THE SCHOOL FOR EXCELLENCE
UNIT 3 PHYSICS 2008
COMPLIMENTARY WRITTEN EXAMINATION 1 - SOLUTIONS

SECTION A – CORE STUDIES

AREA OF STUDY 1 - MOTION IN ONE AND TWO DIMENSIONS

QUESTION 1 The answer is D

QUESTION 2

$$v = \sqrt{3^2 + 5^2} = 5.8 ms^{-1}$$

QUESTION 3

$$d = ut + \frac{1}{2}at^2$$
$$0 = 5t + \frac{1}{2}(-10)t^2$$
$$t = 1s$$
$$x = v_x t = 3m$$

QUESTION 4 The answer is C

QUESTION 5 Jo, object will drop at g, free fall, N=0

QUESTION 6 From graph, m=10 kg

QUESTION 7

From the graph:

$$F = 4.5 \times 10^6 N$$
$$k = F / x$$
$$= 4.5 \times 10^6 / 0.05$$
$$k = 9 \times 10^7 Nm^{-1}$$

QUESTION 8

Impulse = Area under graph = 48 squares (accept 46 – 50)

$$\begin{aligned}\textbf{Impulse} &= 48\times 0.5\times 10^{6}\times 0.5\times 10^{-3}\\ &= 12000Ns\end{aligned}$$

QUESTION 9

$p_i = p_a$

$1000\times 15 = 1000v + 2000\times 6$

$v = 3ms^{-1}$ to the right.

QUESTION 10

$mu = (m_1 + m_2)v$

$v = 5ms^{-1}$

$\frac{1}{2}mu^2 = \frac{1}{2}(m_1 + m_2)v^2$ for an elastic collsion

$112.5J \neq 37.5J$ therefore, collision is not elastic.

QUESTION 11

$T = \frac{1}{f} = 2s$

$r = 0.5\sin 60$

$a = \frac{4\pi^2 r}{T^2}$

$= 4.3ms^{-2}$

QUESTION 12

$mg = T\cos 60$

$m = 100g$

QUESTION 13 The answer is D

QUESTION 14

On surface: $F \propto \frac{1}{r^2} = \frac{1}{R^2}$

In orbit: $r' = 3R$

$$F' \propto \frac{1}{r'^2} = \frac{1}{(3R)^2} = \frac{1}{9R^2} = \frac{1}{9}F$$

QUESTION 15

Work done = Area under graph = 4 squares (accept 3-5)

$$W = 4 \times 3 \times R$$
$$= 12R$$

QUESTION 16

$$\frac{r_1^3}{r_2^3} = \frac{T_1^2}{T_2^2}$$

$$\frac{(5R)^3}{(3R)^3} = \frac{(50)^2}{T_2^2}$$

$$T_2 = 40 days$$

AREA OF STUDY 2 - ELECTRONICS AND PHOTONICS

QUESTION 1 Answer is D

QUESTION 2

The V – I graph shows that a potential difference of 3.0 volts will be maintained across the LED (provided a minimum current of 10mA flows).

QUESTION 3

The potential difference across R1 is 9V.

$$R = \frac{V}{I} = \frac{9}{0.045} = 200\Omega$$

QUESTION 4

The current through the LED branch is found by finding the current through the resistor parallel to the LED, and subtracting it from the total current.

$$I\ (through\ 100\Omega) = \frac{V}{R} = \frac{3}{100} = 0.03A$$
$$I\ (LED) = 0.045 - 0.03 = 0.015\ or\ 15\,mA$$

Answer = 15mA

QUESTION 5

$$I = \frac{V_T}{R_T} = \frac{12}{200 + 100} = 0.04A\ or\ 40mA$$

QUESTION 6

This value is read directly from the graph - 6 kohms.

QUESTION 7

$$V_{OUT} = \frac{R_2}{R_2 + R_{LDR}} \times V\,IN = \frac{4}{4+6} \times 20 = 8V$$

QUESTION 8

At 10 lux, R_{LDR} = 16 kohms

$$V_{OUT}\,(at\ 10\ lux) = \frac{R_2}{R_2 + R_{LDR}} \times V\,IN = \frac{4}{4+16} \times 20 = 4V$$

$$\Delta V_{OUT} = 8 - 4 = 4V$$

Answer = 4V

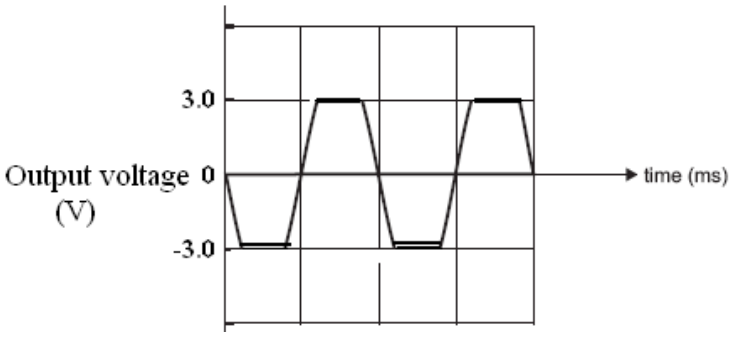
QUESTION 9

$$A_V = \frac{\Delta V_{OUT}}{\Delta V_{IN}} = \frac{3.0}{60 \times 10^{-3}} = 50$$

QUESTION 10

This is read directly from the graph. Answer = 2.0V

QUESTION 11



Inversion of wave pattern - 1 mark
Correct values - 1 mark
Clipping - 1 mark

QUESTION 12

$$I_C = I_B \times gain = 10 \times 10^{-6} \times 100 = 1.0 \times 10^{-3} A$$
$$\Delta V = \Delta I \times R_C = 1.0 \times 10^{-3} \times 1000 = 1.0 V$$

Answer = 1.0V

QUESTION 13

Any two of the following (1 mark each):

- Narrower spectral spread which reduces material dispersion.
- More focused beam, hence higher intensity
- Faster response time

QUESTION 14

Circuit B would best achieve the desired result(1 mark). As light levels increase, so too does the base current. This results in a greater current from the emitter, and hence a larger potential drop across the resistor and a higher V_{OUT} (2 marks).

Or converse explanations for Circuit A (2 marks).

SECTION B – CORE STUDIES

DETAILED STUDY 1
EINSTEIN'S SPECIAL RELATIVITY

QUESTION 1 Answer is A

QUESTION 2 Answer is B and D

QUESTION 3 Answer is D

QUESTION 4 Answer is C

QUESTION 5 Answer is D

QUESTION 6 Answer is C

QUESTION 7 Answer is B

QUESTION 8 Answer is C

QUESTION 9 Answer is A

QUESTION 10 Answer is C

QUESTION 11 Answer is B

QUESTION 12 Answer is D

QUESTION 13 Answer is C

DETAILED STUDY 2
FURTHER ELECTRONICS

QUESTION 1 Answer is C

QUESTION 2 Answer is A and B

QUESTION 3 Answer is A

QUESTION 4 Answer is C

QUESTION 5 Answer is B

QUESTION 6 Answer is D

QUESTION 7 Answer is A

QUESTION 8 Answer is B and C

QUESTION 9 Answer is A and C

QUESTION 10 Answer is C

QUESTION 11 Answer is C

QUESTION 12 Answer is B

QUESTION 13 Answer is B

DETAILED STUDY 3
STRUCTURES AND MATERIALS

QUESTION 1 Answer is A

QUESTION 2 Answer is C

QUESTION 3 Answer is E

Young's modulus = $0.03 \times 10^{-6} / 0.003\% = 3 \times 10^{4} / 3 \times 10^{-5} = 1 \times 10^{9}$ Pa

QUESTION 4 Answer is B

It fractures without a plastic region under less strain than other materials

QUESTION 5 Answer is B

QUESTION 6 Answer is A

QUESTION 7 Answer is B

QUESTION 8 Answer is A

QUESTION 9 Answer is D

QUESTION 10 Answer is D

$\cos 10 = 20 / (L+x)$

$L+x = 20/\cos 10 = 20.3085 \text{ m} \approx 20.31 \text{ m}$

Total new length of cable = 40.62 m x = 0.62 m

QUESTION 11 Answer is C

QUESTION 12 Answer is D

The upward component of the tension = 4000 N down.

i.e. $T \sin 10 = 4000$ T = 23,035 N = 23 kN

QUESTION 13 Answer is C

Area = $\pi r^2 = 5.027 \times 10^{-5}$

F = tension = 23035 N

x = 0.3085 m, L = 20 m

Young's modulus = $2.97 \times 10^{10} \approx 3 \times 10^{10}$