**2015 AJC H1 Physics Prelim Paper 1**
**Mark Scheme (30 marks)**

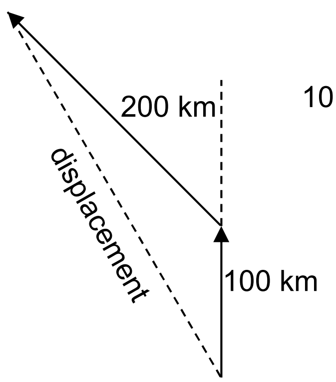
| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| A | D | B | B | C |
| 6 | 7 | 8 | 9 | 10 |
| D | A | A | C | B |
| 11 | 12 | 13 | 14 | 15 |
| D | C | C | A | A |
| 16 | 17 | 18 | 19 | 20 |
| B | D | C | D | D |
| 21 | 22 | 23 | 24 | 25 |
| C | C | B | C | B |
| 26 | 27 | 28 | 29 | 30 |
| A | A | B | B | D |

1 **A**
From graph, change in R is large for low temperatures. Hence $\Delta I$ is large at low T.
When temperature is low, the thermistor has high resistance→ current is small
Thus pointer is on the left side of scale.

2 **D**
Measurement of temperature requires 1 scale reading. Uncertainty of scale reading = ½ of smallest division = 0.5°
Decimal place of reading follows d.p. of uncertainty

3 **B**
Since the aircraft can only travel 50 more km, it needs to make an emergency landing.

Also, the displacement of the aircraft can be determined using the cosine rule




$$x^2 = 200^2 + 100^2 - 2(200)(100)\cos 135°$$

$x^2 = 78284$
$x = 279$ km → outside of Cambridge's air-traffic control space

4 **B**

$s = \frac{1}{2}gt^2$ on earth, $s = \frac{1}{2}\left(\frac{g}{6}\right)t'^2$ on moon

→ $t'^2 = 6t^2$ and $t' = \sqrt{6}t$

5 **C**
At launch, E=½ m $v^2$
At highest point, KE = ½ m $v_x^2$
where $v_x$ = v cos 30 = √3 v / 2
Hence at highest point,
KE = ½ m (√3 v / 2)$^2$
= ¾ × ½ m $v^2$
= ¾ E = 0.75 E

6 **D**
Consider vertical motion:

↓: $h = \frac{1}{2}gt^2 \rightarrow t = \sqrt{\frac{2h}{g}}$

Consider horizontal motion:

→: $d = vt = v\sqrt{\frac{2h}{g}}$

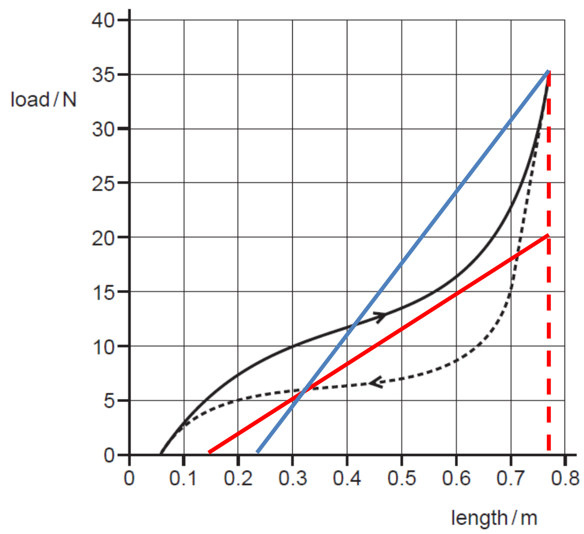
7 **A**
90 kg min$^{-1}$ = 1.5 kg s$^{-1}$

$F = \frac{\Delta(mv)}{t} = v\frac{\Delta m}{t} = 20 \times 1.5 = 30$ N

8 **A**
$\sum p_i = \sum p_f$ →(3m)v – m(2v) = (4m)v'
v' = v/4

9 **C**
Consider N2L on the system of carts 2, 3 & 4:
$T = (3 \times 400)(2)$ =2400 N

10 **B**




WD to stretch = ½ × 0.5 × 35 = 9 J
Energy recovered = ½ × 0.6 × 20 = 6 J
Total WD in 1 cycle =
Energy remaining in 1 cycle = 9 – 6 = 3 J

11 **D**

Force at pivot is not zero as the force at the biceps have a horizontal component.
Hence there must be a force at the pivot.
If the load is moved nearer to pivot, the force from biceps would be smaller due to smaller moments.
Force from biceps + Force at pivot = $W_1$ + $W_2$

12 **C**

$$P = \rho g h = \frac{F}{A}$$

$$1030 \times 9.81 \times h = \frac{8.24 \times 10^6}{0.50 \times 0.40}$$

$h$ = 4077 m

13 **C**

Instantaneous Power =
gradient of Energy – time graph
$P_{max}$ occurs during t = 2 s to t = 3 s.

Gradient = $\frac{40-10}{1} = 30$ W

14 **A**

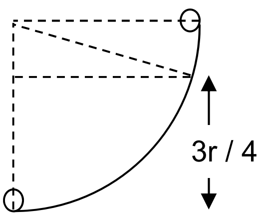
Work done = p$\Delta$V= $p(V_2 - V_1)$

15 **A**

GPE decreases from P to Q implies the direction of the G-field is towards →
Since mgx = E,
g = E / mx

16 **B**

$E_p = E_T$
mgr = ½ m ($4^2$)
gr = 8
Let x be the point where GPE has decreased by E/4,




$E_p = E_x$
mgr = mg(3r/4) + ½ m $v^2$
$v^2$ = ½ gr
v = 2.0 $ms^{-1}$

17 **D**

Microwaves are polarised when passed through a metal grid. Light is also polarised when reflected or scattered. Sound waves are longitudinal waves, and hence cannot be polarised.

18 **C**

Amplitude is maximum displacement = 2.0$\mu$m
Frequency = 1/T = 1/(2×10×$10^{-6}$)= 50 kHz

19 **D**

The amplitude of the sound waves is a maximum in the straight through position and decreases as it moves away from the central peak.
The intensity minima further from central maximum do not cancel out completely as amplitude of waves from the individual sources reaching the minima are not equal.

20 **D**

$v = f\lambda \rightarrow \lambda = \frac{v}{f}$

To produce the same wave pattern, the wavelength must remain constant.

To maintain the same wavelength at a higher frequency, the speed must be increased.

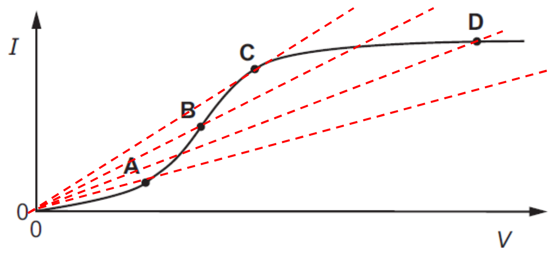
21 **C**

$Q = It$

$$I = \frac{ne}{t} = \frac{3000 \times 10^{11} \times 10^4 \times 1.6 \times 10^{-19}}{1}$$

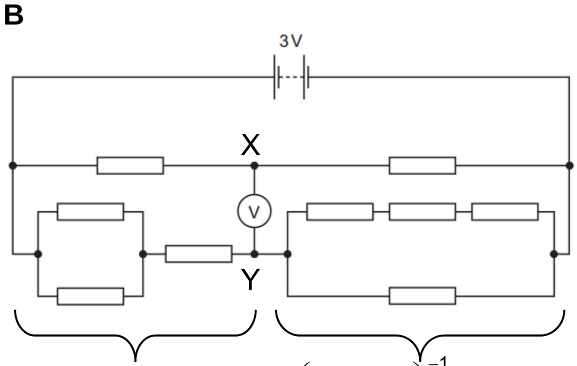
= 0.48 A ≈ 500 mA

22 **C**




Smallest R → largest I/V

23 **B**




1.5 R

$$\left(\frac{1}{3R} + \frac{1}{R}\right)^{-1} = 0.75\,\text{R}$$

Potential at X = 1.5 V

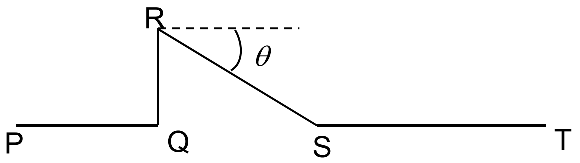
Potential at Y = $\frac{0.75}{1.5 + 0.75} \times 3 = 1.0$ V

Hence voltmeter reading is 0.5 V

24 **C**

When the switch is closed, the effective resistance in the circuit decreases, hence the current flowing increases. The voltmeter also takes a larger fraction of the potential difference across the power supply, hence the voltmeter reading increases too.

25 **B**




$L_{RS}$ sinθ = $L_{QR}$
$F_{QR}$ = BI($L_{QR}$) = BI($L_{RS}$ sinθ) = $F_{RS}$
$L_{PQ}$ and $L_{ST}$ are parallel to B-field
$F_{PQ}$ = $F_{ST}$ = 0

26 **A**

$F_B$ = N x (BIL sinθ) = 100 x 0.55 x 1.6 x 0.1
= 8.8 N
Torque = 8.8 x 0.05
= 0.44 N m
Using FLHR, direction of force on right edge is moving into the plane of paper.

27 **A**

$$P = IA \rightarrow \frac{nhf}{t} = IA \rightarrow \frac{n}{t} = \frac{IA}{hf}$$

$$F = \frac{\Delta p}{t} = \frac{n\left[\frac{hf}{c} - \left(-\frac{hf}{c}\right)\right]}{t}$$

$$F = \frac{2n}{t}\frac{hf}{c} = \frac{2IA}{hf}\frac{hf}{c} = \frac{2IA}{c}$$

28 **B**

P: photoelectric effect, particle nature
Q: electron diffraction, wave nature

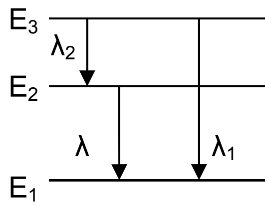
29 **B**

$$hf = \phi + \frac{1}{2}mv_{max}{}^2$$

$$\frac{hc}{650 \times 10^{-9}} = 1.81 \times 1.6 \times 10^{-19} + \frac{1}{2}mv_{max}{}^2$$

$$v_{max} = 1.9 \times 10^5 \text{ m s}^{-1}$$

30 **D**




Let λ be wavelength of the other spectral line.
$E_3 - E_1 = hc/\lambda_1$ and $E_3 - E_2 = hc/\lambda_2$
Hence $E_2 - E_1 = hc/\lambda_1 - hc/\lambda_2 = hc/\lambda$

$$\therefore \lambda = \frac{\lambda_1\lambda_2}{\lambda_2 - \lambda_1}$$