



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

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

QUESTION 3

$$d = ut + \frac{1}{2}at^2$$

$$0 = 5t + \frac{1}{2}(-10)t^2$$

$$t = 1\text{s}$$

$$x = v_x t = 3\text{m}$$

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:

$$F = 4.5 \times 10^6 \text{ N}$$

$$k = F / x$$

$$= 4.5 \times 10^6 / 0.05$$

$$k = 9 \times 10^7 \text{ Nm}^{-1}$$

QUESTION 8

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

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

QUESTION 9

$$p_i = p_a$$

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

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

QUESTION 10

$$mu = (m_1 + m_2)v$$

$$v = 5 \text{ms}^{-1}$$

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

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

QUESTION 11

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

$$r = 0.5 \sin 60$$

$$\begin{aligned}a &= \frac{4\pi^2 r}{T^2} \\ &= 4.3 \text{ms}^{-2}\end{aligned}$$

QUESTION 12

$$mg = T \cos 60$$

$$m = 100\text{g}$$

QUESTION 13

The answer is D

QUESTION 14

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

$$\text{In orbit: } r' = 3R$$

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

QUESTION 15

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

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

QUESTION 16

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

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

$$T_2 = 40 \text{ days}$$

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.

$$I (\text{through } 100\Omega) = \frac{V}{R} = \frac{3}{100} = 0.03A$$

$$I (LED) = 0.045 - 0.03 = 0.015 \text{ or } 15 \text{ mA}$$

Answer = 15mA

QUESTION 5

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

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

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

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

Answer = 4V

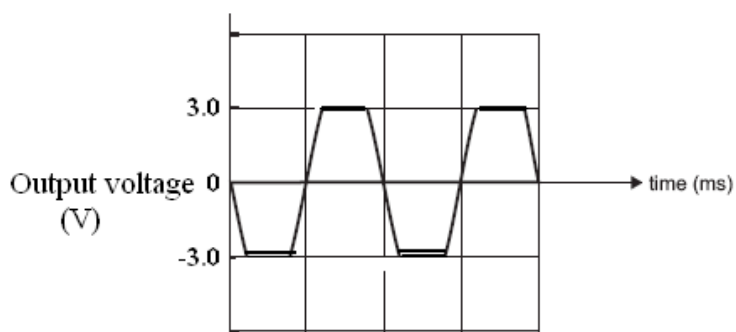
QUESTION 9

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

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

$$I_C = I_B \times \text{gain} = 10 \times 10^{-6} \times 100 = 1.0 \times 10^{-3} \text{ A}$$

$$\Delta V = \Delta I \times R_C = 1.0 \times 10^{-3} \times 1000 = 1.0 \text{ V}$$

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

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

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

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

$$\text{Total new length of cable} = 40.62 \text{ m} \quad x = 0.62 \text{ m}$$

QUESTION 11 Answer is C

QUESTION 12 Answer is D

The upward component of the tension = 4000 N down.

$$\text{i.e. } T \sin 10^\circ = 4000 \quad T = 23,035 \text{ N} = 23 \text{ kN}$$

QUESTION 13 Answer is C

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

$$F = \text{tension} = 23035 \text{ N}$$

$$x = 0.3085 \text{ m}, \quad L = 20 \text{ m}$$

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