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# **Question 1**

General Comments

Weakness/Remedies

Candidate's Strength

The force, F, acting on the wings of an aircraft moving through the air of velocity, v, and density, is given by the equation where, is a dimensionless constant and A is the surface area of the wings of the aircraft. Use dimensional analysis to determine the values of and.

## Observation

Most candidates provided incorrect first steps for the solution by making the wrong substitution of dimension units of velocity, density and area.

### EXPECTED RESPONSES: Determination of values of x,y and z

For M; y = 1 T; x = 2 For L; = 1 = 1 z = 1

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# **Question 2**

**General Comments** 

1. Define strain energy.

Weakness/Remedies Write an expression for the energy stored, E, in a stretched wire of original length, Candidate's Strength Candidate's Strength

### Observation

In 2(a), most candidates accurately defined strain energy.

A few of the candidates mistook strain energy for elastic constant.

In 2(b), some candidates rendered the expression as instead of .

### **EXPECTED RESPONSES:**

### (a) **Definition of strain energy**

The energy stored in a material as a result of a change in its shape/size/dimension. **OR** 

The potential energy stored in an object when it is deformed/ stretched/compressed by an applied force.

### OR

The work done on a material when a force is applied to change its shape/stretch it/compress it.

(b) Expression for E in terms of I, A, e and Y

 $E = \frac{YAe^2}{2l}$ 

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# **Question 3**

**General Comments** 

Weakness/Remedies

Candidate's Strength

1. A projectile is fired at an angle, to the horizontal with velocity, u. Show that at an time, t, during the motion, the:

The horizontal component of the velocity is independent of **t**; The vertical component of the velocity depends on **t**.

2. State the assumption on which projectile motion is based

## Observation

In 3(a), many candidates gave the vertical component as instead of since motion is against gravity.

In 3(b), only a few candidates could state the assumption on which projectile motion is based correctly.

### **EXPECTED RESPONSES:**

(a) Horizontal and vertical components of velocity

(1) for horizontal component, v<sub>x</sub> = u<sub>x</sub> - gt for horizontal direction, g = 0 ∴ v<sub>x</sub> = u cos θ
(ii) for the vertical component v<sub>y</sub> = u<sub>y</sub> - gt, u<sub>y</sub> = u sin θ V<sub>y</sub> = u sin θ - gt

### (b) Assumption

The only force acting on the body is its weight/force of gravity.

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# **Question 4**

**General Comments** 

Weakness/Remedies

Candidate's Strength

### State three differences between and geostationary satellites and polar satellites

### **Observation**

Many candidates were able to differentiate between geostationary and polar satellites correctly. Some of the candidates could not give more than one difference.

### **EXPECTED RESPONSES:**

#### Differences between geostationary and polar satellites

Geostationary	Polar
The period of revolution is the same as the period of rotation of the Earth/24 hours/1 day	The period of revolution in orbit is not the same as the period of rotation of the Earth/varies
Orbits directly along the equator/latitude	Travels from pole to pole in orbit/along the longitude
It appears to be stationary above a point on the Earth's surface	It is not always in the same position relative to the Earth
Provides continuous coverage of specific regions/areas	Provides global coverage





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# **Question 5**

### General Comments Weakness/Remedies Candidate's Strength

 Using the kinetic theory, explain the term
 Name one phenomenon that demonstrates that light behaves as a: Wave;
 Particle.

## Observation

In (a), some of the candidates defined kinetic theory and diffusion without touching on the specific terms. Many candidates acknowledged either the random motion or the collision between molecules of gases and the walls of their container but failed to state both occurrences to get the full mark.

In (b), many candidates were able to provide a satisfactory response to the question about the phenomena of light and were able to demonstrate this knowledge.

### EXPECTED RESPONSES:

### (a) Diffusion of fluid molecules using kinetic theory:

The process where fluid molecules move randomly and collide (1) with neighbouring molecules due to the possession of kinetic energy. (1)

### (b) List of the phenomenon

- (i) Wave;
- Refraction
- Reflection
- Diffraction
- Interference
- Polarization
  - (ii) Particle;

- Photoelectric effect
- Compton effect/scattering
- Thermionic effect
- Black body radiation

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# **Question 6**

**General Comments** 

Weakness/Remedies

Candidate's Strength -

State one difference between an intrinsic and an extrinsic semiconductor.
 Draw a circuit diagram to illustrate full-wave smoothing rectification.

## Observation

Many candidates differentiated between intrinsic and extrinsic semiconductors correctly.

Only a few candidates answer (b) and it was executed poorly. It is necessary to provide candidates with more assistance in this particular aspect of Physics.

### **EXPECTED RESPONSES:**

(a) Difference between intrinsic and extrinsic semiconductors

Intrinsic	Extrinsic
Pure	Contains impurities /doped
An equal number of charge carriers/holes and electrons	Has majority and minority charge carriers/unequal number of charge carriers
Low electrical conductivity/high resistivity	High electrical conductivity/low resistivity
Thermally generated charge carriers	Charge carriers result from doping

(b) Sketch of the circuit to show full wave smoothing rectification



D1 and D2 shown Capacitor shown **NB**: (i) Accept diode-bridge arrangement (ii) Do **not** accept d.c. source (iii) Score zero for missing a.c. source

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# **Question 7**

General Comments Weakness/Remedies

Candidate's Strength

(a) What is fibre optics?

(b) State two reasons why optical fibres are preferred to copper cables in the telecommunication industry.

# Observation

Most candidates are well-informed and have a good understanding of the subject matter. They were knowledgeable about the differences between optical fibre and fibre optics. They were able to provide valid reasons why optical fibres are often preferred over copper cables in telecommunication.

### **EXPECTED RESPONSES:**

### (a) Fibre optics

Technology that transmits information/data using pulses of light (through thin transparent fibres made of high-quality glass/plastic).

### (b) <u>Reasons for preferring optical fibres to copper cables</u>

- Have greater bandwidth
- Transmits signals faster
- Cover longer distances
- Greater efficiency
- High-quality transmission
- Low resistance

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# **Question 8**

General Comments

Weakness/Remedies

Candidate's Strength

(a) (i) State the reason why simple harmonic motion is periodic.

(ii) State **two** factors that affect the period of oscillation of a simple pendulum.
(iii) Sketch a graph of the total mechanical energy, **E**, against displacement, y, for the motion of a simple pendulum from one extreme position to the other.

(b) The diagram below illustrates an oscillatory pendulum.



Calculate the work done in raising the pendulum to point B, if the mass of the bob is 50g.

[g = 10 *ms*-2]

1. A spiral spring of spring constant, *k*, and natural length, *l*, has a scale pan of mass 0.04*kg* hanging on its lower end while the upper end is firmly fixed to a support. When an object of mass 0.20*kg* is placed on the scale pan, the length of the spring becomes 0.055*m* and when the object is replaced with another object of mass 0.28*kg*, the length of the spring becomes 0.065 *m*. Calculate the values of *k* and *l*.

# Observation

In question 8a, a significant number of candidates were able to aptly justify why Simple Harmonic Motion is periodic.

However, in question 8a(iii), most candidates were unable to obtain the maximum mark possible due to their inability to sketch the graph of the total mechanical energy, E, against displacement, y, for the motion of a simple pendulum.

In question 8b, most candidates did not perform well due to incorrect substitution. Finally, in question 8c, the majority of candidates failed to answer correctly because they did not take into account the weight of the scale pan.

### **EXPECTED RESPONSES:**

### (a) (i) Reason why Simple Harmonic Motion is periodic

- It is a motion that continuously repeats itself (in a specific pattern).
- Due to the balance between the restoring force and the inertial force/weight.

### (ii) Factors that affect the period of oscillation of a simple pendulum

- Length (of the pendulum)
- Acceleration of free fall/ acceleration due to gravity

### (iii) Sketch of E against y



**A6** 

(b) Calculation of work done

OR  $W = mgl(1 - \cos\theta)$   $= 0.05 \times 10 \times 0.6 (1 - \cos 60)$  = 0.15 J W = mgh  $= 0.05 \times 10 \times 10$ = 5 J

(c) Calculations of values of *I* and k

From Hooke's law,  $F = ke \quad \mathbf{OR} \ W = (m + m_0)g = k(l_1 - l_0)$ For 0.20 kg : (0.20 + 0.04) × 10 = k(0.055 - l) = k(0.055 - l) = 2.4....eqn a For 0.28 kg : (0.28 + 0.04) × 10 = k(0.065 - l) = k(0.065 - l) = 3.2....eqn b Divide eqn b. by eqn. a  $\frac{k(0.065 - l)}{k(0.055 - l)} = \frac{3.2}{2.4}$ = 3(0.065 - l) = 4(0.055 - l) 4l - 3l = 0.22 - 0.195 l = 0.025 m

From eqn a 
$$k = \frac{2.4}{0.055 - l}$$
  
 $k = \frac{2.4}{0.055 - 0.025}$   
 $= 80 \text{ N m}^{-1}$ 

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# **Question 9**

**General Comments** 

Weakness/Remedies

Candidate's Strength

(a) Define each of the following terms used with simple machines:

(i)Pivot;

(ii) load; (iii) efficiency.

(b) A truck of mass 1.2 3 kg is pulled from rest by a constant horizontal force of 25.2

N on a levelled road. If the maximum speed attainable in the process is 60km h-1. (i) Work done by the force;

(ii) Distance travelled by the truck in reaching the maximum speed.

(c) State two differences between absolute zero temperature and ice point.

(d)An uncalibrated liquid-in-glass thermometer was used in determining a Celsius temperature. The readings are tabulated below.

Temperature/°C	6	0	100
Length of column/cm	L	2.0	15.0

Determine the value of L.

### Observation

In guestion 9a, a significant number of candidates accurately defined the pivot, load, and efficiency.

Most candidates performed well in question 9b, with only a few struggling to convert km/hr to m/s.

In question 9c, the majority of candidates correctly distinguished between absolute zero temperature and ice point.

Finally, in question 9d, most candidates earned full marks by accurately calculating the value of L.

### **EXPECTED RESPONSES:**

### (a) **Definition of terms**

(i) **<u>Pivot</u>**: The point about which the <u>turning effect occurs</u> in the machine.

(ii) **Load**: The force overcome by an effort.

(iii) <u>Efficiency</u>: The ratio of work/energy output to the work/energy input (expressed as a percentage)

A6

(b) <u>Calculation of</u>
 (i) <u>Work done</u> = change in kinetic energy

$$= \frac{1}{2} mv^{2}$$
  
=  $\frac{1}{2} \times 1.2 \times 10^{3} \times (16.7)^{2}$   
= 1.67 × 10<sup>5</sup> J

(ii) distance travelled

Work done = Force (F) × displacement (d) Fd =  $1.67 \times 10^{5}$  J  $25.2 d = 1.67 \times 10^{5}$  J d =  $6.63 \times 10^{3}$  m B4

### (c) Differences between absolute zero temperature and Ice point

Absolute zero	Ice point
The temperature at which all molecules are at rest	The temperature at which vibratory molecular motion still occurs
The lowest temperature on the absolute scale	A temperature lower than 0 °C exists on the Celsius scale
Not a fixed point on the absolute scale	The lower fixed point on the celsius scale
Has a value of 0 K/ -273.15 °C	Has a value of 0 °C/ 273.15 °C

C2

(d) Determination of L

 $\frac{L_{\theta} - L_0}{L_{100} - L_0} = \frac{\theta}{100}$  $\frac{L - 2}{15 - 2} = \frac{-6}{100}$  $\frac{L - 2}{13} = -0.06$ L = 1.2 cm

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# **Question 10**

**General Comments** 

Weakness/Remedies

Candidate's Strength

(a) (i) Why are parabolic mirrors suitable for use in headlamps of vehicles?

(ii) Draw a ray diagram to illustrate the answer in **10**(*a*)(*i*).

(b)(i) State two applications of echoes.

(ii) An observer standing at a point, **P**, on the same horizontal ground as the foot, H, of a tower shouts and 1.20 *s* later, he hears the echo. He then moved to another point, Q, 40m from P, and shouts again but the echo was heard after 1.45 *s*. Calculate the:

(i) Distance between **P** and **H**;

(ii) Speed of sound in air.

(c) (i) Define the term absolute refractive index of a medium.

(ii) A piece of coin falls accidentally into a tank containing two immiscible liquids **A** and **B** as illustrated in **Fig. 10.0**.



Calculate the displacement of the coin when viewed vertically from above. [refractive index of A = 1.3, refractive index of B = 1.4]

## Observation

In question 10a, a large number of candidates correctly identified the reason for using a parabolic mirror as a car headlamp. However, several candidates drew a concave mirror instead of a parabolic mirror.

Question 10b saw most candidates performing well in identifying the applications of echo.

In question 10c, the majority of candidates accurately defined the absolute refractive index but struggled to calculate the displacement of a coin in a tank containing two immiscible liquids.

### **EXPECTED RESPONSES:**

(a)

### (i) **Reason for using a parabolic mirror**

• They produce a <u>parallel beam</u> of light with the same <u>intensity</u> over a long distance.



Mirror showed (1) Rays showed (1) NB: Missing focus = score zero

A3

### (b) (i) <u>Applications of echo</u>

- Location of ores/solid minerals
- Determination of the depth of the sea/ocean floor
- Echolocation/navigation
- · Determination of the speed of sound
- Used in radars
- Used in MRI/ Ultrasound
- Location of wreckage

(I) 
$$v = \frac{2d}{t}$$
  
 $v = \frac{2d}{1.2}$   
 $v = \frac{2(d+40)}{1.45}$   
 $\frac{2d}{1.2} = \frac{2(d+40)}{1.45}$   
 $1.45d = 1.2d + 48$   
 $d = 192 m$ 

(II) 
$$v = \frac{2(192)}{1.2} = 320 \text{ m s}^{-1}$$

### (c) (i) Definition of absolute refractive index

• The ratio of the speed of light in vacuum/air to the speed of light in the medium.

 The ratio of the Sine of the angle of incidence in vacuum/air to the Sine of the angle of refraction in the medium.

[2 marks]

(ii) <u>Calculation of displacement</u> (1) = 0.092 m = 9.2 cm (½) = 0.023 m = 2.3 cm (½) The displacement from the bottom (1) = 0.092 + 0.023 = 0.115 m= 11.5 cm

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# **Question 11**

General Comments

Weakness/Remedies

Candidate's Strength

(a) (i) Define the electric potential at a point in an electric field.

(ii) An uncharged body, **A**, was charged electrostatically by a test charge, B, using the method of induction and the method of contact. State two differences between the two methods.

(b) An important precaution during an electricity experiment is to open the circuit when **no** readings are being taken. Give two reasons for the stated precaution.
(c) **Fig. 11.0** is a circuit diagram in which a coil of inductance, **L**, and a resistor of

resistance,  $\mathbf{R}$ , are connected to a variable alternating source of frequency, f.

The table shows the square of the impedance, Z2; corresponding to each value of f2.

i. Write down the equation for Z in terms of f2, R2 and L2.

ii. Plot a graph of Z2 against f2 and use it to determine the values of:

- I. *L;*
- II. R

[π2 = 10]

### Observation

In question 11a, a significant number of candidates failed to make any reference to materials A and B, resulting in them losing out on full marks. However, in question 11b, the majority of candidates were able to provide the correct answers. When it came to question 11c, most candidates struggled to determine the values of L and R from the graphs they plotted.

#### (i) <u>Electric potential at a point in an electric field</u>

The work done per unit positive charge in bringing the charge from infinity to the point.

(ii) <u>Difference between inddetion and contact meth</u>		
Induction	Contact	
B never touches A	B touches A	
The polarity of B is opposite to that of A eventually	The polarity of B is the same as A eventually	
Charge on B is repelled to the opposite end of A	Charge on B is transferred to the same side of the contact	
Requires earthing	Does not require earthing	

### (ii) Difference between induction and contact methods

### (b) Reason for precaution

- To prevent/minimize overheating (in the load)
- To prevent the cell from running down/draining quickly.
- To allow the depolarizer to recover

(c) (i)

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# Question 12

**General Comments** 

Weakness/Remedies

Candidate's Strength

- 1. State the function of **each** of the following parts of a modern X-ray tube:
  - i. heater: ii. high tension source
  - iii. cooling fins
- 2. State **one** reason for **each** of the following design features of a modern X-ray tube: i. the glass envelope is highly evaluated;
  - ii. the target is a metal with a very high melting point;
  - iii. the cooling fins are located outside the glass envelope.
- 3. In a nuclear fission reaction, a nuclide is bombarded with a neutron to produce and with additional neutrons, the energy involved in the process is Q.

[mass of = 235.044 u, mass of mass of = 140.914 u, mass of neutron = 1.009 u, 1 u = 1.66 - 27 kg, c = 3.0 8 ms - 1]

- 1. Write down the balanced nuclear reaction equation for the process.
- 2. State with reason whether **Q** is absorbed or released in the process.
- 3. Calculate the value of **Q** in joules.
- 4. State three differences between nuclear fusion and nuclear fission.

## Observation

Part (a): This guestion was popular among the candidates but unfortunately performance was fair. Many candidates stated the wrong definition. Part (b): Performance was fair although some candidates got only one right answer. Part (c): Performance was fair although some candidates wrongly cited nuclear bomb as an example of peaceful use of nuclear energy.

Part (d): Many candidates scored full mark allotted to this question. Some however, still found it difficult to interpret the equation. Performance was below average.

The expected answer is:

### 12.(a) Binding Energy

Binding energy is the minimum work/energy required to separate the nucleons of an atom.

OR

The minimum work/energy required to remove an electron from the influence of the nucleus.

### (b) Required Evidences

- Not affected by electric /magnetic fields
- Can travel through a vacuum
- Travels with the speed of light
- Can be polarized
- Causes fluorescence

### (c) Peaceful Uses

- Generates electricity
- Treatment of tumour
- Power submarines/rockets

Food irradiation

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