MARK SCHEME for the October/November 2013 series

5054 PHYSICS

5054/22   Paper 2 (Theory), maximum raw mark 75

Section A

1 (a) (i) arrow(head) on chain pointing to the right   B1

      (ii) vertical arrow downwards and part of arrow touching **or** within rectangle
of lights **or** direction of arrow in **(i)** and **(ii)** correct (by eye)   B1

(b) scale given (must have unit of cm:N **or** cm/N **or** N:cm **or** N/cm)   B1
correct triangle **or** rectangle (might be implied) and correct resultant
(compulsory e.c.f. from **(i)** or **(ii)**: i.e. correct diagonal according to
candidate's **(i)** and **(ii)**)   B1
$272 \leq$ candidate's value $\leq 283\,$N   B1   [5]

2 (a) $(m =) \rho V$ **or** 1000×0.150 C1
$150\,$kg   A1

(b) (when full) greater mass **or** greater momentum   B1

      more inertia **or** mass resists change in state of motion
or small(er) deceleration (for same force)
or large(r) force for same deceleration (rate of decrease of momentum for
deceleration)   B1
or
greater kinetic energy   (B1)
more work done in same distance (to stop)   (B1)   [4]

3 (a) (i) $(p =) F/A$ **or** $12\,000/0.048$ **or** $12\,000/0.14$
or (in **(ii)**) $(F =) pA$ **or** $2.5 \times 105 \times 0.14$ C1
$2.5 \times 10^5\,$Pa   A1

      (ii) $35\,000\,$N   A1

(b) atmospheric pressure **or** friction (between cylinder and piston/oil)
(accept bubbles (of air) in oil **or** viscosity of oil)   B1

(c) (W.D. =) $F \times d$ **or** $12\,000 \times 0.065$ **or** $35\,000 \times 0.065$ **or** 2275   C1
$780\,$J   A1

(d) (liquids) incompressible **or** air spongy **or** (oil) lubricates the system **or** (oil)
reduces friction
(**ignore** density references, **ignore** oil compresses less)   B1   [7]

4 **(a)** 56 °C (**not** ° **or** C°)   B1

(b) (Q =) ml **or** 110 × 210   C1
2.3(1) × 10^4 J   A1

(c) **(i)** (wax) is solidifying **or** freezing   B1

(ii) (molecules) form structure/come closer/lose PE
or bonds made/stronger (no e.c.f. from **(c)(i)**)   M1
KE. of molecules const. **or** replace/release/produce energy/heat
(transferred to environment/latent heat emitted)
(no e.c.f. from **(c)(i)**)   A1   [6]

5 **(a)** transmission of energy through a medium **or** vibration **or** oscillation **or**
two opposite motions (e.g. up and down) **or** compressions and rarefactions   C1
vibration direction parallel to energy travel/wave direction **or** similar   A1

(b) **(i)** 1.5–2.5 × 10^4 Hz **or** 15–25 kHz cao   B1
15–25 Hz cao   B1

(ii) (λ =) c/f **or** 330/either of candidate's frequencies   C1
330/candidate's higher frequency and correctly calculated with unit
(candidate's higher frequency is either the one stated as the highest
or the one that is in fact the higher)   A1   [6]

6 **(a)** electrons (move)   M1
to the fuel **or** from the pipe **or** pipe becomes positively charged
(**not** moving protons/+ve charges)   A1

(b) spark (jumps from the plane)   B1
ignite the fuel/explosion/blast   B1
or
current from ground   (B1)
shock (to worker/passenger)   (B1)

(c) **(i)** (metal an electrical) conductor **or** has low resistance **or allows/lets** charges/
electrons to flow through it
(this is general: about the conduction property of metals)   B1

(ii) charge/electrons flow along the cable **or** (plane/charges) earthed
(this is specific: about the conduction in this case)   B1   [6]

7 (a) a power × a time × the unit price

(e.g. 1.2 × 75/60 × 4 × 21 **or** 1200 × 75/60 × 4 × 21 **or** 1.2 × 75 × 4 × 21

or 1.2 × 75/60 × 21 **or** 5 (hr) **or** 6 (kW h)) C1

a power × a time × the unit price and with maximum of one physics

error (i.e. use of 1200 **or** omits 60 **or** omits 4)

(e.g. 1200 × 75/60 × 4 × 21 **or** 1.2 × 75 × 4 × 21 **or** 1.2 × 75/60 × 21 **or**

126 000 **or** 7560 **or** 31.5 (accept 0.21 for 21 and 75.60 and 0.315)

(if this C mark is scored so is the previous one) C1

126/130 c **or** $1.26/1.30 **or** €/£/Rs 1.26/1.30 etc. A1

(b) (if) case becomes live **or** live wire touches the case B1

fuse blows **or** (large) current to earth **or** no current in workman

(**ignore** excess; **not** "some current") B1   [5]

8 (a) (i) any two of:

minimise time of exposure

lead clothing (e.g. lead gloves **not** radioactive suit)

tongs, manipulator, forceps, tweezers

behind protective/lead glass/shield

wear film badge B2

(ii) (radioactive emission) random/unpredictable (process)

(e.g. background radiation is random; **ignore** spontaneous) B1

(b) penetration strong(er) **or** penetrates casing (accept α **or** β **or** both;

ignore larger range) B1

(more) weakly/slowly ionising B1

either explained: harms health **or** hazardous **or** dangerous

or air is not ionised **or** sounds all the time (accept doesn't work) B1   [6]

[Total: 45]

Section B

9 **(a)** force × distance **or** $F × d$ with F and d defined **or** $F × d_{perp}$ C1
force × perpendicular distance **or** $F × d_{perp}$ with F and d_{perp} defined   A1   [2]

     (b) **(i)** **1.** 6 × 750 × 1.2 **or** 750 × 1.2 **or** 900   C1
         5400 N m   A1

         2. mgh **or** 350 × 10 × 160 **or** 350 × 10 × 1.6   C1
         350 × 10 × 1.6 **or** 5.6 × 105   C1
         5600 J   A1

       (ii) friction at axle/boat **or** drag due to water
         or chain lifted also   B1
         heat produced (**ignore** in sailors) **or** work done against friction/drag
         or work done raising chain   B1

       (iii) same amount of work done **or** $P = E/t$ **or** $P = WD/t$ B1
         in less time **or** power inversely proportional to time (**ignore** faster rate)   B1   [9]

     (c) clear/labelled diagram with ruler, fulcrum, at least two weights   B1
       any three of the following points made in words:
       balance ruler (on its own)
       place weights on ruler so it balances
       clockwise and anticlockwise moments equal **or** net moment zero
       repeat (apply similar principles to other possible methods)   B3   [4]

                                                                  [Total: 15]

10 (a) (i) start at origin **and** not horizontal   B1
gradient (gradually) decreasing (**ignore** sudden decrease)
(not if part of curve above horizontal section)   B1
final horizontal section (≥ 1 cm) (not if v is shown as ≠ 40 m/s)   B1

      (ii) area **under** the graph **or** count squares **under** graph   M1
between $t = 0$ and horizontal section **or** when speed is changing **or**
calculate equivalent distance to 1 cm^2 (after counting squares)   A1   [5]

   (b) (i) friction/air resistance increases (as speed increases)   B1
resultant force decreases
(**not** if driving force decreases)   B1

      (ii) (air resistance increases until) net force becomes zero **or** forces balance
or air resistance and driving/forward force are in equilibrium/balanced/equal B1   [3]

   (c) (i) (KE =) $\frac{1}{2}mv^2$ C1
$\frac{1}{2} \times 5.5 \times 10^5 \times 40^2$ C1
4.4×10^8 J   A1

      (ii) (total energy input =) useful energy output efficiency **or**
efficiency = useful power output/total power input **or** $4.4 \times 10^8/0.40$ C1
1.1×10^9 J   A1

     (iii) two valid examples
e.g. furnace/boiler/turbines/generator/coils/cooling water/cooling towers/heat
exchanger/transformer/chimney/waste gases/
transmission cables/lines/wires (**ignore** power station/all parts of motor)   B2   [7]

                                                     [Total: 15]

11 (a) work done per (unit) charge/coulomb/C **or** energy transformed per (unit) charge/
coulomb/C   B1
property of a source (of electricity) **or** energy transformed to electrical energy
per (unit) charge/coulomb/C   B1   [2]

  (b) (i) ammeter in series   B1

    (ii) voltmeter in parallel with lamp **or** lamp and ammeter   B1   [2]

  (c) (i) ($V =$) 2.0 (V)   C1
($R =$) V/I **or** 2.0/0.70   C1
2.9/2.86 Ω (i.e. 2 **or** 3 s.f. only)   A1

    (ii) (resistance) increases   B1   [4]

  (d) ($P =$) VI **or** ($P =$) V^2/R **or** $I^2 R$ **or** 12 × 2.0 **or** 12 × 0.70   C1
24 W   A1   [2]

  (e) (i) emission of electrons   M1
from heated metal/named metal/filament/wire   A1

    (ii) 1. prevents collision with air (molecules) **or** prevents deflection **or** lets
electrons/particles reach screen/travel unimpeded   B1

       2. moves vertically (e.g. up/down/above/below **or** vertical line) **not** with
horizontal movement due to this voltage   B1
attracted by positive **or** repelled by negative **or** attracted by one plate
and repelled by the other **or** electric field (acts on charge)   B1   [5]

[Total: 15]