Theory and Science specimen paper – answers and reasoning

Question 1.1/ EMQ 228a
Subject: Science of Practice
Answer E - Double blind randomised controlled trial

Reasoning:

Answer A - Case controlled study

In a case-controlled study, patients with a certain outcome or disease and an appropriate group of controls without the outcome or disease are selected and then information is obtained on whether the subjects have been exposed to the factor under investigation.

Answer B - Case series

A case series is a nonanalytic or descriptive study, which measures the frequency of several factors, and hence the size of a problem.

Answer C - Cohort study

In a cohort study data are obtained from groups who have been exposed, or not exposed, to the new technology or factor. No allocation of exposure is made by the researcher. Best for studying the effect of predictive risk factors on an outcome.

Answer D - Cross over trial

In a cross over study the participants sequentially receive both interventions. This is not the case here.

Answer E - Double blind randomised controlled trial is the best answer

The gold standard approach for assessing the benefit of a new investigation or treatment approach is a randomized controlled trial (RCT). In this setting, each patient is randomly allocated to receive either standard therapy/placebo or the new treatment. This removes the potential for biasing the outcome by allocating one particular group of patients, e.g. a more severe pattern of disease, to one arm or other.

Answer F - Meta-analysis

Meta-analysis is usually used to refer to statistical methods of combining numeric evidence**.**

Answer G - Open label study

In an open label study both health providers and participants are aware of the intervention.

Answer H - Qualitative study

This is a nonanalytic or descriptive study, to develop understanding of a defined area by collecting information, analysing it and using the output to generate new ideas or hypotheses which may or may not then be suitable for quantative analysis.

Answer I - Quasi-randomised control study

A quasi-randomised trial is one in which participants are allocated to different arms of the trial (to receive the study medicine, or placebo, for example) using a method of allocation that is not truly random.

Answer J - Systematic review is wrong

The purpose of a systematic review is to identify all available high-quality primary research evidence and summarize the findings in order to address a clearly defined question**.**

Further Reading

- http://www.cebm.net/study-designs/
- The Science of Paediatrics MRCPCH Mastercourse. Ed Lissaeur T Carroll W 2017 Chapter 37 Clinical research

Question 1.2/ EMQ 228b
Subject: Science of Practice
Answer D - Cross over trial

Reasoning:

Answer A - Case controlled study

In a case-controlled study, patients with a certain outcome or disease and an appropriate group of controls without the outcome or disease are selected and then information is obtained on whether the subjects have been exposed to the factor under investigation.

Answer B - Case series

A case series is a nonanalytic or descriptive study, which measures the frequency of several factors, and hence the size of a problem.

Answer C - Cohort study

In a cohort study data are obtained from groups who have been exposed, or not exposed, to the new technology or factor. No allocation of exposure is made by the researcher.

Answer D - Cross over trial is the best answer

A cross over study is appropriate in view of the absence of blinding and small numbers. In such a study, individuals provide both control and experimental arm by sequentially receiving multiple/all interventions at different time-points, interspersed with periods for intervention 'wash-out'.

Answer E - Double blind randomised controlled trial

Blinding is not possible, and numbers are small. The gold standard approach for assessing the benefit of a new investigation or treatment approach is a randomized controlled trial (RCT). In this setting, each patient is randomly allocated to receive either standard therapy/placebo or the new treatment. This removes the potential for biasing the outcome by allocating one particular group of patients, e.g. a more severe pattern of disease, to one arm or other.

Answer F - Meta-analysis

Meta-analysis is usually used to refer to statistical methods of combining numeric evidence.

Answer G - Open label study

In an open label study both health providers and participants are aware of the intervention.

Answer H - Qualitative study

This is a nonanalytic or descriptive study, to develop understanding of a defined area by collecting information, analysing it and using the output to generate new ideas or hypotheses which may or may not then be suitable for quantative analysis.

Answer I - Quasi-randomised control study

A quasi-randomised trial is one in which participants are allocated to different arms of the trial (to receive the study medicine, or placebo, for example) using a method of allocation that is not truly random.

Answer J - Systematic review

The purpose of a systematic review is to identify all available high-quality primary research evidence and summarize the findings in order to address a clearly defined question.

Further Reading:

http://www.cebm.net/study-designs/

The Science of Paediatrics MRCPCH Mastercourse. Ed Lissaeur T Carroll W 2017 Chapter 37 - Clinical research

Question 1.3/ EMQ 228c
Subject: Science of Practice
Answer H - Qualitative study

Reasoning:

Answer A - Case controlled study

In a case-controlled study, patients with a certain outcome or disease and an appropriate group of controls without the outcome or disease are selected and then information is obtained on whether the subjects have been exposed to the factor under investigation.

Answer B - Case series

A case series is a nonanalytic or descriptive study, which measures the frequency of several factors, and hence the size of a problem.

Answer C - Cohort study

This requires a qualitative study as it is not assessing an intervention. In a cohort study data are obtained from groups who have been exposed, or not exposed, to the new technology or factor. No allocation of exposure is made by the researcher.

Answer D - Cross over trial

There are no interventions to be compared, a cross over study is appropriate in view of the absence of blinding and small numbers. In such a study, individuals provide both control and experimental arm by sequentially receiving multiple/all interventions at different time-points, interspersed with periods for intervention 'wash-out'.

Answer E - Double blind randomised controlled trial

This requires a qualitative study as it is not assessing an intervention. The gold standard approach for assessing the benefit of a new investigation or treatment approach is a randomized controlled trial (RCT). In this setting, each patient is randomly allocated to receive either standard therapy/placebo or the new treatment. This removes the potential for biasing the outcome by allocating one particular group of patients, e.g. a more severe pattern of disease, to one arm or other.

Answer F - Meta-analysis

Meta-analysis is usually used to refer to statistical methods of combining numeric evidence.

Answer G - Open label study

This requires a qualitative study as it is not assessing an intervention.

Answer H - Qualitative study is the best answer

A qualitative study is appropriate in this instance where detailed information is required from small numbers of participants. Qualitative research aims to develop understanding of a defined area by collecting information, analysing it and using the output to generate new ideas or hypotheses which may or may not then be suitable for quantitative analysis. Information collecting may involve: • Review of documented evidence • Observational approaches – recording uninfluenced behaviours • Interviews – usually open-ended and defined by topics rather than specific questions • Group discussion – specifically focusing on the interactions of the group setting.

Answer I - Quasi-randomised control study

No specific intervention is being assessed. A quasi-randomised trial is one in which participants are allocated to different arms of the trial (to receive the study medicine, or placebo, for example) using a method of allocation that is not truly random.

Answer J - Systematic review

The purpose of a systematic review is to identify all available high-quality primary research evidence and summarize the findings in order to address a clearly defined question.

Further reading:

- http://www.cebm.net/study-designs/
- The Science of Paediatrics MRCPCH Mastercourse. Ed Lissaeur T Carroll W 2017 Chapter 37 - Clinical research

Question 2.1/ EMQ 217a
Subject: Gastroenterology and Hepatology
Answer D - Cow's milk sensitive enteropathy

Reasoning:

Answer A Abetalipoproteinaemia

There is no triglyceride accumulation in villous enterocytes.

Answer B Autoimmune enteropathy

Although there is partial or complete villous atrophy in this condition and no increase in the number of intraepithelial lymphocyte, increased eosinophils are not a feature.

Answer C Coeliac disease

Although the histologic appearances of coeliac disease and cow's milk protein allergy can be similar the presence of increased numbers of eosinophils means this is not the best answer.

Answer D Cow's milk sensitive enteropathy is the best answer

Although duodenal histologic changes in patients with cow's milk protein allergy vary and in individuals with a T-cell mediated hypersensitivity reaction, the duodenal biopsies show changes similar to those seen in coeliac disease (low- grade villous blunting and intraepithelial lymphocytosis). However, advanced lesions are rarely encountered. In those with elevated IgA, the predominant biopsy finding is heavy mucosal eosinophilia, often with sheets of eosinophils. The presence of increased numbers of eosinophils means that this is the best answer but should still be interpreted in the context of medical history and oral challenges.

Answer E Crohn's disease

Duodenal involvement in Crohn's is uncommon.

Findings on colonoscopy can include patchy, nonspecific inflammatory changes (erythema, friability, loss of vascular pattern), aphthous ulcers, linear ulcers, nodularity, and strictures. Findings on biopsy may be only nonspecific chronic inflammatory changes. Noncaseating granulomas, similar to those of sarcoidosis, are the most characteristic histologic findings.

Answer F Giardiasis

In chronic giardiasis there are chronic inflammatory changes, including eosinophilic infiltration of the lamina propria and in a fresh specimen, trophozoites usually can be visualized by direct wet mount. However, the other features mentioned would not be expected.

Answer G Lymphangiectasia

In lymphangiectasia there is no inflammatory infiltrate, the length of the villi is normal and lacteals are dilated.

Answer H Microvillous inclusion disease (microvillous atrophy)

In this condition there is diffuse thinning of the mucosa, with hypoplastic villus atrophy but no inflammatory infiltrate.

Answer I Primary hyperlipidaemia

There are only extremely rare reports of xanthomatous lesions in the small bowel with none of the other described features.

Answer J Whipple’s disease

Whipple's disease is a rare bacterial infection. It occurs primarily in Caucasian males older than 40 years. The small intestinal mucosa of most patients is characterized by the presence of large foamy macrophages and a loss of microvilli. The macrophages are filled with PAS-positive particles.

Question 2.2/ EMQ 217b
Subject: Gastroenterology and Hepatology
Answer G - Lymphangiectasia

Reasoning:

Answer A Abetalipoproteinaemia

There is no triglyceride accumulation in villous enterocytes.

Answer B Autoimmune enteropathy

There is partial or complete villous atrophy, crypt hyperplasia, and an increase in chronic inflammatory cells and no ectatic villous core lacteals in this condition.

Answer C Coeliac disease

There is partial or complete villous atrophy, crypt hyperplasia, and an increase in chronic inflammatory cells and no ectatic villous core lacteals in this condition.

Answer D Cow's milk sensitive enteropathy

There is low- grade villous blunting and intraepithelial lymphocytosis and no ectatic villous core lacteals in this condition.

Answer E Crohn's disease

This is not the pattern of patchy, nonspecific inflammatory changes (erythema, friability, loss of vascular pattern), aphthous ulcers, linear ulcers, nodularity, and strictures seen in Crohn's disease.

Answer F Giardiasis

In chronic giardiasis there are chronic inflammatory changes but ectatic villous core lacteals are not present.

Answer G Lymphangiectasia is the best answer

In lymphangiectasia, small bowel mucosal biopsy can show dilated lacteals with distortion of villi and no inflammatory infiltrate. Examination of mucosa under a dissecting microscope reveals pale villi of normal length. On higher magnification the lymphatics of the lamina propria and submucosa are distended and filled with lipid staining material.

Answer H Microvillous inclusion disease (microvillous atrophy)

Ectatic villous core lacteals are not present in this condition.

Answer I Primary hyperlipidaemia

There are only extremely rare reports of xanthomatous lesions in the small bowel with none of the other described features.

Answer J Whipple's disease

This condition is characterized by the presence of large foamy macrophages and a loss of microvilli.

Question 2.3/ EMQ 217c
Subject: Gastroenterology and Hepatology
Answer C - Coeliac disease

Reasoning:

Answer A Abetalipoproteinaemia

There is no triglyceride accumulation in villous enterocytes.

Answer B Autoimmune enteropathy

In contrast to gluten-sensitive enteropathy (coeliac disease), there is no increased number of intraepithelial lymphocytes in this condition.

Answer C Coeliac disease is the best answer

The classic histological findings of coeliac disease include flattened duodenal mucosa with loss of crypt architecture, intraepithelial lymphocytosis and glandular hyperplasia.

Answer D Cow's milk sensitive enteropathy

Although duodenal histologic changes in patients with cow's milk protein can show changes similar to those seen in coeliac disease the predominant biopsy finding is heavy mucosal eosinophilia, often with sheets of eosinophils. The absence of increased numbers of eosinophils means that this is not the best answer.

Answer E Crohn's disease

The pattern of changes is not that seen in Crohn's disease.

Answer F Giardiasis

Eosinophilic infiltration of the lamina propria is not present.

Answer G Lymphangiectasia

In lymphangiectasis there is no inflammatory infiltrate, the length of the villi is normal and lacteals are dilated.

Answer H Microvillous inclusion disease (microvillous atrophy)

In this condition there is diffuse thinning of the mucosa, with hypoplastic villus atrophy but no inflammatory infiltrate.

Answer I Primary hyperlipidaemia

There are only extremely rare reports of xanthomatous lesions in the small bowel with none of the other described features.

Answer J Whipple's disease

Whipple's disease is a rare bacterial infection. It occurs primarily in Caucasian males older than 40 years. The small intestinal mucosa of most patients is characterized by the presence of large foamy macrophages and a loss of microvilli. The macrophages are filled with PAS-positive particles.

Further reading:

- Nelson Textbook of Pediatrics 20th edition
- Chapter 338.2 Celiac disease
- Chapter 338.3 Other Malabsorptive Syndromes (Autoimmune enteropathy, microvillous inclusion disease, abetalipoproteinaemia, lymphangiectasis.)
- Chapter 338.4 Intestinal Infections and Infestations Associated with Malabsorption (Whipple disease)
- Chapter 282.1 Giardia lamblia
- Chapter 336.2 Crohn Disease
- MRCPCH Mastercourse
- Chapter 14 Gastroenterology – Histopathology and Cellular Function
- Celiac Disease and Other Causes of Duodenitis Daniel R. Owen, BSc, MD; David A. Owen, MB, BCh, FRCPC Owen & Owen; Arch Pathol Lab Med. 2018;142:35–43; (Cow's milk protein allergy)

Question 3.1/ EMQ 511v1a:2
Subject: Pharmacology
Answer F - Morphine

Reasoning:

Answer A - Dexamethasone

Common problems include adrenal suppression, glucose instability, hypertension and increased risk of cerebral palsy if given in the first week of life.

Answer B - Dopamine

Side-effects include arrhythmias, hypertension, mydriasis and vasoconstriction.

Answer C - Furosemide

side-effects include dehydration, electrolyte imbalance, hypotension and metabolic alkalosis.

Answer D - Indomethacin

side-effects include agranulocytosis, arrhythmias, fluid retention and hypotention.

Answer E - Liposomal amphotericin

side-effects include anaemia, diarrhoea, electrolyte imbalance and hepatic function abnormalities.

Answer F - Morphine is the best possible answer

Common side effects of morphine (1% to 10%): Respiratory depression - less common urinary retention and bradycardia and hypotension.

Answer G - Prostaglandin E2

common side-effects include apnoea, arrhythmias, fever and hypotension.

Answer H - Sildenafil

common side-effects include haemorrhage, vasodilation, arrhythmias and gastro-oesophageal reflux disease.

Answer I - Gentamicin

common side effects include nephrotoxicity, hearing impairment, colitis and neurotoxicity.

Answer J - Vancomycin

common side-effects include agranulocytosis, hearing loss, pseudomembraneous colitis and red man syndrome.

Further reading

- BNF-C 2018-19

Question 3.2/ EMQ 511v1b:2
Subject: Pharmacology
Answer E - Liposomal amphotericin

Reasoning:

Answer A - Dexamethasone

Common problems include adrenal suppression, glucose instability, hypertension and increased risk of cerebral palsy if given in the first week of life.

Answer B - Dopamine

Side-effects include arrhythmias, hypertension, mydriasis and vasoconstriction.

Answer C - Furosemide

Side-effects include dehydration, electrolyte imbalance, hypotension and metabolic alkalosis.

Answer D - Indomethacin

Side-effects include agranulocytosis, arrhythmias, fluid retention and hypotention.

Answer E - Liposomal amphotericin is the best answer

Anaemia, diarrhoea, electrolyte imbalance and hepatic function abnormalities.

Answer F - Morphine

Common side effects of morphine (1% to 10%): respiratory depression - less common urinary retention and bradycardia and hypotension.

Answer G - Prostaglandin E2

Common side-effects include apnoea, arrhythmias, fever and hypotension.

Answer H - Sildenafil

Common side-effects include haemorrhage, vasodilation, arrhythmias and gastro-oesophageal reflux disease.

Answer I - Gentamicin

Common side effects include nephrotoxicity, hearing impairment, colitis and neurotoxicity.

Answer J - Vancomycin

common side-effects include agranulocytosis, hearing loss, pseudomembraneous colitis and red man syndrome.

Further reading

- BNF-C 2018-19

Question 3.3/ EMQ 511v1c:2
Subject: Pharmacology
Answer A - Dexamethasone

Reasoning:

Answer A - Dexamethasone is the best answer

Common problems include adrenal suppression, glucose instability, hypertension and increased risk of cerebral palsy if given in the first week of life.

Answer B - Dopamine

Side-effects include arrhythmias, hypertension, mydriasis and vasoconstriction.

Answer B - Furosemide

Side-effects include dehydration, electrolyte imbalance, hypotension and metabolic alkalosis.

Answer D - Indomethacin

Side-effects include agranulocytosis, arrhythmias, fluid retention and hypotention.

Answer E Liposomal amphotericin

Side-effects include anaemia, diarrhoea, electrolyte imbalance and hepatic function abnormalities.

Answer F - Morphine

Common side effects of morphine (1% to 10%): respiratory depression - less common urinary retention and bradycardia and hypotension.

Answer G - Prostaglandin E2

Common side-effects include apnoea, arrhythmias, fever and hypotension.

Answer H - Sildenafil

Common side-effects include haemorrhage, vasodilation, arrhythmias and gastro-oesophageal reflux disease.

Answer I - Gentamicin

Common side effects include nephrotoxicity, hearing impairment, colitis and neurotoxicity.

Answer J - Vancomycin

Common side-effects include agranulocytosis, hearing loss, pseudomembraneous colitis and red man syndrome.

Further reading:

- BNF-c 18-19 and Early (up to seven days) systemic postnatal corticosteroids for preventing bronchopulmonary dysplasia in preterm infants. Authors: Doyle LW, Cheong JL, Ehrenkranz RA, Halliday HL. Cochrane Library 24 October 2017

Question 4.1/ EMQ 175:2a

Subject: Metabolism and Metabolic Medicine

Answer C – Red blood cell galactose-1-phosphate uridyl transferase activity

Reasoning:

Answer A - Cerebrospinal fluid glycine

Glycine is one of the non-essential amino acids and is used to help create muscle tissue and convert glucose into energy. Glycine encephalopathy (non-ketotic hyperglycineaemia) is a rare autosomal recessive inherited metabolic disorder characterised by abnormally high levels in bodily fluids and tissues manifesting as encephalopathy.

Answer B - Plasma phenylalanine

At 7 days of age it is very unlikely that accumulation of plasma phenyl alanine will have any overt clinical manifestations. However, detection by newborn screening is essential to prevent future consequences of the metabolic derangement.

Answer C - Red blood cell galactose-1-phosphate uridyl transferase activity is best answer

Galactosemia: Red blood cell galactose-1-phosphate uridyl transferase activity is decreased. Typically, transferase-deficient infants present within a few days after birth with vomiting, diarrhoea, failure to thrive and persistent jaundice. The history of e coli septicaemia and the neonatal death of a sibling make this the most likely diagnosis and galactose-1-phosphate uridyltransferase: the most appropriate test.

Answer D - Plasma insulin

Normal birth weight and blood sugar does not suggest hyperinsulinism as the cause.

Answer E - Serum 17-hydroxyprogesterone

Usually presents in male infants with no genital abnormalities presentation is with salt losing crisis which may be life threatening.

Answer F - Urine succinylacetoacetate

Urine succinylacetoacetate is WRONG. Succinylacetoacetate is an organic acid and an intermediate that arises as a result of incomplete breakdown of tyrosine. At high levels it can induce acidosis as seen in tyrosinaemia type 1. Patients develop features such as hepatic necrosis, renal tubular injury and hypertrophic cardiomyopathy.

Answer G - Serum cortisol

Plasma cortisol is not likely to give the diagnosis.

Answer H - Serum lactate

It is likely to be raised in mitochondrial disorders, disorders of gluconeogenesis and glycogen storage disorders but will not be diagnostic for any of them.

Answer I - Plasma acylcarnitine

Defects in acylcarnitine present with attacks of fasting induced hypoglycaemia, hyperammonaemia and cardiorespiratory collapse.

Answer J - Urine methylmalonic acid

Organic acidemia would have raised plasma ammonia and metabolic acidosis with raised urine organic acid, such as methylmalonic acid.

Further reading:

- Nelson Textbook of Pediatrics 20th edition p640
- The Science of Paediatrics Mastercourse ed Lissaeur T Carroll W 2017
- Galactosemia: Clinical features and diagnosis. Sutton VR. In UpTodate

Question 4.2/ EMQ 175:2b
Subject: Metabolism and Metabolic Medicine
Answer D – Plasma insulin

Reasoning:

Answer A - Cerebrospinal fluid glycine

Glycine is one of the non-essential amino acids and is used to help create muscle tissue and convert glucose into energy. Glycine encephalopathy (non-ketotic hyperglycineaemia) is a rare autosomal recessive inherited metabolic disorder characterised by abnormally high levels in bodily fluids and tissues manifesting as encephalopathy.

Answer B - Plasma phenylalanine

At 7 days of age it is very unlikely that accumulation of plasma phenyl alanine will have any overt clinical manifestations. However, detection by newborn screening is essential to prevent future consequences of the metabolic derangement.

Answer C - Red blood cell galactose-1-phosphate uridyl transferase activity

Red blood cell galactose-1-phosphate uridyl transferase activity is decreased. In Galactosemia: Typically, transferase-deficient infants present within a few days after birth with vomiting, diarrhoea, failure to thrive and persistent jaundice. There is usually history of e coli septicaemia and neonatal death of siblings.

Answer D - Plasma insulin is best answer

Large birth weight and hypoglycaemia suggests hyperinsulinism as the cause.

Answer E - Serum 17-hydroxyprogesterone

Usually presents in male infants with no genital abnormalities presentation is with salt losing crisis which may be life threatening.

Answer F - Urine succinylacetoacetate

Succinylacetoacetate is an organic acid and an intermediate that arises as a result of incomplete breakdown of tyrosine. At high levels it can induce acidosis as seen in tyrosinaemia type 1. Patients develop features such as hepatic necrosis, renal tubular injury and hypertrophic cardiomyopathy.

Answer G - Serum cortisol

Plasma cortisol is not likely to give the diagnosis.

Answer H - Serum lactate

It is likely to be raised in mitochondrial disorders, disorders of gluconeogenesis and glycogen storage disorders but will not be diagnostic for any of them.

Answer I - Urine acylcarnitine

Defects in acylcarnitine present with attacks of fasting induced hypoglycaemia, hyperammonaemia and cardiorespiratory collapse.

Answer J - Urine methylmalonic acid

Organic acidemia would have raised plasma ammonia and metabolic acidosis with raised urine organic acid, such as methylmalonic acid.

Further reading:

- Nelson Textbook of Pediatrics 20th edition p640
- The Science of Paediatrics Mastercourse ed Lissaeur T Carroll W 2017

Question 4.3/ EMQ 175:2:c
Subject: Metabolism and Metabolic Medicine
Answer J - Urine methylmalonic acid

Reasoning:

Answer A - Cerebrospinal fluid glycine

Glycine is one of the non-essential amino acids and is used to help create muscle tissue and convert glucose into energy. Glycine encephalopathy (non-ketotic hyperglycineaemia) is a rare autosomal recessive inherited metabolic disorder characterised by abnormally high levels in bodily fluids and tissues manifesting as encephalopathy.

Answer B - Plasma phenylalanine

At 7 days of age it is very unlikely that accumulation of plasma phenyl alanine will have any overt clinical manifestations. However, detection by newborn screening is essential to prevent future consequences of the metabolic derangement.

Answer C - Red blood cell galactose-1-phosphate uridyl transferase activity

Red blood cell galactose-1-phosphate uridyl transferase activity is decreased. in Galactosemia: Typically, transferase-deficient infants present within a few days after birth with vomiting, diarrhoea, failure to thrive and persistent jaundice. There is usually history of e coli septicaemia and neonatal death of siblings.

Answer D - Plasma insulin

Normal birth weight and blood sugar does not suggest hyperinsulinism as the cause.

Answer E - Serum 17-hydroxyprogesterone

Usually presents in male infants with no genital abnormalities presentation is with salt losing crisis which may be life threatening.

Answer F - Urine succinylacetoacetate

Succinylacetoacetate is an organic acid and an intermediate that arises as a result of incomplete breakdown of tyrosine. At high levels it can induce acidosis as seen in tyrosinaemia type 1. Patients develop features such as hepatic necrosis, renal tubular injury and hypertrophic cardiomyopathy.

Answer G - Serum cortisol

Plasma cortisol is not likely to give the diagnosis.

Answer H - Serum lactate

It is likely to be raised in mitochondrial disorders, disorders of gluconeogenesis and glycogen storage disorders but will not be diagnostic for any of them.

Answer I - Plasma acylcarnitine

Defects in acylcarnitine present with attacks of fasting induced hypoglycaemia, hyperammonaemia and cardiorespiratory collapse.

Answer J - Urine methylmalonic acid is best answer

Acidosis and hyperammonaemia is suggestive of organic aciduria. Organic acidemia has raised plasma ammonia and metabolic acidosis with raised urine organic acid, such as methylmalonic acid.

Further reading:

- Nelson Textbook of Pediatrics 20th edition p640
- The Science of Paediatrics Mastercourse Ed Lissaeur T Carroll W 2017
- The child with elevated ammonia -Clinical Cases for MRCPCH Theory and Science chapter 31 - RCPCH 2014
- Organic acidemias. Bodamer OA. In Up-to-date Dec 16.2016

Question 5/ BO5 119
Subject: Respiratory Medicine with ENT
Answer D - Restrictive lung disease

Reasoning:

Answer A - Bronchial hyper-reactivity

Bronchial hyper-reactivity should be apparent following bronchodilator. There was no significant change post bronchodilator in peak flow measurement (significant would be >12%).

Answer B - Hyperinflation

Hyperinflation may due to air trapping, secondary to obstructive airway disease such as COPD, asthma, Cystic fibrosis. Hyperinflation is not easily diagnosed using spirometry but rather whole body plethysmography.

Answer C - Impairment of gas exchange

Impairment of gas exchange is not diagnosed using spirometry.

Answer D - Restrictive lung disease is best answer

The results of this spirometry show a reduction in both FEV_1 and FVC and the FEV_1/FVC ratio is not reduced therefore indicative of restrictive lung disease in keeping with the child's presentation of muscle weakness. An increase of 8-12% following bronchodilatation would be expected in asthma. In restrictive lung disease there is a reduction in both FEV_1 and FVC, FEV_1/FVC ratio is not reduced and there is no response to bronchodilator so this is a restrictive pattern.

Answer E - ventilation perfusion mismatch

Impairment of ventilation perfusion mismatch is not diagnosed using spirometry

Reference:

- The Science of Paediatrics MRCPCH Mastercourse 2017 p325-326
- Jat KR. Spirometry in children. Primary Care Respiratory Journal. 2013;22:2219

Question 6/ BO5 353
Subject: Musculoskeletal
Answer E - Staphylococcus aureus

Reasoning:

The stem describes a case of osteomyelitis. The most common causative organism in children is Staphylococcus aureus. Whilst the other pathogens can also cause osteomyelitis, there is nothing further in the history/stem to suggest that this case will be atypical and make a less common pathogen more likely. In a three-year-old the commonest organisms are Staphylococcus aureus, Haemophilus influenzae, Group A Streptococcus, Streptococcus pneumoniae. MRSA is an increasing problem.

Answer A - Haemophilus influenzae

The introduction of vaccination against Haemophilus influenzae type b (Hib) has virtually eliminated the incidence of osteomyelitis caused by this organism in countries where the vaccination is available.

Answer B - Mycobacterium tuberculosis

Whilst Mycobacterium tuberculosis can cause osteomyelitis, there is nothing further in the history to suggest that this is likely here.

Answer C - Pseudomonas aeruginosa

Whilst Pseudomonas aeruginosa can cause osteomyelitis and the child is at risk given their immune compromise from acute lymphoblastic leukaemia this is unlikely here.

Answer D - Salmonella enteritidis

Salmonella osteomyelitis in children is an uncommon condition, typically associated with hemoglobinopathies or other underlying disorders. Only few cases have been reported in children without predisposing factors.

Answer E - Staphylococcus aureus is best answer

The most common causative organism in children is Staphylococcus aureus.

Further reading:

- Bone and joint infections Ross Cronin, Anne-Marie McMahon Paediatrics and Child Health, Vol. 25, Issue 12, p561–566 Published online: September 20, 2015.
- Forfar and Arneil 7th ed. 2008 p1402
- Nelson Textbook of Pediatrics 20th edition Chapter 684 Osteomyelitis

Question 7/ BO5 1110
Subject: Haematology and Oncology
Answer E – von Willebrand disease

Reasoning:

Answer A - Glanzmann thrombasthenia

Glanzmann thrombasthenia is an autosomal recessive disorder due to deficiency of the platelet glycoprotein GPIIb leading to failure of platelet aggregation. This results in a severe bleeding tendency despite a normal platelet count. Other clotting factors would be normal.

Answer B - Haemophilia B

Factor IX not low as in Haemophilia B.

Answer C - Protein C deficiency

Protein C deficiency is a congenital or acquired condition that leads to increased risk for thrombosis.

Answer D - Vitamin K deficiency

PT and APPT not consistent with Vitamin K deficiency.

Answer E - von Willebrand disease is best answer

Low factor VIII and slightly abnormal APPT consistent with von Willebrand disease - commonest inherited coagulation disorder.

Further reading:

- The Science of Paediatrics MRCPCH Mastercourse. Ed Lissaeur T Carroll W 2017 p 455-458
- Ghosh K. Glanzmann thrombasthenia: an editorial perspective. Expert Opinion on Orphan Drugs. 2018;6(2):91-3

Question 8/ BO5 1144:2
Subject: Science of Practice
D - Research team not blinded

Reasoning:

Answer A - Inappropriate statistical analysis

The Pearson's chi-square test is used in the case of categorical outcomes, regardless of the number of categories of the outcome or the exposure variables.

Answer B - No intention-to treat analysis

Intention to treat is an assessment of the people taking part in a trial, based on the group they were initially (and randomly) allocated to. This is regardless of whether or not they dropped out, fully adhered to the treatment or switched to an alternative treatment. ITT analyses are often used to assess clinical effectiveness because they mirror actual practice, when not everyone adheres to the treatment, and the treatment people have may be changed according to how their condition responds to it. Studies of drug treatments often use a modified ITT analysis, which includes only the people who have taken at least 1 dose of a study drug. However, it is not an essential aspect of a study.

Answer C - Non-comparable populations

The studied populations whilst not identical are comparable.

Answer D - Research team not blinded is best answer

The research team was not blinded - this makes the study a single blinded rather than a double-blinded study. It is generally accepted that double-blinded study is stronger as there is less room for bias on the part of the research team. This introduces potential bias.

Answer E - Subject not blinded

The subjects were blinded but the nurse was not**.**

Further reading:

- Gonzalez-Chica DA, Bastos JL, Duquia RP, Bonamigo RR, Martínez-Mesa J. Test of association: which one is the most appropriate for my study? Anais Brasileiros de Dermatologia. 2015;90(4):523-Schulz KF, Grimes DA.
- Blinding in randomised trials: hiding who got what. The Lancet. 2002;359(9307):696-700.

Question 9/ BO5 6051
Subject: Ophthalmology
Answer A - Dysfunction of the levator palpebrae superioris

Reasoning:

Answer A - Dysfunction of the levator palpebrae superioris is best answer

An isolated ptosis is most commonly due to dysfunction of the levator palpebrae superioris: Histologically, the levator muscles of patients with congenital ptosis are dystrophic. The levator muscle and aponeurosis tissues appear to be infiltrated or replaced by fat and fibrous tissue. In severe cases, little or no striated muscle can be identified at the time of surgery. This suggests that congenital ptosis is secondary to local developmental defects in muscle structure.

Answer B - Facial nerve zygomatic branch compression injury

Facial nerve palsy will demonstrate weakness of other facial muscles and the stem states isolated ptosis. The zygomatic branch innervates upper and lower eyelids.

Answer C - Transplacental acetylcholine receptor antibodies

Transplacental acetylcholine receptor antibodies cause transient neonatal myasthenia gravis which is most likely to cause bilateral ptosis and muscular weakness.

Answer D - Disruption of the sympathetic nerve supply to the eye

Horner syndrome is caused by disruption of the sympathetic nerve supply to the eye and would also result in miosis (constricted pupil).

Answer E - Congenital third nerve palsy

Third nerve palsy causes marked ptosis and restriction of eye movements. The eye is typically turned down and outwards.

Further reading:

- Decock CE, De Baere EE, Bauters W, et al. Insights into levator muscle dysfunction in a cohort of patients with molecularly confirmed blepharophimosis-ptosis-epicanthus inversus syndrome using high-resolution imaging, anatomic examination, and histopathologic examination.
- Archives of Ophthalmology. 2011;129(12):1564-9.
- Marenco M, Macchi I, Macchi I, Galassi E, Massaro-Giordano M, Lambiase A. Clinical presentation and management of congenital ptosis. Clinical Ophthalmology (Auckland, NZ). 2017;11:453-63.

Question 10/ BO5 6024
Subject: Pharmacology
Answer A - Interstitial nephritis

Reasoning:

Answer A - Interstitial nephritis is best answer

This is the most likely short-term side effect.

Answer B - Sensorineural hearing loss

A few dozen cases of hearing loss associated with vancomycin have been reported. Most of these patients had kidney dysfunction or a preexisting hearing loss or were receiving concomitant treatment with an ototoxic drug.

Answer C - Pulmonary haemorrhage

This is not a documented side-effect.

Answer D - Anaphylaxis

Anaphylaxis is a rare side effect of vancomycin administration. The more common red man syndrome is due to over rapid administration the risk of which is reduced by administration as a slow intravenous infusion.

Answer E - Neutropenia

Reversible neutropenia, usually starting 1 week or more after onset of therapy with vancomycin or after a total dosage of more than 25 g, has been reported. Neutropenia appears to be promptly reversible when vancomycin is discontinued.

Further reading:

- British National Formulary Children: Vancomycin; Side effects

Question 11/ BO5 112 SUR
Subject: Neurology
Answer C - Pituitary fossa

Reasoning:

Answer A - Brain stem

Children with brain stem tumours characteristically present with motor weakness, cranial nerve dysfunction, cerebellar dysfunction and/or raised ICP.

Answer B - Cerebellopontine angle

Children with cerebellopontine angle tumours characteristically present with hearing loss, problems with speech, ataxia, nystagmus and involvement of local cranial nerve nuclei.

Answer C - Pituitary fossa is the best answer

Tumours arising in the pituitary gland or the suprasellar region can extend to compress the optic chiasm leading to bitemporal hemianopia and problems with visual acuity.

Answer D - Posterior fossa

Children with posterior fossa tumours characteristically present with symptoms and signs of raised ICP and cerebellar dysfunction.

Answer E - Temporal lobe

Children with temporal lobe tumours characteristically present with seizures, usually focal.

Further reading:

- Nelson Textbook of Pediatrics 20th edition Chapter 497

Question 12/ BO5 6046:2
Subject: Dermatology
Answer: D - Exfoliative toxin A

Reasoning:

Answer A - Exfoliative toxin B

Bullous impetigo and staphylococcal scalded skin syndrome (SSSS) are both caused by exfoliative toxin released by Staphylococcus aureus. Of the two main serotypes, A and B, toxin B circulates through the blood stream causing blistering distant from the infection and thus SSSS.

Answer B - Panton-Valentine leukocidin

Panton-Valentine leukocidin is a cytotoxic protein produced by some strains of Staphylococcus aureus that increases the virulence. It causes neutrophil destruction and tissue necrosis.

Answer C - Toxic Shock Syndrome Toxin 1

Toxic Shock Syndrome Toxin 1 (TSST-1) is a superantigen that induces production of interleukin-1 and tumour necrosis factor causing fever, multisystem failure and shock. It is linked to tampon use.

Answer D - Exfoliative toxin A is best answer

Bullous impetigo is due to strains of Staphylococcus aureus that produce exfoliative toxin A. This causes loss of cell adhesion in the superficial epidermis by targeting the protein desmoglein 1.

Answer E - Enterotoxin A

Staphylococcus aureus produces several enterotoxins ingestion of which cause vomiting and diarrhoea with a short incubation. The commonest is Type A, a frequent cause of food poisoning.

Further reading:

- Nelson Textbook of Pediatrics 20th edition Chapter 181 (Page 1316)
- https://www.uptodate.com/contents/impetigo
- Clinical Cases for MRCPCH Theory and Science 2013 p37-40

Question 13/ BO5 1275:2
Subject: Pharmacology
Answer C - Inhibition of purine nucleoside synthesis

Reasoning:

Answer A - Downregulation of interleukin-6

Tocilizumab used in Rheumatoid arthritis has this mechanism of action.

Answer B - Downregulation of tumour necrosis factor alpha production

This is the mode of action of infliximab.

Answer C - Inhibition of purine nucleoside synthesis is best answer

Azathioprine inhibits the synthesis of purine nucleosides and thus the proliferation of T and B lymphocytes and antibody formation.

Answer D - Acts as a calcineurin inhibitor

Calcineurin catalyses some of the intracellular processes associated with the activation of T-lymphocytes. Class drugs inhibiting calcineurin include cyclosporine and tacrolimus.

Answer E - Inhibition of tetrahydrofolate dehydrogenase

This is the mode of action of methotrexate.

Further reading:

- UpToDate 2019
- Nelson Textbook of Pediatrics, 20th Edition

Question 14/ BO5 6187
Subject: Metabolism and Metabolic Medicine
Answer A - Increases calcium absorption from the gut

Reasoning:

Answer A - Increases calcium absorption from the gut is best answer

Vitamin D binds to an intracellular receptor and regulates gene transcription. Its most important biological action is to promote enterocyte differentiation and the intestinal absorption of calcium.

Answer B - Increases phosphate absorption from the gut

Vitamin D increases phosphate absorption but the effect is less significant because most dietary phosphate absorption is vitamin D independent.

Answer C - Increases bone resorption

Vitamin D promotes bone resorption via osteoclast regulation but this effect on calcium is less important than absorption from the gut.

Answer D - Increases calcium reabsorption from the kidney

Vitamin D reduces renal loss of calcium (and phosphate) but this effect is less is less important than absorption from the gut.

Answer E - Stimulates parathyroid hormone secretion

Vitamin D actively suppresses parathyroid hormone (PTH) release. PTH release is also inhibited by the vitamin D induced rise in serum calcium.

Further reading:

- Nelson Textbook of Pediatrics,20th Edition, p336

Question 15/ BO5 6324
Subject: Neonatology
Answer D - Alcohol

Reasoning:

Answer A - Valproate

Valproate has predominantly neural tube defect as a feature, facial features are different, may have clefts which are not described.

Answer B - Phenytoin

Phenytoin can cause growth retardation and developmental delay, but classically involves limbs and finger deformities.

Answer C - Nicotine

Nicotine can cause small babies, and may have links with learning difficulties, but facial features and cardiac features less well described.

Answer D - Alcohol is best answer

The classical features of Foetal alcohol syndrome are characteristic facial features, central nervous system involvement such as delayed milestones in infancy / irritability, and growth retardation. All these features are described in the stem. Most common associated malformations in FASD are ASD and VSD (may present at 8w baby check).

Answer E - Warfarin

Warfarin classically causes nasal hypoplasia and chondrodysplasia, and commonly causes cleft and chloanal atreaia.

Further reading:

- Uptodate (accessed 5th October 2018): 'Fetal alcohol spectrum disorder', 'risk associated with epilepsy and pregnancy'. J Ostet Gynaecol Can 2005 27 (7) 702-706 'warfarin embryopathy.
- Edorium J Neurol 2016;3:17–25 'neuroembryology and congenital disorder'
- Nelson Textbook of Pediatrics 20th edition pg 895-896

Question 16/ BO5 147 SUR:2
Subject: Neonatology
Answer C - Mean airway pressure

Reasoning

Answer A - Inspiratory : expiratory ratio

Will help, but only in its effects on MAP.

Answer B - Alveolar minute ventilation

Will not directly affect oxygenation.

Answer C - Mean airway pressure is best answer

Oxygenation is determined by mean airway pressure (MAP) and fraction of inspired oxygen. MAP = (Ti x PIP) + (Te x PEEP)/(Ti + Te).

Answer D - Inspiratory time constant

Is a function of the mechanics of the respiratory system, and is not changed by ventilatory adjustments, except possibly by alveolar recruitment.

Answer E - Tidal volume

Carbon dioxide elimination is achieved by increasing the peak inspiratory pressure (tidal volume) or the rate of the ventilator.

Further reading:

- Auckland Hospital Ventilation basics. http://www.adhb.govt.nz/newborn/teachingresources/ventilation/ventilationbasics.htm
- Nelson Textbook of Pediatrics 20th edition pg 854

Question 17/ BO5 97 SUR
Subject: Cardiology
Answer B - Beta-adrenoreceptor antagonist

Reasoning:

Answer A - Angiotensin converting enzyme (ACE) inhibitor

Angiotensin converting enzyme (ACE) inhibitors act on the Renin-Angiotensin system to reduce blood pressure e.g. Captopril.

Answer B - Beta-adrenoreceptor antagonist is best answer

Atenolol is a pure selective Beta-adrenoreceptor blocker.

Answer C - Calcium channel blocker

Calcium channel blockers differ in their predilection for the various possible sites of action and therefore their therapeutic effects are disparate e.g. Verapamil, Nifedipine.

Answer D - Alpha and beta-adrenoreceptor antagonist

Alpha and beta-adrenoreceptor antagonist- Alpha and beta dual receptor blockers are a subclass of beta blockers which are commonly used to treat high blood pressure (BP). Drugs in this class include carvedilol and labetalol.

Answer E - Alpha adrenoreceptor antagonist

Alpha adrenoreceptor antagonist- Alpha blockers relax certain muscles and help small blood vessels remain open. They work by keeping the hormone norepinephrine (noradrenaline) from tightening the muscles in the walls of smaller arteries and veins, which causes the vessels to remain open and relaxed. This improves blood flow and lowers blood pressure. E.g. Doxazosin and Prazosin.

Further reading:

- BNF 17-18

Question 18/ BO5 6009
Subject: Neonatology
Answer B - Escherichia coli

Reasoning:

Answer A - Pseudomonas aeruginosa

Pseudomonas are gram negative bacilli.

Answer B - Escherichia coli is best answer

E. coli strains (especially those possessing the K1 polysaccharide capsular antigen) are the leading Gram-negative bacilli causing neonatal meningitis.

Answer C - Haemophilus influenzae

Haemophilus influenza is a gram-negative coccobacillus.

Answer D - Listeria monocytogenes

Listeria is a gram-positive rod.

Answer E - Neisseria meningitidis

Neisseria meningitidis is a gram-negative diplococcus.

Further reading:

- The Science of Paediatrics Mastercourse Ed Lissaeur T Carroll W 2017 pg 279
- Neonatal bacterial meningitis: an update Paul T. Heath, Ifeanyichukwu O. Okike Paediatrics and Child Health, Vol. 20, Issue 11, p526–530 Published in issue: November 2010 Medical Microbiology, 4th edition Editor: Samuel Baron . http://www.ncbi.nlm.nih.gov/books/NBK7627/

Question 19/ BO5 630:2
Subject: Haematology and Oncology
Answer A - Disseminated intravascular coagulation

Reasoning:

Answer A - Disseminated intravascular coagulation is best answer

It is a clinical picture dominated by excessive bleeding although thrombotic complications can occur. Investigations show prolonged PT and APTT, raised fibrinogen and low platelets.

Answer B - Haemolytic uraemic syndrome

HUS will not cause coagulopathy.

Answer C - Haemophilia

Haemophilia will not cause coagulopathy, renal impairment or thrombocytopenia.

Answer D - Immune thrombocytopenic purpura

ITP will not cause coagulopathy or renal impairment.

Answer E - Salicylate ingestion

Salicylate ingestion will not cause prolonged APTT.

Further reading:

- The Science of Paediatrics Mastercourse ed Lissaeur T Carroll W 2017 pg 457
- nih.gov/medlineplus/ency/article/000573.htm

Question 20/ BO5 31 SUR:2
Subject: Respiratory Medicine with ENT
Answer D - Rapid eye movement sleep

Reasoning:

The normal sleep pattern has several phases. Muscle relaxation usually occurs during rapid eye movement sleep, possibly as a protective mechanism to prevent sleep movements during dreaming. A child's soft pharyngeal upper airway is held open only by active pharyngeal muscle tone. Relaxation of the pharyngeal constrictor muscles narrows the airway at the pharynx. Obstructive sleep apnoea may be caused by anatomical obstruction in the pharyngeal airway or a reduction of pharyngeal muscle tone, or a combination of both. Negative pharyngeal pressure is generated by the diaphragm to compensate for the upper airway resistance, which contributes to airway obstruction.

Answer A - Slow-wave sleep

Slow-wave sleep is entered into relatively quickly after sleep onset.

Answer B - Stage 1

Non-REM Stage 1 is a nebulous non-REM stage that bridges the gap between definitive wakefulness and definitive sleep.

Answer C - Stage 2

Non-Rem Stage 2 is light sleep from which we can waken readily to environmental stimuli.

Answer D - Rapid eye movement sleep is the best answer

Snoring and pauses in breathing are most likely to occur during REM sleep. A cardinal characteristic of REM sleep is an absence of tone so that skeletal muscles are effectively paralysed. Accessory muscle function is reduced, particularly during REM sleep. This may contribute to hypoventilation and ventilation-perfusion mismatching resulting in oxygen desaturation.

Answer E - At any time

Snoring and apnoea ae most likely to occur during REM sleep.

Further Reading:

- Powell S, Kubba H, O'Brien C, Tremlett M. Paediatric obstructive sleep apnoea. BMJ. 2010 ;340
- Nelson Textbook of Pediatrics 20th edition: Obstructive sleep apnoea P115-118