [1]
Heat is also **radiated** (from the structure) [1]   [3]

Quality of written communication   [2]

Response	Mark
Candidates describe in detail using good spelling, punctuation and grammar 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 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]

2 out of 3 gets [2] for QWC
conduction, convection, radiation [1]
and award [1] for QWC

(ii) Black is the best emitter of (radiant) heat   [1]
absorber and emitter give [1]

3 **(a)** Luminous give out their own light [1]
Non-luminous reflect light, do not emit light or are seen by reflected light [1]   [2]

(b) **(i)** Extended/large   [1]

(ii) Circular/round/same as object/ball   [1]

(iii) Ray from top of source glancing bottom of ball [1] } must be extended
Ray from bottom of source glancing top of ball [1] } towards screen   [2]
poorly drawn rays penalty [−1]

(iv) Region of partial shadow identified – correct rays needed before credit here   [1]

(v) Using larger screen – no change [1]   more than 1 tick per row [0]
Moving screen away from ball – size increases [1]
Moving light source away from ball – size decreases [1]   [3]

(c) **(i)** Waves circular curved (in correct sense) [1]
Wavelength unchanged (judge by eye) [1] or stated   [2]

(ii) Diffraction/or difraction **only**   [1]

(d) (i) When angle of incidence (in water) is 49° **or** at this angle of incidence
angle of refraction (in the air) is 90°   **or** light emerges along
boundary
or perpendicular to boundary

or

When the angle of incidence (in water) is **greater** than 49°
total internal reflection occurs   [1]

(ii) Refracted ray on correct side of normal, along boundary [1]
and weak reflected ray [1]   judge by eye   [2]

(iii) Total internal reflection at the boundary [1]
Angle of incidence = angle of reflection (judge by eye) [1]
Any ray in the air give [0]   [2]

(iv) Endoscope or **keyhole** surgery/looking directly/any-oscopy
into the body [1]
Takes light in and brings image out [1]
Fibre transmits light by total internal reflection [1] or TIR
Flexible/small/thin/bendy
Any **three** statements   [3]

Quality of written communication   [1]

Response	Mark
Candidates describe in detail using good spelling, punctuation and grammar the main points shown above. The form and style is of a high standard and specialist terms are used appropriately at all times.	1
Response not worthy of credit.	0

(e) (i) Ray from top of object parallel to Pr axis refracted to
top of image **or** ray reverse from image [1]
Pr focus marked where ray cuts Pr axis with an F [1]   [2]

(ii) Focal length = 2.0 ± 0.2 (cm) **or** consistent with their ray diagram   [1]

AVAILABLE MARKS

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4 **(a)** **(i)** N pole at the right end [1]

(ii) One straight line through core [1]
Two loops, one above one below from one end to the other [1]
Direction from the right end to the left end [1] one arrow [3]
Conflicting arrows no credit for direction
Any three lines
Consistent with their N pole
Crossing line, [–1]
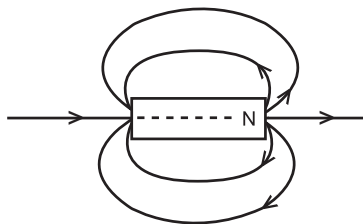
(iii) A (Core) (electromagnet) magnetised energised (when current flows/switch) closed [1] strengthens the magnet/becomes an electromagnet/ attracts B

B (Armature) attracted to electromagnet [1] moves towards electromagnet/causes hammer to strike gong

C (Spring flexible conductor) to return armature to starting position [1] allows armature to move to and fro

D Contact opens or closes **or** to make or break the circuit [1] [4]

(b) **(i)** BC – No   None or blank [1]
CD – Yes   Up [1] [2]
both needed

(ii) (Electric) motor/generator/moving coil meter/dynamo [1]

(c) Top left   DC [1]   Top right   AC [1]
Bottom left   DC [1]   Bottom right   AC [1] [4]

(d) **(i)** Two coils around the core [1] coils must have 2 ends
One with more turns than the other [1]
Input connected to fewer turns [1]
Output connected to greater turns [1] [4]
Battery connected [–1]
Two coils joined give [0]

(ii) Iron [1]
To increase the strength of the magnetic field [1] [2]
– temporary magnetism
To transfer the magnetic field
easily magnetised and demagnetised
or magnetically soft
soft iron [–1]

(iii) **Changing** current/magnetic field (in one coil) [1]
induces/produces/makes a current or voltage in the other coil [1] [2]

(iv) Step up at the power station end [1]
Step down at the consumer end [1] [2]

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5 **(a)** **(i)** Gravity [1]

    (ii) Milky Way [1]

    (iii) The **distance** from Earth to centre of galaxy **or** distance travelled by light in 27 000 years [1]

    (iv) Universe/Space is expanding **or** galaxies are moving apart
    Universe had a definite start [1]

    (v) (Light from these galaxies is) red shifted [1]
    Doppler [0]

  (b) **(i)** Heliocentric – planets orbit the sun/Sun at the centre (of the solar system) [1]   universe [0]
    Geocentric – Earth at the centre (of the solar system) [1] [2]

    (ii) The **retrograde motion** of the planets – looping of the planets [1]
    Strange motion [0]

    (iii) The Church/The Pope/Religion/Christian [1]

  (c) Correct order 3 6 2 [2]
  3 in the correct order give [2]
  1 in the correct position give [1]

  (d) **(i)** In the summer more energy per square metre falls on the Earth
    or the reverse in the winter [1] **or** longer time in sky **or** high in the
    sky [1] ⎱ N. Hemisphere tilt towards the sun [1] so longer time in
    ⎰ sky [1] **or** more energy/m^2 [1] [2]
    higher in the sky [1]

    (ii) Axis tilted to NE to SW   [1]

    (iii) B Spring ⎱ both needed
    D Autumn ⎰ [1]

    (iv) 9 months/270 days/$\frac{3}{4}$ year [1]

    (v) left hand half shaded   accept curved terminator [1]

    (vi) B [1]

  (e) Increasing gravitational force [1]
  Gravitational force increases as distance decreases [1] [2]   20

Total	**125**