4E5N Sci(Physics) Preliminary Examinations (2019) suggested answers

Paper 1

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
B	**B**	**B**	**C**	**C**	**D**	**C**	**A**	**D**	**D**
Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
C	**D**	**A**	**C**	**B**	**C**	**A**	**B**	**A**	**A**

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Paper 2

Section A

1 (a) $P = \frac{F}{A}$

$= \frac{14\,000\ N}{500\ cm^2}$ [C1]

$=$ **28 N/cm²** [A1]

(b) $P_{larger} = P_{smaller}$

$\frac{F_{larger}}{A_{larger}} = \frac{F_{smaller}}{A_{smaller}}$ [B1]

$\frac{F_{larger}}{F_{smaller}} = \frac{A_{larger}}{A_{smaller}}$

$= \frac{1440\ cm^2}{500\ cm^2} > 1$ [B1]

Therefore $F_{larger} > F_{smaller}$.

OR

$F_{larger} = 28\ N/cm^2 \times 1440\ cm^2$

$= 40\,230\ N$ [B1]

Since $F_{smaller} = 14\,000\ N$, $F_{larger} > F_{smaller}$ [B1]

2 (a) elastic potential energy to kinetic energy and gravitational potential energy [B1]

(b) (i) $W = F \times d$

$= 85\ N \times 0.42\ m$ [C1]

$=$ **35.7 J** [A1]

(ii) G.P.E gained = work done

$0.16\ kg \times 10\ N/kg \times h = 35.7\ J$ [allow e.c.f. from **(b)(i)**] [C1]

$h =$ **22.3 m** (3 s.f.) [A1]

(c) Some of the **energy is converted to thermal energy** due to work done against air resistance. [B1]

3 **(a)** The **air above the candles is heated** and **becomes less dense** so **it rises to** the **warming tray**. [B1]
The **cooler air below the warming tray is denser** and **sinks to takes its place**. [B1]
The whole process is repeated and forms a convection current to heat the warming tray.

(b) As the **handles are made of metal** and **metal is a good conductor of thermal energy/ heat**, [B1]
the **handles** may **become hot** and **injure the user**. [B1]

4 **(a)** t = 15 min = 15 × 60 = 900 s

E = Pt
= 600 W × 900 s [C1]
= **540 000 J** [A1]

(b) At BC, **thermal energy is absorbed to break the intermolecular bonds**. [B1]
The **kinetic energy of the molecules remains constant** [B1]
but the **potential energy of the molecules increases**. [B1]

(c) The **kinetic energy increases** and [B1]
the **spacing between the molecules remains constant / increases slightly**. [B1]

5 **(a)** The **light ray** will not emerge from BC as it **undergoes total internal reflection at face BC**. [B1]
The **angle of incidence** (62°) **is larger than the critical angle** (43°), and the light ray is going from a optically denser medium to a optically less dense medium. [B1]

(b) $n = \frac{1}{\sin 43}$ [B1]
= **1.47** (3 s.f.) [A1]

6 **(a)** The **air particles travel** through a **series of compressions and rarefactions parallel to the direction that the sound wave travels**. [B1]
The sound energy is transferred as the **air particles collide with each other**. [B1]

(b) T = 4 ms

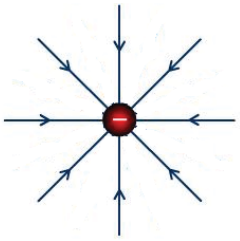
$f = \frac{1}{4 \times 10^{-3}}$ [C1]
= **250 Hz** [A1]

(c) $v = f\lambda$

$\lambda = \dfrac{330 \text{ m/s}}{250 \text{ Hz}}$ [allow e.c.f. from **(b)**] [C1]

$= \underline{\mathbf{1.32 \text{ m}}}$ [A1]

7 (a)



[A1]

(b) The **water drop will move upwards** as it is **attracted to the positively-charged cloud** [B1]
since **unlike charges attract** [B1]

8 (a) Join brown wire to fuse to heating coil [B1]
Join heating coil to blue wire [B1]
Join green wire to metallic casing [B1]

(b) $I = \dfrac{P}{V} = \dfrac{1\,500 \text{ W}}{240 \text{ V}}$ [C1]

$= 6.25 \text{ A}$

Fuse = $\underline{\mathbf{8 \text{ A}}}$ [A1]

(c) $E = Pt$

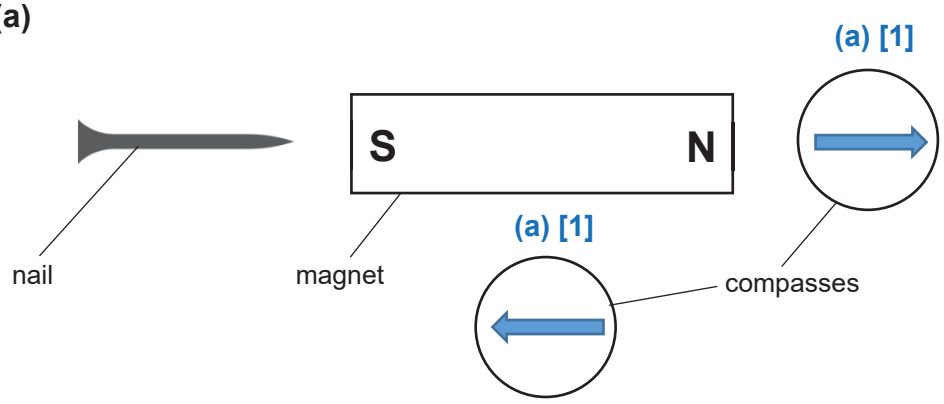
$= 1.5 \text{ kW} \times \dfrac{30}{60} \text{ hour}$

$= 0.75 \text{ kWh}$ [C1]

Cost per day = 0.75 kWh × \$0.20
= \$0.15 [C1]

Cost for 30 days = \$0.15 × 30 days
= $\underline{\mathbf{\$4.50}}$ [A1]

9 (a)



(b) Steel [B1]

Section B

10 (a) 0 m/s^2 [A1]

(b) The object falls at **decreasing acceleration**. / increasing speed at decreasing rate.
[A1]

(c) As the **object falls**, **air resistance increases**. [B1]
The **weight remains unchanged**, hence the **resultant force of the object decreases**
[B1]

From F = ma, the **acceleration of the object decreases**. [B1]

(d) distance = area under the graph
= ½ × (35 + 33) × 25 [C1]
= **850 m** [A1]

(e) $a = \frac{v - u}{t}$

$= \frac{0 - 25}{2}$ [C1]

$= -12.5\ m/s^2$ [C1]

F = ma
= 5.0 kg × (-12.5 m/s^2)
= **- 62.5 N** (accept 62.5 N) [A1]

11 (a) Centre of gravity is a point on an object where the entire weight appears to act on .
[B1]

(b) W = mg
= 50 kg × 10 N/kg
= **500 N** [A1]

(c) clockwise moment = 500 N × 0.90 m [allow e.c.f. from **(b)**] [C1]
= **450 Nm** [A1]

(d) F × 1.4 m = 450 Nm [allow e.c.f. from **(c)**] [C1]
F = **321 N** [A1]

(e) (i) The **total clockwise moments about O increases**. [B1]
The **additional weights provide an additional clockwise moment about O**. [B1]

(ii) Since **the total clockwise moments is increased, the total anti-clockwise moments increased too**. [B1]
Hence **F increases**. [B1]

12 (a) Electromotive force is the work done required to move a unit charge around the complete circuit. [B1]

(b) The **total resistance of the circuit increases** [B1]
and the **current through the circuit and lamp decreases**. [B1]
The brightness of the lamp will decrease.

(c) (i) When switch is closed, the **total resistance of the circuit decreases**, [B1]
hence **current in the circuit and through the lamp increases**. [B1]
The ammeter A_2 reading will increase.

(ii) $R = \left(\frac{1}{120} + \frac{1}{40}\right)^{-1} + 90$ [C1]
= **120 Ω** [A1]

(iii) $I = \frac{24\ V}{120\ \Omega}$ [allow e.c.f. from **(c)(ii)**]
= **0.20 A** [A1]

(iv) $V_{lamp} = 24\ V - (0.20\ A \times 90\ \Omega)$
$= 6.0\ V$ [C1]

$I = \frac{6.0\ V}{40\ \Omega}$
= **0.15 A** [A1]

or

$I = \frac{120\ \Omega}{160\ \Omega} \times 0.20\ A$ [C1]
= **0.15 A** [A1]